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## CONTENTS

Bayandina E.I., Yachnik S.P. ELECTROMYOSTIMULATION AT THE EARLY POSTOPERATION PERIOD IN PATIENTS WITH DAMAGED KNEE JOIN CARTILAGE AFTER ARTHROSCOPIC MICROFRACTURE.....	10
Bayandina E.I., Katyukova L.D., Yachnik S.P., Yarygin S.V. RECOVERY OF THE QUADRICEPS FEMORIS MUSCLE AS PER DYNAMOMETRY DATA IN PATIENTS AFTER RECONSTRUCTION OF ANTERIOR CRUCIATE LIGAMENT.....	11
Belikov S.B., Shalomeyev V.A., Tsyvirko E.I., Aykin M.D., Chorny V.M. INCREASING THE QUALITY OF BIODEGRADABLE MAGNESIUM ALLOY FOR OSTEOSYNTHESIS BY ISOSTATIC PRESSING .....	12
Boyko I.V., Shcherbakov D.E., Makarov V.B., Sabsay O.V., Maliy I.V. IMPLANTATION OF THE RADIAL HEAD AT THE "TERRIBLE TRIAD" ELBOW INJURY .....	14
Vasilenko A.V., Zazirniy I.M. BIOMECHANICAL ASSESSMENT OF SURGICAL TREATMENT METHODS FOR SEVERE UNSTABLE INTRA-ARTICULAR DISPLACED DISTAL METAPHYSEAL RADIUS FRACTURES (AO23-C3) .....	15
Vesnin V. V., Golka G. G. EXPERIMENTAL MODELING OF TUBERCULOUS SPONDYLITIS .....	17
Gayko G.V., Sulima O.M., Podgayetskiy V.M., Osadchuk T.I. HIP JOINT REVISION REPLACEMENT IN PATIENTS WITH ASEPTIC INSTABILITY OF THE ACETABULAR COMPONENT OF HIP JOINT IMPLANT.....	18
Gayko G.V., Lazarev I.A., Podgayetskiy O.M., Osadchuk T.I., Sulima O.M. CONDITIONS OF REVISION REPLACEMENT OF HIP JOINT IMPLANTS IF BONE TISSUE DEFECTS ARE AVAILABLE (BIOMECHANICAL MODELING) .....	19
Gayko G.V., Gritsay M.P., Podgayetskiy O.M., Sulima O.M., Kozlov G.B., Kozak R.A. TREATMENT OF COMPLICATIONS OF HIP JOINT IMPLANT REPLACEMENTS .....	21
Gerasimenko S.I., Gayko O.G., Polulyakh M.V., Perfiliva L.V., Guzhevskiy I.V., Babko A.M., Polulyakh D.M. METHODOLOGY OF ELECTROPUNCTURE DIAGNOSTICS IN PATIENTS WITH DYISPLASTIC COXARTHROSIS, STAGE III-IV .....	24
Gerasimenko S.I., Babko A.M., Kostogryz O.A., Kostogryz Y.O. THE ROLE OF POSTERIOR (DORSAL) SYNOVECTOMY IN TREATMENT OF PATIENTS WITH PIGMENTED VILLONODULAR SYNOVITIS OF THE KNEE JOINT .....	25

Gertsen G.I., Dybkalyuk S.V. NONCONVENTIONAL DIAGNOSTIC METHOD FOR DYNAMIC EXSTRAVASAL COMPRESSION OF VERTEBRAL ARTERY IN V1 AND V2 SEGMENTS IN PATIENTS WITH CHRONIC DISORDER OF BLOOD CIRCULATION IN THE VERTEBROBASILAR BASIN AGAINST THE BACKGROUND OF CERVICAL SPINE DYSFUNCTION .....	27
Gertsen G.I., Shtonda D.V. DIAGNOSTICS AND TREATMENT OF FEMUR FRACTURES AFTER HIP JOINT REPLACEMENT .....	29
Golka G.G., Burlaka V.V., Perkhun M.V., Palamarchuk V.V. OUR EXPERIENCE IN HIP JOINT REPLACEMENT .....	29
Guzhevsliy I.V., Gerasimenko S.I., Solodey I.I. MATHEMATICAL MODELING OF THE CONTACT STRESS DISTRIBUTION ON THE SURFACES OF THE ACETABULAR COMPONENT OF HIP JOINT IMPLANT AT VARIOUS THICKNESSES OF THE BOTTOM OF ACETABULAR FOSSA .....	31
Degtyar V.A., Zatsepin A.V., Kaminskaya M.O., Mokhov O.I. LONG-TERM RESULTS OF SURGERY TREATMENT WITH BIO IMPLANTS FOR BENIGN TUMORS AND TUMOR-LIKE LESIONS OF BONES IN CHILDREN .....	32
Degtyar V.A., Shulga D.I., Kaminskaya M.O., Mokhov O.I. MINIMALLY INVASIVE CORRECTION OF PECTUS CARINATUM ("PIGEON CHEST") IN CHILDREN .....	33
Degtyar V.A., Sadovenko O.G., Kaminskaya M.O., Shchudro S.A. PARTICULARITIES OF URGENT ENDOSCOPY IN CHILDREN WITH POLYTRAUMA .....	34
Dolgopolov O.V., Bezruchenko S.O. CLINICAL AND X-RAY RESULTS OF TREATMENT OF PATIENTS WITH DAMAGES OF THE ACROMIAL END OF THE CLAVICLE WITH SPECIALIZED CLAVICLE HOOK PLATE .....	35
Zinchenko V. V. UNCOMPLICATED LOW-ENERGY COMPRESSION FRACTURES OF VERTEBRAL BODIES .....	36
Kalashnikov A.V., Stavinskiy Y.O., Osadchuk T.I., Litun Y.M. UNICOMPARTMENTAL (PARTIAL) KNEE REPLACEMENT IN COMPLEX TREATMENT OF GONARTHROSIS .....	37
Kalashnikov A.V., *Malik V.D., Lazarev I.A., Stavinskiy Y.O., Litun Y.M. SURGICAL TREATMENT OF PERTROCHANTERIC FRACTURES .....	38

Kanzyuba A.I., Shimon V.M. TOTAL HIP JOINT REPLACEMENT IN PATIENTS WITH OSTEOGENESIS IMPERFECTA (CLINICAL OBSERVATION) .....	38
Kanzyuba A.I., Shamova T.O. “INSUFFICIENCY FRACTURES” OF PELVIC RING .....	40
Klimovitskiy V.G., Kanzyuba M.A., Kanzyuba A.I., Khaylo P.A. IPSI LATERAL FRACTURES OF THE FEMORAL NECK AND DIAPHYSIS: SURGICAL TACTICS .....	41
Klimovitskiy V.G., Kanzyuba A.I., Klimovitskiy F.V., Chernysh V.Y., Kanzyuba M.A. FEMORAL HEAD FRACTURES (PIPKIN INJURY): SURGICAL TACTICS .....	42
Klimovitskiy F.V., Goncharova L.D., Tyazhelov A.A. RESULTS OF HIP JOINT REPLACEMENT WHEN USING PREOPERATIVE EXERCISE THERAPY .....	43
Korolkov A.I., Katsalap E.S., Rachman P.M. MODERN MINIMALLY INVASIVE TREATMENT METHODS FOR ORTHOPEDIC MANIFESTATIONS OF GENETIC SYNDROMES IN CHILDREN .....	45
Korolkov A.I., Kuzyo Z.T., Katsalap E.S. MODELING RESECTION OF THE FEMORAL HEAD (MRFH) IN CHILDREN .....	46
Korolkov A.I., Rakhman P.M., Rykun N.D. PREVENTIVE SURGERY OF THE HIP JOINTS IN CHILDREN WITH CEREBRAL PALSY .....	48
Kostogryz O.A., Zubov D.O., Kostogryz Y.O. INTERMEDIATE RESULTS OF SURGICAL TREATMENT OF POSTRAUMATIC DAMAGES OF KNEE JOINT CARTILAGE WITH AUTOLOGICAL CHONDROCYTES .....	48
Kosyakov A. N., Miloserdov A. V., Fedin E. M., Nechay A. A. COMPENSATION OF BONE DEFECTS IN REVISION HIP JOINT AND KNEE JOINT REPLACEMENT BY USING ADDITIVE TECHNOLOGIES .....	49
Krasnoperov S.N., Golovakha M.L. EFFECT OF BONE CANAL DILATATION AFTER RECONSTRUCTION OF ANTERIOR CRUCIATE LIGAMENT (ACL) .....	51
Krivenko S.N., Popov S.V. POLYMER MATERIALS USED IN PATIENTS WITH SHOULDER DIAPHYSIS DEFECTS .....	52

Leontyeva F.S., Morozenko D.V., Vorontsova M.P. DIAGNOSTIC SENSITIVITY OF LABORATORY MARKERS IN PATIENTS AFTER LARGE JOINT REPLACEMENT .....	54
Litvin Y.P., Litvin V.V., Logvinenko V.V. SURGICAL TREATMENT OF PECTORALIS MAJOR MUSCLE TENDON RUPTURE .....	55
Makarov V.B., Lipovskiy V.I., Levadny E.V., Boyko I.V. TAKING INTO ACCOUNT MEASUREMENT ERROR FOR THE RIGIDITY OF METAL OSTEOSYNTHESIS OF THE PROXIMAL HUMERUS FRACTURES .....	57
Makarov V.B., Strelnitskiy V.E., Vasilyev V.V., Boyko I.V. DIAMOND-LIKE CARBON FILMS AS A COATING FOR SPHERICAL IMPLANT ELEMENTS .....	58
Makarov V.B., Dedukh N.V., Nikolchenko O.A. EXPERIMENTAL HISTOLOGICAL ANALYSIS OF BIOCOMPATIBILITY, OSSEOINTEGRATION, AND BIODEGRADATION OF INGENO™ BIOPOLYMER 4032D POLYLACTIDE .....	60
Mashikhina I.V., Polakov G.L., Chemirsov V.V., Ipatov O.P., Gaydachuk A.S. MISTAKES OF THERAPEUTIC AND PREVENTIVE INSTITUTIONS WHEN REFERRING PATIENTS AND DISABLE PERSONS TO FOR ASSESSMENT TO TRAUMATOLOGICAL MEDICAL AND SOCIAL EXPERT COMMISSION (MSEC) .....	61
Mirenkov K.V., Lezhnyuk A.S. TREATMENT TACTICS FOR OPEN INTRA-ARTICULAR FRACTURES OF SHOULDER DISTAL EPIMETAPHYS .....	64
Nasr Al Kali OPTIMIZING REHABILITATION TREATMENT OF PATIENTS WITH DISORDERS OF HIP AND KNEE JOINTS IN POST-OPERATIVE PERIOD .....	65
Panchenko K.M., Kostogryz Y.O., Sokolovskaya O.R., Salmanova K.M. IMMUNOLOGICAL PARAMETERS IN PATIENTS WITH PIGMENTED VILLONODULAR SYNOVITIS OF THE KNEE JOINT .....	66
Petrov V.G., Shevchenko S.D., Logvin G.B., Bayev P.O., Pivovarov V.V. RESULTS OF TREATING CHILDREN WITH SPASTIC PARALYSIS AND HIP JOINT DISORDERS WITH ORTHOSES .....	68
Petrov V.G., Shevchenko S.D., Nagornaya V.V., Vatolinskiy L.E. PARTICULARITIES OF TREATMENT OF PATHOLOGICAL RESIDUAL LOWER LIMBS IN CHILDREN AND THEIR REPLACEMENT .....	69

Piven Y.M. , Litvin Y.P. REHABILITATION OF PATIENTS AFTER SURGERY IN MULTIFRAGMENTARY PROXIMAL HUMERAL FRACTURES .....	70
Polivoda O.M., Chabanenko D.S. SURGICAL TREATMENT OF DIAPHYSIAL FRACTURES OF FOREARM BONES .....	72
Polulyakh M.V., Gerasimenko S.I., Chernyak V.P., Babko A.M., Gerasimenko A.S., Polulyakh D.M. PARTICULARITIES OF KNEE JOINT REPLACEMENT IN PATIENTS WITH RHEUMATOID ARTHRITIS .....	73
Protsenko V.V., Chorniy V.S. RESULTS OF INTERSCAPULAR THORACIC RESECTION IN TUMORS OF PECTORAL GIRDLE .....	75
Protsenko V.V., Chorniy V.S. INTEGRATED TREATMENT FOR PLASMOCYTOMA .....	76
Roy I.V., Strafun S.S., Gayko O.G., Perfilova L.B. APPLICATION OF THE METHOD OF ELECTROPUNCTURE DIAGNOSTICS FOR ASSESSMENT OF EFFICIENCY OF POSTOPERATIVE THERAPEUTIC AND REHABILITATION MEASURES IN PATIENTS WITH DAMAGES OF INTRA-ARTICULAR KNEE JOINT STRUCTURES .....	77
Roy I.V., Zinchenko V.V., Rusanova T.E. PARTICULARITIES OF TREATMENT OF HIP JOINT FORMATION DISORDERS IN CHILDREN OF THE FIRST YEAR OF LIFE .....	78
Roy I.V., Pilipenko O.V., Yachnik S.P. MANUAL THERAPY FOR REHABILITATION OF PACIENTS WITH VERTEBRAL CANAL STENOSIS IN LUMBAR SPINE .....	79
Rushay A.K., Bebykh O.P., Buglak A.I. CORRECTION OF CHANGES IN IN PATIENTS WITH NON-UNION TIBIA BONES AFTER BONE FRACTURES .....	80
Rushay A.K., Bebykh O.P., Buglak A.I. PREVENTION OF INFLAMMATORY COMPLICATIONS IN TRAUMATOLOGY AND ORTHOPEDICS .....	81
Sadovenko O.G., Digtyar V.A., Kaminska M.O., Andreychenko I.I., Mokhov O.I. USE OF ULTRASOUND EXAMINATION AS PER "FAST" PROTOCOL IN CHILDREN WITH POLYTRAUMA .....	82
Strafun S.S., Roy I.V., Gayko O.G., Perfilova L.V. USING ELECTROPUNCTURE DIAGNOSTIC METHOD IN PATIENTS WITH INJURIES OF INTRA-ARTICULAR STRUCTURES OF THE KNEE JOINT .....	83

Strafun S.S., Fishchenko O.V., Karpinskiy M.Y., Karpinskaya O.D. BIOMECHANICAL PARTICULARITIES OF GAIT WHEN PRESERVING AND REDUCING THE MOMENT ARM LENGTH. ACTIONS OF HIP ABDUKTORS AFTER HIP JOINT REPLACEMENT .....	85
Tankut O. V., Dudko O.G. CLASIFICATION OF KNEE BONES DEFECTS FOR PROPER PREOPERATIVE PLANNING (EILF DATABASE REVIEW).....	86
Tereshlin K.I., Pasieshvili L.M., Istomin A.G. CLINICAL MANIFESTATIONS OF OSTEOARTHRISIS IN PATIENTS OF YOUNG AGE IN THE BACKGROUND OBESITY SUBJECT TO THE AVAILABILITY OF ADVERSE VDR (BSML C.IVS7 G> A) AND LCT (-13910T> C) GENES POLYMORPHISM .....	87
Fishchenko Y.V., Kudrin A.P. APPLICATION OF INTERLAMINAR EPIDURAL ANAESTHETIC BLOCKS IN TREATMENT OF PAIN SYNDROME IN THE LUMBAR SPINAL STENOSIS .....	89
Fishchenko Y.V., Kudrin A.P., Chernoby S.P. APPLICATION OF RADIOFREQUENCY NEUROABLATION IN PATIENTS WITH COXALGY ON THE BACKGROUND OF THE HIP JOINT OSTEOARTHRISIS .....	90
Fishchenko Y.V., Kudrin A.P. TRANSFORAMINAL EPIDURAL ANAESTHETIC BLOCKS IN TREATMENT OF PAIN SYNDROM IN DEGENERATIVE DYSTROPHIC DISORDERS OF THE LUMBOSACRAL SPINE	91
Fishchenko V.O., Branitskiy O.Y., Karpinskaya O.D. FACTORS CONTRIBUTING TO FORMATION OF THE PATHOLOGICAL GAIT PATTERN IN LONG-LASTING COXARTHOSIS AND THEIR EFFECT ON REHABILITATION AFTER JOINT REPLACEMENT .....	93
Chernyshova I.M., Kovalyova S.V., Raychenko N.A., Logvin G.B. SYSTEMATIC APPROACH TO DEVELOPING PHYSICAL REHABILITATION PROGRAMS FOR CHILDREN WITH PROGRESSIVE NERVOUSE-MUSCULAR DISEASES .....	94
Chernyshova I.M., Kovalyova S.V., Danilchuk A.V., Logvin G.B. PECULIARITIES OF ACTIVE REHABILITATION OF CHILDREN WITH SECONDARY DYSPLASIA OF THE HIP JOINT .....	95
Chernyshova I.M., Kovalyova S.V., Bekhzad Kh.Z., Kabanenko I.V., Boboshko P.O. TRAINIG AND EVALUATION OF GAIT FUNCTION IN AMPUTEES WITH DEFECTS OF LOWER EXTREMITIES .....	96
Chorny V.S., Protsenko V.V. EWING SARCOMA/PNET (PRIMARY NEUROECTODERMAL TUMOR), RESULTS OF INTEGRATED TREATMENT .....	97



Shimon V.M., Pushkash I.I., Shimon M.V., Sheregiy A.A. SAGITTAL DEVIATION SYNDROME. PARTICULARITIES OF LOAD CHANGE.....	98
Shimon V.M., Pushkash I.I., Shimon M.V., Sheregiy A. A. TREATMENT OF OSTEOCHONDROSIS OF THE LUBAR SPINE IN ATHELETS AND THEIR REHABILITATION .....	99
Schekin O.V., Schekin A.O., Kukhtina S.A., Shatskiy A.V., Polubotko B.A., Mariev G.S. OUR EXPERIENCE IN TREATING TRANSCONDYLAR AND SUPRACONDYLAR HUMERUS FRACTURES IN CHILDREN .....	100
Yurik O.E., Duda B.S., Yurik N.E. NEUROLOGIC DISORDERS IN CHILDREN WITH CONGENITAL DYSPLASIA OF LARGE JOINTS OF EXTREMITIES .....	102
Yurik O.E. DIFFERENTIAL DIAGNOSTICS OF GROIN PAIN IN ATHLETES .....	103

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**ELECTROMYOSTIMULATION AT THE EARLY POSTOPERATION PERIOD IN PATIENTS WITH DAMAGED KNEE JOINT CARTILAGE AFTER ARTHROSCOPIC MICROFRACTURE**

**Bayandina E.I., Yachnik S.P.**

*State Institution "Scientific Research Institute of Traumatology and Orthopedics of Ukraine" under National Academy of Medical Sciences of Ukraine, Kiev, Ukraine*

One of the goals of early postoperative treatment of patients with damaged articular cartilage after arthroscopic microfracture is the recovery of the muscular function of the extremity operated, first of all the function of the knee joint extensors. Rehabilitation of this category of patients has certain features, which are early development of movements in the knee joint in a passive mode without axial loads on the extremity operated. The rehabilitation program is based on exercises done in the initial decubitus position and electromyostimulation prescribed for more rapid recovery of muscular activity.

**Reserach objective:** Increasing the efficiency of patients' rehabilitation after arthroscopic microfracture of local defects of articular cartilage due to the combined use of therapeutic gymnastics and electromyostimulation

26 patients with local injuries of articular cartilage (up to 2 cm<sup>2</sup>) of the joint surface of the medial process of the femur (Stage 3-4 over Outerbridge) with hypotrophy of the femoral muscles were examined. The patients' average age was  $31.2 \pm 5.4$  years old. The patients' were operated at clinics of State Institution "Scientific Research Institute of Traumatology and Orthopedics of Ukraine" and underwent a course of rehabilitation therapy in the rehabilitation department. The first group patients (14 persons) performed therapeutic exercises (TE) and received electromyostimulation of the quadriceps femoris muscle; and the second group patients performed only therapeutic exercises (TE). The treatment was controlled according to the goniometry and superficial electromyography data.

Particular attention was paid to rehabilitation treatment at the early postoperative period for the first 6 weeks after surgery. This is the period of protection of the fibrin clot formed in the process of microfracture. Therefore, the therapeutic exercises program was based on passive motions and isometric exercises. The second group patients, in addition, were prescribed electromyostimulation of the rectus femoris muscle on the AEST-01 apparatus for 20 minutes. In 6 weeks after surgery, the patients of both groups demonstrated an increase in the range of motion over 90 degrees in the joints operated. Prior to the therapy, there was no difference in the average amplitude of the rectus femoris muscle: the first group patients had muscle amplitude of  $(88.3 + 6.2) \mu\text{V}$  and the second group patients had muscle amplitude of  $(89.3 + 5.8) \mu\text{V}$ . After 6 weeks of therapy, a marked increase in bioelectric muscle activity was observed in the first group  $(136.7 + 9.1) \mu\text{V}$  and an insignificant increase in the second group  $(105.1 + 8.5) \mu\text{V}$ .

**Conclusions**

The results showed that the combined use of therapeutic exercises and electromyostimulation at the early postoperative period was an effective treatment method, and it made it possible to restore the range of knee joint motion and bioelectric muscular activity in the lower extremity in most cases.

# RECOVERY OF THE QUADRICEPS FEMORIS MUSCLE AS PER DYNAMOMETRY DATA IN PATIENTS AFTER RECONSTRUCTION OF ANTERIOR CRUCIATE LIGAMENT

\*Bayandina E.I., \*\*Katyukova L.D., \*\*Yachnik S.P., \*\*Yarygin S.V.

*\* Zhovten clinical sanatorium State Institution,*

*Ukrprofzodorovitsa closed joint stock company, Kiev*

*\*\* State Institution "Scientific Research Institute of Traumatology and Orthopedics of Ukraine" under National Academy of Medical Sciences of Ukraine, Kiev, Ukraine*

Long-standing weakness of knee extensors is often observed in patients after reconstruction of the anterior cruciate ligament (ACL), which affects joint stability, increases the risk of recurrent injuries, and accelerates the development of gonarthrosis. Recovery of the muscle power of the extremity operated is one of the main goals of the rehabilitation therapy.

**Reserach objective:** Determining the effectiveness of power exercises in rehabilitation therapy of patients after reconstruction of the anterior cruciate ligament (ACL)

## Materials and methods

The analysis of treatment of 24 patients after arthroscopic reconstruction of ACL surgery was carried out; the patients' average age was  $31 \pm 2.3$  years old. All the patients were operated in clinics of the State Institution "Scientific Research Institute of Traumatology and Orthopedics of Ukraine" under National Academy of Medical Sciences of Ukraine, Kiev, Ukraine. The patients were admitted to rehabilitation department after restoration of supporting function not earlier than at the 7<sup>th</sup> week after surgery. The treatment duration was 3 or 4 weeks. The first group patients (12 persons) were treated as per the standard program; the second group patients (12 people) were treated as per force program, with the exercise duration being 40 minutes in both groups. General exercises to develop muscle power and rehabilitation exercises lasted for the same time in both programs. In the power program, the 60% of the time was spent for power exercises; in the standard program, only 25% of the time was spent for power exercises due to the reduced time spent for flexibility and coordination exercises. Power exercises were used as isometric (when muscular contraction is not accompanied by a change in the muscle length), and as dynamic (when muscular contraction is accompanied by a change in the muscle length). Dynamic exercises included exercises that used mass of patient's own body mass or mass of objects; resistance exercises; exercises on weight machines.

The patients were evaluated clinically and with the Lysholm knee scoring scale; the range of motion was evaluated as per the goniometry data; the power of knee extensors was evaluated by the method of electrotensodynamometry. The limb index was determined: it is the ratio of the muscle power of the extremity operated to the muscle power of the one non-operated in ercentage terms. The criterion of convalescence was considered an index higher than 85%. The patients were examined at the beginning of the rehabilitation treatment (in 8 or 9 weeks after the surgery), after the treatment end in a hospital setting (in 12 or 13 weeks after the surgery) and 6 months after the surgery.

## Research findings

According to the goniometry results, the majority of patients in both groups reached the knee joint bend angle of 120 degrees or more in 12 weeks after surgery; at the end of the treatment, the range of motion in the knee joint was close to the physiological norm in all the patients.

The muscle power characteristics before the beginning of rehabilitation were reduced in both groups; the group of patients engaged in the power program had the moment of force of the quadriceps femoris muscle significantly higher than before the treatment at the end of the late postoperative period (in 16 weeks after surgery); and the patients of both groups obtained a significant increase in the moment of force at the end of the period of elevated loads (in 26 weeks) in comparison to the starting values; the patients of the force group, however, were rehabilitated probably better ( $p < 0.05$ ).

**Table**  
**Limb index according to the data of moment of force of the quadriceps femoris muscle in patients after reconstruction of the anterior cruciate ligament (ACL)**

Patients' groups	Number of patients	Limb index, %					
		Extremity operated			Extremity non-operated		
		Before treatment	16 weeks after surgery	26 weeks after surgery	Before treatment	16 weeks after surgery	26 weeks after surgery
Standard program	12	41.05±9.29	45.9±5.6	83.6±23.8#	86.1±11.6	87.4±9.6	121.4±15.7
Power program	12	33.48±5.9	62.78±8.9*#	92.15±12.2*#	99.08±12.2	104.95±11.4	117.7±14.34

**Notes:**

\* probable difference between the groups (standard and power programs) with  $p < 0.05$

# probable difference in comparison to the condition before treatment ( $p < 0.05$ ) in the same group

Thus, the muscle power characteristics are probably better recovered when undergoing treatment as per the power program.

**Conclusions**

1. The results of dynamometric studies of the quadriceps femoris muscle and the assessment of the functional condition of the knee joint in accordance with the Lysholm knee scoring scale show the advantage of using the force program in comparison with the standard program for restoring the power parameters of knee extensors.

2. Patients who were rehabilitated as per both programs showed the restoration of the range of motion in the joint operated within the first 12 weeks after the reconstruction of the anterior cruciate ligament.

3. Power indicators of the muscles of the extremity operated on are restored at a slow pace, which prevents the early return of the patients operated on to significant physical activity.

## **INCREASING THE QUALITY OF BIODEGRADABLE MAGNESIUM ALLOY FOR OSTEOSYNTHESIS BY ISOSTATIC PRESSING**

**\*Belikov S.B., \* Shalomayev V.A., \*Tsyvirko E.I., \*Aykin M.D.,  
\*\*Chorny V.M.**

*\*Zaporozhye National Technical University*

*\*\*Zaporozhye State Medical University, Zaporozhye, Ukraine*

The production of biodegradable implants for osteosynthesis sets high demands for the quality of the alloy they are made of. Therefore, improving the structure and properties of magnesium based alloy is a priority.

The objective solution is related to the need to develop new scientific approaches that take into account the relationship between the structural state of the metal and its physical and mechanical properties.

The analysis of academic literature on metallurgy and materials science of magnesium-based alloys showed that the main vector of these studies is improving the metal structure that has a very significant effect on the biodegradability and mechanical properties.

To produce biodegradable implants, a new alloy of the Mg-Zr-Nd-Ag system is used; the alloy production includes alloy smelting in gas induction-heating furnaces, refining liquid melt with flux, molding and heat treatment. In this, foundry products may include microporosity areas, which impairs mechanical properties of the material and causes its biocorrosion.

One of the promising vectors of eliminating the microporosity of magnesium alloy castings may be the use of the gas isostatic pressing (GIP) technology. When using this technology, the micropore walls are welded (collapsed) as a result of high temperature creep and metal diffusion. The application of GIP magnesium alloys has not been studied so far. Therefore, testing GIP technology is promising in terms of improving quality of casting magnesium alloys and their physical and mechanical properties.

The purpose of this work is researching the feasibility of application of GIP technology for magnesium alloy castings, and researching its influence on the structure and properties of magnesium castings. The quality of magnesium alloys castings was determined in industrial conditions by non-destructive testing methods: X-ray testing, fluorescent penetrant testing and dye penetrant testing methods. X-ray testing of defects in magnesium alloy castings was carried out with RAP-150/30, RUP 400-5, and MIRA-2D instruments, and the data obtained were recorded on RM-1 and RT-2 X-ray films.

Luminescent control of the castings was carried out by LUM-17-P and LUM-K methods that use capillary penetration of a luminescent penetrant into the cavity of the product defect. After cleaning the product in technical water and drying it, the magnesium oxide developer was applied onto the surface to control. The presence of defects was detected by the glow in the ultraviolet light generated by the KDZ-ZL irradiator.

To test products for defect by CM15-B dye-penetrant method, a layer of indicator penetrant was applied to the pre-cleaned surface of the product. After exposure, when the penetrant filled the surface defects, the surface was treated with OZh-2 liquid and removed with a mixture (composed of 70% of transformer oil or MS-8P oil and 30% of TS-1 or RT fuel. To fix the defect, the developer was used.

To carry out metallographic control and determine mechanical properties, the specimens were made of the castings, which contained microporosity, before and after gas isostatic pressing (GIP). Gas isostatic pressing was carried out in the QUINTUS gasostat at a temperature of  $395 \pm 5$  °C and a pressure of 9.2 MPa for 1.5 hours.

The strength and relative elongation of the specimens were determined on P5 tear-off machine at room temperature. The macro- and microstructure of the investigated alloys were researched by means of Neophot 32 and OLYMPUS X 70 light microscopes.

The low density portions of the castings made of the magnesium based alloy investigated, had homogeneous finely divided macrostructure, with the microporosity areas in the castings being separated by sections of normal density with a uniform decrease in density at the places of their location; therefore microporosity areas were classified as concentrated lamination areas. The microstructure of the heat-treated magnesium alloy investigated represented a  $\delta$ -solid solution with the presence of a spherical form eutectic ( $\delta + \gamma$  (MgZr12Nd)) and complicated single intermetallic compounds. The intermetallic phase dimensions were of 0.5 to 2.0 microns, and a distance between the axes of dendrites of the second order was of 6 to 10 microns.

The metallographic analysis showed that GIP did not affect the dimensions of macro- and micro-grains of magnesium alloy castings. At the same time, there was a packing of metal due to the removal of micropores. GIP contributed to the strengthening of metal in superficial layers of the castings due to their deformation. The microhardness of metal in the superficial layers of the casting was much higher than in its central part. At the same time, an increase in the metal density was 10 to 15%; an increase in the strength boundary was  $\sim 15\%$ ; and an increase in plasticity was  $\sim 20\%$ .

Thus, using gas isostatic pressing (GIP) technology to treat magnesium based alloy castings is an effective technology that makes it possible to eliminate the microporosity of cast metal, increase its density, and obtain a metal with improved mechanical properties for the production of high-quality biodegradable implants.

## **IMPLANTATION OF THE RADIAL HEAD AT THE "TERRIBLE TRIAD" ELBOW INJURY**

**\*Boyko I.V., \*\*Shcherbakov D.E., \*\*\*Makarov V.B., \*\*\*\*Sabsay O.V., \*\*\*\*Maliy I.V.**

*\* State Scientific Institution "Scientific and Practical Center for Preventive and Clinical Medicine" of the State Administration, Kiev, Ukraine*

*\*\* Communal Institution "Krivoy Rog Municipal University Hospital No.10", Krivoy Rog, Ukraine*

*\*\*\* State Institution "Specialized General Hospital No. 1 of the Ministry of Healthcare of Ukraine", Dniepr, Ukraine*

### **Introduction**

The "terrible triad" elbow injury means the combination of radial head fracture with elbow dislocation, coronoid process fracture, and rupture of the capsular ligament apparatus. This name is used because of the instability emerged or, vice versa, severe elbow contracture when using conservative therapy.

**Reserach objective:** Studying the results of surgical treatment of patients with "terrible triad" elbow injury with application of a new modular cementless radial head implant

## **Materials and methods**

The authors operated 6 patients with a "terrible triad" elbow injury (4 men and 2 women) aged 29 to 63 years in the period of 2016-2018. All the patients were operated in 2 or 3 days after the injury. The observation period was between 3 and 12 months. All the patients had multifragmental fractures, radial head fractures and combination of Mason-Hotchkiss types III and IV radial head fracture with elbow dislocation. Regan-Morrey type I coronoid process fractures were found in 5 patients, and Type II fracture was found in one patient after osteosynthesis with plate and screw fixation. The lateral collateral ligament complex (LCC) was restored via a transosteal suture in all the patients. The medial collateral ligament was damaged in 2 cases, but its surgical restoration was not performed due to obtaining complete elbow stability after implantation of radial head implant and suture of the collateral ligament complex and the elbow anterior capsule. In those patients, the elbows were immobilized with plaster splints for 3 weeks. In other patients, plaster splint provided immobilization to the elbow for 5 days, and it was replaced with a soft bandage later on. The development of passive motions began in the second day after the surgery; the development of active motions began after reducing the edema and pain syndrome, in 5 or 7 days after the surgery. To assess the treatment result, the Mayo Elbow Performance Score was used.

## **Research findings**

Clinical and X-ray results of surgical treatment were assessed in all the patients in the period from 3 to 12 months. The average flexion angle in the elbow joint was 130 ° (within the range of 110 to 140 °); the average range of the elbow extension deficit was 10 ° (within the range of 5 to 20 °); the mean pronation range was 75 ° (within the range of 70 to 90 °); the mean supination range was 75 ° (within the range of 70 to 90 °); the average flexion-extension ratio was 125 ° (within the range of 100 to 130 °); the average pronation-supination range was 140 ° (within the range of 130 to 160 °). In accordance with the Mayo Elbow Performance Score, 3 patients had excellent results, 2 patients had good results, and one patient had satisfactory results, with an average score of 88.5.

## **Conclusions**

1. Using the modular cementless bipolar radial head implant and early elbow mobilization allow all patients with "terrible triad" elbow injury to obtain positive results.
2. Early elbow joint mobilization and the restoration of the capsule-ligament apparatus, the metal osteosynthesis of the coronoid process at injuries of Regan-Morrey Type II-III are the determining factors of achieving the stability of the elbow joint and positive clinical and functional results.

# **BIOMECHANICAL ASSESSMENT OF SURGICAL TREATMENT METHODS FOR SEVERE UNSTABLE INTRA-ARTICULAR DISPLACED DISTAL METAPHYSEAL RADIUS FRACTURES (AO23-C3.)**

**\*Vasilenko A.V., \*\*Zazirniy I.M.**

*\* Kiev Municipal University Hospital of Emergency Medical Aid, Kiev, Ukraine*

*\*\* Centre for Orthopedics, Traumatology and Sports Medicine of Feofania University Hospital, Kiev, Ukraine*

## **Introduction**

Distal radius fractures are among the most common fractures in humans, and they constitute the main part of work for orthopedic and surgical departments worldwide.

Currently, the issue of selecting the treatment management for the distal radius fractures remains challenging. Currently, the issue of selecting the treatment management for the distal radius fractures remains challenging. The challenge of treating unstable intra-articular displaced distal metaphyseal radius fractures lies in a high-energy nature of the injury and high incidence of ligament injuries. The fundamental requirements to the treatment of such fractures are resetting a broken bone in its anatomical position, restoring joint surface and radius length, and achieving stable fixation of bone fragments. At present, a large number of treatment methods are available, including closed resetting of a broken bone in its anatomical position and plaster splinting, closed fracture osteosynthesis with Kirshner wires, external fixation with a modular rod-type device, and open resetting and internal fixation with a volar locking plate.

## **Study objective**

The main study goal was to improve the treatment of patients with severe unstable intra-articular displaced distal metaphyseal radius fractures of C3 type. The study purposes were: determining the relation between the magnitude of the displacement of the bone fragments and the magnitude of the load applied when fixing the bone with various fixing systems; determining the stabilization properties of various types of fixation (wires of 2.0 mm, plates without angular stability, plates with angular stability and fixed angles, and plates with multiaxial angular stability) when simulating an unstable intra-articular displaced distal metaphyseal radius fracture of C3 type; determining the optimal option for fixation of the an unstable intra-articular displaced distal metaphyseal radius fracture of C3 type.

## **Materials and methods**

The study was conducted on 24 synthetic models of SYNBONE SWISS MADE company (7001 right radius), which are close to human bone tissue in terms of their anatomical and mechanical properties. The intra-articular displaced distal metaphyseal radius fracture of C3 type was simulated on the SYNBONE SWISS MADE models by cutting. Each fracture model was fixed in 4 fixation ways: with 2.0 mm wires; with a plate without DSP angular stability; with a plate that has angular stability and a fixed angle (LSP Synthesis,) and with a plate that has multiaxial (multilevel articular support) angular stability (LSR Stryker).

The models were subjected to various long-acting cyclic compressive loads. To determine the mechanical properties of the specimen, it was subjected to a compressive load, by using a machine for biomechanical research. The specimens were set on the moving table of the experimental machine. The load was applied by displacing the machine moving table upright. The experiment was repeated with each fixation option on 6 synthetic radial bone models. The specimen deformation rate was



changed from 2 to 8 mm/min. The previous load was 50 N. The compression effort was measured with a dynamometer. The dynamometer signal enters the microprocessor of the CAS CI-2001A strain-gauge dynamometer that has the SBA-100L strain gauge. Upon completion of the study, the information obtained was recorded as a deformation diagram in the coordinates of "P load –  $\Delta\pi$  absolute deformation (displacement)".

While working with the program, the test machine indicator showed the following data: the current number of load cycles; the current value of the load (P) acting to the specimen; and the displacement of a movable traverse. The data were recorded at the cyclic loading tests, using the ASUS PC with a built-in ASUS webcam (1.3 mp). The data obtained from the experiment were statistically processed. The calculations were carried out using the SPSS 11.0 package data processing and analysis. The data had been pre-processed in the MS Excel +2017 package. To determine the statistical characteristics of the fixation models, the following standard methods of descriptive statistics were used: determination of the mean standard deviation of the sampling; and variance of the measurement results. To determine the degree of difference between the fixation types, analysis of variance with Bonferroni correction was used to eliminate the effect of multiple comparisons.

### **Research findings**

After the comparative analysis, we obtained the standard deviation and variance values, which indicated that the variability of the data obtained from the study differed substantially in the groups studied. Thus, we obtained the following results: the worst research findings, as predicted, we obtained in the method of fixation with 2 mm wires (there was an effect of "creep", as we called it, at a load of 3,0 kg); two other types of fixation of the DSP and LSP plates are close to each other in terms of their ability to withstand the load, although it should be noted that the load onto the radius surface and the axial load demonstrated the failure of the plate without angular stability (there was a "creep" effect, which started at a load of 8.0 kg). The best load resistance values were obtained in a group of models fixed by multi-axial blocked plates (LSP-P); the "creep" effect, which we obtained at various load vectors, starting at a load level as low as 10.0 kg. Based on the data obtained from the study, and taking into account the "creep" effect at various fixation methods, the study result (debris displacement of 2 mm) was considered satisfactory; and we have analyzed objectively the stability of fixation with various systems. After the experiment that studied the stabilization properties of various fixation methods for the AO23-C3 radius fracture, a fair question arose to determine the place of each implant in the treatment. Carried out by us, the variance analysis procedure determined the ratio of systematic (group) variance to random (intra-group) variance in the data measured. To determine the degree of variance between the fixation types, we applied analysis of variance to determine Fisher's criterion. The ratio of intra-group variance to intergroup variance indicated that the average values in the groups differed due to the use of devices, which had different designs, to fixate bone fragments. The closest were the figures when the load was applied from the palmar surface. At this type of loading, all the designs were close to each other in terms of their characteristics. However, when the load was applied from the radial surface (simulation of deviation), the divergence between fixing characteristics of the structures was the biggest.

### **Conclusions**

The worst method of fixation for the AO23-C radius fracture should be considered the use of 2 mm as the fragment union rigidity is lost even at insignificant loads. The plate that has no angle stability is not

substantially different from wires, although it can withstand the load almost 2 times higher. The blocked plate with a fixed angle have good fixation properties, but inferior to those of multiaxial blocked systems, as it cannot withstand multilevel load types on the joint surface, which leads to the collapse of the joint facet in the area of fixation of the bone fragments.

## **EXPERIMENTAL MODELING OF TUBERCULOUS SPONDYLITIS**

**Vesnin V. V., Golka G. G.**

*Kharkov National Medical University, Kharkov, Ukraine*

Bone and joint tuberculosis ranks second (2.6%) among all clinical forms of the disease and it ranks first (almost 50%) among extra-pulmonary tuberculosis in Ukraine.

To study the modern clinical and pathomorphological features of the experimental tuberculous spondylitis (TBS) and the influence of modern antibiotic therapy on the development of the specific destructive process, we carried out an experimental modeling of TBS in guinea pigs (according to our methodology, patent number No.112423 (UA) Ukraine).

The animals were chosen due to their high susceptibility to *Mycobacterium tuberculosis* and skeleton structure, although the latter is different in size and shape, however, the general plan of the anatomical structure is similar.

For the study, 40 guinea pigs were taken. The animals were divided into 4 groups. The modelling was carried out by injecting the suspension of live *Mycobacterium Tuberculosis* of human type into the vertebral body.

Groups 1, 2 and 3 (the main groups): one injection of 0.5 ml suspension of *m. tuberculosis* was administered (0.1 mg of dry weight in 1 ml).

Group 1 (10 guinea pigs): specific first line antibacterial drugs were administered to treat the animals.  
Group 2 (10 guinea pigs): specific second line antibacterial drugs were administered to treat the animals.

Group 3 (10 guinea pigs): no treatment was administered.

Group 4 was a control group. Animals were injected with a sterile physiological solution (0.9% - 0.5 ml).

Group 1 was injected with specific first line antibacterial drugs in dosages according to the weight of animals (parenterally).

Group 2 was injected with specific second line specific antibacterial drugs in dosages according to the weight of animals (parenterally).

The medications were administered daily. All the experimental animals were dynamically monitored (clinical and radiological changes were observed). X-ray of the spine was performed various times (3 to 6 times) for medical reasons during the experiment period. The animals of Groups 1 and 2 (who were administered with specific antibacterial drugs) were withdrawn from the experiment at 2 stages: at the term of 6 weeks (pre-spondylitis stage), and at the term of 8 weeks (spondylitis stage).

A pathomorphological study was carried out in all the animals removed from the experiment. The study attention was focused on the pathomorphology of vertebrae affected by a specific process. The animals from Group 3 died within a period of 4 to 6 weeks after inoculation because of generalization of the tuberculous process. The animals were subjected to a pathology study. The

animals treated with second-line drugs showed a clear demarcation line in the early treatment term (pre-spondylitis stage).

## **Conclusions**

Thus, the study showed that conducting modern intensive specific antibiotic therapy in experimental conditions made it possible to achieve a delimitation of the destructive process in relatively early stages of the disease (4-5 weeks).

Obtained in the experiment, new knowledge about the pathomorphological features of the course of tuberculosis allows us to perform radical surgery on the spine at earlier stages of the disease with no risk of generalization of the tuberculous process.

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**HIP JOINT REVISION REPLACEMENT IN PATIENTS WITH ASEPTIC INSTABILITY OF THE ACETABULAR COMPONENT OF HIP JOINT IMPLANT**

**Gayko G.V., Sulima O.M., Podgayetskiy V.M., Osadchuk T.I.**

*State Institution "Scientific Research Institute of Traumatology and Orthopedics of Ukraine" under National Academy of Medical Sciences of Ukraine (NAMN), Kiev, Ukraine*

## **Introduction**

The number of complications of joint replacement increases drastically, and today medical centers perform up to 25 percent of revision hip joint replacements all in the world. Ukraine has not reached yet the peak of the number of revision operations.

It is known that the results of revision joint replacements are much worse than the results of primary joint replacements. The incidence of recurrent instability of the acetabular component is 30% in 10 years after the surgery, and almost 60% in 15 (Kosyakov A. N., 2002; Loskutov A.E., 2006; Buma P. 2007; Paprosky W. G., Perona P. C., Lawrence J. M. 1998).

**Reserach objective:** Improving the results of treatment of patients with aseptic instability of the acetabular component of the hip joint implant by identifying errors and complications of revision implant replacement

## **Materials and methods**

The work was based on the results of a research of 188 patients with aseptic instability of the acetabular implant component, which was used for revision replacement of the hip joint.

## **Research findings and discussion**

By analyzing the results of the revision hip implant, the authors determined the incidence of complications of revision joint replacement: repeated aseptic instability and septic instability of the implant component, and dislocation of the implant.

Aseptic instability of the revision implant component was observed in 22 cases (12% of all the joints revised) within the first 10 years after the revision surgery. That is, our own clinical material allowed us to determine that the cemented type of implant fixation was predominant among the unstable revision components, wherein plastic reconstruction the defects over 50 cm<sup>3</sup> was performed with bone cement (19 cases, 86%). As for the design, INMED implant became repeatedly unstable (13 cases, 59%). When performing revision surgery, the recommended component position was not reached in 15

cases (68%), the coverage of the bone did not reach 40% in 16 cases (73%). In case of using plastic material, the volume of defects was in average over 150 cm<sup>3</sup>, the contact of the bone graft with the bone bed did not reach 50% in 100% of cases.

Also, the cause of the complications is the implantation of the component in an unrecommended position and a small (up to 40%) bone overlapping. When using a bone graft more than 150 cm<sup>3</sup>, the contact of the bone graft with the bone bed did not reach 50%, which led to the lysis of the bone graft and the secondary displacement of the component.

Septic complications were observed in 12 cases (6%) within 10 years. Direct correlation was determined between the incidence of septic complications and positive results of microorganism isolation ( $r = 0.58-0.77$ ) in the course of revision surgeries. Bacterial contamination of the joint in the course of revision surgeries increases the number of complications, which justifies the need for microbiological and serological examination of patients with aseptic instability and the need for antibiotic prophylaxis of complications ( $p < 0.05$ ).

Dislocations of the head of the revision implant in the postoperative period were observed in 8 cases (4%), mainly in the early postoperative period, up to 3 months. It was determined that chronic dislocations of the implant head correlated reliably with the unrecommended position and a small bone overlapping (less than 40%) of the acetabular component of the revision hip joint implant  $r = 1.0$ ,  $p < 0.05$ .

## **Conclusions**

1. The following complications prevailed among the complications of revision joint replacement: repeated aseptic instability of the implant components (12% of cases), septic instability (6% of cases), and dislocations of the head of revision implant (4% of cases).

2. The following are the factors found to lead to repeated aseptic instability:

a) Using implants without functional coverage and cemented fixation of the revision component;

b) Absence of the osteoplastic substitution of the acetabular defects larger than 50 cm<sup>3</sup>; implantation of the component in the unrecommended position; and a small (less than 40%) bone overlapping;

c) Errors in the technical implementation of the osteoplasty of defects larger than 150 cm<sup>3</sup>; it failed to provide a contact of the bone transplanted with the bone bed (less than 50%), and led to the lysis of the bone transplanted and the secondary displacement of the component within the first three years.

3. Septic instability of the revision component was the result of bacterial contamination of the hip joint and an inadequate antibiotic prophylaxis.

4. Dislocations of the heads of the revision implants were the cause of the implantation of the revision component in an unrecommended position, and cause of a small bone overlapping (less than 40%).

# CONDITIONS OF REVISION REPLACEMENT OF HIP JOINT IMPLANTS IF BONE TISSUE DEFECTS ARE AVAILABLE (BIOMECHANICAL MODELING)

Gayko G.V., Lazarev I. A., Podgayetskiy O. M., Osadchuk T.I., Sulima O.M.

*State Institution "Scientific Research Institute of Traumatology and Orthopedics of Ukraine"  
under National Academy of Medical Sciences of Ukraine (NAMN), Kiev, Ukraine*

## Introduction

One of the most important complications of primary joint replacement is aseptic instability of the implant components. Patients' quality of life and the duration of stable and painless functioning of the revision implants depend greatly on the anatomical adequacy of the acetabulum that is a support or a bed for the acetabular implant component. However, it should be noted that explicit instability signs (such as severe pain, joint dysfunction, increasing radiolucency between the implant components and the bone bed, changes in the position of implant components, and joint destruction) appear only after 3-5 years of functioning of an unstable implant.

## Study objective

The main goal of the study was the biomechanical analysis of the effect of the position of the acetabular component of the hip joint implant on the development of its aseptic instability, and biomechanical conditions of revision replacement in patients with bone defects.

## Research findings and discussion. Biomechanical simulation

Under the action of body weight (F force), the head of the femoral implant component displaces, deforming the surface of acetabular component, which is much milder. Further the investigation of contact interaction between the head and the acetabular component of the hip joint implant was carried out by finite element modeling (FEM).

In the model, the zone of the maximum pressure (up to 230 N/cm<sup>2</sup>) is located above the equatorial plane of the acetabulum, towards the maximum displacement of the head. The lower part of the contact surface remains unloaded or poorly loaded (less than 50 N/cm<sup>2</sup>).

Thus, in the cementless implantation of the acetabular component of the hip joint implant in the recommended position, it is possible to achieve the maximum area of the contact between the acetabular component and the acetabular bone bed (100%), with the pressure to the acetabular bone not exceeding the strength limit of spongy bone of 500 N/cm<sup>2</sup>.

If the acetabular component is set inexactly (a small deviation angle of 25°), internal rotation of the extremity at 10° will create a load of  $P = 691.3 \text{ N/cm}^2$ . Due to the stresses concentration in some areas, the pressure can exceed the pressure calculated.

In case of an inexact setting of the revision acetabulum (without the osteoplastic replacement of bone defects) into a defect associated not with rotation but with the displacement of the acetabulum up or down (at an angle of 45°), it is also important to take into consideration the location of the crosspoint of forces of the muscles engaged. In case when the acetabulum is set 5 mm up, into the defect of the acetabular roof, the muscle force balance will be altered. At the same time, we believe that the muscle forces were not altered (patient's muscles did not adapt to a new position, although theoretically such an adaptation is possible). In this case, the angle is 14.2°. Then the arc (it is altered very slightly because of the shift) will be divided in the proportion as follows: 3.01 and 3.27 cm with a total length of 6.28 cm. The force, as earlier, will be divided in inverse proportion: 3,36 and 3,64 kg. Accordingly, it gives a pressure in a smaller area  $36.4 / 3.01 = 10.21 \text{ N/cm}^2$ , which is about 3.7% of

the pressure caused by body weight. However, in this case, the effect of the pressure created by the muscles leads to a decrease in the imbalance of pressure, that is, it contributes to mitigation of the negative effects of pressure distribution caused by patient's body weight.

Thus, the displacement of the acetabular component upwards weakens the effect of uneven pressure distribution on the acetabulum. Accordingly, when the component is displaced down, the effect will be the same, but with the opposite sign. Namely, the effect of the pressure caused by muscle forces will increase the pressure imbalance caused by patient's body weight, and the pressure imbalance will be the same 3.7%. In the most unfavorable case when the acetabulum is displaced down and set with a deviation from the nominal position to an angle of  $10^\circ$ , the proportion of muscle pressure will be about 8% of the total pressure caused by patient's weight.

## **Conclusions**

In case of erroneous implantation of an acetabular implant with a deviation of more than  $10^\circ$  from the nominal position, the component contact area is reduced, becoming less than 62%, which increases the pressure onto the bone, contributes to implant destabilization, and increases the imbalance of muscle pressure (it contributes to a additional increase in pressure, not decrease).

In case of a inaccurate setting of the revision acetabulum (without the osteoplastic replacement of bone defects) into a defect associated not with rotation but with the acetabulum displacement up or down, the balance of forces is affected.

When the acetabular component of the hip joint implant is displaced upwards, the effect of uneven pressure on the acetabulum, which is caused by the action of patient's weight, decreases due to the effect of muscles. When the acetabular component of the hip joint implant is displaced downwards, the effect of uneven pressure on the acetabulum, which is caused by the action of patient's weight, increases more due to the effect of muscles.

When displacing the acetabular component of the hip joint implant downwards and setting it with a deviation from the nominal position, the role of pressure caused by the muscles is a secondary factor.

## **TREATMENT OF COMPLICATIONS OF HIP JOINT IMPLANT REPLACEMENTS**

**Gayko G.V., Gritsay M.P., Podgayetskiy O.M., Sulima O.M., Kozlov G.B., Kozak R.A.**

*State Institution "Scientific Research Institute of Traumatology and Orthopedics of Ukraine" under National Academy of Medical Sciences (NAMS) of Ukraine, Kiev, Ukraine*

The development of certain complications of the hip joint replacement requires revision surgical interventions, with their number increasing every year, including in Ukraine. It requires a detailed analysis of the causes leading to the negative consequences to prevent them from happening in the future. Everything mentioned above determines the relevance of the study.

Based on the material obtained in the clinic, a detailed analysis was carried out and the structure of complications of the total hip joint replacement was studied. There were 344 cases of the total hip joint replacement, with 339 patients with complications examined after the surgery.

The structure of complications after the total hip joint replacement was investigated and the results of complication treatment were analyzed. The following research methods were used: clinical, radiological, immunological, microbiological, serological and statistical methods.

The analysis and clarification of the causes of complications of hip joint replacement underlie the

proposed principles for preoperative planning, component implantation techniques, and measures to prevent complications. Moreover, to prevent complications, an algorithm is proposed to select the implant according to the type of fixation, shape, and friction pair. Based on the analysis of the complication treatment results, complication treatment algorithms were proposed and the treatment tactics were improved. Following the recommendations above will make it possible to improve significantly the results of the total hip joint replacement and to reduce the number of errors and complications.

### **Relevance**

Due to a widespread incorporation of hip joint replacement into a clinical practice, the number of errors and complications associated with it keeps on steadily growing. The most common complications are: aseptic loosening of components, dislocation of the femoral head, heterotopic ossification, periprosthetic fractures of the femoral bone, suppurative complications, and pain syndrome that is not associated with instability.

The development of other complications of the hip joint replacement requires revision surgical interventions, with their number increasing every year, including in Ukraine. It requires a detailed analysis of the causes leading to the negative consequences to prevent them from happening in the future. Everything mentioned above determines the relevance of the study.

**Research objective:** Improving the results of total hip joint replacement by reducing the number of errors and complications

### **Materials and methods**

There were 344 cases of the total hip joint replacement, with 339 patients with complications examined after the surgery. The structure of complications after the total hip joint replacement was investigated and the results of complication treatment were analyzed.

### **Research findings and discussion**

Complications after hip joint replacement were detected in 339 patients from 344 cases of the total hip joint replacements performed. The structure of the complications was as follows: aseptic instability of the components in 158 cases (45.9%), dislocation of the hip implant head in 41 cases (11.9%), para-articular heterotopic ossification in 30 cases (8.7%), periprostheses fractures of the femur bone in 25 cases (7.3%), pain in the implant joint (not associated with instability) in 35 cases (10.2%), and infectious complications in 55 cases (16.0%).

The total instability of the components of the hip joint implant was observed in 43 cases (27.2%), the instability of the acetabular component was observed in 65 cases (41.1%), femoral component instability was observed in 50 cases (31.6%).

Components with cementless fixation prevailed among unstable acetabular components (59 components or 54.6%). Components with cemented fixation prevailed among the unstable femoral components (53 components or 57.0%). Aseptic instability of the components in 5 years after the surgery was detected in 51 cases (32.3%), in 5 to 9 years after the surgery was detected in 64 cases (40.5%), and in 10 to 14 years after the surgery was detected in 43 cases (27.2%). The majority of the implants destabilized between 5 and 9 years after the hip joint replacement surgery.

The research analyses the results of the treatment of complications of the total hip joint replacement. In patients with instability of the acetabular component, the results of revision replacement of the acetabular component were the best in case of acetabular defects of Type I, and Type II according to the Paprosky classification, and revision implantation of primary acetabular components with the

cemented fixation. So, in 10 years after the revision replacement, the absolute majority of acetabular components (33 components, 86.8%) remained stable ( $t = 9.3$ ,  $p < 0.05$ ). The average lifetime of primary acetabular components implanted in the revision with the cementless fixation was  $8.2 \pm 0.5$  years, and with the cemented fixation was  $4.5 \pm 0.5$  years.

The results of the revision replacement of unstable femoral components with cemented and cementless fixation types in 10 years after the revision did not have a substantial difference. Thus, the average lifetime of femoral components implanted in revision with cementless fixation, was  $7.8 \pm 0.5$  years, and with cemented fixation was  $8.1 \pm 0.5$  years. Relapse of aseptic instability was observed only in 7 cases, 5 of which (71.4%) were with cemented fixation.

No difference was found in the results of revision implantation at total instability when using only primary components and a combination of primary components with revision reconstructive systems of components. In 10 years, the absolute and reliable majority ( $t = 7.3$ ,  $p < 0.05$ ) was represented by the cases with preserved stability of the components (35 cases, which made 81.4%). Relapse of instability of one of the components was observed in 8 cases, which was 18.6% of the total number of the total revision component replacement.

Relapse of the dislocation of the hip joint implant head after a closed adjustment was observed in 72.7% of cases, and after surgery treatment only in 20.6% of cases. The efficacy of surgical treatment of dislocations is reliably higher in comparison to the efficacy of closed adjustment of dislocation ( $\chi^2 = 15$ ;  $p < 0.01$ ).

In the treatment of para-articular heterotopic ossification in patients with contracture in the hip joint  $> 20^\circ$  in two planes, the most effective method of joint restoration and treatment is surgical excision of ossificates, although the relapse of ossification was observed in 70% of cases.

The only effective method of treatment of periprosthetic fractures was the repositioning of debris and osteosynthesis with screw fixation in 100% of cases. No relapses of the femur fracture or false joint were found.

In case of vertebrogenic pain, the best treatment results were found in patients with damages of the back column of the lumbar spine. Conservative treatment proved its efficiency in all patients with both positional and neuropathic pain.

## **Conclusions**

The structure of the complications of the replacement of the hip joint was as follows: aseptic instability of the components - 158 cases (45.9%), dislocation of the implant head - 41 cases (11.9%), para-articular heterotopic ossification - 30 cases (8.7%), periprosthetic femur fractures – 25 cases (7.3%), pain in the implant joint (not associated with instability) – 35 cases (10.2%), and infectious complications – 55 cases (16.0%).

The most efficient methods of treatment of complications were revision replacement with replacement of components and osteoplasty of bone defects if any. The only effective method of treatment of periprosthetic femur fractures was the reposition of fragments and osteosynthesis with screw fixation. In the case of vertebrogenic pain, the best results of treatment were found in patients with damages of the back column of the lumbar spine. Conservative treatment proved its efficiency in all patients with both positional and neuropathic pain.



# METHODOLOGY OF ELECTROPUNCTURE DIAGNOSTICS IN PATIENTS WITH DYISPLASTIC COXARTHROSIS STAGE III AND IV

Gerasimenko S.I., Gayko O.G., Polulyakh M.V., Perfilova L.V.,  
Gezhevskiy I.V., Babko A.M., Polulyakc D.M.

*State Institution "Scientific Research Institute of Traumatology and Orthopedics under National Academy of Medical Sciences of Ukraine (NAMN)", Kiev, Ukraine*

## Introduction

Dysplastic coxarthrosis (DC) is one of the most severe diseases of the hip joint (HJ). The disease is characterized by rapid progression and a small effect of conservative treatment, which, in turn, amplifies indications for surgery. Severe DC forms are almost 19% of all DC cases, with the most efficient treatment method being the total joint replacement (TJR). Unsatisfactory TJR results are observed in almost 20% of patients with severe DC (R.M. Tykhilov, 2014). The issue of unsatisfactory TJP results in DC remains relevant and unresolved, which is confirmed by a large number of academic publications on the subject. Among the causes of TJP unsatisfactory results, the pathologic processes in periarticular structures (PS) of the hip joint, in particular, in the muscles surrounding the joint, are not the least. Well-known research methods will not allow us to obtain information on the nature of the pathological process (inflammatory or degenerative) and on the degree of its intensity in the periarticular structures of the hip joint.

So, the relevance of the study is in introduction of new quantitative methods of functional diagnostics to increase its efficiency, i.e. a comprehensive study, by obtaining new information about the functional status of the periarticular structures of the hip joint in patients with DC stage III and IV.

**Research objective:** Quantifying the functional status of the periarticular structures of the hip joint (the nature and degree of severity of the pathological process in the periarticular structures of the hip joint at various stages dysplastic coxarthrosis stage III and IV, by applying electro-acupuncture diagnostic technique (EAPD) in accordance with R. Fall method.

## Materials and methods

23 patients with DC stage III and IV, were examined with EAPD method: 17 women and 6 men aged 19-69 years. 13 persons had bilateral DC with a predominant lesion in one of their hip joints, and 10 patients had unilateral DC. More than 46 measurements were carried out in the biologically active points (BAP) of the periarticular structures of the hip joint located at a distance of 3 mm from the base of the nail of the second toe on its medial posterior surface symmetrically, taking into account the maximum values at the most affected side.

EAPD method is a non-invasive rapid method that allows quantitative determination of the character (inflammatory or degenerative) and the intensity (degrees I-III) of the pathological process in any organ or tissue, in particular, in periarticular structures of the hip joint, in a few minutes. Also The EAPD method allows monitoring conditions of periarticular structures of the hip joint at various stages of the disease. EAPD can define and evaluate the functional status of any human organ or tissue on the basis of the results skin electrical conductivity measured in the corresponding BAP, with the "function" (according to Encyclopedic Dictionary of medical terms) being the activity of the cell,

organ or organ system as a physiological process. By measuring skin electrical conductivity in representative BAPs, it is possible to obtain information on the status of any organ and tissue. Increased electrical conductivity of a BAP indicates the presence of inflammatory process of varying intensity at various stages according to R. Fall, however, reduced conductivity in a BAP is a sign of degenerative process of various stages.

EAPD method has been used for 16 years in the scientific and practical activities of our institution to carry out for detailed and comprehensive diagnostics of orthopedic and traumatological diseases. EAPD method, however, has not been used in patients with DC stage III and IV.

**Inflammation stages according to R.Fall classification:** Stage I – subacute inflammation stage (SIS) – 66-75 standard units (SU); Stage II – acute local inflammatory process (ALI) – 76-85 SU; Stage III – acute total inflammatory process (ATI) – 86-100 SU.

**Degeneration stages according to R.Fall classification:** Stage I – the initial stage of degeneration – 49-36 SU; Stage II – progressive degenerative process – 35-26 SU; Stage III – marked degenerative process – 25-0 SU.

### **Research findings and discussion**

Following the data of EAPD method:

- In patients with bilateral DC: stage I of inflammation according to R. Fall (subacute inflammation stage (SIS)), was diagnosed in 1 patient (4.5%) at affected side; stage II of inflammation (acute local inflammatory process (ALI)) was diagnosed in 6 patients (26%) at affected side; and stage III of inflammation (acute total inflammatory process (ATI)) was diagnosed in 6 patients (26%) at affected side.

- In patients with unilateral DC: stage II of inflammation (acute local inflammatory process (ALI)) was diagnosed in 4 patients (17.5%) at affected side; and stage III of inflammation (acute total inflammatory process (ATI)) was diagnosed in 6 patients (26%) at affected side.

It should be noted that an increase in measurements is interpreted as a stage of inflammation as per R. Fall classification, solely because of the pain syndrome as the main sign of inflammation. If the medical examination finds an increase in the measurements, while pain syndrome is absent, this indicates only a higher function (hyperfunction) of the organ or tissue (loadings at walking, etc.). Probable degenerative process can be registered in DC stage III and IV by EAPD method if inflammatory changes are absent in an organ or in a tissue at the same time. If inflammatory changes, even insignificant, are present against the background of degenerative changes, then EAPD method determines precisely inflammation as a more energetically active process.

### **Conclusions**

1. The new obtained quantitative data on different intensity of the inflammatory process in stages I and III as per R.Fall classification made it possible to assess objectively the functional status of periarticular structures of the hip joint in patients with DC stages III and IV.
2. The inflammatory nature of the pathological process of various intensity degrees was quantitated as stages I-III as per R.Fall classification in periarticular structures of the hip joint in 100% of the patients examined.
3. The most intense stages of inflammation as per R.Fall classification (II - ALI and III - ALT) was found in the overwhelming majority (95.5%) of patients.

4. Taking into account the high intensity of the inflammatory process as per R.Fall classification in periarticular structures of the hip joint in patients with DC, to prevent the risk of complications after the total joint replacement (TJR), it is suggested that preoperative anti-inflammatory correction should be administered in patients with severe forms of DC.
5. Diagnostic capabilities of EAPD method were used for the first time ever to determine the functional status of periarticular structures of the hip joint in patients with DC stage III and IV, determine the practicability of the wide use of EAPD to complement substantially the complex of well-known diagnostic measures.

## **THE ROLE OF POSTERIOR (DORSAL) SYNOVECTOMY IN TREATMENT OF PATIENTS WITH PIGMENTED VILLODULAR SYNOVITIS OF THE KNEE JOINT**

**Gerasimenko S.I., Babko A.M., Kostogryz O.A., Kostogryz Y.O.**

*State Institution "Scientific Research Institute of Traumatology and Orthopedics of Ukraine"  
under National Academy of Medical Sciences of Ukraine (NAMN), KLiiev, Ukraine*

**Introduction.** In 1941, pigmented villonodular synovitis (PVNS) was isolated as an individual nosological form by H. Jaffe *et alii* who suggested this term. This purely studied disease is underlain by a specific lesion of the joint synovial membrane, tendon sheaths and synovial bursas. The morphological picture is polymorphic: multiple cells of histiocytic and fibroblastic type are observed, and macrophages, lymphoid cells, giant multinucleated cells and foam cells. There is no a single point of view on the origin of the disease to date, and all existing hypotheses have not found a sufficient evidence. The idea of inflammatory genesis has dominated for many years, however, the number of authors who consider PVNS to be a tumor-like disease has increased recently, which is reflected in the histological classification by WHO (Geneva, 1974). As a rule, one joint is usually affected in pigmented villonodular synovitis; however, cases of multiple joint damages are also described. One of the most common localizations is the knee joint, which accounts for up to 80% of all cases of the disease. Depending on the extension of the pathological process, two disease forms are distinguished: local and diffuse. They are characterized by the involvement of the whole joint synovial membrane or a significant part of it, tendon sheaths or synovial bursa with possible invasion into the bone tissue and formation of foci of tissue destruction. In the local disease, the method of choice is a surgery titled a partial synovial capsulectomy. Treatment of the diffuse form is difficult. Postoperative recurrence rates remain high (33-46%) after the surgical interventions currently used to treat diffuse form of pigmented villonodular synovitis [Johansson J. E.]. Repeated and often numerous operations are associated with an extensive surgical treatment, and, as a consequence, with the risk of functional complications. In case of recurrences, extremity amputations are described. F. Jones *et alii* report extremity amputations after 6 surgeries for PVNS recurrence.

High recurrence rate after subtotal *synovial capsulectomy*, including high recurrence rate after the combination of this surgery with radiotherapy, in patients with diffuse form, is an opportunity to improve current treatment methods and develop new treatment methods for pigmented villonodular synovitis. A particular attention should be focused on the "dorsal" synovectomy.

**Research objective:** Studying and analyzing the current potential of "dorsal" synovectomy in the treatment of pigmented villonodular synovitis of the knee joint

**Materials and methods**

Within the period from 2011 to 2018, 48 patients were examined and operated, with the diagnosis pigmented villonodular malignant synovitis of the knee joint (PVNS KJ) confirmed with histopathological examination, at the Department of Joint Replacement in adults of State Institution "Scientific Research Institute of Traumatology and Orthopedics of Ukraine" under National Academy of Medical Sciences of Ukraine (NAMN), Kiev, Ukraine.

Two forms of PVNS exist: diffuse and local (Granowitz, 1975). We treated 28 patients with a diffuse form and 20 patients with a local one. There were 22 patients among them diagnosed with PVNS KJ and subjected to "dorsal" synovectomy. Most patients are young people, mostly female, with an average age of 34 years. The duration of the disease was of 3 to 10 years. At the preoperative stage, all of them were treated conservatively at their place of residence; some of them were also subjected to surgeries in other medical institutions. The patients were clinically, laboratory and instrumentally examined. The diagnostic value of X-ray, ultrasound, and MRI was evaluated retrospectively, taking into account intraoperative data (arthroscopy data in some cases) and pathomorphology data.

## Research findings

The patients came to see a doctor with complaints of persistent pain and discomfort, periodic pain, severe edema, and limitation of the range of knee motions, which was observed in all the patients under Study, with 7 of them complained about the presence of "protrusion", a feeling of swelling in the area of the popliteal fossa.

When carrying out clinical examination, there were characteristic signs of the knee joint synovitis. The range of motion was much smaller in comparison to the contralateral extremity because of flexion and extension contracture of the knee. Preoperative differential diagnosis of pigmented villonodular synovitis was performed with giant cell tumor, synovial sarcoma, synovioma, rheumatoid arthritis and synovial chondromatosis. Standard X-ray images are rarely informative about the disease itself. Ultrasound examination also is not much informative. However, unlike all other cases in the PVNS of the knee joint, if a swelling is present in the popliteal fossa, we have always performed ultrasound with the purpose of preoperative planning, since in 2 cases, there was ingrowth of the pathological process in the *neurovascular* bundle. The most informative is MRI. This method makes it possible to estimate the dimensions, location, and extent of the damage to the joint structures.

"Dorsal" synovectomy of the knee joint has become an integral part of the treatment for the pigmented villonodular synovitis of the knee over the past few years, especially when it comes to diffuse form or relapse of the disease. A frequent mistake in the treatment of the manifestations of PVNS of the knee joint in the popliteal fossa was the underestimation of the extent of the damage to the dorsal surface of the knee joint. The 5 patients operated by us have been already operated previously for popliteal Baker's cysts, but those surgeries were unsuccessful.

The 22 patients were subjected to the "total" synovectomy of the knee joint. An open "dorsal" synovectomy was performed on 6 patients (popliteal cyst, a so-called Baker's cyst, clinically available and confirmed with ultrasound and MRI examinations).

The remaining 16 patients were subjected to synovectomy of the posterior portions, using arthroscopic technique. The synovial membrane (visualized intraoperatively by us) was characteristic for PVNS of the knee joint: changes in the form of villous and nodal enlargements with their characteristic coloration in reddish brown color due to the presence of hemosiderin and lipids. The color of pigmentation ranged from yellow to dark brown, depending on the frequency and volume of hemorrhages from fragile newly formed vessels.

For this group of patients: the maximum follow-up period was 5 years, the minimum follow-up period was 1 year. Long-term results are considered good.

## Conclusions

Among the non-invasive instrumental methods of examination, MRI is the most informative, which makes it possible to make the most accurate assessment of the disease extent and dissemination. However, if a tumor-like mass is present in the popliteal fossa, it is also necessary to do ultrasound examination to rule out ingrowth of the pathological process into the neurovascular bundle.

“Dorsal” synovectomy should be an integral part of the treatment for PVNS to reduce substantially the possibility of recurrence in this group of patients.

Patients with PVNS require dynamic follow-up with periodically repeated MRI to rule out the possibility of recurrence.

Once pathomorphological diagnosis has been confirmed in patients with recurrence of PVNS of the knee joint, they require additional follow-up and consultation of the oncoorthopedist to consider the relevance of further radiotherapy.

## NONCONVENTIONAL DIAGNOSTIC METHOD FOR DYNAMIC EXTRAVASAL COMPRESSION OF VERTEBRAL ARTERY IN V1 AND V2 SEGMENTS IN PATIENTS WITH CHRONIC DISORDER OF BLOOD CIRCULATION IN THE VERTEBROBASILAR BASIN AGAINST THE BACKGROUND OF CERVICAL SPINE DYSFUNCTION

**Gertsen G.I., Dybkalyuk S.V.**

*P.L.Shupik National Medical Academy of Postgraduate Education, Chair of Orthopedics and Traumatology No.1, Kiev, Ukraine*

The vertebral artery compression syndrome (VACS) is under M-47.0 code among the list of musculoskeletal system diseases in International Statistical Classification of Diseases and Related Health Problems (ICD-10). However, some features of this syndrome can be found in many classification rubrics, e.g.: G46.2 "Posterior cerebral artery syndrome"; G46.3 "Brain stem Stroke syndrome"; G46.4 "Brain stroke syndrome"; G46.5 "Transient global amnesia", etc. In foreign literature, as a rule, one can find the VACS titled "bow hunter's stroke". The vertebral artery compression is manifested as onsets associated with head rotations. Also, the development of reflex vasospastic reactions as a result of irritation of the sympathetic plexus of the vertebral artery (VA) plays an important role in the pathogenesis. Extravasal compression of the vertebral artery may be asymptomatic for a long time, which complicates its early diagnostics. The instrumental diagnostics of this syndrome is based on Doppler ultrasound examination with positional tests and multislice computed tomography-angiography with positional tests.

**Reserach objective:** Offering the optimal diagnostic method for compression of the vertebral artery in the background of a disorder of static and dynamic functions of the spine

The disadvantages of the method are as follows: 1) conducting multislice computed tomography angiography (MCT AG) in combination with standard positional orthopedic tests, which is insufficient for the diagnosis of vertebrogenic miogenic forms of dynamic extravasal compression of the vertebral artery, which are detected in motion;  
2) Conducting MCT AG in at least two positional tests elongates the total time of the study, and, accordingly, the exposure of ionizing radiation, as well as increases the volume of contrast material required for the tight filling and, as a result, increases the load on the kidneys.

## Materials and methods

The diagnostics of dynamic extravasal compression of the vertebral artery in V1 and V2 segments

was carried out in 217 patients with chronic cerebrovascular disorder in the vertebrobasilar basin against the background of clinical signs of static and dynamic dysfunction of the cervical spine by conducting multislice computed tomography angiography. **The particularity of the method was as follows:** Doppler ultrasound examination was performed previously, with the patient being in the position of the maximum compression of the vertebral arteries and the minimum diameters of the vertebral artery measured in V1 and V2 segments. Multislice CT angiography was performed simultaneously, with the head being in a neutral position and in position with the maximum compression of the vertebral artery, and with the minimum diameters of the vertebral artery measured in V1 and V2 segments, and pathological tortuosity of the vertebral artery detected. Thus, the method ensured the precision of the detection of dynamic extravasal compression of the vertebral artery in V1 and V2 segments, which was manifested in motion; and the overall time of the study was shortened, and, accordingly, the exposure of ionizing radiation, as well as the amount of contrast material required for the tight filling was reduced.

Doppler ultrasound examination was carried out on ALOKA 5000 ultrasound apparatus that has output power of 10 to 200 mW/cm and the capability of triplex mapping with a sensor of 7.5 to 13 MHz. MCT AG was performed when a patient was in supine position, horizontally on the desk of the TOSHIBA AQUILION 64 apparatus; the scan area was marked from the arc of the thoracic aorta to the base of the skull. Ultravist-370, iodine-containing x-ray contrast agent, was administered as an intravenous push injection at a dosis of 2 ml/kg of patient weight in 10 or 20 ml of 0.9% sodium chloride solution, with an injection rate of 4.5-5 ml/sec. The scan started at the 20<sup>th</sup> second after the injection, with the head being in a neutral position and in the position with the maximum compression of the vertebral artery.

### **Research findings and discussion**

The use of a nonconventional diagnostic method for extravasal compression of the vertebral arteries in case of clinical signs of static and dynamic dysfunction of the cervical spine made it possible to increase the informativeness of the neurological imaging diagnostic methods due to increasing the sensitivity of the method from  $35.2 \pm 7.2\%$  ( $p < 0.05$ ) to  $88.5 \pm 4.2\%$  ( $p < 0.05$ ). A "new" radiological phenomenon of "fixed artery" was described.

### **Conclusions**

Adding functional and orthopedic tests to standard diagnostic methods allows to improving significantly the efficiency and informativeness of the study.

## **DIAGNOSTICS AND TREATMENT OF FEMUR FRACTURES AFTER HIP JOINT REPLACEMENT**

**Gertsen G.I., Shtonda D.V.**

*P.L.Shupik National Medical Academy of Postgraduate Education, Chair of Orthopedics and Traumatology No.1, Kiev, Ukraine*

### **Introduction**

Peri-implant fractures of the femur (PIFF) after hip joint replacement (HJR) require consideration of the following factors for successful treatment: patient's general condition, fracture localization, stability of the femoral implant component, quality of bone tissue, and the presence of an implant in the femoral canal, which prevents the introduction of screws or nails when using metal osteosynthesis (MOS) in the peri-implant area.

**Reserach objective:** Determining the optimal classification for successful planning and surgical treatment of peri-implant fractures of the femur after hip joint replacement; and improving metal osteosynthesis technique for various types of the fractures specified

### **Materials and methods**

67 patients with PIFF after HJR underwent surgery, with the incidence of various PIFF types being as follows: A type PIFF was in 7 cases (10.45%), B1 type PIFF was in 17 cases (25.37%), B2 type PIFF was in 24 cases (35.82%), B3 type PIFF was in 13 (19.4 %) and C type PIFF was in 6 cases (8.96%).

### **Research findings**

In the follow-up dynamics of the 67 patients with PIFF after HJR for various reasons, long-term functional results of treatment in  $(4.4 \pm 1.2)$  (1.0-6.2) years were evaluated in 54 (85.71%) patients.

A good functional result was obtained in 51.9% of patients with PIFF after HJR after surgery. A long-term functional result of PIFF treatment was medium according to Harris Hip Score, which corresponds to:  $(83.2 \pm 1.6)$  scores in A type PIFF;  $(81.5 \pm 4.1)$  scores in B1 type PIFF;  $(78.4 \pm 4.2)$  scores in B2 type PIFF;  $(77.1 \pm 3.9)$  scores in B3 type PIFF; and  $(81.2 \pm 3.1)$  scores in C type PIFF. A satisfactory result was obtained in 42.6% of cases. A long-term functional result of PIFF treatment was medium according to Harris scale, which corresponds to:  $(73 \pm 1.)$  in B1 type PIFF;  $(75.2 \pm 2.9)$  scores in B2 type PIFF;  $(75.3 \pm 3.3)$  scores in B3 type PIFF; and 76 scores in C type PIFF. Unsuccessful result was observed in 5.5% of cases.

### **Conclusions**

Using Vancouver classification, differentiated method of surgical treatment of patients with PIFF after HJR (osteosynthesis, revision replacement or simultaneous use of the two methods), taking into account the quality of bone tissue, made it possible to obtain good functional results in 51.9% of cases; satisfactory results in 42.6% of cases; and unsatisfactory results in 5.5% of cases. In case of peri-implant femoral fractures after hip joint replacement and in case of osteoporosis, the use of metal cemented osteosynthesis with LCR DCP plates with insertion of polymethyl methacrylate cement into canals under the screws allows achieving stability of fixation of bone fragments and preventing the development of complications as migration of implants.

## **OUR EXPERIENCE IN HIP JOINT REPLACEMENT**

**Golka G.G., Burlaka V.V., Perkhun M.V., Palamarchuk V.V.**

*Traumatology and Orthopedics Chair, Kharkov National Medical University;*

*Professor O.I. Meshchaninova Kharkov Municipal Universital Hospital of Emergency Medical Aid No.4, Kharkov, Ukraine*

### **Introduction**

Currently, bone / joint replacement is one of the most effective surgical methods to treat injuries and various diseases of the hip joint, which makes it possible to eliminate quickly and effectively pain, restore function of a join and an extremity, and improve the quality of life for patients over a long period.

**Reserach objective:** Evaluating the results of the hip joint replacement

### **Materials and methods**

Two traumatological departments of Professor O.I. Meshchaninova Kharkov Municipal University Hospital of Emergency Medical Aid No. 4 have started hip joint replacement since November 2015. Within the period specified (2.5 years), the hip replacement was performed in 115 patients. Men and women were 37 and 78 respectively, with an average age of 68.5 years. Cemented replacement was performed in 48 cases (the average age was 58.9 years), cemented replacement was performed in 65 cases (the average age was 74.1 years), and hybrid replacement was performed in 2 cases (66 and 70 years old). In most cases, total hip joint implants were used, and bipolar replacement was used in 3 patients. With regard to acute trauma, surgery was performed in 77 patients (67%): in 72 patients (71.3 years old) with fracture of the femoral neck; and 5 patients (70.6 years old) with pertrochanteric fracture combined with coxarthrosis and fibroankylosis of the hip joint. With regard to consequences of injuries and diseases, 38 surgeries (33%) were performed: in 19 patients (61.7 years old) with arthrosis; in 4 patients (59 years old) with arthrosis as a consequence of reactive arthritis; in 1 patient (47 years old) with dysplastic arthrosis; in 3 patients (53.7 years old) with posttraumatic arthrosis; in 5 patients (58.8 years old) with false joint of the femoral neck; in 3 patients (46.7 years) with aseptic necrosis of the femoral head; in 2 patients (46 years old) with infectious arthritis (as the second stage after preliminary curing by using a spacer); and in 1 patient (87 years old) with aseptic instability of the hip component of the implant. The treatment results were assessed by questioning and examining the patients for the presence and degree of manifestation of the following criteria: pain (at rest and in motion), lameness, gait and ability to sit, stiffness and range of motion in the joint, the ability to dress and put on his/her shoes, and recovery of professional abilities (simplified Harris Hip Score).

### **Research findings and conclusions**

The treatment results are evaluated within the period of 3 months to 2.5 years after the surgery, with the results rated as "good" in the overwhelming majority of patients (109 - 94.8%). A fatal outcome occurred in 1 patient in 10 days after the surgery, which was due to thromboembolism of the pulmonary artery. Dislocation of the hip joint in 3 months after the surgery was in 3 patients (2.6%), in all the cases it was associated with a violation of the orthopedic regime; a closed removal of dislocation was carried out, and complications did not recur later on. A peri-implant fracture occurred in 1 patient (0.9%) 6 months after the joint replacement as a result of an adequate trauma; an open reposition and metal osteosynthesis were carried out. Contracture in the hip joint was found in 2 patients (1.7%) within a period more than 3 months after the surgery; in both cases, X-ray revealed heterotopic ossification of soft tissue in the area of the hip joint. A rehabilitation course and medical treatment were carried out, with moderate positive dynamics observed, however, certain dysfunctions remained. Early superficial complications in the area of postoperative wound occurred in 3 patients (2.6%), manifesting within a period of 10 to 12 days after the surgery; a local treatment was applied, and recovery was achieved. Early deep infectious complications were detected in 3 patients (2.6%) within a period of up to 2 weeks after surgery, requiring an early revision and debris removal; however, with a negative result (formation of chronic para-implant infection). Two patients from this group underwent a revision surgery with the implant removal (without replacement), and the third patient continued treatment on a stage-by-stage basis in other clinic followed by further recovery.

Thus, good treatment results were observed in 109 patients (94.8%), satisfactory results were observed in 2 patients (1.7%), joint contracture, unsatisfactory results, fatal outcomes, and profound infectious complication were observed in 4 cases (3.5%).



# MATHEMATICAL MODELING OF THE CONTACT STRESS DISTRIBUTION ON THE SURFACES OF THE ACETABULAR COMPONENT OF HIP JOINT IMPLANT AT VARIOUS THICKNESSES OF THE BOTTOM OF ACETABULAR FOSSA

\* **Guzhevskiy I.V.**, \* **Gerasimenko S.I.**, \*\* **Solodey I.I.**

\* *State Institution "Scientific Research Institute of Traumatology and Orthopedics of Ukraine" under National Academy of Medical Sciences of Ukraine (NAMN), Kiev, Ukraine*

\*\* *State Institution "Research Institute for Structural Mechanics of Kiev National University of Civil Engineering and Architecture", Kiev, Ukraine*

## **Introduction**

Currently, the total joint replacement is the most effective treatment for adult patients with advanced stages of dysplastic coxarthrosis. At the same time, hip joint replacement in patients with severe forms of dysplastic coxarthrosis is referred to in all academic publications as complicated surgeries whose results are significantly inferior to those of the primary hip joint replacement in patients with idiopathic coxarthrosis. In particular, in congenital acetabular bone deficiency, the time of successful functioning of the implant depends essentially on a reliable primary fixation of the cementless acetabular component of the hip joint implant. The theoretical substantiation of the implantation technique for the standard acetabular component of a cementless hip joint implant in patients with severe dysplasia of the acetabular cavity remains little covered in the academic literature on the subject available.

**Research objective:** Carrying out mathematical modeling of the contact stress distribution on the surfaces of a cementless acetabular component of the hip joint implant at various thicknesses of the bottom of the acetabular fossa.

## **Materials and methods**

Mathematical modeling of the contact stresses distribution on the surfaces of the acetabular component of the hip joint implant and in the surrounding acetabular bone was carried out by using SAFEM software. To construct and substantiate the load model, finite element implant approximations were developed, with the implant set by pressing it into the acetabular fossa. To obtain a volumetric model of the pelvis, the finite element grid was divided into cortical and spongy layers. Radial (compressive) and tangential (stretch) stresses were studied for placing an acetabular implant cup at an angle of 45 degrees when modelling two types of boundary conditions for fixation of the study object in space (taking into account the symphysis supportive capacity and without taking it into account), and various thicknesses of the bone of the bottom of the acetabular fossa. Contact stresses on the inner and outer surfaces of the acetabular implant cup were evaluated under the influence of patient's own weight (the direction corresponds to standing position). The calculations were performed on the basis that there was no mutual displacement of the implant components, and the deformation compatibility was achieved due to the elastic deformation of the superficial layers of materials.

## **Research findings**

The calculations have shown that when implanting the acetabular component of the cemented hip joint implant, the main stretching and compressive loads in both layers of the bone tissue of the acetabular fossa were located along its periphery, which occurs both due to the distribution of natural loads for

the human body and the shape of the acetabular component of the cemented hip joint implant, which blocks the acetabular cup precisely along its periphery. It was established that the distribution of stresses in the implant/bone system made it possible to expect successful implementation of the "press-fit" effect over the perimeter of the cementless acetabular component of the hip joint implant when displacing its medial sector beyond the bottom of the acetabular fossa not more than 0.5 cm.

### **Conclusions**

The deficiency of the bone tissue of the acetabular bottom is not a critical factor that ensures primary stable fixation of the cemented acetabular component of the hip joint implant; for this, the main condition is preservation of the bone tissue of the walls of the acetabular fossa.

## **LONG-TERM RESULTS OF SURGERY TREATMENT WITH BIO IMPLANTS FOR BENIGN TUMORS AND TUMOR-LIKE LESIONS OF BONES IN CHILDREN**

**Degtyar V.A., Zatsepin A.V., Kaminskaya M.O., Mokhov O.I.**

*State Institution "Dnepropetrovsk State Medical Academy under Ministry of Healthcare of Ukraine"  
Communal Institution "Dnepropetrovsk Regional University Children Hospital", Dnepr, Ukraine*

### **Introduction**

Treatment of benign tumors and tumor-like lesions of bones in children is one of the most complicated sections of Pediatric Orthopedic Oncology. Currently, bioimplants of bone tissue are widely used in Pediatric Orthopedic Oncology to replace defects resulting after resection of abnormal bone areas.

**Reserach objective:** Analysing the results of surgical treatment of benign tumors and tumor-like lesions of bones in children, using bone plastic material of bioimplants.

### **Materials and methods**

Bone bioimplants of various shapes were used in Regional Children University Hospital in Dniepr city. 146 children aged 2 to 18 years old (who had undergone replacement bone-plastic surgeries for benign tumors and tumor-like bone lesions of various localizations) were under medical follow-up within a period of 2013 to 2018; the children. In the group, 19 children (13.3%) had benign tumors (osteoma, osteoid osteoma, chondroma, osteochondroma, chondroblastoma, osteoblastoclastoma), and 127 patients (86.6%) had tumor-like bone defects (solitary and aneurysmal bone cysts, fibrosis dysplasia, eosinophilic granuloma). In terms of localization and nature of the pathological process, the distribution of the patients was as follows: 39 patients (26.7%) had upper limb bones and 107 (73.3%) patients had lesions in the lower extremity bones, with pathological focus localized more often in the femur - 28 patients (18, 9%) and in tibia - 60 patients (41.1%). Fibrous dysplasia was observed in 91 patients (62.2%); bone cysts were observed in 32 patients (22.23%); osteoblastoclastoma was observed in 3 patients (2.22%); osteoid osteoma and chondroblastoma were observed in 5 patients (3.33%); eosinophilic granuloma and chondroma was observed in 3 patients (2.22%); and osteoma and osteochondroma was observed in 2 patients (1.11%).

### **Research findings**

Long-term results were traced up to 8 years in the patients followed up. The treatment results were considered good in 110 children (75.3%) in a long-term period after the surgery: there were no complaints, and the segment shape and function were fully preserved, with X-ray showing no relapse and showing full functional recovery of the bone. Satisfactory results were obtained in 31 children (22.2%): the reduction of the segment operated was no more than 1 or 2 cm, with supporting and

motor functions fully preserved; the presence of residual cavities in the operation area of 0.8 to 1.0 cm diameter. Unsatisfactory results were obtained in 5 cases (3.5%).

Two unsatisfactory results were associated with a fracture of the graft at the treatment stage; in two cases there was a relapse of the tumor; in one case there was a shortening of the limb operated up to 5 cm, which was associated with a tumor of the growth plate.

### **Conclusions**

Thus, using bone bioimplants of various shapes is effective in the surgical treatment of benign tumors and tumor-like lesions of bones in children, and it allows achieving positive results.

## **MINIMALLY INVASIVE CORRECTION OF PECTUS CARINATUM ("PIGEON CHEST") IN CHILDREN**

**Degtyar V.A., Shulga D.I., Kaminska M.O., Mokhov O.I.**

*State Institution "Dnepropetrovsk State Medical Academy under Ministry of Healthcare of Ukraine"*

*Communal Institution "Krivoy Rog Municipal University Hospital No.8", Krivoy Rog, Ukraine*

*Communal Institution "Dnepropetrovsk Regional University Children Hospital", Dnepr, Ukraine*

### **Introduction**

Anterior protruding chest wall deformation or pectus carinatum ("pigeon chest") (PC) is a severe malformation characterized by a marked cosmetic defect. Domestic and foreign academic literature on the subject describes a large percentage of good results of the correction of this malformation in an open way; however, all types of surgeries are very traumatic because of using a wide operational access and manipulations on the bone, cartilage, and muscle tissues of the chest, with a high risk of intra- and postoperative complications. In this regard, the need to develop new minimally invasive methods of surgical correction of this chest malformation is relevant. The minimal invasive methods allow for the minimum trauma of the skin and the sternocostal complex to eliminate chest deformation, taking into account the aesthetic requirements of the patient.

**Reserach objective:** Aalyzing the results of minimum invasive anterior thoracoplasty in children with pectus carinatum

### **Materials and methods**

35 children with pectus carinatum ("pigeon chest") II and III degree in compensation and subcompensation stages underwent surgical correction in Dnipropetrovsk Regional University Children Hospital. There were 32 boys (91.4%), 3 girls (8.6%). 15 children (42.85%) had pectus carinatum type I (sternocostal type) according to V.B. Shamik classification (2003); 20 children (57.15%) had pectus carinatum type II (costosternal type). The most often malformation shapes were ellipsoid and round. Dysplasia of the adjacent tissues was detected in all the patients: spine deformation (scoliosis or kyphosis), flat feet, small hear malformations, and hypoplasia of the pulmonary tissue. Most children were operated at the age from 11 to 18 years, when the chest deformation was most pronounced. The chest deformation progression starts at puberty. All the children underwent a comprehensive assessment as per the standard methodology. Surgical correction was performed by the method of minimally invasive anterior thoracoplasty with a titanium plate. The method allows for elimination of the chest deformation by compressing the titanium plate in the areas

wherein the anterior chest wall is deformed; the plate is inserted subfascially over sternum and ribs through a pre-formed tunnel from two cuts in the anterior-axillary areas on both sides.

### **Research findings**

Neither packed red cells nor blood-derived products were transfused in patients operated by this method. The average duration of surgical intervention was within a period of 60 to 100 minutes. No anesthesia with narcotic analgesics was carried out. Epidural anesthesia was administered, which made it possible to move patients to the upright position and allow them to walk the second day after the surgery. Early postoperative complications (conservative treatment of pneumothorax) occurred in one patient (2.85%). Rupture of a metal thread fixing stabilizers was detected in two patients (5.7%), and seroma was detected in one case (2.85%) in a delayed postoperative period.

All the patients were followed up in a postoperative period for treatment results. Good results were observed in 32 cases (91.4%) and satisfactory results were observed in 3 cases (8.6%). No unsatisfactory results were observed.

### **Conclusions**

The use of minimally invasive anterior thoracoplasty with a titanium plate has the following advantages in comparison to resection techniques: no resection of the ribs and sternum is practiced; mobilization of the retrosternal space; shortening surgery time; less pronounced pain syndrome; no plate migration takes place; growth and development of the chest are possible; chest deformation is eliminated with a successful functional and cosmetic result.

## **PARTICULARITIES OF URGENT ENDOSCOPY IN CHILDREN WITH POLYTRAUMA**

**Degtyar V.A., Sadovenko O.G., Kaminskaya M.O., Shchudro S.A.**

*State Institution "Dnepropetrovsk State Medical Academy under Ministry of Healthcare of Ukraine"  
Communal Institution "Dnepropetrovsk Regional University Children Hospital", Dnepr, Ukraine*

### **Relevance**

Carried out by resuscitation teams in patients with polytrauma, urgent endoscopy is important to improve therapy in children with damages of internal organs.

**Research objective:** Analyzing the need for urgent endoscopy at various stages of providing medical care to children with polytraumas.

### **Materials and methods**

165 endoscopic studies were performed in children with polytrauma, open and closed craniocerebral traumas over the last 5 years (2013-2017).

21 fibrogastroduodenoscopies (FGDSs) (9 primary FGDSs and 12 repeated FGDSs) and 144 fibrobronchoscopies (FBSs) (41 primary FBSs and 103 repeated FBSs) were performed. The total number of children is 92, including 27 children under 7 years old and 65 children aged 8 to 18 years old. Indications for emergency bronchoscopy in children were urgent conditions with acute or

progressive chronic respiratory insufficiency developed as a result of bronchial obturation by viscous mucus, blood and stomach contents.

### **Research findings and discussion**

The purpose of the bronchoscopy was to diagnose the causes of bronchial obstruction to restore bronchial patency to improve pulmonary gas exchange. In patients with assisted pulmonary ventilation, fibrobronchoscopy was performed through an intubation or tracheostomy tube. Oxygenation was provided by ventilation through an intubation tube through a special connector. In children with spontaneous breathing, preference was given to face mask general anaesthesia. Rigid bronchoscopy was performed under general anesthesia with the obligatory use of short-acting muscle relaxants. When performing fibrobronchoscopy, vital functions and oxygen saturation of hemoglobin in arterial blood were monitored. Particularities of endoscopic examination in children are determined primarily by anatomical features of the respiratory system: small size of the organs examined; high mobility of the walls of the trachea and bronchi, which complicates the insertion of the instrument; and trend to edema of the mucous membrane and hyperproduction of bronchial secretion.

In polytrauma with lung injury and pulmonary hemorrhage, bronchoscopy was performed once the patient had been brought out of a severe condition to avoid deeper hypoxia and occurrence of reflex disorders in case of severe respiratory and blood circulation disorders. In the first hours after the injury, it is important to restore cardio-respiratory balance. Be sure to decompress the mediastinum and pleural cavities in case of intense pneumothorax and mediastinum emphysema. Clean the tracheobronchial tree by aspirating the trachea and bronchi contebt with a transnasal catheter, bronchoscope; cure the tracheobronchial tree through intratrachial administration of antibiotics and enzymes, or through microtracheostomy. Modern anesthetic equipment allows a continued use of mechanical ventilation without triggering tracheobronchitis and bronchial obstruction. In patients with severe brain stem dysfunction, there is hyperproduction of the mucous secretion and the absence of a cough reflex, which leads to complications from the respiratory organs. When performing fibrobronchoscopy, a small volume of fluid is administered with immediate aspiration.

### **Conclusions**

Indications for emergency bronchoscopy in children were urgent conditions with acute or progressive chronic respiratory insufficiency. Endoscopic examination in children is determined, first of all, by the anatomical particularities of the respiratory system. In polytrauma with lung damage and pulmonary hemorrhage, bronchoscopy was performed once the patient had been brought out of a severe condition. In children with polytrauma, timely bronchoscopy reduces the number of subsequent bronchoscopies and significantly reduces the manifestations of inflammations.

## **CLINICAL AND X-RAY RESULTS OF TREATMENT OF PATIENTS WITH DAMAGES OF THE ACROMIAL END OF THE CLAVICLE WITH SPECIALIZED CLAVICLE HOOK PLATE**

**Dolgoplov O.V., Bezruchenko C.O.**

*State Institution "Scientific Research Institute of Traumatology and Orthopedics of Ukraine" under National Academi of Medical Sciences of Ukraine (NAMN), Kiev, Ukraine*

## Introduction

Traumatic damages to the acromioclavicular joint with dislocation of the acromial end of the clavicle are a common trauma of the upper limb. The rate of dislocations of the acromial end of the clavicle is within the range of 12 to 15% of the upper extremity dislocations, and 8% of dislocations of other localizations; and it ranks third after the dislocation of the shoulder and forearm.

In 1976, the original Hook plate was first used to treat the dislocation of the acromial end of the clavicle (*Balser et alii*). Its design consisted of a plate fixed to the acromial end of the clavicle, and a hook inserted through the acromioclavicular joint and fixed in it. Since then, this locking element has been modified a number of times, and after changing the original design, the hook of modern plates does not pass directly through the joint. Currently, the Hook plate is a popular fixation for dislocations and fractures of the acromial end of the clavicle. Nevertheless, contemporary studies show a large number of unsuccessful functional results in patients underwent surgical intervention that used this method of fixation.

**Research objective:** Improving the results of treatment of patients with damages of acromioclavicular joint by preventing of errors and complications caused by using Hook plate.

## Materials and methods

A retrospective analysis of 74 patients who underwent treatment in hospital setting within a period from 2011 to 2018 in the State Institution “Scientific Research Institute of Traumatology of Ukraine” and Orthopedics under the National Academy of Medical Sciences of Ukraine”, Kiev, Ukraine for the following reasons: 52 patients (70%) for traumatic dislocation of the acromial end of the clavicle stage III and V according to Rokwood (stage III according to Tossy), and 22 patients (30%) for closed fracture of the acromial end of the clavicle, using Hook plates. The age of the patients ranged from 18 to 56 years old (average age was 28.7 years); men of working age prevailed (61 men or 82%); the number of women was 13 (18%). In most cases, the damaged limb was dominant (87%). When analysing, a special attention was paid to the technical and tactical complications that arose in the course of surgical interventions on the acromioclavicular joint, using Hook plates.

The following complications were observed in 36 patients: dislocation of the acromial end of the clavicle stage III according to Rokwood - 18 patients, type V - 14 patients, and fracture of the acromial end of the clavicle, IIB type according to Neer - 1 patient, and type V - 3 patients.

The analysis of errors and complications was evaluated clinically and by instrumental research methods. The following X-ray projections were used: plain X-ray of both acromioclavicular joints, X-ray in the Zanca projection, X-ray of the shoulder joint in the projection of Alexander and axial projection. Computed tomography (CT) and magnetic resonance imaging (MRI) were performed in particularly difficult cases.

## Research findings

Specialized Hook plates provide stable fixation of the acromioclavicle joint, allowing early rehabilitation and early beginning of motions in the shoulder joint after surgical treatment of traumatic dislocations of the acromial end of the clavicle types III-VI according to Rockwood, and after fractures

of the acromial end of the clavicle IIA, IIB, and type V according to Neer. However, a number of complaints of the impossibility of the full functioning of the upper limb and persistent pain in the postoperative period require an analysis of these complications. We found the following errors and complications: incorrect placement of the locking element in 6 patients (16%); osteolysis of the acromial end of the clavicle in 18 patients (50%); migration of the locking element in 2 patients (5%); decubital ulcers and defect of the acromial process in 2 patients (5%); aseptic necrosis of the acromial end of the clavicle in 1 patient (3%); ossification of the coracoclavicular ligament in 8 patients (22%); posttraumatic deforming arthrosis of the acromioclavicular joint II-IV according to Kellgren in 11 patients (31%); subacromial impingement and partial damage to the tendons of shoulder rotator cuff in 5 patients (14%).

## **Conclusions**

Thus, the retrospective analysis of the errors and the complications that arose intraoperatively and in the course of treatment of patients with dislocation of the acromial end of the clavicle and fracture of the acromial end of the clavicle, allowed identification and analysis of the factors that significantly affect the final treatment result. In general, resuming the analysis of the results of the consequences and complications of surgical treatment of patients with dislocation of the acromial end of the clavicle operated, using a specialized plate with a hook, we can conclude that a certain part of the complications is due to technical errors, such as non-compliance with the technique to install locking elements. To prevent complications, it is necessary to observe strictly the rules of preoperative planning, the rules of operating technique, and to be careful when manipulating soft tissues in surgical interventions.

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## **UNCOMPLICATED LOW-ENERGY COMPRESSION FRACTURES OF VERTEBRAL BODIES**

**Zinchenko V. V.**

*State Institution "Scientific Research Institute of Traumatology and Orthopedics under National Academy of Medical Sciences of Ukraine (NAMN)", Kiev, Ukraine*

Systemic osteoporosis is considered one of the most common diseases of the skeleton. Violation of the structural and functional status of bone tissue is one of the causes of the genesis of compressive fractures of vertebral bodies. Therefore, it is relevant to search possible links between bone mineral density (BMD) and the incidence and severity of compression fractures of the vertebral bodies in patients.

**Research objective:** Investigating bone mineral density in patients with uncomplicated low-energy compressive fractures of vertebral bodies.

The work is based on the results of X-ray densitometric examination of bone tissue in 31 patients (22 women and 9 men) with uncomplicated low-energy compression fractures of vertebral bodies. The average age of the patients examined in the center of osteoporosis of the State Institution "Scientific

*Research Institute of Traumatology and Orthopedics under National Academi of Medical Sciences of Ukraine (NAMN)", Kiev, Ukraine, was  $63.3 \pm 2.2$  years.*

### **Research findings and discussion**

The analysis of the data of X-ray densitometry of patients with uncomplicated low-energy compression fractures of vertebral bodies is presented. The research covered the particularities of localization shape of compression, and changes in bone mineral density in uncomplicated low-energy compressive fractures of vertebral bodies.

### **Conclusions**

The research showed that the regularity of the appearance of single or multiple low-energy fractures of vertebral bodies was not directly proportional to bone mineral density (BMD).

Low-energy fractures of vertebralbodies in women occurred in women with average BMD of L1-L4 vertebral bodies:  $0.8495 \pm 0.03 \text{ g/cm}^2$ ;  $T = -2.8 \pm 0.25$ ;  $Z = -1.5 \pm 0.25$ ; in men:  $1.0663 \pm 0.05 \text{ g/cm}^2$ ;  $T = -1.3 \pm 0.42$ ;  $Z = -1.2 \pm 0.40$ . That is, compression fractures of the vertebral bodies appeared in men when BMD of L1-L4 vertebral bodies was reduced as a result of osteopenia, and in women as a result of osteoporosis only.

The most common localization of compression fractures of the vertebrae was Th12 and L1 vertebral bodies.

In terms of compression shape of the vertebral bodies, double-convex (49%) and wedge-shaped (34%) deformations prevailed.

## ***UNICOMPARTMENTAL (PARTIAL) KNEE REPLACEMENT IN COMPLEX TREATMENT OF GONARTHROSIS***

**Kalashnikov A.V., Stavinskiy Y.O., Osadchuk T.I., Litun Y.M.**

*State Institution "Scientific Research Institute of Traumatology and Orthopedics under National Academi of Medical Sciences of Ukraine (NAMN)", Kiev, Ukraine*

### **Introduction**

Osteoarthritis of large joints remains a significant problem in modern orthopedics, which is greatly stipulated by a steady increasing number of patients. It is known that only one of the joint compartments – more often medial – is affected predominantly among patients with gonarthrosis (in 5-20% cases) who undergo the total knee joint replacement. Modern orthopedics considers unicompartamental (partial) knee replacement to be the best method for surgical treatment for elderly patients with isolated degenerative-dystrophic lesions of the medial portion of the femorotibial joint. Indications for unicompartamental (partial) knee replacement are: medial gonarthrosis with varus deformation of the knee joint up to  $15^\circ$ , isolated degenerative-dystrophic lesion of the internal portion of the knee joint and aseptic necrosis of the medial process of the femur. An essential prerequisite for such surgeries is preservation of the knee joint ligaments.

**Reserach objective:** Studying the results of unicompartamental (partial) knee replacement in patients with gonarthrosis



## **Materials and methods**

Within a period from 2009 to 2015, 37 unicompartmental (partial) knee replacements were carried out. All surgeries were performed using a minimally invasive surgical access. In 25 cases, surgery was started as diagnostic arthroscopy.

## **Research findings and discussion**

All the patients operated were followed up within a period from 6 months to 5 years, and the surgical treatment results were studied using KSS and WOMAC scores to assess the function of the knee joint. Excellent results were noted in 11 patients (29.7%), good results were noted in 20 patients (54.0%), and satisfactory results were noted in 6 patients (16.3%). No necessity existed to repeat surgical interventions because of disorder progress in the adjacent joint portion or aseptic instability of the implant components within the follow up period. With regard to complications, it should be noted that one patient had superficial necrosis of the wound edges, which did not affect the final functional treatment results.

## **Conclusions**

Unicompartmental knee replacement is the best surgery method for patients with isolated lesion of only one compartment of the knee joint; the surgery allows preservation of quite a high level of physical activity.

Unicompartmental knee replacement, if performed on the basis of indications, is not inferior to the total knee joint replacement; it allows achievement of more complete recovery of the knee joint function.

## **SURGICAL TREATMENT OF PERTROCHANTERIC FRACTURES**

**Kalashnikov A.V., \* Malik V.D., Lazarev I.A., Stavinskiy Y.O., Litun Y.M.**

*State Institution "Scientific Research Institute of Traumatology and Orthopedics under National Academy of Medical Sciences of Ukraine (NAMN)", Kiev, Ukraine*

*\* M.V. Sklifosovskiy Poltava Regional University Hospital, Poltava, Ukraine*

## **Introduction**

Fractures of the proximal femur reduce the average life expectancy of the affected person by 12-15%. More than 50% of them are not able to move without assistance, and one third of them lose their ability to look after themselves.

**Reserach objective:** Determining indications for the use of the proximal femoral rod with trans- and supra-acetabular fractures of the femur

## **Materials and methods**

The results were studied in 105 patients with bone fractures. Male patients were 46 (43.8%), a female patients were 59 (56.2%); the mean age was  $71 \pm 3$  years. The affected persons underwent clinical and X-ray examinations, and general laboratory tests as well.

The spatial geometry of the locking element / bone system was simulated on the basis of axial scans of multi-slice computed tomography (SCT) of femoral bone models with different fixation options, using a software package, in the Laboratory of Biomechanics of State Institution "Scientific *Research* Institute of Traumatology and Orthopedics under National Academi of Medical Sciences of Ukraine (NAMN)", Kiev, Ukraine, and finite element mesh of 314 511 nodes and 181 741 elements was generated. Models in polylines were imported into the SolidWorks environment, where simulated 3-D models of the proximal femur bone were created, by using relevant tools.

### **Research findings and discussion**

The research discovered that the minimum stresses on the locking elements are different and depend on the distal fixation of the rod and the type of fracture.

The minimum stresses were detected due to the absence of free locking in the A1 type fractures as per AO / ASIF international classification, absence dynamic distal locking in the oval hole in A3 type fractures, and absence of static locking in cases of A2.2 and A2.3 type unstable fractures.

We used this approach to treatment in 105 patients with fractures of the proximal femur. The results of surgical treatment were studied within a period of 6 weeks to 3 years. The average evaluation as per Harris Hip Score was as follows: in 6 weeks - 56.6, in 6 months - 64.4, in the course of 1 year - 71.2 and 73.4 respectively. No cracks or migration of the locking elements were observed.

### **Conclusions**

It was established that the use of proximal femoral rods in osteosynthesis for pertrochanteric and subtrochanteric fractures of the femur had a positive effect to the treatment results due to a number of factors, such as minimal invasiveness, relatively short surgical intervention, minimal blood loss, possibility to achieve and preserve a stable fixation of fragments, and early patient activation followed by a functional treatment.

## **TOTAL HIP JOINT REPLACEMENT IN PATIENTS WITH OSTEOGENESIS IMPERFECTA (CLINICAL OBSERVATION)**

**Kanzyuba A.I., Shimon V.M.**

*State Higher Education Establishment "Uzhgorod National University", Chair of General Surgery with course of traumatology, orthopedics, operative surgery and forensic medicine, Uzhgorod, Ukraine*

### **Introduction**

Osteogenesis imperfecta (OI) or brittle bone disease is a genetic connective tissue disease characterized by fragility of bones and an increased risk of fractures caused by a mild trauma. The range of clinical manifestation of this disorder is extremely wide: from perinatal death to symptoms that are very difficult to detect at a later age, as the disease may run under the mask of early osteoporosis. Patients with osteogenesis imperfecta may have growth retardation, wormian bones (ossa Wormiana), scoliosis and extraskkeletal manifestations, such as imperfect dentinogenesis, hearing loss, macrocephalia, blue sclera, barrel shaped chest. According to academic literature on the subject,

degenerative lesions of hip joints occur quite often and complicate substantially performance status of patients.

**Research objective:** Determining the particularities of orthopedic disorders in patients who suffer from OI and need a total replacement of hip joints on the basis of a retrospective analysis of changes in the musculoskeletal system

### **Materials and methods**

We observed three cases of family osteogenesis imperfecta type I (according to the classification of Sillence D.O., 1979) among residents of Transcarpathian region (a total of 9 people aged 24 to 56 years). The patients sought orthopedic care within a period from 2017 to 2018 for deformations of extremities and the spine. Medical examination revealed substantial angular and rotational deformation of some segments of lower extremities due to numerous fractures and surgical interventions in infancy, adolescence and young age. Some patients received more than 40 fractures of different localization in their lifetime, with the fractures occurring without traumatic effects, sometimes spontaneously. All the patients (7 men and 2 women) had typical external manifestations of the disease: blue sclera, increased susceptibility to *petechiae* and *macular* hemorrhages, hearing loss or hypermobility syndrome. Three men, age 32, 41 and 56 respectively, had dystrophic necrotic changes in hip joints stage 3 (according to the classification of N.S. Kosinskaya). One of them underwent total cemented replacement of the hip joint.

### **Research findings**

In 14 months after the surgery, the evaluation of functional result was 88.7 scores as per Harris Hip Score (HHS). When planning and performing the surgery, some violations were identified, which determined the particularities of surgical access to the hip joint and the preparation of bone structures before setting implant components. The main factors were osteoporosis, significant contracture of the muscles of the pelvic girdle and lumbar region, deformation of the lumbar spine, bone hypertrophy in the joint area. The factors have caused a relatively slowdown in the rehabilitation period. However, the recovery of the supporting and motor function of the operated hip joint contributed to a significant improvement in the function of both lower extremities and the spine. The operative wound healing occurred in normal terms without complications.

Based on the retrospective assessment of the observations, we assume that the etiological factors associated with the development of coxarthrosis in patients with OI were complex progressive biomechanical disorders of the entire musculoskeletal system in addition to systemic osteoporosis and impaired connective tissues metabolism.

### **Conclusions**

Based on the data of world academic literature on the subject and on our own observations, we believe that total hip joint replacement in patients suffering from OI can significantly improve static and dynamic capabilities and patient's performance status.

## “INSUFFICIENCY FRACTURES” OF THE PELVIC RING

\* *Kanziuba A.I.*, \*\* *Shamova T.A.*

\* *State Higher Education Establishment "Uzhorod National University", Chair of General Surgery with course of traumatology, orthopedics, operative surgery and forensic medicine, Uzhorod, Ukraine*

\*\* *Asclepia Medical Centre, Kiev, Ukraine*

### **Introduction**

According to the data of world academic literature on the subject, stress fractures are divided into two groups: "fatigue fractures" and fractures due to bone failure or "insufficiency fractures". Stress fractures or fatigue induced fractures are defined as a result of long lasting repeated excessive loads on the bone in practically healthy and physically active people, such as military men, athletes, ballet dancers. Various aspects of the diagnostic and treatment of fatigue fractures in the pubic bones and the sacral bone in long distance runners are discussed widely in academic literature on the subject. Unlike fatigue fractures, "insufficiency fractures" occur as a result of low-energy impacts or physiological loads on an affected and weakened bone having a low elastic resistance. General pathophysiology of "insufficiency fractures" is the unconformity between the strength of the bone and the magnitude of the load applied to it, i.e. from low energy load to physiological load (daily loads created by person's own body mass).

Due to an increase in life expectancy, an increasing number of patients may have low-energy fractures of the pelvic ring, which occur spontaneously due to severe osteoporosis.

**Research objective:** Substantiating and optimizing clinical and X-ray diagnostic of "insufficiency fractures" of the pelvic ring on the basis of our own clinical observations.

### **Materials and methods**

3 patients with identified fractures of the pelvic ring were examined, with clinical manifestations underwent retrospective evaluation. The results of X-ray, multislice computed tomography (MCT) and MRI of the pelvic ring were analyzed; and rationale for a comprehensive diagnosis was presented.

### **Research findings**

Clinical manifestations of pelvic "insufficiency fractures" are gradually progressive pain localized in the lumbar region, sacrum and inguinal areas, increasing pain while walking, without a past history of injury suffered. Differential diagnosis should be done with osteochondrosis of the lumbar spine. If typical clinical symptoms are found, plain X-ray of the pelvis, X-ray in Outlet and Inlet projections, and X-ray of hip joints in the axial projection are recommended. "Insufficiency fractures" localized in the parasymphyseal area and fractures of the branches of the pubic bones may be identified on X-ray images.

A vertical fracture line is identified at an early stage. Paraosseal regenerate is characteristic for a later stage; and in case of slow regeneration, a zone of lysis is determined. If a past history of an injury is absent, late changes versions may be perceived as tumorous lesions. It is difficult to determine insufficiency fractures in the sacrum area and en iliac bones on X-ray images. When determining damages in the area of pubic bones on an X-ray image, it is recommended to do pelvis MCT to detect latent fractures in the posterior portions of the pelvic ring. Performed in case of persistent unexplained pain in the lumbar and sacral areas, MRI is also informative.

### **Conclusions**

Insufficiency fractures of the pelvic ring, as a kind of fatigue fractures, form a special group of lesions other than high-energy fractures of the pelvic bones. Relatively low incidence of insufficiency fractures of the pelvic ring in elderly and senile age persons, inadequate awareness of orthopedic doctors about certain factors, and the peculiarities of clinical manifestations predetermine difficulties in diagnostics and choice of therapeutic tactics.

## **IPSILATERAL FRACTURES OF THE FEMORAL NECK AND DIAPHYSIS: SURGICAL TACTICS**

**\* Klimovitskiy V.G., \* Kanzyuba M.A., \*\* Kanzyuba A.I., \*\*\* Khaylo P.A.**

*\* Scientific Research Institute of Traumatology and Orthopedics of M. Gorky Donetsk National Medical University, Donetsk, Ukraine*

*\*\* State Higher Education Establishment "Uzhgorod National University", Chair of General Surgery with course of traumatology, orthopedics, operative surgery and forensic medicine, Uzhgorod, Ukraine*

*\*\*\* Communal Therapeutic and Preventive Institution "Municipal University Hospital", Slavyansk, Ukraine*

### **Introduction**

An increasing number of patients with fractures of the proximal femur all over the world is accompanied by an increase in the incidence of femoral neck fractures among young and middle-aged people. The incidence of fractures of the femoral neck is within the range of 2 to 6% of all the hip joint fractures in people under the age of 60, nevertheless, the general trend to an increase in their number is due to an increase in injuries, as well as an increase in the upper limit of young and middle age. At a young age, femoral neck fractures are mainly a consequence of a high-energy trauma, such as catatrauma or road traffic accidents. According to the data exposed in academic literature on the subject, the mechanogenesis of the injury causes multiple and combined injuries in patients aged 15 to 50 years in 43% of cases. A particular problem is represented by ipsilateral (unilateral) fractures of the femoral neck, which occur in a young age in more than 20% of cases. At the same time, 19 to 31% of the injured are diagnosed untimely. The following aspects are controversial: choice of the optimal surgical tactics in patients with polytrauma; choice of locking elements; sequence of stabilization of the neck and diaphysial femoral fractures; effect of necessary late osteosynthesis of the femur neck on the incidence of avascular necrosis of the femoral head.

**Reserach objective:** Substantiating a differentiated approach to the choice of surgical tactics for ipsilateral fractures of the neck and diaphysial femur fractures on the basis of the analysis of the results of the application of internal osteosynthesis

## Materials and methods

17 patients aged 18 to 58 years (average age  $42.3 \pm 1.1$  years) were examined in the departments of the Research Institute of Donetsk National Medical University and healthcare facilities of Donetsk Region from 2009 to 2016. Circumstances of trauma: Traffic accident - 12 (70.5%), catatrauma - 5 (29.4%). All the fractures were basicervical and belonged to type III according to Pauwels classification. With regard to displacement nature: displacement corresponded to type II (according to Garden classification) in 4 cases, to types III and IV in 14 cases. Two persons had open diaphysal femur fractures of type I and type II according to Gustilo classification. Six persons had multiple fractures of various bones of the skeleton, and three persons had combined injuries. The severity index of the injured persons was within the range of 14 to 33 scores according to scale of the department of field surgery for injuries and mechanical traumas VPKh-P (SP). Залежно від загального стану постраждалих, остеосинтез стегнової кістки виконано у період з 9 по 18 добу після травми.

## Research findings

Long-term results of osteosynthesis in femoral neck fractures were studied in all the patients operated. The follow-up period was within the range of 2 to 6 years. Consolidation of neck and diaphysal fractures was achieved in all the patients; the motor and support function of the damaged limb were recuperated. In 14 patients, the average result was  $94.43 \pm 1.30$  scores according to Harris Hip Score. In 2 patients, the results were 84.43 and 86.23 scores respectively. Unsatisfactory results were in 1 patient due to an apparent destructive dystrophic process in the hip joint, predominantly with manifestations of avascular necrosis of the femoral head.

The particularities of surgical interventions – patient's position on the operating table; choice of the fixation method; and sequence of osteosynthesis of femur diaphysis and neck – depended on the general condition of injured persons due to the nature of the polytrauma, the nature of the displacement of the fragments of the femur neck, as well as the localization and type of diaphysal femur fractures. The optimal operation is considered to be in supine position with a permanent traction along the hip axis. In 3 cases, as no fragment displacements were found in the femur neck, a separate fixation of proximal metaphysis with DHS device and osteosynthesis of fractured diaphysis with an external bone fixation plate were performed. An open reposition of femur neck and diaphysis fractures (osteosynthesis of both fractures with a cephalomedullar nail) was performed in 12 patients with femoral neck fractures with fragment displacements. In 2 cases, retrograde osteosynthesis of the diaphysis fracture was used with subsequent open reposition and fixation of the neck fracture with cannulated screws. According to our observations, the reposition of the neck fracture is greatly facilitated after the intramedullary fixation of the diaphysal fracture. In this case, distal blocking intramedullary locking element is advisable to perform after the stabilization of the neck fracture. Stabilization of femoral fractures contributed to early activation of the patient and to the shortening of the rehabilitation period.

## Conclusions

1. Combination of the fractures of femur neck and diaphysis (ipsilateral fractures) is a result of a high-energy trauma.

2. Mandatory X-ray examination of the hip joint in patients with polytrauma with the active search for possible hidden damage can prevent diagnostic errors.
3. When planning and performing internal osteosynthesis, it is necessary to take into account the severity of the condition of the person injured, anatomical and physiological particularities of the proximal femur, the localization and type of neck fracture, the nature of the diaphysial fracture, and the condition of the surrounding soft tissues.

## **FEMORAL HEAD FRACTURES (PIPKIN INJURY): SURGICAL TACTICS**

**\*Klimovitskiy V.G., \*\*Kanzhyuba A.I., \*Klimovitskiy F.V., \*Chernysh V.Y.,  
\*Kanzhyuba M.A.**

*\* Scientific Research Institute of Traumatology and Orthopedics of M. Gorky Donetsk National  
Medical University, Liman, Ukraine*

*\*\* State Higher Education Establishment "Uzhgorod National University", Chair of General Surgery  
with course of traumatology, orthopedics, operative surgery and forensic medicine,  
Uzhgorod, Ukraine*

### **Introduction**

Femoral head fractures take a special place among dislocated fractures in the hip joint. Numerous versions of these fractures are referred to as Pipkin fractures or injuries in academic literature on the subject. They belong to high-energy injuries, including a combination of femoral head fracture with a hip dislocation, as well as fracture of the femoral neck and the acetabulum. Depending on the location of the femoral head fracture and intra-articular injury associated with it, 4 types are distinguished: Type I - femoral head fracture is more distal than the place wherein the round ligament is attached; Type II - fracture of the upper pole of the femoral head, including the place wherein the round ligament is attached; Type III - fracture of the femoral head and neck; IV type - fracture of the femoral head and the acetabulum. Due to the injury mechanism, the hip joint injury is a polytrauma component in most cases. The complexity of anatomical damages to the hip joint and contusive lesion of the bone and cartilage leads to controversy in the choice of surgical tactics.

**Research objective:** Substantiating a differentiated approach to the choice of surgical tactics for Pipkin injury on the basis of clinical, radiological, and intraoperational research

### **Materials and methods**

The study object was constituted by 26 injured persons treated in clinics and departments of the Research Institute of Donetsk State Medical University in the period from 2007 to 2016, with 23 men and 3 women among them: 24 patients were aged 32 to 46 years (average age was  $40.04 \pm 0.7$  years), the age of 2 injured persons was 62 years. The hip joint injury included hip dislocations with a fracture of the femoral head, including 5 patients with acetabulum fractures. Pipkin injury type I – 13 persons, type II – 5 persons, type III – 3 persons, IV type – 5 persons. When planning surgical intervention, the nature of injury of the hip joint and the pelvic ring was assessed by X-ray and multislice computed tomography angiography (MCT) data. Reconstructive surgeries included open reposition, internal osteosynthesis of the head in 16 patients, removal of loose fragments bone and cartilage of the lower segment of the head (type I) in 2 patients. Primary total hip joint replacement was performed in the 10

patients with old lesions referring to type II (2 cases), type III (3 cases) and type IV (5 cases) within a period of 4 to 8 weeks after the trauma.

### **Research findings**

The results of reconstructive surgeries within the period of 5 to 7 years after the trauma on the Harris Hip Score (average score) were as follows:  $93.14 \pm 0.81$  – in 3 patients;  $86.26 \pm 0.44$  – in 10 patients;  $76.47 \pm 1.09$  – in 3 patients. Transacetabular osteotomy was performed in 4 patients in connection with progressive post-traumatic coxarthrosis within the first 3 years after the trauma. The results were excellent as per Harris Hip Score: an average score was  $94.43 \pm 0.12$  in all the patients operated within a period of 3 to 7 years after the total hip joint replacement.

### **Conclusion**

In case of Pipkin injury, the choice of surgical tactics is determined by the nature of the hip joint injury and degenerative changes in the hip joint tissues.

## **RESULTS OF HIP JOINT REPLACEMENT WHEN USING PREOPERATIVE EXERCISE THERAPY**

**\* Klimovitskiy F.V., \* Goncharova L.D., \*\* Tyazhelov A.A.**

*\* Scientific Research Institute of Traumatology and Orthopedics of M. Gorky Donetsk National Medical University, Liman, Ukraine*

*\*\* State Institution “Professor M.I. Sitenko Scientific Research Institute of spine and joint diseases” under National Academy of Medical Sciences of Ukraine”, Kharkov, Ukraine*

### **Introduction**

Adduction-flexion contracture of the hip joint in coxarthrosis leads to a change in the pelvis position and in some cases complicates the positional adaptation of the implant components, which may lead to a decrease in total femoral offset angle and impaired functioning of the abduction mechanism.

Conducted by us, clinical, x-ray, and biomechanical research showed that the quality of the positional adaptation of the hip joint implant components and postoperative rehabilitation depended on the presence of a pronounced adduction-flexion contracture. Muscles are the main dynamic factor of compensation of upright posture and erect position when the spine and pelvis are deformed.

**Research objective:** Developing a complex of preoperative rehabilitation treatment aimed at facilitating the positional adaptation of the implant components; restoring the functioning of the compromised muscles of the pelvic girdle and the range of motion in the hip joint.

### **Research findings**

We developed a complex of preoperative exercise therapy, wherein we recommend the exercises to be performed from a simplified initial position, with opposition to the maximum resistance, with a gravitational unloading of the joint. We recommend to reduce an increased tension of certain muscle groups (adductors and flexors of the hip joint), which contributes to the formation of joint contracture, by means of relaxing techniques and passive exercises and massage.



Developed by us, the technique of preoperative exercise therapy was used in the clinical practice of Arthroplasty Department of the Research Institute of Traumatology and Orthopedics of Donetsk National Medical University, Liman, Ukraine, in 10 patients aged from 48 to 68 years, with 6 women and 4 men among them.

After the surgery – the total cementless hip joint replacement – the general femoral offset angle of the operated hip joint was calculated for all the patients. Comparison of the length of the arm of force of the abductors before and after the implant replacement surgery showed that no difference of parameters more than 5 mm was observed in any case, i.e. parameters were not changed. It confirms our assumption that the positional adaptation of the hip joint implant components depends on the state of the soft tissues surrounding the hip joint, mainly on the state of the muscles of the pelvic girdle.

In the postoperative period, all the patients underwent a standard rehabilitation course. Muscle performance was assessed according to the method developed by us.

The efficiency of the muscles that maintain upright posture in patients of the clinical approbation group who underwent exercise therapy before the surgery, corresponded to the assessment as “good condition of the muscles” by 6 months after the surgery and exceeded not only the same parameter of the retrospective analysis group but also the retrospective analysis group parameter by 12 months after the surgery.

### **Conclusion**

Elimination of adduction-flexion contracture and recuperation of elasticity and strength of abductors before the surgery provides optimal positional adaptation of the hip joint implant components, facilitates the implementation of the total cementless replacement, and ensures a good basis for a subsequent postoperative rehabilitation.

## **MODERN MINIMALLY INVASIVE TREATMENT METHODS FOR ORTHOPEDIC MANIFESTATIONS OF GENETIC SYNDROMES IN CHILDREN**

**\* Korolkov A.I., \*\* Katsalap E.S., \*\* Rachman P.M.**

*\* Communal Institution of Lvov Regional Council “OKHMADET Lvov Regional Children University Hospital”, Lvov, Ukraine*

*\*\* State Institution “Professor M.I. Sitenko Scientific Research Institute of spine and joint diseases” under National Academy of Medical Sciences of Ukraine”, Kharkov, Ukraine*

### **Introduction**

In genetic syndromes, clinical and X-ray manifestations of musculoskeletal system disorders are very diverse; they may occur at any age of a child and may be both local and generalized (systemic). In particular, pathological processes in the bones are accompanied by the following major changes:

- deviations in shape and size (atrophy, hypertrophy, deformation, disparity in development, including shortening and lengthening of some segments of the extremities, underdevelopment of the some segments, aplasia, hypoplasia, hyperplasia, etc.);

- changes in the contour and structure of the bone (hyperostosis, cystic rearrangements, osteopenia, osteoporosis, osteolysis, destruction, osteosclerosis, necrosis, sequestration, etc.);
- delayed or advanced bone age of the child.

Moreover, changes are possible in the tissues surrounding the bone: muscles, nerves, blood vessels, joint capsules, etc.

From an orthopedic point of view, it is necessary to identify the following main types of clinical changes in musculoskeletal system:

- Primary or secondary deformations of the spine (scoliosis, kyphosis, kyphoscoliosis);
- Deformation of the upper and lower extremities (for example, in one or several joints that are single- or multiplanar and are localized in the epiphysis, metaphysis, diaphysis, or a combination thereof);
- Joint contractures (desmogenic, arthrogenic, myogenic, tonogenic, mixed);
- Hypermobility of the joints and muscle weakness;
- Increased fragility of bones and changes in bone quality (osteopenia and osteoporosis, osteosclerosis);
- Disorders of bone growth zone.

In genetic syndromes, the above mentioned pathological changes in musculoskeletal system of a child often limit or make impossible self-care and social adaptation of such patients.

**Reserach objective:** Presenting proper experience in the treatment of orthopedic manifestations of genetic syndromes in children using modern minimally invasive techniques.

### **Materials and methods**

The study included 116 patients aged 2 to 14 years with different genetic syndromes; they were undergoing treatment in hospital setting from 2000 to 2017. The main of these syndromes are Ehlers-Danlo, Ulrich, Larsen, Freeman-Sheldon, Poland syndrome, arthrogryposis, Apert syndrome, Proteus syndrome, neurofibromatosis, Tselveger syndrome, Marfan syndrome, Prader-Willy syndrome, Down syndrome, TAR Syndrome, Charco Marie, Duchenne Muscular Dystrophy, **Congenital Constriction Band Syndrome**, Fetal Alcohol Syndrome, Caudal Regression Syndrome, Russell-Silver Syndrome, Diastrophic Dysplasia, and many others).

In the course of treatment, the children underwent the standardized range of clinical and instrumental examinations before and during treatment: clinical, radiological, biomechanical, and neurological examinations, genetic testing, ultrasound examinations, dynamometry and electromyography of muscles, and other examinations according to the indications.

The above-mentioned group of children underwent minimally invasive surgical interventions on the lower limb segments (hemiepiphyodesis of growth zone of the femur and/or the tibia in case of axial deviations; temporary total blockage of the distal posterior growth zone of the femur and/or the tibia in case of the shortening of a limb segment or the whole limb; talocalcaneonavicular arthrosis in case of

flexible flat-valgus deformation of the foot with pain syndrome), by using modern devices of intraoperative visualization (electron-optical converter), which makes it possible to minimize traumatization of tissues in operation areas and to reduce substantially the intervention time.

## **Results and discussion**

Minimally invasive surgical interventions were used in the following cases:

- Deformation of the bones of the lower extremities in frontal and sagittal planes in children with preserved growth zones;
- Valgus deformation of the proximal femur;
- Difference in length of limb segments from 1 to 3 cm;
- "Flexible" flat-valgus deformation of the feet with pain syndrome;
- Aseptic necrosis of the femoral head and deformation of the proximal femur accompanied by a high position of the greater trochanter (coxa vara as a rule).

It should be noted the benefits of such interventions: minimal invasiveness; full load on the limb at a second or third day after the surgery; possibility of polyphocal correction of deformation; possibility of repeated correction in the process of growth; fewer complications; the method is a direct competitor to osteotomy in correction of angular deformations of the lower extremities in children; reduced hospital stay; the fastest return to normal life; significant positive psychological impact on the patient and his/her family; absence of the expressed pain syndrome and cosmetic result; reducing the cost of treatment and reducing the percentage of complications and eventual disability.

## **Conclusions**

1. Treatment of children with genetic pathology in combination with abnormalities in the musculoskeletal system should be based on the principles as follows: the treatment should be carried out on a stage-by-stage basis; treatment comprehensiveness, consistency, and maximum functionality with the use of the whole range of pharmaceutical, conservative, and surgical methods; using implants and orthopedic methods; sanatorium and spa treatment; exercise therapy and physiotherapy.
2. Modern non-invasive techniques for the treatment of children with genetic pathology allow obtaining a high percentage of good and satisfactory results (depending on the age at which treatment is started, the degree of deformation and concomitant diseases) with full compliance with the technique, comprehensive rehabilitation treatment and adequate orthosis. The use of domestically made products may reduce the cost of treatment by more than 60% compared to foreign counterparts.

### **MODELING RESECTION OF THE FEMORAL HEAD (MRFH) IN CHILDREN**

**\* Korolkov A.I., \* Kuzyo Z.T., \*\* Katsalap E.S.**

*\* Communal Institution of Lvov Regional Council "OKHMADET Lvov Regional Children University Hospital", Lvov, Ukraine*

*\*\* State Institution "Professor M.I. Sitenko Scientific Research Institute of spine and joint diseases" under National Academy of Medical Sciences of Ukraine", Kharkov, Ukraine*

## **Introduction**

The following diseases of the hip joint (HJ) in children lead often to the deformation of the the femoral head: aseptic necrosis (AN) of the femoral head (FH), pathological and congenital hip dislocation (CHD) and post-traumatic deformation of the proximal femur (PDPF).

One of the intervention types, which may be applied in these cases, is resection of the femoral head (RFH).

**Study objective:** Presenting the results of the use of the MRFH in children

### **Materials and methods**

44 patients (26 girls and 18 boys) aged from 10 to 18 years were followed up. Long-term results of the MRFH were followed up from 5 to 20 years (average follow up period was 8.4 years) and evaluated according to clinical, biomechanical, and radiological criteria.

Methodology of modeling resection of the femoral head:

- Stage 1: Decompression of soft tissues of the hip joint;
- Stage 2: Access to the hip joint, anterior or lateral, with osteotomy of the greater trochanter;
- Stage 3: The proper modeling resection of the femoral head: the femoral head is configured to have the most possible round shape by cutting away the deformed lateral and / or upper lateral margins and osteophytes from the margins of the femoral head, with the cartilage cover preserved in the maximum way in the central and especially upper (most loaded) part of the femoral head;
- Stage 4: Depending on the indications, the **OBB**, **OBBep** and/or **KMO** were performed according to the generally accepted technique.

In the postoperative period, the immobilization was carried out in a derotational boot with drawing over bed for a period within 1.5 to 2 months; and movement workout was carried out in the domestically produced apparatus for automatic movement workout in the joints.

### **Research results**

The following data were revealed in patients in the late postoperative period: patients who had previously undergone intra-articular interventions on the hip joint, as well as pathological hip dislocation, showed a decrease in the range of motions in the joint. 4 patients had stiffness in the hip joint and ankylosis later on. 8 patients had symptoms of aseptic necrosis of the femoral head, which appeared or increased. 11 patients noted pain syndrome when walking a distance of 500 to 1000 m, and a moderate decrease in the range of motion in the hip joint. The operated lower limb was 1 to 3 cm shorter than the opposite one in 37 children (61.4%); the hip was 3 cm shorter in 27 children (38.6%). Normalization of the hip joint component parameters (**KB**, ratio of hip joint coverage by the acetabulum, **KBC**, etc.) was observed in comparison to the data in the pre-operative period ( $p < 0.05$ ), which indicates the elimination of misalignment and subluxation in patients of this group.

Long-term treatment results were distributed as follows: good 14 patients (31.8%), satisfactory results were in 18 patients (40.9%), unsatisfactory results were in 12 patients (27.3%).

## Conclusions

1. Indications for modeling resection of the femoral head are: significant bone and cartilage growth in the area of the femoral head and/or saddle-shaped deformation of the femoral head, which prevent the alignment of the femoral head in the acetabulum; cases where a deformed part of the femur head occupies a portion of  $\frac{1}{4}$  to  $\frac{1}{2}$  of its diameter in misalignment and hip subluxation, but with a sufficient range of motion in the sagittal plane.

2. Unsatisfactory results were obtained primarily due to the baseline condition of the hip joint at the time of modeling resection of the femoral head, and the characteristics of the underlying disease. Thus, the largest percentage of unsatisfactory results (24%) after modeling resection of the femoral head was obtained by us in a subgroup of patients with pathological hip dislocation, while the smallest percentage (9%) of unsatisfactory results was obtained in patients with aseptic necrosis of the femoral head.

## PREVENTIVE SURGERY OF THE HIP JOINTS IN CHILDREN WITH CEREBRAL PALSY

\* Korolkov A.I.,\*\* Rakhman P.M., \* Rykun N.D.

\* *Communal Institution of Lvov Regional Council "OKHMADET Lvov Regional Children University Hospital", Lvov, Ukraine*

\*\* *State Institution "Professor M.I. Sitenko Scientific Research Institute of spine and joint diseases" under National Academy of Medical Sciences of Ukraine", Kharkov, Ukraine*

## Introduction

A long-standing muscular imbalance and lack of normal walk in due time, i.e. lack of load on the hip joints, in children with cerebral palsy lead to the coxa valga formation and, as a result, to the development and progression of hip decentration, subluxation and dislocation

**Study objective:** Providing treatment options aimed at preventing the instability of the hip joints in children with cerebral palsy.

## Materials and methods

110 children aged 2 to 12 years with cerebral palsy were examined according to Gross Motor Function Classification System (GMFCS): 45 patients (40.91%) had level II, 37 patients (33.64%) had level III, and 28 patients (25, 5%) had level IV (children with I and V GMFCS levels were not included in the study). The average follow-up period was 6.7 years.

Examination before and in the course of treatment: clinical, radiological, neurological, biomechanical, ultrasound, dynamometry and electromyography of muscles

## Research findings

Children aged 1 to 5 years received conservative treatment to reduce muscle tone and immobilization in orthoses, with efficiency being approximately 16%. When treatment was unsuccessful, botulinum toxin was injected into the target muscles under ultrasound control or soft tissue interventions were

performed on the muscles of the lower extremities. When coxa valga progressed in 22 patients (40 joints), temporary or permanent hemiepiphyodesis of the medial part of the growth zone of the femoral head was used with screw fixation and/or bone autoplasty. Only 3 joints showed no effect of the intervention carried out. In the rest of the patients with the progression of instability of the hip joint, routine interventions were performed on the femoral and pelvic hip joint components with soft tissue decompression of the hip joint (intertrochanter corrective osteotomy of the femur and/or pelvic osteotomy according to indications).

## **Conclusions**

The data obtained show that the preventive surgery for hip joint in children with cerebral palsy is a promising practice. Further research is needed to clarify the indications for the use of temporary or permanent hemiepiphyodesis of the growth zone of the femoral head in children with cerebral palsy.

## **INTERMEDIATE RESULTS OF SURGICAL TREATMENT OF POSTTRAUMATIC DAMAGES OF KNEE JOINT CARTILAGE WITH AUTOLOGICAL CHONDROCYTES**

**Kostogryz O.A.,\* Zubov D.O., Kostogryz Y.O.**

*State Institution "Scientific Research Institute of Traumatology and Orthopedics under National Academy of Medical Sciences of Ukraine (NAMN)", Kiev, Ukraine*

*\* State Institution "Scientific Research Institute of Traumatology and Orthopedics under National Academy of Medical Sciences of Ukraine (NAMN)", Kiev, Ukraine*

## **Introduction**

The article presents the results of treatment of patients with full-thickness traumatic defects of the articular cartilage of the knee joint with autologous chondrocyte transplantation.

**Reserach objective:** Studying intermediate results of treatment of full-thickness traumatic defects of the articular cartilage of the knee joint with autologous chondrocyte transplantation.

## **Materials and methods**

The treatment results in 7 patients with traumatic defects in the articular cartilage of the medial process of the femur were analyzed. All the patients were men aged approximately 31 years. The average cartilage defect area was 4.3 cm<sup>2</sup>. The results were evaluated in accordance with IKDC *subjective knee evaluation form (IKDS Questionnaire)*, Lysholm knee scoring scale, and MRI examination in 6, 12, 24, 36, and 60 months after the surgery.

## **Research findings and discussion**

The patients were operated in the period from 2007 to 2008; the cartilage damage was diagnosed in 2 patients only in the preoperative period by MRI, with injury area being unknown.

At the first stage of treatment, partial resection of damaged parts of the medial meniscus was performed and loose cartilage bodies were removed arthroscopically. A fragment of the surrounding cartilage was taken and immersed in the nutrient medium to cultivate chondrocytes.

The original culture of chondrocytes was obtained in the laboratory by enzymatic disaggregation

method. The cultivation was carried out in accordance with a generally accepted technique. 10 million cultivated chondrocytes were obtained within 30 days.

Autologous chondrocyte transplantation was performed at the second stage of treatment by miniarthrotomy in 3-4 weeks after the first surgical intervention. On 22 November, 2007, we performed the first operation with clinical use of autologous chondrocytes.

Intraoperatively cultured chondrocytes were placed in 5 mL of agarose mucopolysaccharide matrix that had excellent plastic and adhesive properties. This gelled mass was placed at the defect site whose edges were formed by a healthy cartilaginous tissue. Once the gelled mass had thickened, the graft surface was covered with a TahoComb plate, and the edges were sealed with fibrin glue. An individual rehabilitation was practiced in the postoperative period.

According to the IKDC subjective knee evaluation form, the patients had an average of 48 scores before the surgery, 68 scores in 6 months after the surgery, 76 scores in 12 months after the surgery, 84 scores in 24 months after the surgery, and 60 scores in 36 months after the surgery. According to Lysholm Knee Scoring scale, the patients had an average of 62 scores before the surgery and a steady result of 88 scores in 1 year after the surgery. Following the MRI findings, full integration of the graft with surrounding articular cartilage was observed in 1 year after the surgery. Two patients with the largest area of defect underwent corrective valgusing osteotomy in 1 year after transplantation when a varus deformity appeared. A long-term postoperative period was satisfactory.

### **Conclusions**

Intermediate results of autologous chondrocyte transplantation in full-thickness traumatic defects of articular cartilage showed its efficiency and gave a certain hope in the future for the restoration of large-area defects in the articular cartilage of the knee joint.

## **COMPENSATION OF BONE DEFECTS IN REVISION HIP JOINT AND KNEE JOINT REPLACEMENT BY USING ADDITIVE TECHNOLOGIES**

**Kosyakov A. N., Miloserdov A. V., Fedin E. M., Nechay A. A.**

*Kiev Municipal Centre of Joint Replacement, Surgery and Rehabilitation, Kiev, Ukraine*

While the number of primary replacements of large joints is increasing, the number of revision joint replacements is inevitably growing. A special group is formed by patients with instability of implant components and extensive bone defects. The development of technologies for digital image processing and relatively affordable 3D printing methods by using various materials amplifies greatly capabilities of orthopedic surgeons when planning and conducting revision joint replacements.

One of the main problems of revision arthroplasty of the hip and knee joints is the problem of pelvic, femoral and tibial bone defects.

**Study objective:** Studying the results of the recovery of complex bone defects in revision replacements of the hip and knee joints by using spatial modeling and prototyping.

### **Materials and methods**

Patients with bone defects in the hip and knee joints were examined before surgery. The main diagnostic method was computed tomography followed by spatial reconstruction and the printing of

life-size plastic bones. Defects were evaluated according to W.G. Paprosky classification of acetabular bone loss and Anderson Orthopedic Research Institute (AORI) classification.

The main causes of bone loss under the implant components are as follows:

- Infection;
- Joint instability;
- Failure of the auxiliary apparatus of the joints;
- Osteolysis caused by friction pair degradation products (polyethylene, metallic debris, loose fragments of bone cement);
- Disruption of the normal transfer of mechanical loads between the articulated bones (the implant components absorb and redistribute physical stresses, concentrating them on the “implant – bone” borderline). Under these conditions, the bone spongy substance and the relatively weak cortical layer of the epimetaphyseal parts of the bones undergo atrophy and destruction;
- Migration of unstable components causes indentation and crushing of the underlying bone up to its impression fractures.

The main stages of using additive technology for revision replacement of the hip and knee joints are as follows:

- Visualization of defects on X-ray images and CT scans, and their classification;
- Creation of a computer model of the pelvis, hip and lower leg; design of an individual implant;
- Manufacture of life-size bone and implant plastic prototypes on a 3D printer;
- Verification of conformity of the revision implant components and implant simulation models, and their additional refinement;
- Conducting a “trial operation” and making final adjustments;
- Printing the metallic implant on a medical 3D printer;
- Trial assembly of the entire revision implant system;
- Subsequent processing, packaging, sterilization;
- Revision surgery.

## **Conclusions**

Created on the basis of computed tomography (CT), 3D bone models correspond to a real bone in terms of its anatomy.



Preliminary planning and carrying out "operations before the surgery" make it possible to choose the best option for surgical treatment and reduce substantially surgery time.

## **EFFECT OF BONE CANAL DILATATION AFTER RECONSTRUCTION OF ANTERIOR CRUCIATE LIGAMENT (ACL)**

**Krasnoperov S.N., Golovakha M.L.**

*Zaporozhye State Medical Universit, Zaporozhy, Ukraine*

There are various types of complications after reconstruction of the anterior cruciate ligament (ACL), and one of them is bone canal dilatation in the postoperative period, which can lead to such problems as delayed graft integration with the bone tissue and the development of secondary instability, as well as to increasing cost and a two-stage ACL revision reconstruction.

The most often used methods of graft fixation in the femoral and tibial bones include the use of button suspension clamps withdrawn from the place of attachment of the anterior cruciate ligament, and interference screws that fix the graft directly at the place wherein the graft appears from the bone canal.

Despite the fact that this problem has not been completely solved up to date, a small number of works exist, which would compare the effect of various fixation methods on the dilatation of bone canals in the postoperative period.

**Reserach objective:** Evaluating the dilatation of bone canals after reconstruction of the anterior cruciate ligament on the basis of computed tomography

### **Materials and methods**

The study included 44 patients: A group (24 patients) – “all inside” technique with fixation of the graft obtained from the semitendinous muscle tendon with cortical clamps on the femoral and tibial bones; B group (20 patients) – fixation of the graft obtained from the tendon of the semitendinosus and gracilis muscles with interferential screws in the femur and tibia (transportal technique The rehabilitation protocol was the same for the patients of the two groups. The average period of CT examination was 10 months (from 9 to 13 months) after the surgery.

Clinical examination results were evaluated simultaneously with the CT scan results, and they were compared in patients of two groups.

### **Research findings**

In group A, an average increase in the diameter of the femur bone canal was +15% at the canal input, and it was +12% in the middle of the canal. In group B, an average increase in the diameter of the femur bone canal was +10% at the canal input, and it was +7% in the middle of the canal.

In group A, an average increase in the diameter of the tibial canal was +19% at the canal input, and it was +15% in the middle of the canal. In group B, an average increase in the canal diameter was +15% at the canal input, and it was +11% in the middle of the canal. No statistically significant difference was found between the two groups of patients according to clinical examination.

### **Conclusions**

The group where cortical fixators were used demonstrated an increase in the femur bone canal diameter by 15% at the canal input and by 12% at its middle part, and an increase in the tibia bone canal diameter by 19% and 15%, respectively. The group where the interference screws were used demonstrated an increase in the femur bone canal diameter by 10% at the canal input and by 7% at its middle part, and an increase in the tibia bone canal diameter by 15% and 11%, respectively.

The bone canal dilatations turned to be larger in the group wherein cortical fixators were used than in the group wherein the interference screws were used, however, the difference of this increase in the two groups was not significant: it was only 5% for the femoral canal, and less than 4% for the tibial canal.

Following the research findings, the conclusion may be done that the X-ray results of the bone canals dilatation do not correlate with the clinical subjective and objective results of reconstruction of the anterior cruciate ligament

Thus, when using cortical suspension fixators, the bone canal dilatations slightly exceeds those when using interference screws (within the range of 5% to 4%), and the results of the clinical examination do not differ in the two groups of patients.

**Key words:** anterior cruciate ligament reconstruction, dilatation of bone canals, computed tomography

## **POLYMER MATERIALS USED IN PATIENTS WITH SHOULDER DIAPHYSIS DEFECTS**

**Krivenko S.N., Popov S.V.**

*M. Gorky Donetsk National Medical University, Donetsk, Ukrain.*

### **Relevance**

Treatment of patients with the shoulder diaphysis defect is a topical issue as this injury is one of the most often causes of disability. In 2010, roads accidents were the cause of death of 280 thousand persons. This type of damages is accompanied by deep disorders of the homeostasis system, which exceed adaptation capabilities of the human body, which stipulates the high level of lethality (49.6%) and disability (29%) among victims. The study of metabolic alterations at the bones of extremities in injurees with the shoulder diaphyseal defect is instrumental for the correct understanding of compensatory mechanisms in the human body to develop surgical and therapeutical tactics for treatment of skeletal injuries; it is aimed at the prevention of exhaustion of the major tissue depots providing compensation of losses for rapid recovery of the long bones of extremities in patients with the diaphyseal shoulder defect, and to prevent complications.

The research is underlain by the following factors: lack of the single conceptual position related to the proper metabolic reaction of the human body to an injury, the nature of changes in the body of injured persons, terms of recuperation of metabolic processes, influence of various surgical treatment methods,

and terms of their implementation to restore metabolic equilibrium of the body of injured persons, When studying general metabolic reaction of the body, it was found that it was characterized by two phases. Once the trauma has occurred, the catabolic reaction appears: it is represented by the redistribution and alteration of metabolic processes accompanied by the substantial loss of a number of organic and mineral substances due to disintegration of tissular proteins.

The first phase lasts up to two weeks. The anabolic phase comes to the end of the second week of the posttraumatic period; the functional ability of the liver and kidneys recovers; the concentration of blood proteins and electrolytes increases; and composition of blood and plasma is normalized. The general catabolic body response to an injury contributes to the release of the major chemical elements necessary for regeneration. Negative nitric balance with the loss of proteins is set in the body in the initial catabolic phase, with a great amount of nitrogenous substances, which are released from the protein decomposition, excreting by the kidneys. Such redistribution of proterins is an element of the active part of the body, which begins prevailing gradually and contributes to the compensation of the proteins lost in the injury, and, thus, to the full-fledged regeneration process. Low concentration of blood proteins persists for two weeks after the injury. A marked catabolic reaction is related to metabolic imbalance and adaptation of the body to new conditions by redistributing internal resources.

### **Materials and methods**

To research various aspects of the pathogenesis of the humeral diaphyseal defect in Donetsk State Research and Scientific Institute of Traumatology and Orthopedics within a period of 2010-2016, we carried out the integrated clinic and laboratory assessemnet of 140 patients with humeral diaphyseal defects treated with a polymer material (akril oxide). We studied the patients treated by the method offered by us with the use of internal and external osteosynthesis for closed fractures of shoulder segments. The metabolic state of the body in njured persons was studied in 1, 7, 14, and 21 days after the injury. Metabolic state of injured persons at the 1st day after the injury was characterized by normal indexes of blood potassium, sodium and calcium. Indexes of blood magnesium, chlorine, and phosphorus in the injured persons did not differ from those in of practically healthy persons. The particularities of protein metabolism in the injured persons represented active protein catabolic processes that appear in a decrease of concentration of the whole protein and an increase of the products of protein metabolism– urea and creatinin – in the blood. The study of the protein metabolism indexes in persons with the humeral diaphyseal defect showed that the amount of the whole protein in the blood was reduced to  $60.24 \pm 1.48$  g/L ( $P < 0.05$ ) in acute period and early period of traumatic disease in comparison with normal whole protein of ( $75.46 \pm 4.72$  g/L). Thus, the protein metabolism indexes in patients with humeral diaphyseal defects have a typical conformity to the law: greater duration of decrease in protein levels depended on the injury severity; more intensive protein disintegration in the places of several fractures of the humeral segments; and on a more prolonged time of catabolic reaction in this category of injured persons.

Mathematical analysis of the results of biochemical researches of the main components made it possible to reveal the underlying structure of biochemical processes within the acute period of humeral diaphyseal defect, and to define its integral indexes. It was set that the first main component explains 54% of all internal factors determined by us as “early phase changes of metabolism processes in an injury”. For a better understanding of the pathogenesis of the phenomenon under study, correlations of these biochemical indexes in the injured persons in the acute period of trauma and in the control group are analyzed for comparison. Only correlation coefficients were taken for the analysis. The profile of metabolic processes in the extremities of the injured persons with humeral diaphyseal defects were characterized by decreased activity of serum transaminase and lizosomal enzymes, and increased activity of

amylasa and alkaline fosphotasa on the 7th day after the injury in comparison with the activity of those enzymes on the first day. It should be noted that the level of the activity of AST, ALT, RNA-elements, DNA-elements, and cathepsin D exceeded normal, without taking into account their decreased activity. The De Ritis ratio (AST/ALT) in thwe injured persons was 0.7 (the normal De Ritis ratio is 1.3), which suggested liver dysfunction. Increased activity of alkaline phosphatase in the injured persons was caused by inflammatory processes in the bones and muscular tissue. Increased activity of blood amylase was caused by the functional changes of the pancreas, which resulted in post-traumatic diabetes developed in the injured persons, which was confirmed by high blood glucose concentration levels. The method of factor analysis sets the main component that characterizes the internal factors of metabolic processes on the 7th day after the injury, and which was adopted by us as “protein catabolic process activity”. The profile of metabolic processes on the 14th day after the injury was characterized by increased concentration of blood whole protein, albumines, and decreased level of -1- and -2-globulines, urea, uric acid, and creatinin in comparison with the first few days after the injury. These protein metabolism alterations are characterized by a trend to decreased activity of protein catabolic process. The main component of this period of traumatic disease, wich was adopted by us, correlated directly with “activity of protein synthesis processes”, while blood globulins correlated with the cerebral cortex. On the 21st day after the injury, the metabolic alterations were characterized by a decrease in -1- and -2-globulines, urea and creatinin on the background of a subsequent increase in the whole protein blood concentration in comparison with the fiest few days after the injury, which suggests normalization of protein metabolism in patients. The normal indexes of AST, ALT, acid phosphatase, creatinkinase, Lactate dehydrogenase (LDH), and lizosomal enzymes were registered in the injured person within this period, whiler the indexes of activity of amylase and alkaline phosphates were high.

## **Conclusions**

Thus, it should be noted complex metabolic alterations - both in the site of multiple humeral diaphyseal fractures and in the whole body – which act in the injured person as a protective reaction to unfavorable environment factors. The unfavorable reactive changes arising in the body are regulated by the cerebral cortex. The general metabolic reaction changes all physiological processes of the body in reply to an injury: it includes complex metabolic alterations of proteins, carbohydrates, minerals, and enzymes. This protective reaction of organism is characterized by two phases: a catabolic and anabolic pahese. The catabolic phase is characterized by the metabolic alterations as follows: disintegration of tissular proteins and excretion of nitric substances from the body. The catabolic reaction mobilizes all the necessary resources for future reparation processes. Correlation of metabolic processes towards the biosynthesis of organic and mineral components occurs in anabolic phase in a period of 2 to 3 weeks after the fracture to provide fracture healing. To explain general metabolic reaction of the body in the humeral diaphyseal defect treated with a polymer material, the indexes of proteins, carbohydrates, and enzymes were the most informative.

## **DIAGNOSTIC SENSITIVITY OF LABORATORY MARKERS IN PATIENTS AFTER LARGE JOINT REPLACEMENT**

**Leontyeva F.S., Morozenko D.V., Vorontsova M.P.**

*State Institution “Professor M.I. Sitenko Scientific Research Institute of spine and joint diseases”  
under National Academy of Medical Sciences of Ukraine”, Kharkov, Ukraine*

## **Introduction**

The development of algorithms for diagnostic and treatment of large joints osteoarthritis and introduction them in practice should be based not only on clinical but also on biochemical criteria that characterize metabolic alterations after the joint replacement.

Treating patients in the late osteoarthritis stages by the joint replacement method is a very relevant and a complex problem of modern orthopedics. Concomitant diseases that complicate a postoperative period and worsen the final treatment results are often observed in patients with osteoarthritis of large joint, which requires joint replacement. To identify the possibility of a concomitant disease in time, it is necessary to use efficient and informative laboratory tests that meet the requirements of evidence-based medicine. This goal may be achieved by using the optimal set of biomarkers for inflammatory-destructive disorders, lipid metabolism, immune status and hemostasis. The study of lipid metabolism disorders in patients with osteoarthritis of large joints after joint replacement is particularly important. The metabolic disorders mentioned have not been investigated sufficiently; however, they may affect substantially the general somatic state of the patients.

**Study objective:** Establishing the most sensitive diagnostica markers that may be used to foecast complications in the postoperative period

### **Materials and methods**

147 patients with III and IV stages of osteoarthritis who had underwent joint replacement, were examined in the clinic of State Institution “Professor M.I. *Sitenko* Scientific Research *Institute* of spine and joint diseases” under National Academy of Medical Sciences of Ukraine”, Kharkov, Ukraine. The patients aged from 40 to 87 years. The results of laboratory tests were processed using the formula of A.M. Zemsky. The diagnostic informativeness of laboratory tests was calculated bny mence of the modified formula of A.M. Zemsky:  $((A / B) - 1) \times 100\%$ ,

where

A - laboratory index of patients with osteoarthritis prior to joint replacement,

B - laboratory index after joint replacement.

### **Research findings**

Glycoproteins were the most informative for diagnostic of large joint osteoarthritis after joint replacement (96.2%), which indicates the representativeness of this marker for this disorder and makes it the most informative diagnostic marker. The following markers were very informative: chondroitin sulfate (94.3%), interleukin-1 (92.1%), haptoglobin (91.3%), C-reactive protein (83.4%), interleukin-6 (83.2%), activity of  $\gamma$ -glutamyltransferase (89.7%) and acid phosphatase (80.7%). Such diagnostic sensitivity of biochemical markers (glycoproteins, chondroitin sulfates, C-reactive protein, haptoglobin, acid phosphatase) is pathogenetically substantiated since all of the markers are indicators of inflammatory and destructive disorders in the connective tissue of patients with osteoarthritis in stages III – IV of the hip and knee joints. High diagnostic sensitivity of inflammatory interleukins (IL-1 and IL-6) indicated immune disorders, and a high sensitivity of  $\gamma$ -glutamyltransferase is associated probably with the development of severe patients' intoxication caused by a long-term administration of nonsteroidal anti-inflammatory drugs to reduce pain syndrome.

## **Conclusion**

The specified diagnostic criteria of the informativeness of biochemical and immunological markers will make it possible to broaden knowledge of scientists and practicing orthopedic surgeons on the assessment of performance status of patients with osteoarthritis who undergo large joint replacement.

## **SURGICAL TREATMENT OF PECTORALIS MAJOR MUSCLE TENDON RUPTURE**

**\* Litvin Y.P., \*\* Litvin V.V., \* Logvinenko V.V.**

*\* State Institution "Dnepropetrovsk Medical Academy under Ministry of Healthcare of Ukraine"*

*\*\* Communal Institution "Municipal University Hospital No.16", Dnepr, Ukraine*

## **Relevance**

The rupture of the pectoralis major muscle is a relatively rare injury that often remains unrecognized, which may lead to weakness and disturbance of the mobility of the upper extremity in the future. This trauma is typical mainly for young men aged 20 to 45 years who are actively engaged in sports or heavy physical labor. So, having received such a damage, patients often fail to continue to fully train or work. Primary care physicians often underestimate the severity of the injury and its consequences, which leads to the late referral of patients to a specialized care.

**Research objective:** Demonstrating the possibilities of surgical treatment of patients with pectoralis major muscle tendon injury and evaluating its results.

## **Materials and methods**

5 patients with an injury of pectoralis major muscle (4 men and 1 woman) were under our supervision for the period from 2012 to 2017. The patients aged 26 to 43 years (average age was 27.4 years). The injury age was from 2 weeks to 3 months. All the patients underwent clinical, X-ray, and ultrasound examination; in three cases magnetic resonance imaging (MRI) was performed. Three patients were operated; two patients were treated conservatively. The rehabilitation period was about 6-8 weeks.

## **Research findings and discussion**

When diagnosing, first of all, we should rely on the clinical picture and ultrasound examination data, which may be used as a "screening" method for verifying complete damage of the tendon and its localization. If ultrasound examination data are absent or questionable, to diagnose the tendon injury we used MRI. Foreign authors state that MRI makes it possible to take a decision in the cases when it is necessary to determine the damage degree in partial muscle rupture. Thus, due to the MRI data, partial damage to the pectoralis major muscle tendon was diagnosed in 2 cases, and the tendon was completely damaged in the first case. Moreover, a complete rupture of the pectoralis major muscle tendon was found intraoperatively in all the patients operated, which confirmed the data of the diagnostic visualization methods. Thus, the correct interpretation of the data of radial diagnostic

methods allows distinguishing partial tendon rupture from complete tendon rupture, which finally affects the treatment tactics.

Surgical treatment is restoration of the integrity of both the tendon and the muscle itself, with the tendon returned subsequently to the area wherein the pectoralis major muscle tendon is attached naturally, i.e. the crest of the greater tubercle of the humerus, which is located outside the tendon of the biceps long head. For this purpose, we used deltopectoral access, which provides a good visualization of the tendon fixing zone and the possibility to carry out myolysis of the fascicles of the pectoralis major muscle on sufficient length; and the miorrphy, tenorrhaphy, and resection of the tendon itself were carried out using anchor fixators. Such a technique makes it possible to restore both the anatomical integrity of the muscle and the biomechanics of its movement. Creating a reliable tendon fixation with minimal injury of both the tendon and the humerus bone, allows shortening the time of limb immobilization up to 3 weeks and starting earlier a controlled function.

The results of surgical treatment in the 3 cases are considered excellent as patients have no pain at all; the whole range of motions is observed; and no cosmetic defects were observed. No significant (<10%) difference in the strength of limb abduction was observed at manual assessment in comparison to a healthy hand, and no restrictions in physical exercises is observed.

Unlike surgical treatment, conservative treatment can not fully restore the strength of internal rotation and adduction, however, a partial damage makes it possible to get the full range of painless motions. According to publication data, in all cases of complete rupture treated conservatively, a marked cosmetic defect is formed, which increases with muscle tension of the pectoral girdle. In two our cases of partial damage, we did not observe a cosmetic defect. The main patients' complaint was reduction in muscle force when adducting the limb; it could be accompanied by moderate pain under considerable physical load. When assessing manually the difference in strength of limb adduction, it was moderate (<20%) in comparison to a healthy hand. These results we rated as good.

### **Conclusions**

To confirm the **pectoralis major tendon rupture**, the degree and localization of the injury, it is advisable to use additional diagnostic visualization methods of investigation (ultrasound, MRI).

In complete **pectoralis major tendon rupture**, surgical treatment is indicated, which makes it possible to avoid severe atrophy and scarring of the damaged muscle and its tendon, restores the full range of motion and strength, and eliminates a cosmetic defect.

Conservative treatment is advisable only in cases of partial and minor injuries (less than 50% of the tendon thickness), since in this case, conservative treatment methods are not inferior to surgical.

### **TAKING INTO ACCOUNT MEASUREMENT ERROR FOR THE RIGIDITY OF METAL OSTEOSYNTHESIS OF THE PROXIMAL HUMERUS FRACTURES**

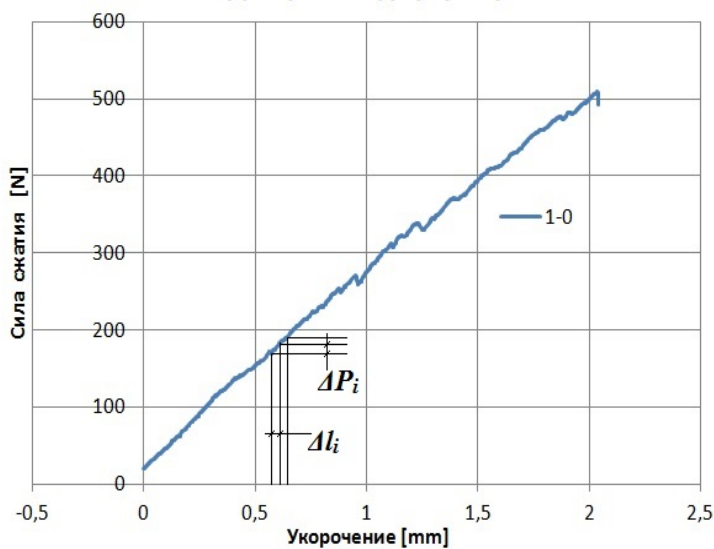
**\* Makarov V.B., \*\* Lipovskiy V.I., \*\*\* Levadny E.V., \*\*\*\* Boyko I.V.**

*\* State Institution "Specialized General Hospital No. 1 of the Ministry of Healthcare of Ukraine",  
Dniepr, Ukraine*

*\*\* Oles Gonchar Dneprovskiy National University, Dniepr, Ukraine*

*\*\*\* Lodz Technological University, Lodz, Poland*

## Диаграмма деформирования



\*\*\*\* State Scientific Institution "Scientific and Practical Center for Preventive and Clinical Medicine" of the State Administration, Kiev, Ukraine

### Introduction

Open resetting and internal fixation of fractures of the proximal humerus may be ineffective due to osteoporosis; therefore, the problem of stiffness of fixation of fragments of the proximal humerus with various metal structures remains a relevant topic.

**Reserach objective:** Substantiating the possibility to study experimentally the rigidity of fixation of bone fragments, taking into account the absolute error of the parameter under study due to random errors following the results of a single deformation diagram

### Materials and methods

When studying the rigidity of an object on the basis of experiments, it is necessary to determine the ratio of the load increment to the absolute size change  $C_i = \Delta P_i / \Delta l_i$ . The figure shows an example of a typical deformation diagram for reposition of a humeral fracture with an intramedullary blocked osteosynthesis by using a titanium reconstructive cannulated rod of 7 mm diameter and locking screws of 3.5 mm diameter. An experimental deformation diagram was obtained by means of an Instron Testing Machine of Model 4485 (High Wycombe, UK) and built on 1,250 measurement points of an electromechanical strain and deformation sensor. A point sampling of a cleared data series, which rules out gross measurement errors, makes it possible to estimate the rigidity of the humeral fracture fixation system with a preset confidence probasbility level following the results of a single deformation diagram for the  $C_i$  sampling.

The data are processed according to the standard methodology:

- Determining the point estimates of the mathematical expectation  $X$ , dispersion of  $Sx^2$ , and the rigidity mean square deviation  $Sx$ ;
- Analyzing a number of measurements to determine gross errors. To determine gross errors of the statistical series, a so-called three-sigma rule is used.

The dispersion of random variables of the average value should not exceed:

$$X_{max, min} = X \pm 3S_x$$

- Finding the point estimates of the cleared data series and determining the interval estimates of mathematical expectation and dispersion by means of confidence probability. Knowing the value of the confidence interval  $2\mu$ , we can obtain the interval estimate of mathematical expectation:  $X - \mu < M < X + \mu$ .

The value of the half of the confidence interval is calculated by the preset confidence probability  $P_D$  based on the relation  $P_D = \varphi(\mu/S_x)$ , where  $\varphi(t)$  is the Laplace function. Half of the confidence interval



is:  $\mu = S_x \cdot t / \sqrt{N}$ . It should be borne in mind that the confidence interval defined in this way characterizes the absolute error of the estimation of the value under investigation due to random errors.

### Research findings

The results of stiffness calculation according to the presented strain diagram are determined for the confidence probability of 99 and 95%. Rigidity is equal to  $262.4 \pm 8.9\%$  for probability of 99%, and it is equal to  $262.4 \pm 6.8\%$  (N / mm) for probability of 95%. The limit of permissible relative error in measuring the strength of the testing machine is 0.5%, and the deformation limit is 0.13 mm in the deformation range up to 13 mm. Since the instrument error  $\Delta$  is small in comparison to the random measurement error, this  $\Delta$  value may be neglected when estimating the rigidity.

### Conclusions

The analysis of the rigidity of fixation of bone fragments with a titanium rod showed that a preset confidence level makes it possible to take into consideration random measurement errors; and reliable results may be obtained from the results of a single deformation diagram to assess the fixation system rigidity.

## DIAMOND-LIKE CARBON FILMS AS A COATING FOR SPHERICAL IMPLANT ELEMENTS

\* Makarov V.B., \*\* Strelnitskiy V.E., \*\* Vasilyev V.V., \*\*\* Boyko I.V.

\* *State Institution "Specialized General Hospital No. 1 of the Ministry of Healthcare of Ukraine", Dniepr, Ukraine*

\*\* *National Scientific Centre "Kharkov Institute of Physics and Technology", Kharkov, Ukraine*

\*\*\* *State Scientific Institution "Scientific and Practical Center for Preventive and Clinical Medicine" of the State Administration, Kiev, Ukraine*

### Introduction

Currently, various materials are used to reduce wear on the rubbing surfaces at the hinged implant components. One of the possible ways to solve this actual problem is the application of a protective diamond-like coating, which has high hardness, biocompatibility and a low friction coefficient, and is chemically inert.

**Research objective:** Developing a process for applying diamond-like carbon coatings onto spherical metal implant components.

### Materials and methods

The National Research Centre of Kharkov Institute of Physics and Technology developed an experimental process of high-performance deposition of diamond-like coatings onto the spherical implant components, in particular, onto metal heads of hip joints (See Figure 1).

Figure 1. Metal hip joint implant heads coated with a diamond-like carbon film

The deposition rate of the diamond-like coating onto a fixed substrate is 5-6  $\mu\text{m}$  / hour, with an arc current being 100 A at a diameter of up to 200 mm at a distance of 150 mm. For comparison, the

deposition rate of a titanium coating onto a stationary substrate is 15  $\mu\text{m} / \text{h}$ , with an arc current being 100 A at a diameter of up to 200 mm at a distance of 150 mm. The plasma source has been patented in Ukraine, Russia, the USA, South Korea, Japan, China, and currently the patenting process is under way in five European countries, including Germany.

### **Research findings**

The process developed provides a high degree of uniformity of the coating thickness controlled at the initial stage of coating deposition by means of the uniform colour of the interference reflection from the deposited film over the entire spherical surface of the product. The uniform colour of the deposited coating indicates a high degree of uniformity of the coating thickness over its entire surface. For the deposition of a diamond-like coating, a high-performance source of filtered vacuum-arc rectilinear type cathode plasma was used, as well as a plasma flow control system that ensures uniform coating over the entire spherical surface. The diamond-like coating deposited has a high level of adhesion to the product material and a low level of internal stresses. The efficiency of this method was tested when applying the diamond-like coating onto the sealing rings of dry gas seals for the shafts of high-pressure compressors used for gas transmission under pressure  $\geq 150$  atm.

### **Conclusions**

The developed process of depositing a diamond-like carbon coating onto spherical metal implant components may significantly increase the service life of a friction pair. Further bench tribological and biomechanical studies will help to obtain more information about the "survival" of the developed diamond-like carbon coating.

## **EXPERIMENTAL HISTOLOGICAL ANALYSIS OF BIOCOMPATIBILITY, OSSEOINTEGRATION, AND BIODEGRADATION OF**

### **INGEO™ BIOPOLYMER 4032D POLYLACTIDE**

**\* Makarov V.B., \*\* Dedukh N.V., \*\*\* Nikolchenko O.A.**

*\* State Institution "Specialized General Hospital No. 1 of the Ministry of Healthcare of Ukraine",  
Dniepr, Ukraine*

*\*\* State Institution "D.F. Chebotaryov Gerontology Institute under National Academy of Medical  
Sciences of Ukraine (NAMN), Kiev, Ukraine*

*\*\*\* State Institution "Professor M.I. Sitenko Scientific Research Institute of spine and joint diseases"  
under National Academy of Medical Sciences of Ukraine", Kharkov, Ukraine*

### **Introduction**

Poly lactides, synthetic materials intended for medical application, attract a special attention of orthopedical surgeons among. Implanted into the bone, poly lactides do not cause an immune reaction; are easy to sterilize; they demonstrate different biodegradation kinetics as a function of the molecular mass and degrade to  $\text{CO}_2$  and  $\text{H}_2\text{O}$ , natural products of metabolic processes. Poly lactide based

materials are constantly modified to improve osseointegration and mechanical properties and to develop materials with controlled degradation.

**Research objective:** Studying structural bone readjustment *in vivo* in rats after implantation of a synthetic material based on Ingeo™ Biopolymer 4032D polylactide.

### **Material and methods**

The experiment was done on 35 white rats. The test polylactide specimens of a 3 x 2 mm, which were fragments of screws made using a 3D printer, were implanted into a metadiaphysial femoral defect in the animals. Ingeo™ Biopolymer 4032D polypeptide (NatureWorks LLC) is a polymerized mixture of D- and L-lactides. The experiment plan was approved by the Bioethics Committee of *Scientific Research Institute "Professor M.I. Sitenko Scientific Research Institute of spine and joint diseases" under National Academy of Medical Sciences of Ukraine*, Kharkov, Ukraine" (Minutes No. 158 dated 21/11/2016).

Bone regeneration was assessed on the basis of histological studies using the morphometry method to determine the osseointegration index in 15 days and 1, 3, 6, and 9 months after the implantation of experimental specimens.

### **Fingings**

It was found that the implant was surrounded by immature bone tissue on the 15<sup>th</sup> day after the surgery, and a high index of osseointegration ( $46.6 \pm 1.1$ ) was determined. The active ossification around the implants took up to 3 months; the osseointegration index was not changed at this period, which may witness the completion of bone readjustment. The implants were tightly located in the defect and they were surrounded by newly formed bone tissue. No marked destructive disorders were found in the main bone and the bone marrow. The bone marrow cells were located directly on the implant on the polylactite sites adjacent to the bone marrow of the intertrabucular spaces. No disorders of cellular composition or cell detritus were detected. No evidence of inflammation was found at all the stages of the study, which indicates the absence of toxicity of the biomaterial and its good biocompatibility. No polylactide deformation or destruction were found in 9 months, i.e. at the final stage of the study. The low rate of resorption of the polylactide tested by us, the high index of osseointegration (97% at the final stage of the study), and a high biocompatibility allow us to recommend polylactide to be used for fixing devices designed for a long period fixation.

### **Conclusion**

The Ingeo™ Biopolymer 4032D polylactite implant is characterized by high osteoconductive and osseointegration properties, low resorption rate, and biocompatibility with bones.

**MISTAKES OF THERAPEUTIC AND PREVENTIVE INSTITUTIONS WHEN REFERRING PATIENTS AND DISABLE PERSONS TO FOR ASSESSMENT TO TRAUMATOLOGICAL MEDICAL AND SOCIAL EXPERT COMMISSION (MSEC)**

**Mashikhina I.V., Polakov G.L., Chemirisov V.V., Ipatov O.P., Gaydachuk A.S.**  
*Communal Institution "Regional Center for Medical and Social Assessment" under Zaporozhye Regional Council, Zaporozhye, Ukraine*

Item 17 of "Regulations on medical and social assessment" approved by the Resolution No. 1317 of the Cabinet of Ministers of Ukraine dated 03/12/2009, and Item 1.4 of "Instructions for establishing disability groups" approved by the Order No. 561 of the Ministry of Healthcare of Ukraine dated 05/09/2011, establish that "Medical and social assessment is carried out after obtaining the data as follows: complete medical examination; necessary laboratory and instrumental examinations; assessment of social needs of a disabled person; establishment of clinical and functional diagnosis; professional and labor forecast; results of appropriate treatment; rehabilitation if data are available to confirm persistent dysfunction of the body caused by diseases, traumas or congenital anomalies that cause disability." Also, Item 4 defines the procedure for referral to Medical and Social Expert Commission (MSEC): "Medical advisory committee (MAC) of a therapeutic and preventive institution refers persons who apply to establish disability for assessment of MSEC, with the referral form approved by the Ministry of Healthcare of Ukraine (Form 088 / o – Referral to MSEC). MSEC accepts documents of persons who applied to establish disability, if they have a stable or irreversible disease, as well as in case of continuous temporary disability, not later than within four months after the date when it occurred or in connection with the same disease within five months with a break for the last 12 months, and within 10 months from the day when disability was established in case of tuberculosis."

**Research objective:** Identifying the mistakes of therapeutic and preventive institutions when referring patients and disabled persons for assessment by traumatological MSEC (hereinafter - MSEC); and formulating the main problems in their referral

## **Materials and methods**

The study was based on the information provided by the referrals to MSEC, Form 088 / o, as well as on the acts of medical examination of the patients referred to MSEC. The main problems to be addressed at the level of a medical organization when referring patients to MSEC are as follows:

1. Determining indications for a substantiated referral to MSEC;
2. Developing and implementing a streamlined route of patients from one medical expert to another, including determination of the examination scope necessary and sufficient to determine the degree of severity of functional disorders and life limitation;
3. Proper formalization of a referral to MSEC.

Made by Medical Advisory Committee (MAC), the mistakes are analysed to:

- Ensure the maximum objectivity when taking expert decisions;
- Meet legal requirements to maintaining medical records;
- Examine patients in time at MSEC sessions and reduce the number of unsubstantiated referrals;
- Prevent complaints and written appeals.

The analysis of mistakes made by a therapeutic and preventive institution when referring patients and disabled persons to MSEC made it possible to determine the main reasons of unsubstantiated referrals to MSEC. The main reasons are as follows:

- *Referral of patients to MSEC before persistent functional disorders.* However, continuing treatment within the framework of temporary disability with a proper clinical and labor forecast contributes to the prevention of disability or reduces its severity;

- *Defects in diagnosis formulation.* The diagnosis does not correspond to International Classification of Diseases (ICD-10); it does not show the degree of functional disorders of patient's organs and systems; no concomitant diagnoses are specified. The above-mentioned mistakes are made entirely due to official negligence or low qualification of the medical advisory committee (MAC) head and its members.

Another group of defects in MAC work includes mistakes in estimation of the degree of deterioration of vital activities, which was caused by health disorders.

- *Inconsistency of patient's condition (exaggeration or underestimation):* incorrect estimation of the degree of severity of medical and social consequences of the disease, injury or defect when patients are referred to MSEC with minor functional disorders and even without functional disorders in some cases; or when the degree of severity of functional disorders is overestimated when referring a patient to MSEC: minor disorders are rated as moderate or severe.

It can be explained, in part, by lack of unified approaches to the assessment of functional disorders and life limitations by MSEC experts and doctors of a therapeutic and preventive institution. Both cases are undesirable: on the one hand, they may violate rights of patients who receive social benefits that might not be consistent with the law; and on the other hand, they may lead to administrative or criminal liability for the deliberate infliction of material damage to the authorities responsible for social assistance. It is difficult to distinguish a diagnostic mistake from deliberate deception of authorities responsible for social assistance (in particular, provision of medical records that incorrectly reflects patient's condition).

Lack of necessary auxiliary examinations that characterize the state of health and degree of functional disorders of the patient. Today, when new diagnostic methods are widely introduced into practice (introsopic, endoscopic, laboratory, etc.), the diagnostics of diseases and their complications is greatly simplified, but the high cost of the assessments and consumables for them (as a rule, imported) make them practically unaffordable for the overwhelming majority of disabled people. As a result, it is necessary to assess the persons referred to MSEC only in the range confirming the diagnosis; and documents of the patients underassessed should return to medical advisory committee (MAC) at the stage of submission of documents to MSEC.

*Lack of necessary examinations of related medical experts.* Lack of records of related medical experts along with lack of records on concomitant diseases, if any, made by narrow experts in the disorder, which caused disability, is a material deficiency.

*Improper filling (or lack) of plans for rehabilitation measures:* In particular, no groups of medications used for treatment are specified, no measures are included to provide vehicles and orthopedic products, no need for surgical treatment methods, including restorative, is specified. It is clear that today's plans for rehabilitation are only wishes under lack of funding; however, rehabilitation measures are an integral part of the comprehensive rehabilitation of a disabled person.

*Lack of supervision and treatment in the inter-commission period*

*Poor informativeness of the extracts from out-patient hospital records,* which complicates MSEC work. Such extracts are often not sealed with a hospital seal and doctor's personal seal. Lack of

dynamics of the disease course is the most significant deficiency. In fact, diagnosis deficiencies are associated with deficiencies in the maintenance of the outpatient hospital record and the extract from outpatient hospital record.

*Unsubstantiated referral of patients to MSEC:* Although the Medical Advisory Committee (MAC) has no right to refuse a citizen for referral to the MSEC, however, it may be seen as unwillingness to conflict with the patient and a desire to transfer responsibility to MSEC for refusing to recognize a patient as a disabled person.

*Untimely referral of disabled persons for reassessment* is also a significant deficiency in the overall functioning of Medical Advisory Committee (MAC), poor quality of annual health checks and, in particular, the implementation of an individual rehabilitation program.

*Unsubstantiated exceeding of the Disability Leave terms without the examination by MSEC* (without reasonable excuse) is an action that causes financial damage to the Temporary Disability Insurance Fund and must be reimbursed at the expense of the doctor who treats and the MAC head in administrative or judicial proceedings.

The problems existing in conducting medical and social assessment are often related to a poor formalization of the "Referral to MSEC", Form 088/o, lack of data in the referral, which are necessary to take an expert decision. The referral data completeness, objectivity, and reliability are one of the most important conditions for a timely and substantiated decision taken by MSEC. If medical documents are poorly formalized, difficulties and even mistakes are inevitable when estimating obvious limitations of vital functions and taking an expert decision. The deficiencies in formalizing medical documentation to refer patients to MSEC complicate substantially work of expert doctors, often lead to the need to refer patients and invalid persons to additional examination, delay the terms of assessment, and lead to conflict situations.

Following the quality analysis of the formalization of referrals to MSEC, it was found that the most often deficiencies are as follows:

- Too short and poorly informative medical history;
- Poorly informative description of the objective status;
- Noncompliance of medical examination standards;
- Mistakes in formulating the main and concomitant the diagnoses;
- Mistakes in determining the forecast: clinical and labor;
- Mistakes in formulating the purpose of referral to MSEC;
- Poor quality or lack of recommendations for medical rehabilitation;
- Conclusion made by experts of therapeutic and preventive institutions on the issues that are out of their competence (for example, recommendations for the establishment of a specific disability group).

Mistakes and deficiencies in formalizing Form 088/o are largely due to lack of clear regulation of providing expert services by doctors of a therapeutic and preventive institution. No norms of doctor's workload exists for the experts to participate in medical advisory committee work when discussing expert cases; visiting patients to formalize a referral to MSEC often may take more time than visits for diagnostic or therapeutic purposes, however, this time is not taken into account separately and it is

not paid, etc. When filling in a referral to MSEC, patients have to pay medical expert examinations, as well as additional assessments (laboratory tests, X-ray, endoscopy, ultrasound examination, functional evaluations, etc.). It may partly explain the low level or even lack of physicians' motivation to solve properly medical and social problems of their patients, in particular, when they are referred to MSEC.

Thus, the research findings indicate the need to improve the expert work of therapeutic and preventive institutions to refer patients to MSEC. We consider it expedient to continue cooperation between therapeutic and preventive institutions and MSEC to reduce the deficiencies of medical documentation sent to MSEC by applying the measures as follows:

- For chiefs of therapeutic and preventive institutions: Increasing control on quality of filling in documents sent to MSEC, and compliance with current laws, with the control carried out by;
- For heads of regional and interregional MSECs: Continuing analysis of mistakes of therapeutic and preventive institutions;
- Systematic analysis of deficiencies and mistakes of therapeutic and preventive institutions when referring patients and disabled persons to MSEC;
- For chiefs of therapeutic and preventive institutions: Holding systematically workshops on medical assessment issues;
- Informing timely the chief doctors of therapeutic and preventive institutions about deficiencies in work of Medical Advisory Committee.

### **Conclusions**

At present, it seems advisable to address the following issues when referring patients to MSEC:

1. Optimizing interaction between MSCE experts and doctors of Medical Advisory Committee (preliminary consultations, presentation of patients to MSEC by chairmen of Medical Advisory Committee as prescribed by the law);
2. Analysing systematically reasons of unsubstantiated referral to MSEC; discussing the research findings with experts of medical organizations, as well as with the healthcare authorities of the region at joint conferences, workshops, etc;
3. Improving knowledge of doctors and experts of therapeutic and preventive institutions on medical and social assessment and rehabilitation;
4. Providing unified approaches to assessment of the severity of functional disorders and limitation of vital functions by MSEC experts and doctors of therapeutic and preventive institutions.

## **TREATMENT TACTICS FOR OPEN INTRA-ARTICULAR FRACTURES OF SHOULDER DISTAL EPIMETAPHYS**

**Mirenkov K.V., Lezhnyuk A.S.**

*Zaporozhye State Medical University, Zaporozhye, Ukraine*

### **Introduction**

Treatment of intra-articular fractures of the distal shoulder requires a complex surgical intervention, which often ends unsatisfactory, i.e. in persistent impairment of the elbow function (contracture, ankylosis), which may lead to disability. In case of an open fracture, treatment is even more

complicated, and its results are even worse.

**Objective:** Substantiating the optimal treatment tactics for open complex intra-articular fractures of the distal shoulder by analyzing long-term results

### **Materials and methods**

The results of treatment of 28 patients with open transprocess humeral fractures were analyzed. In accordance with the classification of AO / ASIF, 13A type fractures were observed in 2 patients; 13B type fractures were observed in 7 patients; and 13C type fractures were observed in 19 patients. Urgent surgical intervention included primary surgical wound treatment and preventive osteosynthesis with a modular rod device. Primary surgical wound treatment included wound revision, hemostasis, abundant wound cleaning, removal of nonviable tissues and foreign bodies. In 5 cases (IO3 type), the primary surgical treatment was completed by the setting a rinsing system for 2 days. Antibacterial therapy was administered: cephalosporins of 2<sup>d</sup> or 3<sup>d</sup> generations intravenously and ornidazole. Primary osteosynthesis was performed with screws for 2 patients (A1-2 and B1-2 types). The treatment method was changed in 26 patients (B and C types) after primary wound healing (in 12 days on average): it was an open reposition and stable extracortical osteosynthesis with LCP plates. In 21C type fractures, transolecranon access was used. External immobilization was not used in the postoperative period; the elbow joint function was restored actively along with physiotherapeutic treatment.

### **Research findings and discussion**

Urgent installation of an external fixation device stabilized the fracture and provided calm to the area injured, contributing to successful wound healing. Primary wound healing were observed in 19 patients, 3 patients had superficial inflammation, and 4 patients had marginal necrosis. A purulent complication arose in one case. Wound revision and negative pressure wound therapy were used. Fracture healing and restoration of the function of the damaged limb were achieved in all thr cases. The ulnar nerve neuropathy appeared in 5 patients with 13C type fractures after external osteosynthesis with plates. One patient underwent revision and neurolysis, and the rest of patients had conservative treatment that led to recovery. Long-term results (according to Meio Clinic scale) were considered positive in 86% of cases.

### **Conclusions**

Using preventive external osteosynthesis in combination with primary surgical wound treatment and subsequent change of the method with a stable osteosynthesis with LCP plates followed by early recovery of motions in the elbow joint in patients with open intra-articular fractures of the distal shoulder made it possible to prevent the development of infectious complications, improve the quality of life in patients, improve functional results after the treatment and shorten the term of unfitness for work.

## **OPTIMIZING REHABILITATION TREATMENT OF PATIENTS WITH DISORDERS OF HIP AND KNEE JOINTS IN POST-OPERATIVE PERIOD**

**Nasr Al Kali**

*Lvov State Unioversity of Physical Culture, Lvov, Ukraine*

### **Introduction**



Physical rehabilitation of patients with disorders of the lower extremity joints, in particular, hip and knee joints, is a topical issue in this country, since musculoskeletal system injuries and diseases are among the most common disorders. The consequences of injuries and orthopedic diseases have ranked third after cardiovascular and oncological diseases in the structure of primary disability for several decades.

It is pertinent to note that the rehabilitation of patients with disorders of hip and knee joints is permanently improved. In particular, technologies of physical impact on the para-articular muscles and para-articular tissues are widely used: isometric gymnastics; traditional massage and myofascial massage; exercise therapy, and special types of gymnastics (e.g., stretching, a special type of aerobics aimed primarily at the stretching of body muscles, the development of flexibility and elasticity); physiotherapy treatments (e.g., microwave therapy, DANCE therapy, etc.); influence of natural factors on joint tissues (balneological and mud therapy); mechanotherapy with apparatus used for active and passive movement workout in the hip joint; and combination of various techniques and technologies. However, general approaches to rehabilitation treatment remain unchanged and consist of the following principles: integrity, stage-by-stage and individual approach, timely use of physical factors, correct choice of physical factors, continuity in treatment, and choice of dosage adequate to patient's age and performance status.

**Research objective:** Presenting the optimized method of physical rehabilitation for patients with hip and knee joint disorders in postoperative period, using the method of continuous passive motion in the joints with domestic apparatus, and evaluating its efficiency

### **Materials and methods**

A comparative analysis was carried out for the results of rehabilitation of 2 groups of patients identical in sex, age, disorder type, and type of surgical interventions. The two groups consisted of 102 men and 77 women aged 18 to 60 years with a hip and knee joint disorders. The patients were treated in inpatient setting for a period from 2009 to 2017. The first group was a control group including 82 patients, and the second group was the main group including 97 patients. The criteria for selection for the study groups were as follows: patients with disorders of hip and knee joints, with the following surgical interventions performed on the patirns: hip joint replacement and knee joint arthroscopy, which required the use of physical rehabilitation methods in the immediate postoperative period. In the postoperative period, patients of the 1st group received standard rehabilitation treatment, while patients of the 2nd group, in addition to the standard rehabilitation measures, performed passive movement workout in the operated joints, using domestic devices for the automatic movement workout, which were developed together with Svarcon JSC. The patients were assessed according to generally accepted methods prior to surgical treatment, in 9 or 10 days after the start of rehabilitation and in 3 months after the surgery (assessing pain intensity with the visual analog scale, measuring range of motion, Doppler ultrasonography and vascular rheovasography, electromyography of the muscles of affected limbs), with a special questionnaire made to note the individual anatomical and functional features of the hip joint. Based on the data obtained, an individual rehabilitation plan was developed, as well as an assessment of the performance status of each patient.

The data obtained were categorized by clinical and special methods, and assessed with certain scores.

## **Research findings**

The main group patients underwent mechanical therapy with continuous passive motions simultaneously with electrostimulation of the quadriceps femoris muscle. Also the program of physical rehabilitation of patients with hip joint and knee joint disorders was applied; the program consisted of several stages and included methodological guidelines, as well as principles and particularities of a rehabilitation assessment, criteria for evaluating the efficiency of rehabilitation stages. The program was based on the integrated use of a wide range of rehabilitation facilities with differentiated individual approach according to a particular disorder of the hip and knee joints, and the particularities of postoperative period in each patient.

Movement workout using domestic devices for the automatic movement workout was carried out according to the following procedure: on the 2<sup>nd</sup> day after the surgery (and on the 1<sup>st</sup> day of rehabilitation treatment), an examination was done and a decision was taken whether movement workout may be started: 3 times for 5-10 minutes at the minimum movement workout speed and flexion-extension angles in the joint within the range of 5 to 15°;

on the 2<sup>nd</sup> rehabilitation day: 3 or 4 times for 15-20 minutes at the minimum movement workout speed and the range of movements in the hip joint of 10 to 25°;

on the 3<sup>d</sup> rehabilitation day: 3 or 4 times for 40-50 minutes at the minimum movement workout speed and the range of motions in the hip joint of 25 to 45°;

in the following days: movement workout was increased up to 6 or 7 times a day, and movement workout speed and duration was increased up to 2 hours within one session; the range of motions was increased up to 70 or 90° (according to particularities of the joint disease and the intensity of the pain syndrome).

The retrospective assessment of clinical data (range of motion in the joints, pain intensiveness) and results of instrumental examination methods (electromyography, Doppler ultrasound examination and rheovasography) showed a positive effect of the method of continuous passive motion in joints to restoration of the range of motion in both the hip and knee joints in the main group in comparison to the control group.

## **Conclusions:**

1. Evaluation of clinical data and results of instrumental examinations in the two groups showed that the method of continuous passive motion (when using domestic machines for automatic movement workout in the integrated physical rehabilitation of patients with hip and knee joint disorders) reduced the rehabilitation time and increased the range of motions by an average of 7% in the immediate postoperative period (up to 3 weeks after the surgery) in comparison to the control group, with the pain syndrome reduced significantly (the pain was reduced by 14% in the main group according to assessment with the visual analog scale).

2. Expediency and high efficiency of using domestically developed machines for automatic movement workout in the integrated rehabilitation of patients with hip and knee joint disorders were proven. The machines mentioned improve greatly the quality of life of patients in the first 3 weeks of the postoperative period, which allows them to be recommended for widespread introduction in clinical use at the various stages of physical rehabilitation in rehabilitation centers and orthopedic and trauma departments.

## IMMUNOLOGICAL PARAMETERS IN PATIENTS WITH PIGMENTED VILLONODULAR SYNOVITIS OF THE KNEE JOINT

Panchenko K.M., Kostogryz Y.O., Sokolovskaya O.R., Salmanova K.M.

State Institution "Institute of Traumatology and Orthopedics under National Academy of Medical Sciences of Ukraine (NAMN)", Kiev, Ukraine

### Introduction

Pigmented villonodular synovitis (PVNS) is an exudative proliferative pseudotumor dysplastic lesion of synovial membranes of joints, mucous bags and tendon sheaths. PVNS diagnosis is difficult due to the similarity of clinical, radiological, and laboratory manifestations with those of such diseases as hemangioma and synovial angiomatosis, synovial sarcoma, osteoarthritis, chronic synovitis, etc. A slow development of pigmented villonodular synovitis, contradictions of ideas about the nature of its etiology, the high tendency to relapse after surgical treatment makes us study various aspects of reactivity in such patients. Delayed hypersensitivity reaction was shown to participate in the pathogenesis of chronic pathological processes in the connective tissue (V.V. Serov, 1973; E. Thonar, 1972) and in particular, in the synovial membrane (T.N. Kopyeva, 1980). Slow progress of the pigmented villonodular synovitis, predominance of lymphocytes and histiocytes (macrophages) in the synovial fluid in patients, as well as publications data gave a reason to talk about the involvement of delayed hypersensitivity reaction in the pathogenesis of the disease. Taking it into account, the delayed hypersensitivity reaction was researched *in vivo* and *in vitro* in pigmented villonodular synovitis. Also T- and B-lymphocytes count was studied in blood and joint punctate (Rodionova S.S., 1981).

Based on the studies above mentioned, Rodionova S.S. et al. believed that it was difficult to make certain conclusions regarding the evaluation of the research results since no regular changes were found. However, the data obtained by the authors evidenced that synovial fluid, as well as the synovial membrane in patients with pigmented villonodular synovitis of the knee joint, contained quite a high percentage of T-lymphocytes, which participated in the delayed hypersensitivity reaction.

Thus, the data obtained by Rodionova *et al.* suggest that delayed hypersensitivity reaction develops in some patients with a pigmented villonodular synovitis of the knee joint (Rodionova S.S., 1981).

Such processes indicate the need for further study of immunological processes since they may affect the development of pathological changes in the joint, which are triggered by this disease.

**Research objective:** Studying and analyzing the immunological parameters in patients with pigmented villonodular synovitis of the knee joint

### Materials and methods

We examined and operated 48 patients who were treated in a period of 2011 to 2018 at the Department of Joint Diseases in Adults of State Institution "Institute of Traumatology and Orthopedics under National Academy of Medical Sciences of Ukraine (NAMN)", Kiev, Ukraine, with the diagnosis of pigmented villonodular synovitis of the knee joint verified by a pathohistological examination. This nosology is found in two forms: diffuse and local. We followed up 28 patients with a diffuse form and 20 patients with a local. Most of the patients were young people, mostly females, with an average age of  $\pm 30$  years, with disease duration of 3 to 10 years. All the patients were treated conservatively at their place of residence at the preoperative stage; some of them were operated both in our department

and in other health care facilities. Patients in the two groups were examined clinically, laboratory, and instrumentally prior to the surgery, one week after the surgery, and 1, 6, and 12 months after the surgery. Immunological examinations were performed in 15 patients with pigmented villonodular synovitis of the knee joint (Group 1) and 11 patients with injury of meniscus and anterior cruciate ligament (Group 2). The humoral immunity indices were studied: concentrations of immunoglobulins (Ig) of classes A, M, and G by Mancini (Mancini G. et al., 1965), and levels of circulating immune complexes (CIC) by precipitation with polyethylene glycol (Haskova et al., 1978) in serum and synovial fluid.

### **Research findings**

The research showed that The research showed that in blood serum of patients in both groups probably did not differ from each other. No statistically significant difference was found in the number of immunoglobulins in the major classes A, G, and M in the serum of patients in both groups. The average parameters of the indices of humoral immunity (the CIC level and the concentration of major Ig classes: A, M, and G) in the synovial fluid of patients in both groups had minor differences. It should be noted that in 3 patients in Group 1, the CIC level was 1.7-2.2 times higher than the average statistic level. When analysing medical histories, it became clear that the patients had a rather aggressive course of pigmented villonodular synovitis of the knee joint with recurrences. These data were used by us to assess the likelihood of recurrence in those patients after surgery in comparison to other patients in Group 1.

### **Conclusions**

The comparison of the indices of humoral immunity indicate that the majority of patients with pigmented villonodular synovitis of the knee joint had no statistically significant difference in the CIC levels in serum and synovial fluid in comparison to patients with the consequences of the trauma (injury of meniscus and anterior cruciate ligament, etc.).

No significant differences in the number of Ig of A, M, and G classe in the two biological fluids were detected. The study of immunological indices in blood and synovial fluid should be continued with the involvement of other informative indicators, such as vascular endothelial growth factor (VEGF) and proto- and anti-inflammatory cytokine profile, which will further make it possible to characterize the peculiarities of the immune status of patients with pigmented villonodular synovitis of the knee joint to improve preoperative planning and post-operative treatment of patients; and will provide the possibility to forecast the probability of occurrence or non-occurrence of a relapse in the future.

## **RESULTS OF TREATING CHILDREN WITH SPASTIC PARALYSIS AND HIP JOINT DISORDERS WITH ORTHOSES**

Petrov V.G., Shevchenko S.D., Logvin G.B., Bayev P.O., Pivovarov V.V.

*Ukrainian Scientific Research Institute for Prosthetic Assistance, Prosthetic Device Development and Vocational Rehabilitation, Kharkov, Ukraine*

### **Introduction**

The hip joint instability in children with cerebral palsy is between 2.6 and 68% due to an different approaches to the assessment of the hip joint condition, as well as different views on the nature and causes of hip joint alterations. Dislocation / incomplete dislocation of the femoral head is the extreme degree of instability of the hip joint in patients with cerebral palsy; the hip joint instability is formed on the background of muscular imbalance; and it leads to significant disorders of motor function and reduction of the rehabilitation potential of the child. An important role in this process belongs to the impossibility for a sick child to acquire skills or very slow acquisition of skills to take independently a vertical position and to walk.

Hip joint incomplete dislocations are diagnosed more often than hip joint dislocations in children with cerebral at early examinations. To intensify growth, movement workout, and relaxation of the contracted muscles that provide motion in the joint, both conservative and operative methods of treatment are applied, including abduction orthosis for the hip joint to hold the hip in a preset position. It ensures the preservation of the principles of treatment for hip joint dysplasia.

The main effects of the abduction orthosis are: counteracting hypertonia of adductor femoral muscles and reducing it; providing the stability of hip joint components in an adjusted position; normalizing the distribution of pressure between the femoral head and the acetabulum; and reducing the probability of hip dislocation.

**Research objective:** Expanding the possibilities to take preventive measures and increase the efficacy of treatment for children with dislocation / incomplete dislocation of the femoral head, by using technical means of rehabilitation, namely, a relevant orthosis for the hip joint.

### **Materials and Methods**

The Institute clinic had 48 children with various forms of cerebral palsy treated with hip orthoses. The orthosis was recommended for use for 6-8 hours a day. Clinical and X-ray studies were conducted.

### **Research findings**

To evaluate the functional state of the joint, the range of motions was studied and the following X-ray parameters were analyzed: the Reimers migration index (MI) and the acetabular index (AI). The MI value was assessed in accordance with the accepted gradation: the norm is up to 15%; the risk group is 15-33%; incomplete hip dislocation is 33-80%; hip dislocation is more than 80%.

The clinical studies shown that hip dislocations or incomplete hip dislocations were observed in 30% of children with cerebral palsy.

Clinical, X-ray data, determined indicators of the major motor functions in children with spastic paresis showed a decrease in the spasticity of the adduction hip muscles on 1 point before using the hip joint articulated orthosis and in the process of using orthosis in the period of 1.5 months to 2.5 years; reduction of the adduction hip joint contracture at an angle of 5 to 15 ° in 70% of patients. No significant changes were found in the hip joint structure and the proximal femoral bone on the control hip joint X-ray images; and the deformation developments was suspended in 38 children with incomplete hip joint dislocation. The general positive dynamics in the form of inhibition and suspension of an increase in the migration index of the femoral head was observed. Deformation

progression was observed in 9 children, which required surgical intervention in the bone components of the hip joint.

### **Conclusions**

The use of the orthoses for hip joints in children with adduction hip joint contracture and incomplete hip dislocations allowed us to confirm their efficacy in treatment of children with spastic paralysis.

## **PARTICULARITIES OF TREATMENT OF PATHOLOGICAL RESIDUAL LOWER LIMBS IN CHILDREN AND THEIR REPLACEMENT**

**Petrov V.G., Shevchenko S.D., Nagornaya V.V., Vatulinskiy L.E.**

*Ukrainian Scientific Research Institute for Prosthetic Assistance, Prosthetic Device Development and Vocational Rehabilitation, Kharkov, Ukraine*

### **Introduction**

Rehabilitation of children with residual lower limbs is an important medical and social task. The effectiveness of their rehabilitation determines the anatomical and functional qualities of the legs and the correct manufacture of prostheses. The peculiarity of the formation of residual limbs in children is the continuing growth in pathological conditions, the deficiency of soft tissues in relation to bone fragments, the elasticity of the tendons and ligaments, the presence of defects and diseases associated with the use of prosthesis and the child growth.

**Research objective:** Increasing the effectiveness of the rehabilitation process in the treatment of children with a residual lower limb.

### **Materials and methods**

In this work, we used the classification of abnormalities and diseases of residual limbs, which was proposed by V.G.Sanin, M.G.Nikonenko, E.O.Mazurkevich. The amputation was the cause of the absence of a limb in 58 children, while a congenital anomaly was the cause in 29 children among 87 children with residual femurs, legs and feet. Residual limb anomalies and diseases were found in 52 (89.7%) children with limb amputations and in 15 (51.7%) children with congenital defects, which was 77.0% (67 children) of all epy patients examined.

The number of abnormalities and diseases in the residual limbs after amputation per child was 3.3, and in children with a congenital residual limb was 2.6. The most often abnormaloities associated with trauma or surgical intervention are scarred tissues adhered often to the bone, protrusion of the bone cuts in the scare, osteophytes and phantom-pain sensations.

A phantom pain syndrome was low in severity and disappeared or decreased significantly after treatment or with the beginning of walking with prosthesis.

Characteristic diseases and abnormalities in children are conic residual limb, axial deformations, abrasions on the skin, chronic venous congestion of the distal portions of the residual limb. Those abnormalities are related to the prosthetic socket effects on the residual limb, including the area of growth zones and the continuing growth of the residual limb.

Conservative treatment included rehabilitation exercises, massage, various methods of physiotherapeutic treatment, pharmaceutical treatment, and it was used as an independent method, as well as preparation for surgical treatment and after surgery.

Surgical correction of pathological changes in residual limbs was required in 49.4% of children: with post-amputation residual limbs in 56.9% of children, and with residual limbs because of congenital hypoplasia in 27.6% of children among them. The characteristics of surgical interventions were quite diverse, and it predicted the effect on both soft tissues and skeleton of the residual limb. The following methods were applied: reamputation, skin plastic, intervention on soft tissues to cut scars, neuromas, amniotic folds, removal of soft tissue rudiments, effect on the growth area to correct the residual limb deformation, osteomy with distractive osteosynthesis, arthrodesis of the knee joint and feet joints.

### **Research findings**

Good functional treatment were obtained in 91.4% of children with post-amputation residual limbs and in 91.3% of children with congenital residual limbs. Bone replacement should be carried out in children with residual lower limbs at the age of 10 to 12 months with congenital abnormalities and after healing postoperative wound and carrying out preparatory measures at defects of lower limbs resulting from an injury.

The tibia protheses are administered for children with a prosthetic socket covering the femur processes; it is expedient to use a cuff on the hip for children under 3 years of age. Using knee hinges in hip prostheses in most cases is recommended from the age of 3 years. It is possible to make prostheses in children with modular prosthetic systems after the age of 6-8 years. The children should be followed up for a period of 3 to 6 months to assess the status of the residual limb and to adjust the prosthesis height.

### **Conclusions**

Following up children by a rehabilitation team, which consists of an orthopedist, a technician prosthetist, a physiotherapist, and a rehabilitologist, can detect, prevent the development and carry out the necessary treatment of pathological conditions of the residual lower limbs, which are associated with the peculiarities of the residual limb growth and the effect of the prosthetic socket, which allows improving rehabilitation of the patient's of this category.

## **REHABILITATION OF PATIENTS AFTER SURGERY IN MULTIFRAGMENTARY PROXIMAL HUMERUS FRACTURES**

**\* Piven Y.M. , \*\* Litvin Y.P.**

\* State Higher Educational Establishment (VDNZ) of Ukraine "Ukrainian Medical Stomatological Academy", Poltava, Ukraine

\*\* State Institution "Dnepropetrovsk Medical Academy", Dniepr, Ukraine

### **Introduction**

Currently, a large number of the results of numerous studies on surgical treatment of proximal humerus fractures are available. However, the rehabilitation of patients with this type of fracture is little highlighted, which is evidenced by some sporadic publications. All the patients are tried to be managed with the same pattern of therapeutic physical activity (rehabilitation exercises) in the postoperative period, which is unacceptable and it does not provide a complete recovery of the damaged segment, and in some cases it leads to unsatisfactory rehabilitation results despite the brilliant surgical intervention.

**Reserach objective:** Improving the treatment results in patients with multiple proximal humerus fractures by developing a comprehensive treatment system based on the restoration of the anatomical integrity of the humerus and the humerus tendons and capsule with a complete individual rehabilitation in the postoperative period, and by understanding the fracture organization and anatomical aspects of the segment. Thus, preving the development of avascular necrosis of the humerus head, restoring the range of motions in the shoulder joint, reducing the development of posttraumatic arthrosis of the shoulder joint, reducing the terms of disability of patients, reducing the percentage of their disability.

### **Materials and methods**

The study group included 97 patients with a proximal humerus fracture. 51 patients had a three-fragmental fracture, 13 patients had a three-fragment fracture with dislocation of articular surface of the humeral head, 23 patients with a four-fragment fracture, and 10 patients had a four-fragment fracture with dislocation of the articular surface of the humeral head. This type of fracture was accompanied by rotation of more than 45 ° and diastasis between the debris more than 1 cm in all the patients. The patients aged 16 to 83 years (the average age was 49.5 years). There were 40 men and 57 women. All the patients were operated by an original 2-stage osteosynthesis method (patent on utility model number 88435 registered in State Register of Patents of Ukraine on utility models on 11/03/2014): the 1st stage: restoring congruence of articular surfaces; achieving dynamic stability by means of transosteal fixation of debris and restoring the tendon and capsule apparatus of the shoulder joint, its reinsertion, suturing defects by using anchor fixators (elastic fixation); the 2nd stage: periosteal strained osteosynthesis with a plate with screws blocked in it (hard fixation). In the postoperative period, all the patients underwent an individual 4-phase complex of rehabilitation exercises developed for the operated segment.

The control group included 97 patients with a similar type of fracture; they underwent only periosteal strained osteosynthesis in surgical treatment and a standard complex of postoperative rehabilitation.

### **Research findings and discussion**

To determine the function of the upper limb, the Constant-Murley scale was used. The follow-up period lasted for a period of 1 month to 1 year after surgical intervention. Comparison of two rehabilitation methods in a long-term postoperative period showed the superiority of the individual approach over the standard approach, since only an individual therapeutic physical activity makes it possible to restore adequately, without overloading, gradually the function of the upper limb. Excellent and good results were obtained in patients with three-fragment fractures and fractures of the proximal humerus. Satisfactory results were obtained in patients with four-fragment fractures. Unsatisfactory



results were obtained in patients with four-segment dislocated fracture. The negative results are considered to be as follows: 8 patients with avascular necrosis of the humeral head; 2 patients with hematoma suppuration and synovial fistulas in the postoperative period; 1 patient with migration of the metallic structure during epileptic seizures.

### **Conclusions**

Patients with multiple proximal humerus fractures in postoperative period need an individualized therapeutic physical activity according to the type of fracture.

Using the standard approach does not provide a possibility to fully restore the damaged segment, and in some cases it is harmful, resulting in complications and disability of the patient.

Positive treatment results in a long-term postoperative period witness the possibility of using the developed individual rehabilitation method for patients with multiple proximal humerus fractures.

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### **SURGICAL TREATMENT OF DIAPHYSIAL FRACTURES OF FOREARM BONES**

**\* Polivoda O.M., \*\* Chabanenko D.S.**

*\* Odessa National Medical University*

*\*\* Communla Institution “ Odessa Regional University Hospital”, Odessa, Ukraine*

### **Introduction**

According to the academic literature on the subject, the fractures of the forearm bones make up 3.9% of the total number of injuries and 12-20.7% among the diaphysial lesions of long bones, mostly in young people (Gromak GB, 1986; Gaiko G. V., 2006). The forearm bones differ from other humane long bones as they are primarily intended for motion and not for loads. That is why, a large range of motion in the distal portion of humane upper limb is directly related to a unique anatomy of the forearm bones, elbow and radius joints. There are two surgical accesses to the radius bone: Thompson's posterolateral access and Henry's palmar access. Until now, there is no consensus that access is better for treating radius fractures in its upper and middle thirds. (Bartoniček J, Naňka O, Tuček M. 2015). Both accesses may cause damage to n. profundus radialis, which in turn causes a permanent loss of the hand function and disability of the patient (Bellemère P., Alnot J.Y., Oberlin C. 2008).

**Objective:** Determining the effectiveness of modern surgical methods of treatment of diaphysial fractures of the forearm bones and to evaluate the prospects for their use based on scientific literature; analyzing the results of surgical treatment of patients with diaphysial fractures of the forearm bones, using anterior and posterior access to the radius bone; comparing the results of surgical treatment in clinical groups, studying the causes of adverse effects, identifying errors and complications, and identifying ways to eliminate them.

### **Materials and methods**

The research material was represented by the analysis of treatment of 56 patients with closed diaphysial fractures of the radius bone or both forearm bones, which were treated for a period of 2006 to 2018 at orthopedic and traumatological department of Odessa Regional University Hospital. Indications for surgical treatment were unsuccessful closed reposition, unstable fractures and

secondary displacement of debris. The research patients included 35 (62.5%) men and 21 (37.5%) women. The patients aged from 23 to 60 years. The patients were divided into 2 groups: the first group had 16 patients operated by using Henry's anterior access to the radius bone; the second group consisted of 40 patients operated by using Thompson subcutaneous access. Operative treatment of fractures of the elbow, if any, was performed by using standard access to the elbow bone along the line that connects the elbow and styloid process.

### **Research findings**

According to publication data, our own anatomical studies and clinical experience, high risk of iatrogenic damage of n. profundus and n. radialis was observed in case of posterolateral access to the radius bone in its middle and upper thirds. This surgical access is safe in the treatment of the radius bone fractures at the borderline between the middle and lower thirds, if the surgical technique is strictly observed. Henry's anterior access may be used for surgical treatment of fractures of the whole radius bone length, with the technical difficulties being at the borderliner between the middle and lower thirds.

The treatment result after surgery was determined according to the presence of complications in the postoperative period, such as neuritis or neuropathy of branches of the radial nerve, non-union of fractures, formation of radioulnar synostosis, and appearance of purulent and septic complications.

A good result was observed in 5 (31%) patients in the group of patients who had undergone osteosynthesis of the radius diaphyses fracture from the anterior access; a good result was observed in 10 (62.5%) cases of this group, while a satisfactory result was observed in 1 case. The only type of complications observed in this group was slow fracture fusion. A good result was observed in 3 cases in the group of patients who had undergone osteosynthesis of the radius diaphyses fracture from the posterior access; a good result was recorded in 17 cases from this group, a satisfactory result was observed in 15 cases, and unsatisfactory result was observed in 5 cases. When following up the patients of this group, a number of complications were observed: non-union or slow fusion of the radius bone fracture was observed in 9 cases; neuritis or neuropathy of branches of the radial nerve as a result of repositioning was observed in 4 cases; radiolumbar synostosis was observed in 1 case; and deep surgical wound infection was observed in 1 case.

### **Conclusions**

Taking into account the experience gained, we consider it advisable to use Henry's anterior access for treatment of radius fractures localized along its whole length. Despite the complexity, this access proved itself as a non-traumatic, providing the largest visualization of the radius bone and anatomical "radialbow" restoration. Posterior lateral access may be used for the fracture localized on the borderline between the radius middle and lower thirds. In order to prevent the formation of recurrent fractures, we recommend removing metal structures in a period of at least 15 months followed by wearing a soft orthosis for 3 weeks, and limiting loads up to 3 months after removal of the plate.

## **PARTICULARITIES OF KNEE JOINT REPLACEMENT IN PATIENTS WITH RHEUMATOID ARTHRITIS**

**Polulyakh M.V., Gerasimenko S.I., Chernyak V.P., Babko A.M.,  
Gerasimenko A.S., Polulyakh D.M.**

## **Relevance**

Rheumatoid arthritis is second to none among other diseases of the musculoskeletal system in terms of the severity of lesion of the joints. Knee joint lesion is noted in 65-70% of cases, and it is the most common cause of disability. Knee joint lesion in rheumatoid arthritis is accompanied by the formation of contractions and the development of discordant deformations of the lower extremities, which leads to partial or complete loss of the locomotor and support function of the limb. As a result, patients lose their ability to work and ability of self-service, and they become seriously disabled persons.

## **Materials and methods**

The work is based on the analysis of the results of knee joint replacement in 165 patients with rheumatoid arthritis since 2008 in Department of Joint Arthroplasty in Adults at State Institution "Institute of Traumatology and Orthopedics under the National Academy of Medical Sciences of Ukraine (NAMN)", Kiev, Ukraine. There were 132 women and 33 men. The patients aged from 20 to 78 years, and an average age ( $M \pm \sigma$ ) was  $48.33 \pm 12.94$  years.

## **Research findings and discussion**

The knee joint replacement in patients with rheumatoid arthritis has its own peculiarities that must be taken into account when carrying out surgical intervention. Preoperative planning is an important step when preparing for surgery, which should not be limited to determining the implant to the presence of changes in the musculoskeletal system in the area of the knee joint (postoperative scars along the anterior surface of the knee joint; osteopenia, or osteoporosis; contractures, stiffness or ankylosis in the knee joint; limb axis disturbance). The muscle strength should be determined, and the presence of changes in other joints of the limb as well.

These factors need to be taken into account in the pre-operative planning, with osteoporosis of the knee joint bones, controversy, ankylosis, valgus knee joint deformity being the most important among them.

Patients with rheumatoid arthritis quite often have already managed to undergo surgeries on the knee joint. Most often it is an open knee joint synovectomy. In such cases, it is better to use access to the postoperative scar or to step back from the scar at least 6 cm, since there is a risk of developing necrosis of soft tissues in the area of postoperative suture.

The long standing disease results in osteoporosis. The condition of the tissue of the bones forming the knee joint must be taken into account, especially when using PC system implants. Significant osteoporosis of the bones forming the knee joint is an indication for the use of extensions.

Knee joint flexion contraction is another important factor. If flexion contractures at an angle of 10 to 15° are present, surgical intervention may be performed without special preparation. If flexion contracture angle is more than 20°, the knee joint contracture may be eliminated on a phased basis by applying plaster casting; and if fixed contractures are present, they may be eliminated with Volkov-Oganesyan apparatus. In case of knee joint ankylosis, the strength of limb muscles should be determined. If necessary, we conduct pre-operative preparation, which includes massage, electrical stimulation and exercise therapy. The muscle strength should be at least M3 scores.

If valgus deformation is significant, we use access that passes more laterally than the patella. Such access allows a more complete release of the lateral zone of the knee joint.

An important place belongs to the release of soft tissues on the medial, lateral, and especially on the posterior knee joint surface. It is necessary to remove the capsule of the knee joint on the posterior surface, to separate it from the posterior processes of the femur and tibia.

The long standing disease leads to muscle hypotrophy, especially in patients with knee joint ankylosis and significant contractures. The strength of flexor and extensor muscles should be at least M3 scores.

### **Conclusion**

The knee joint replacement in patients with rheumatoid arthritis has its own peculiarities that should be taken in consideration when planning an operation. The most significant of them are knee joint osteoporosis, flexion contracture, ankylosis and valgus deformity. The results of knee joint replacement at significant knee joint contractures and ankylosis are much inferior to those in patients without such changes in the knee joint.

## **RESULTS OF INTERSCAPULAR THORACIC RESECTION IN TUMORS OF PECTORAL GIRDLE**

**\* Protsenko V.V., \*\* Chorniy V.S.**

*\* State Institution "Institute of Traumatology and Orthopedics under National Academy of Medical Sciences of Ukraine (NAMN)", Kiev, Ukraine*

*\*\* O.O. Bogomolets National Medical University under Ministry of Public Health, Kiev, Ukraine*

### **Introduction**

Due to the large number of morphological forms of flat bone tumors, including scapula, sternum, and ribs, the tactic of surgical treatment of tumors of the pectoral girdle may be different. One type of surgical intervention in malignant tumors of the pectoral girdle may be interscapular thoracic resection. Indications for interscapular thoracic resection (Tychoy-Limberg surgery) are malignant tumors of the bones or soft tissues of the pectoral girdle with dissemination to the scapula and shoulder joint, as well as scapula tumors with involvement of the clavicle and / or shoulder joint with compression or germination of the vessels and nerves, and severe pain. The block of tissues to be removed include the scapula, the acromial end of the clavicle, the shoulder joint with the humeral head, and also some areas of muscles of the pectoral girdle and / or their tendons.

**Research objective:** Showing the results of interscapular thoracic resection in tumors of the pectoral girdle as function of morphological structure and aggressiveness of the tumor.

### **Materials and methods**

Once a tumor in the bones of the pectoral girdle has been detected, an open biopsy or trepanobiopsy of the focal bone lesion was performed with morphological verification of the process in the clinical department of the State Institute "Institute of Traumatology and Orthopedics under the National Academy of Medical Sciences of Ukraine (NAMN)", Kiev, Ukraine. Interscapular thoracic resection was performed in 11 patients with pectoral girdle tumors, with 8 women and 3, men among them. Type I: intra-articular proximal humerus resection in 2 patients with chondrosarcoma and in 1 patient with malignant fibrosis histiocytoma. Type II: partial resection of the scapula was performed in 2 patients with a giant cell tumor, in 2 patients with metastatic tumors and in 1 patient with chondrosarcoma. Type III: intra-articular removal of the scapula with resection of 1/2 clavicle was performed in 2 patients with chondrosarcoma. Type IV: extra-articular resection of the scapula and the humeral head is performed in 1 patient with chondrosarcoma.

## **Fingings**

As a result of the interscapular thoracic resection, recurrence of tumors was detected in 1 (9.1%) patient with malignant fibrous hystiocytoma of the humerus and in 1 (9.1%) patient with chondrosarcoma of the humerus. Tumor metastases were detected in 4 (36.4%) patients, with metastases patients in the lungs in 2 (18.2%), metastases in the lung and other visceral organs in 1 (9.1%) patient, and with metastases in the visceral organs and skeletal bones in 1 (9.1%) patient. There were 7 (63.6%) survived patients: 3 patients with chondrosarcoma of the scapula, 2 patients with chondrosarcoma of the humerus, 2 patients with giant cell tumor of the scapula.

## **Conclusions**

1. Performing interscapular thoracic resection in malignant tumors of the pectoral girdle contributes to an increase in the survival of patients by reducing relapse and metastases of the tumor.
2. The decision to carry out interscapular thoracic resection is taken, with morphological neoplasm structure and aggressiveness of the process taken into consideration, which allows a steady positive treatment effect in most cases.

## **INTEGRATED TREATMENT FOR PLASMOCYTOMA**

**\*Protsenko V.V., \*\* Chorniy V.S.**

*\* State Institution "Institute of Traumatology and Orthopedics under National Academy of Medical Sciences of Ukraine (NAMN)", Kiev, Ukraine*

*\*\* O.O. Bogomolets National Medical University under Ministry of Public Health, Kiev, Ukraine*

## **Introduction**

Multiple myeloma (plasmacytoma) is a tumor that consists of plasmatic cells of the bone marrow, and it is related to leukemia or paraproteinemic disorders of a high degree of malignancy, which is characterized by multiple foci of osteolysis in the bones. Tumor cells produce pathological protein or paraprotein. Plasmacytoma usually occurs in adulthood, women are sick 1.5 times more often than men. The following bones are most often affected: vertebrae (39%), skull bones (13%), pelvic bones (13%), and femoral bone (12%). The incidence of multiple myeloma in Ukraine is 1.6 cases per 100,000 populations; a mortality rate is 1.1 cases per 100,000 populations. The disease is asymptomatic in the early period in 20% of cases, then aching pain appears. Osteoporosis is detected radiologically: it may be a mesh structure of the bone or a degeneration center of small size, which increases over time. As a rule, treatment for myeloma multiple is integrated (chemotherapy, hormone therapy, immunotherapy, radiotherapy and surgical treatment), as well as bone marrow transplantation after appropriate high dose chemotherapy.

**Research objective:** Showing the results of the comprehensive treatment of myeloma multiple

### **Materials and methods**

23 patients with myeloma multiple were included in the complex treatment in the Clinical Department of the State Institute "Institute of Traumatology and Orthopedics under the National Academy of Medical Sciences of Ukraine (NAMN)", Kyiv, Ukraine, with 17 patients suffering from multiple myeloma and 6 patients with solitary myeloma among them. The treatment of patients consisted of polychemotherapy with bendamustine, velcade, thalidomide, melphalan (alkeran), vincristine, adriablastin, cyclophosphamide, hormonotherapy (prednisolone, dexamethasone), bisphosphonates (pamifos, pamireedin, zoledronic acid), and also the course of radiation therapy to the total radiation

dose (TRD) of 40-60 Gy on the affected segment of the bone. Integrated treatment without surgical intervention was administered in 12 (52.2%) patients; integrated treatment with surgical treatment was administered in 11 (47.8%) patients. In surgical treatment, as a rule, the following treatment methods are applied on the background of the pathological fracture: extra-focal osteosynthesis with external fixation device in 5 (21.7%) patients; armored intramedullary osteosynthesis in 3 (13%) patients; replacement of joint and bone diaphysis in 2 (8.7%) patients; periosteal osteosynthesis in 1 (4, 3%) patient. In the postoperative period, the patients continued to receive courses of polychemotherapy, hormonal therapy, bisphosphonates, and a course of radiation therapy to the total radiation dose (TRD) of 40 Gy on the affected segment of the bone when using external fixation devices.

### **Research findings**

As a result of the integrated treatment administered, relapse of solitary plasmacytomas was detected in 3 (13%) patients. Postoperative complications were observed in 1 (4.3%) patient (aseptic loosening of the implant stem), new plasmacytoma foci were observed in 4 (17.2%) patients: in the lungs in 1 (4.3%) patient, in the liver 1 (4.3%) patient, in other bone of the skeleton in 2 (8.6%) patients. The limb function recovery after surgical treatment was in 10 (90.9%) patients. A three-year overall patient survival rate was  $86.6 \pm 1.4\%$ , a five-year overall survival rate was  $73.5 \pm 2.2\%$ .

### **Conclusions**

1. The survival rate in multiple myeloma depends on the disease stage and the sensitivity to chemotherapy.
2. Using the integrated treatment for plasmacytoma allows achieving good results in recovery of the limb function and survival rate of patients.

## **APPLICATION OF THE METHOD OF ELECTROPUNCTURE DIAGNOSTICS FOR ASSESSMENT OF EFFICIENCY OF POSTOPERATIVE THERAPEUTIC AND REHABILITATION MEASURES IN PATIENTS WITH LESIONS OF INTRA-ARTICULAR KNEE JOINT STRUCTURES**

Roy I.V, Strafun S.S., Gayko O.G., Perfilova L.B.

*State Institution "Institute of Traumatology and Orthopedics under National Academy of Medical Sciences of Ukraine (NAMN)", Kiev, Ukraine*

An important task in modern traumatology and orthopedics is an objective evaluation of the efficiency of treatment and rehabilitation measures after arthroscopic interventions in patients with lesions of the anterior cruciate ligament (ACL) and the knee joint meniscus.

**The study is relevant** as it introduces new quantitative methods of functional diagnostic to increase its efficiency in lesions of intra-articular structures of the knee joint, which are used to evaluate the efficiency of post-arthroscopic treatment and rehabilitation measures.

**Research objective:** Determining the functional status of the periarticular structures of the knee joint before and after treatment and rehabilitation measures followed by an objective quantitative assessment of the efficiency of treatment and rehabilitation measures by using the quantitative method of functional diagnostic.

**Research objective:** Determining quantitatively the degree of intensity of the inflammatory process by Stages I-III of R. Foll in the periarticular structures of the knee joint in dynamics, and on the basis of quantitative criteria developed on the basis of the quantitative method of functional diagnostic to evaluate the efficiency of treatment and rehabilitation measures

### **Materials and methods**

In accordance with quantitative method of functional diagnostic, 77 patients were examined in dynamics, in particular, 50 women and 27 men aged 17 to 71 years. The patients were distributed by the diagnoses: lesion of the anterior cruciate ligament of the knee joint, combined lesion of the knee joint meniscus and the anterior cruciate ligament. The biologically active point (BAP) of the periarticular structures of the knee joint was investigated at the affected site. More than 77 measurements were carried out in this BAP, taking into account their maximum values.

The period between the examinations ranged from 1 week to 2 years. It should be noted that the patients were initially examined within a period of 1 week to 3 months after arthroscopic interventions.

We used objectively quantified criteria developed by us previously to evaluate the efficiency (excellent, good, satisfactory and unsatisfactory) on the basis of the inflammation of Stages I-III and the norm by R. Foll s, with the research data compared in dynamics (before and after treatment and rehabilitation measures).

The criteria are interpreted as excellent, good, satisfactory and unsatisfactory results: The criteria are interpreted as excellent, good, satisfactory and unsatisfactory results: the transition of inflammation of Stages I-III by R. Foll to the norm is considered to be an excellent result; the transition of Stage II to I, and transition of Stage III to I and II is considered a good result; constancy of the stages: I-I, II-II, III-III is considered to be a satisfactory result. The progression of the inflammatory process, namely, the transition of Stage I to stage II or III, and Stage II to III; or if the initial inflammation stage was III (before treatment and rehabilitation measures) became higher (after the treatment), the result is considered unsatisfactory.

The research findings were calculated by using the non-parametric statistics method and Wilcoxon-Mann-Whitney criterion, as well as the p Statistical significance criterion. At  $p > 0.5$ , the research findings are considered suspect, and the more p is lower than 0.5, the higher is the reliability degree.

### **Research findings and discussion**

According to the data obtained, excellent results were in 26 (33. 7%) patients, good results were in 31 (40. 2%) patients and satisfactory results were in 20 (26%) patients. No unsatisfactory results were found in the patients. That is, positive dynamics (excellent and good results) are found in the overwhelming majority (74%) of patients. Based on the calculations by using the Wilcoxon-Mann-Whitney criteria and the reliability of p, a high degree of reliability of the results of the quantitative research of functional diagnostic (from  $p < 0.05$  to  $p < 0.01$ ) was proved.

### **Conclusions**

1. New quantitative data obtained by using the quantitative research of functional diagnostic method in case of lesion of meniscus and the anterior cruciate ligament of the knee joint in dynamics after arthroscopic treatment and rehabilitation measures made it possible to increase significantly the efficiency of the well-known diagnostic complex.

2. The inflammatory nature of the pathological process of varying intensity degree in Stages I-III by R. Foll in the BAP of the periarticular structures of the knee joint of all the patients (100%) with the specified pathology was determined.
3. Establishing different stages of inflammation in the periarticular structures of the knee joint was the basis for the appointment of anti-inflammatory therapy to improve the efficiency of post-arthroscopic treatment and rehabilitation measures and to prevent possible complications.
4. By means of the quantitative criteria developed on the basis of the quantitative research of functional diagnostic method, an objective assessment of the efficiency of the results of treatment and rehabilitation measures after arthroscopic interventions was carried out.
5. The presence of positive dynamics of treatment and rehabilitation measures in the overwhelming majority (74%) of patients with injuries of meniscus and anterior cruciate ligament (ACL) of the knee joint was determined. The statistically high degree of reliability (of  $p < 0.05$  to  $p < 0.01$ ) of the results of the quantitative research of functional diagnostic method was proved.

In view of the above, using the method of the quantitative research of functional diagnostic method provided an opportunity to evaluate objectively, quantitatively and reliably the efficiency of post-arthroscopic treatment and rehabilitation measures in the injuries of meniscus and anterior cruciate ligament (ACL) of the knee joint.

## **PARTICULARITIES OF TREATMENT OF HIP JOINT FORMATION DISORDERS IN CHILDREN OF THE FIRST YEAR OF LIFE**

**Roy I.V., Zinchenko V.V., Rusanova T.E.**

*State Institution "Institute of Traumatology and Orthopedics under National Academy of Medical Sciences of Ukraine (NAMN)", Kiev, Ukraine*

**Research objective:** Improving the efficiency of early diagnostics and conservative treatment of hip joint formation disorders through the establishment of monitoring and treatment algorithms on the basis of the study of the particularities of hip joint formation in children of the first year of life as function of the connective tissue (CT) condition.

### **Materials and methods**

The research included 1549 children (600 boys and 949 girls) aged from 5 days to 10 months, with the number of children in each age group being more than 20. Ultrasound hip joint examination was carried out according to R. Graf methodology; the risk factors of hip joint formation disorders were determined; and the connective tissue condition was estimated by the iris density by B. Jensen method.

### **Research findings**

We analyzed the sonographically defined the alpha angle of the hip joint. The alpha angle allows evaluating condition of the bone roof development. As a research result, a significant nonlinear correlation between the iris density (marker of connective tissue condition) and the alpha angle (degree of connective tissue maturity) with coefficient  $\eta = 0.96$  ( $p < 0.05$ ) was obtained. Based on the correlation established, an algorithm was proposed for monitoring and treating hip joint formation disorders in children of the first year of life.

### **Conclusions:**



As a research result, a significant nonlinear correlation was established between the connective tissue condition marker and the hip joint maturity degree. This correlation allows using the iris density (marker of connective tissue condition) to predict the hip joint maturity degree.

The algorithm proposed for the monitoring of formation of hip joints in children of the first year of life will allow the introduction of a general ultrasound screening of hip joints in Ukraine.

Using algorithm of treatment for hip joint formation disorders in children of the first year of life will minimize the percentage of development of dysplastic coxarthrosis in the future.

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**MANUAL THERAPY FOR REHABILITATION OF PATIENTS WITH VERTEBRAL CANAL STENOSIS IN LUMBAR SPINE**

Roy I.V., Pilipenko O.V., Yachnik S.P.

*State Institution "Institute of Traumatology and Orthopedics under National Academy of Medical Sciences of Ukraine (NAMN)", Kiev, Ukraine*

**Introduction**

Performed in patients with vertebral canal stenosis, the manual therapy requires special care and caution. Performing it under such dangerous conditions requires to follow mandatory certain particularities and precautions.

Research objective: Determining the particularities of the manual therapy performed in patients with the spinal canal stenosis and studying the effectiveness of its use in various clinical situations

**Materials and methods**

43 patients with stenosis of the lumbar spine canal were examined. The manual therapy was performed in 33 of them, with particularities, which were defined by us, taken into consideration; and contraindications were found for manual therapy in other 10 patients. The relative spine canal stenosis was considered as a relative contraindication to manual therapy. Absolute spinal canal stenosis and clinical manifestations of the compression of neuro-vascular structures were defined as absolute contraindications.

The main goal of manual therapy was restoration of the static and dynamic function of blocked mobile spinal segments that share borders with the stenosis site. The first particularity of the methodology of the proposed manual therapy was minimization (up to complete exclusion) of manipulations in segments with stenosis, especially those related to power application (sharp jerks, traction, clicks, shock manipulations, etc.) and manipulations that may narrow functionally the vertebral canal (extension, rotation). A second particularity was avoidance of a classical test of the "barrier of elasticity" of the spine segments at the stenosis level. A third particularity was an increase attention to the subjective sensations of the patient (discomfort, pain, sensation of paresthesia, etc.). The fourth particularity was that the manipulations had been carried out slowly and gently, without intentions of overcoming the reflex muscle-tonic reactions. The total number of sessions varied from 3 to 5, with the sessions repeated in a day or two.

**Research findings**

The following clinical manifestations were completely eliminated in 12 (36.36%) patients of 33 patients treated: pain, limitation of spinal range of motion, and the presence of muscular tonic revelatory disorders. The control thermographic (TG) and electromyographic (EMG) assessment revealed a significant positive dynamics in the 12 patients. The indicated positive changes in this group of patients made it possible to consider the overall treatment results to be good. This group included patients with lumbalgia and torako-lumbalgia.

A second group included 15 (45.45%) patients with lumbalgia with reflectory ishialgia. After the manual therapy course, the intensity of pain, feeling of stiffness, excessive reflectory muscular disorders, as well as static and dynamic disorders (antalgic posture, pelvic inclination, etc.) did not disappear completely, but significantly decreased ( $p < 0,05$ ). Control TG and EMG assessments also found improvement in those patients but less than in the first group. The treatment result in this group of patients was considered to be satisfactory.

A third group included 6 (18.19%) patients; using only manual therapy MT in those patients did not lead to reliable clinical, TG, and EMG positive changes. The treatment result in this group of patients is considered unsatisfactory. This group included patients with long-standing radiculopathies, epidural fibrosis, and persistent neurological and vascular disorders. Positive treatment result in them was obtained after additional administration of anaesthetic blocks, adhesiolysis procedure, medication therapy, physiotherapy and reflexotherapy.

### **Conclusions**

1. Manual therapy in the presence of spinal canal stenosis should involve minimally spinal segments with stenosis in the manipulation, as well as exclude completely extension and rotation, as well as force measures.
2. Using manual therapy like monotherapy is most effective in lumbalgias and reflectory lumboischialgias. It can be used as part of integrated therapy in other clinical situations.

## **CORRECTION OF CHANGES IN IN PATIENTS WITH NON-UNION TIBIA BONES AFTER BONE FRACTURES**

\* **Rushay A.K., \*\* Bebykh O.R., \*\* Buglak A.I.**

\* *O.O. Bogomolets National medical univers.*

\*\* *Municipal university hospital No.1, Kiev, Ukraine*

### **Relevance**

Failure of union in fracture is a mixed pathology requiring an individual approach in each clinical case, with a certain amount and type of intervention. Ambiguity of approaches and a high level of unsatisfactory results determine its medical and social relevance.

Objective: Improving treatment results for patients with non-union of the tibia after fractures.

Task: - Studing vascular and metabolic disorders in the tibia in bone non-union after fractures.

- Following the data obtained and literature data, offering the optimal amount of medical therapy.

- Studying the efficacy of the integrated treatment proposed in patients with non-union of the tibia after fractures.

## **Materials and methods**

24 injured persons with aseptic non-union of the tibia bones were followed up, with young men predominated - 18 (75%). In 12 (50%) cases, osteogenesis disorders were preceded by high-energy fractures. The posttraumatic period ranged from 6 to 9 months. According to Weber-Cech classification, non-unions were attributed to atrophic. Surgical intervention was the basis for integrated treatment of the patients. It involved treatment of the target lesion, fibulectomy, using a mixture of autospongiosa, hydroxyapatite, Platele-Rich Fibrin PRF fibrin matrix, and hemostatic sponge as a plastic material. Fixation was made with wire and rod apparatuses.

## **Research findings and discussion**

Using the proposed medication principles in 24 patients with tibial non-union suggests the following. Using previous multimodal perioperative anesthesia in the comprehensive treatment, correcting vascular disorders and metabolic alterations were justified. This is evidenced by data confirming the presence of local hypertensive ischemic syndrome; according to ultrasound examination data, non-union was accompanied by changes in the tissues of the segment, which had a character of chronic inflammation / functional venous insufficiency of subcompensated type. In conditions of deficient oxygen level, vascular disorders caused by metabolic alterations and disorders of energy processes (it is confirmed by the dynamics of thermal asymmetry).

According to the Non-Union Scoring System (NUSS) score, the likelihood of restoration of a limb as an organ was questionable. The use of medication made it possible to complement the capabilities of an individual surgical care to the maximum.

Analysis of the results of medical correction of disorders in the segment and the prevention of possible complications of the integrated treatment (taking into account the complexity of the pathology) indicate the high efficacy of the approaches proposed. In 18 cases (75%), satisfactory and a good results were obtained when evaluating it as per the Luboszyce - Mattis - Schwarzberg scale.

## **Conclusions**

The use of the multimodal perioperative anesthesia in the integrated treatment of patients with non-union of the tibia and correction of vascular disorders and metabolic alterations are substantiated.

The analysis of the results of the proposed integrated treatment demonstrates safety and high efficacy: satisfactory and good results were obtained in 18 cases (75%).

## **PREVENTION OF INFLAMMATORY COMPLICATIONS IN TRAUMATOLOGY AND ORTHOPEDICS**

**\*Rushay A.K., \*\* Bebykh O.P., \*\* Buglak A.I.**

*\* O.O. Bogomolets National medical univers.*

*\*\* Municipal university hospital No.1, Kiev, Ukraine*

## **Relevance**

Prevention of post-operative infection remains a relevant issue; it has a medical significance and it is also important in socio-economic aspects. The main vectors to prevent wound infection are methods that prevent contamination of the surgical wound and methods aimed at an increase in local and general immunity.

**Objective:** Improving the results of surgical interventions in orthopedic and traumatologic patients on the basis of integrated prevention of infectious complications of the surgical site.

Tasks: - Setting up measures to prevent intra-operative exposure to surgical site infection.

- Determining vectors of local and general therapy.

- Evaluating the efficacy of the program proposed.

### **Materials and methods**

The results of the prevention of infectious complications were analyzed in Kyiv Municipal Center for Foot Pathology and Rehabilitation of orthopedic and traumatological patients under Kyiv Municipal University Hospital No. 1 for the period of 2015 to 2017 (2696 operations in total). Ioban™ 3M antimicrobial films were used during an orthopedic surgery. The surgery site was separated with several layers of a disposable nonwoven material. To reduce the microbial contamination of the air in the operating room, the air is conditioned and air laminar streams of the "central zone" are created by Flakt-Woods equipment, Sweden. The NSLA flow dispenser provided very clean air; the air was supplied with thermal comfort (air conditioning at a pre-established optimum temperature of 16 to 19 °C). The air was purified by HEPA filter of H13 class in accordance to EN 1822-1 Standard. The air flow was supplied through the entire diffuser surface of the perforated sheet above the operating table, and it was completely laminar, with its speed being low within the range of 0.15 to 0.20 m/s. The maximally atraumatic surgery technique was used. Active drainage was used for 24 hours. Antibiotic prophylaxis was carried out by the administration of drugs before the surgery and in the first postsurgery day. Hemostasis was reliable. If possibility of bleeding is present, a pressing tourniquet should be superimposed and a fixing one later on. It made it possible to reduce blood loss to the minimum. For this purpose, tranexamic acid was infused before the surgery. It was used together with low molecular weight heparin (Zibor) (to prevent postoperative thrombosis). In cases of severe soft tissue lesions, antioxidant therapy was administered (beriliton, vitamins, and endothelium protectors such as pentoxifylline and reforthan).

### **Research findings and discussion**

No purulent complications were observed in all the cases of applying submersion osteosynthesis (1222) and hip joint (245) and knee joint (50) replacements. Inflammatory complications of various degrees were observed only in 29 (1.5%) cases of 2696 surgeries. The complications originated in urgent traumatologic patients who had a high risk of complication (12 cases in patients with severe metabolic alterations - severe type 2 diabetes and obesity; 9 cases in patients with ischemia of extremities of various degrees; 8 cases after severe injuries with soft tissue necrosis). The data of air culture evidenced high efficacy of the preventive measures taken (no pathogen growth in air was observed in the most cases; only the growth of non-pathogenic sarcina was observed in 12 cases at a minimum permissible concentration of 20 to 45 colonies per 1 m<sup>3</sup>, with the maximum permissible concentration of non-pathogens being 500 colonies per 1 m<sup>3</sup>).

### **Conclusions**

1. Prevention of infectious complications in patients with orthopedic and traumatologic disorders was integrated.
2. Protection of the surgery site included the use of protective films with antimicrobial properties, nonwoven disposable materials for covering surgery site and laminar flows.
3. Preoperative examination of orthopedic patients, detection of concomitant pathology and its treatment was mandatory.

4. Multimodal anesthesia, blood preservation tactics, application of low molecular weight heparins with tranexamic acid, correction of metabolic alterations were important components of the preventive integrated measures.
5. The results obtained evidence the high efficacy of the preventive measures implemented.

## **USE OF ULTRASOUND EXAMINATION AS PER "FAST" PROTOCOL IN CHILDREN WITH POLYTRAUMA**

**Sadovenko O.G., Digtyar V.A., Kaminska M.O., Andreychenko I.I., Mokhov O.I.**

*State Institution "Dnepropetrovsk State Medical Academy under Ministry of Healthcare of Ukraine"  
Communal Institution "Dnepropetrovsk Regional University Children Hospital", Dnepr, Ukraine*

### **Introduction**

Ultrasound examination has become an integral part of urgent traumatology and surgery. A brand new approach to ultrasound examination in polytrauma opens significant opportunities in the diagnostics of damages to internal organs in children. Pediatric traumatologists and surgeons (who are the first to provide assistance to affected children) must be master of FAST methodology to clarify the diagnosis and continue tactics of additional examination and treatment.

### **Materials and methods**

For the past five years 1,125 ultrasound examinations were carried out in 327 children in the ultrasound diagnostic room in Dnepropetrovsk Regional Children's University Hospital (DOR). All the children examined were admitted to emergency department and intensive care unit with the diagnosis of polytrauma; they were subjected to ultrasound examination at standard points according to FAST protocol. Liver injuries were observed in 21 children (6.4%); spleen injuries were observed in 123 (37.6%) children; and kidney injuries were observed in 48 (14.6%) children. 117 children (35.8%) with closed trauma of the chest and abdominal cavity in case of polytrauma were examined in the ultrasound diagnostic room as per FAST protocol.

### **Research findings**

Urgent doctors should be prepared to the possibility to carry out ultrasound examination by themselves as per FAST protocol when providing medical care to children with polytrauma. The examination is important for determining the source of bleeding, for differential diagnosis in an injured person, and for defining tactics of further diagnostics and treatment. After a plain ultrasound examination carried out by an urgent surgeon and ultrasound doctor as per FAST protocol, and in case of detecting an internal organ injury, the immediate surgical treatment or further additional examination of the child is considered. In this case, the more experienced ultrasound diagnostic physician will carry out a more thorough examination to find the injury and determine the type of trauma of the internal organs of the thoracic and abdominal cavities.

To detect a possible injury of parenchymal organs in polytrauma, it is expedient to carry out ultrasound screening as per FAST protocol at standard points. The sequence of examination at standard points depends more on the clinical condition of the child. The examination area in patients with stable hemodynamics is unimportant as ultrasound examination is carried out quickly within a period of 3 to 5 minutes.

Once patient's condition has been stabilized, an in-depth re-examination of parenchymal organs may be carried out. Significant lesions may be easily and quickly detected by a more experienced physician.

However, ultrasound diagnostic not always may be carried out in emergency departments by ultrasound doctors immediately after the patient admission to hospital; therefore all urgent traumatologists and surgeons of Dnepropetrovsk Regional University Children Hospital have undergone a postgraduate course for ultrasound diagnostics as per FAST protocol in polytrauma and injuries of internal organs in children.

### **Conclusions:**

1. Ultrasound diagnostics as per FAST protocol is a screening method of examination, which should be practiced by urgent traumatologists and surgeons.
2. Advantages of the method: speed, mobility, possibility to carry out examination at the pre-admission stage, ability to be carried out simultaneously with resuscitation procedures, absence of ionizing radiation, a relatively inexpensive and non-invasive method.
3. Clinical value of positive FAST examination in children with polytrauma is its ability to identify quickly patients in a critical state with signs of internal bleeding.
4. In case of unstable hemodynamics, an urgent surgical intervention is indicated.
5. In case of stable hemodynamics, an additional diagnostics of the injury may be carried out.

## **USING ELECTROPUNCTURE DIAGNOSTIC METHOD IN PATIENTS WITH INJURIES OF INTRA-ARTICULAR STRUCTURES OF THE KNEE JOINT**

**Strafun S.S., Roy I.V., Gayko O.G., Perfilova L.V.**

*State Institution "Institute of Traumatology and Orthopedics under National Academy of Medical Sciences of Ukraine (NAMN)", Kiev, Ukraine*

The issue of rehabilitation treatment in patients with traumatic knee joint injuries is relevante due to a frequent lesion of the anterior cruciate ligament and meniscus of the knee joint (almost 50% of injuries of all the joints and up to 24% of the lower limb injuries).

**The research relevance** is attributed to the introduction of new quantitative methods of functional diagnostics to increase its efficacy (informativeness) in injuries of the intra-articular structures of the knee joint.

**Research objective:** Increasing the efficacy of diagnostics of the lesions of intra-articular structures of the knee joint due to quantitative assessment of the functional state of periarticular structures of the knee joint by using the electropuncture diagnostics method (EPD).

**Research tasks:** Quantifying the degree of intensity of the pathological process (inflammatory or degenerative) in the periarticular structures of the knee joint.

### **Materials and methods**

In total, 87 patients were examined by using electropuncture diagnostics method (EPD); with 55 women and 32 men aged 17 to 71 years among them. All the patients were divided according to the diagnoses: lesion of the meniscus of the knee joint (45 patients), lesion of the anterior cruciate ligament of the knee joint (18 people), and also the combined lesions of the meniscus and the anterior cruciate ligament of the knee joint (24 persons). The biologically active point (BAP) of the

periarticular structures of the knee joint at the affected site was investigated. More than 87 parameter measurements were made in the biologically active point of the periarticular structures of the knee joint, taking into account the maximum values of the parameters measured.

The electropuncture diagnostics method (EPD) as a non-invasive express- diagnostic method allows quantifying the presence and degree of intensity (Stages I-III) of inflammatory or degenerative changes in the periarticular structures of the knee joint.

Inflammation stages determined by R. Foll: Stage I - subacute inflammation stage (SAI) - 66-75 standard units (SU); Stage II - local acute inflammatory process (LAI) - 76-85 standard units; Stage III - total acute inflammatory process (TAI) - 86-100 standard units. Degeneration stages determined by R. Foll: Stage I – initial degeneration stage - 49-36 standard units; Stage II - progressive degenerative process - 35-26 standard units; Stage III - pronounced degenerative process - 25-0 standard units.

### **Research findings and discussion**

Following the data obtained,

At the BAP of periarticular structures of the knee joint *in patients with lesion of meniscus of the knee joint*: Stage I of inflammation was determined in 17 (19.5%) cases; Stage II of inflammation – local acute inflammatory process – was determined in 24 (27.6%) cases; and Stage III of inflammation – total acute inflammatory process – was determined in 4 (4.6%) cases.

At the BAP of periarticular structures of the knee joint *in patients with lesions of the anterior cruciate ligament of the knee joint*: Stage I of inflammation was determined in 7 (8%) cases; local acute inflammatory process was determined in 9 (10.3%) cases; and total acute inflammatory process was determined in 1 (1.1%) case.

At the BAP of periarticular structures of the knee joint *in patients with combined lesion of meniscus and the anterior cruciate ligament of the knee joint*: Stage I of inflammation was determined in 12 (13.7%) cases; local acute inflammatory process was determined in 9 (10.3%) cases; and total acute inflammatory process was determined in 4 (4.6%) cases.

Thus, 100% of patients with the periarticular structures of the knee joint exclusively inflammatory pathological process of various intensity degrees (Stage I-III as per R.Foll) was diagnosed; no degenerative changes were diagnosed in patients of this category. Quantitative determination of inflammatory changes in the periarticular structures of the knee joint was an objective basis to recommend administration of non-specific anti-inflammatory therapy to improve the efficacy of treatment and rehabilitation measures, and to prevent possible complications.

### **Conclusions**

1. Using the electropuncture diagnostics method (EPD) to examine patients with lesions of meniscus and the the anterior cruciate ligament, new quantitative data were obtained for the first time, which made it possible to improve the efficacy of well-known diagnostic measures implemented.
2. The inflammatory nature of the pathological process of various intensity degrees (Stages I-III by R. Foll) was found in the BAP of periarticular structures of the knee joint in 100% of patients with lesions of meniscus and the posterior cruciate ligament of the knee joint.
3. The presence of inflammation and various inflation intensity degrees (Stages I-III) established in the periarticular structures of the knee joint in case of lesion of meniscus and the posterior cruciate ligament of the knee joint predetermined objectively the administration of pathogenetically grounded

anti-inflammatory therapy to improve the efficacy of treatment and rehabilitation measures and to prevent possible complications.

Thus, using the electropuncture diagnostics method (EPD) for the first time has made it possible to improve significantly the efficacy of diagnostics of lesions of meniscus and the posterior cruciate ligament of the knee joint by obtaining brand new quantitative data.

## **BIOMECHANICAL PARTICULARITIES OF GAIT WHEN PRESERVING AND REDUCING THE MOMENT ARM LENGTH. ACTIONS OF HIP ABDUKTORS AFTER HIP JOINT REPLACEMENT**

**\* Strafun S.S., \*\* Fishchenko O.V., \* Karpinskiy M.Y., \* Karpinskaya O.D.**

*\* State Institution "Institute of Traumatology and Orthopedics under National Academy of Medical Sciences of Ukraine (NAMN)", Kiev, Ukraine*

*\*\* N.I. Pirigiv Vinnitsa National Medical University under Ministry of Healthcare of Ukraine, Vinnitsa, Ukraine*

*\*\*\* State Institution "Professor M.I. Sitenko Scientific Research Institute of Spine and Joint Diseases" under National Academy of Medical Sciences of Ukraine*

### **Introduction**

The number of injuries and diseases of the hip joint is 8.1% of the joint-and-muscle system diseases. Surgical treatment is the most efficient method. Approximately 1,000 patients per one million people require joint replacement each year; for Ukraine, this figure is about 40 thousand patients annually. Despite the ever-increasing number of surgical procedures and models of implants, the number of postoperative complications increases simultaneously. One of the particularities of the hip joint implants is not compliance with the length of the moment arm of hip abductors of the joint replaced in comparison with the contralateral one. This problem is little studied by both domestic and foreign authors. While the joint replacement quality in patients is evaluated predominantly by X-ray, the biomechanics of movement in such patients is not sufficiently studied. The works devoted to the long-term complications of the hip joint replacement in patients with different moment arm length of the hip abductors are few in numbers.

**Objective:** Studying the peculiarities of geometric gait parameters of the patients before and after the total hip joint replacement while preserving and reducing the moment arm length of the hip abductors after the hip joint replacement within a long-term observation period.

### **Materials and methods**

The gait parameters of 46 patients with coxarthrosis, which were divided into 2 groups, were analyzed. Group I included 26 patients; X-ray examination showed no change in the moment arm length of the hip abductors after the hip joint replacement. Group II included 20 patients; X-ray examination showed a decrease more than 1.0 cm in the moment arm length of the hip abductors. The data were obtained using GaitRite system.

### **Research findings**

The following were observed in patients before the hip joint replacement: a decrease in the duration of support to the diseased limb and, accordingly, a decrease in the stride length of both extremities. Attempts to increase the speed of travel caused an increase in the duration of support to healthy limbs



in patients; at the same time the stride length of the diseased limb almost did not change, which led to increased lameness.

In coxarthrosis, the limb posture changes: the foot is turned laterally. The hip joint replacement corrected partially this defect. A significant improvement of gait parameters was observed in a year, however, the gait parameters deteriorated once again in 5-7 years, especially in patients of Group II. When the moment arm length of the hip abductors is reduced, a permanent strain occurs in the lower limb muscles, which led to the development or progression of degenerative changes in other lower limb joints in a long-term period (in the knee joint and the ankle joint) and in the lumbar spine, which increased the rate of progression of degenerative changes in the joints.

### **Conclusions**

The analysis showed that there is the loss of support and walking skills acquired after the hip joint replacement is observed in patients with a decrease in the moment arm length of the hip abductors in a long-term period because of a long-lasting unilateral overstrain of the muscles of the prosthetic limb.

## **CLASIFICACION OF KNEE BONES DEFECTS FOR PROPER PREOPERATIVE PLANNING**

### **(EILF DATABASE REVIEW)**

**Tankut O. V., Dudko O.G.**

*State Institution "Professor M.I. Sitenko Scientific Research Institute of Spine and Joint Diseases" under National Academy of Medical Sciences of Ukraine  
HSEEU "Bukovynian State Medical University", Traumatology and Orthopedics Department,  
Chernovtsy, Ukraine*

### **Relevance**

Bone defects of articulation surfaces are considered a challenging issue that requires surgical treatment. The knee joint is a weight-bearing joint; it needs a complete restoration of its shape and function. There are various causes of the development of knee bones defects, such as intra-articular fractures with depression of tibial or femoral condyles, advanced stages of osteoarthritis, and previously performed primary and revision total knee replacement. The number of total knee replacements is progressively increasing all over the world. The bone resection done may cause further problems if surgery is needed later on. The second revision surgery is more complicated and expensive.

**The study objective:** Carrying out a systematic review of papers for the last 15 years to analyse existing attempts to classify knee bones defects and choose the most suitable one for preoperative planing. The Pubmed database by means of trial access to eILF database of EBSCO Host Company was used for this purpose. 57 scientific papers were chosen according to the following criteria: publication in a review journal; classification of knee bones defects is available; results of clinical approbation are provided; the follow-up is at least 12 month after the surgery.

### **Research findings and discussion**

Management of bone defects should be planed in accordance with the size and location of bone defects in femur and tibia, and most of the authors use Anderson Orthopedic Research Institute (AORI) classification, though we have to point out that it does not define properly the exact shape and size of a bone defect. The classification categorizes the defects of femur and tibia in three types: First type: the metaphyseal bone is intact with minor defects that will not affect the stability of revision components.

Second type: the metaphyseal bone is affected. There is a defect of cancellous bone in the metaphyseal area. The joint congruence should be restored by filling defects with bone graft, cement or augments made of synthetic materials, such as porous titanium, tantalum or various polymeric materials.

Third type: a significant metaphyseal bone defect involving the most of tibial plateau or condyle, or femoral condyle. Those defects require long-stem implants in combination with bone graft or augments use so as collateral or patella ligaments attachment is involved. The individually manufactured hinged prosthesis is another option for those complicated cases.

### **Conclusion**

Preoperative planing of surgical treatment for knee bones defects should consider the bone defect location, size and type. Various types of bone loss can be managed by using structural or morselized bone grafts, cement alone or a combination with screws and mesh, metal or polymeric augments of various shapes, custom-made or hinged prosthesis.

## **CLINICAL MANIFESTATIONS OF OSTEOARTHRISIS IN PATIENTS OF YOUNG AGE IN THE BACKGROUND OBESITY SUBJECT TO THE AVAILABILITY OF ADVERSE VDR (BSML C.IVS7 G> A) AND LCT (-13910T> C) GENES POLYMORPHISM**

**Tereshlin K.I., Pasieshvili L.M., Istomin A.G.**

*Kharkov National Medical University, Kharkov, Ukraine*

### **Introduction**

The main vectors of genetic researches of osteoarthritis were focused mainly on the study of candidate genes related to bone metabolism (Richards J. B., 2009). The role of the gene encoding the vitamin D receptor has been actively studied for decades. BsmI c.IVS7 G> A (VDR) is a mediator of the action of the hormonal-active form of vitamin D<sub>3</sub> (1,25 (OH)<sub>2</sub> D<sub>3</sub>), which occurs by modulating the transcription of target genes. Also VDR was presented as one of the gene candidate for genetic control of maintaining sufficient bone mass (Yang M., 2015). 1,25 (OH)<sub>2</sub> D<sub>3</sub> interacts with VDR in osteoblasts, stimulating the expression of the NF-κB nuclear factor activator receptor ligand, which, in turn, interacts with the NF-κB nuclear factor activator receptor, inducing the transformation of immature monocytes in mature osteoclasts, which dissolve the matrix and mobilize calcium and other minerals from bone tissue (Holick MF, 2011). The VDR polymorphism (BsmI c.IVS7 G> A) was detected through the use of BsmI, ApaI, TaqI, and FokI restriction enzymes (restrictases). In general, there are well-known results of eleven epidemiological studies showing the link between the VDR gene polymorphism and the risk of low-trauma fractures. Six of them showed that the VDR genotype was associated with an increased risk of fractures, including hip and spine fractures (Guang-Rong J., 2007). In recent years, the evidence has appeared that vitamin D is involved in metabolism not only in bone but also in cartilaginous tissue. In particular, it has been shown that vitamin D stimulates the synthesis of proteoglycan by chondrocytes, modulates the activity of metalloproteinase involved in the destruction of cartilage. Thus, a decrease in the level of 24,25- and 1,25-vitamin D is associated with an increase in the activity of metalloproteinases, and its normal level reduces the activity of those enzymes in vitro (Arden N., 2006).

One of the ways of the development of predisposition to osteoarthritis is lactose intolerance (LI), in which lactose can not be split into glucose and galactose due to the absence of intestinal lactase (Marozik P. 2013). Study of polymorphism – 13910 T / C lactase (LCT) gene – has a diagnostic and prognostic value, which makes it possible to determine lactose intolerance and predict its development (Pohl D., 2010). The LPH (LCT) gene encodes the amino acid sequence of the lactase enzyme. This enzyme is synthesized in the small intestine, and it is involved in the cleavage of lactose.

Polymorphism of this gene affects the development of lactase. In this case, the normal polymorphism variant (CC) is associated with inhibition of lactase synthesis, and the mutant polymorphism variant (TT) is associated with the preservation of lactase activity in adulthood. Thus, homozygous carriers of C variant are unable to absorb lactose (the level of synthesis of mRNA lactase gene in them is reduced to 2-22%); homozygous carriers of T variant easily assimilate lactose (Boschmann S. E., 2016). Lactose intolerance due to the presence of the CC-allele polymorphism variant – 13910 T / C lactase (LCT) gene – and the unconscious desire to abandon dairy products leads to a decrease in bone mass and a 2-5-fold increase in the risk of fractures (Yilmaz H., 2012).

**Research objective:** Studying the peculiarities of the clinical course of osteoarthritis on the background of obesity in young people in the presence of adverse variants of polymorphism of VDR (BsmI c.IVS7 G> A) and LCT (-131910> C) genes to improve diagnostics and prognostication.

### **Materials and methods**

The study involved 96 obese patients with a diagnosed osteoarthritis, with 24 men (25%) and 72 women (75%) aged 21 to 45 years (mean age  $35.54 \pm 0.9$  years) among them. The control group included 96 practically healthy persons selected on the "copy-pair" basis. The comparison group included 18 individuals with an isolated osteoarthritis of the same age group with reciprocal sex distribution. All the patients were further examined for gene polymorphism. The survey was conducted using a polymerase chain reaction (PCR) on the Rotor-Gene 6000 amplifier (Australia) in the real-time regime. To detect polymorphisms in the human genome, PCR was performed using the following sets: VDR (BsmI c.IVS7 G> A) "Mutation of vitamin D receptor"; and LCT MSM-6 (-13910T> C) "Lactase deficiency". Diagnostics of the disturbance of mineral density of bone tissue was performed following the results of dual-energy X-ray absorptiometry (DEXA) that was carried out on the HOLOGIC Explorer QDR W Series Bone Densitometer apparatus, USA. The mineral density of bone tissue measurements were carried out in three skeleton areas: the lumbar spine, proximal femoral area and the forearm bones. The evaluation criteria were as follows: bone mass deviation (BMD), in particular the T- and Z-criteria (Radchenko V.A., 2015). The evaluation of the severity of osteoarthritis manifestation was performed according to the WOMAC technique (Nasonova E.L., 2005). The assessment of critically excessive body weight (cEBW) and the obesity degree was performed in accordance with clinical recommendations, using the Kettle height-and-weight index. The evaluation of the process the stage was carried out, using radiological criteria (Kellgren J.H., Lawrence J.S., 1957). When summarizing the results obtained, the methods of clinical statistical analysis and variation statistics (calculation of average values, average errors, one-side Student credibility criterion), as well as elements of polynomial analysis and modeling implemented by the standard package of application programmes of variation statistics: Stadia 6.0, Statistica for Windows 6.0.

### **Research findings**

42.2% of the main group patients had the mutant genotype of the BB gene of the vitamin D receptor; - 37.4% of patients had normal genotype of the CC lactase gene (LCT, -13910T> C) but unfavorable for the osteoarthritis course and formation of disturbances of mineral density of bone tissue.

At the same time, the presence of both unfavorable genotypes was detected in 20.2% of patients with osteoarthritis. In the comparison group, the mutant BB genotype was found in 55.6% of patients, the unfavorable CC genotype was found in 72.2% of patients. An adverse linkage of both homozygous genotypes was in 44.4% of patients.

When undertaking clinical evaluation of patients with unfavorable genotypes, lesions of major joints were found in 90.5% of the major group and in 75.0% of the comparison group, with the majority of patients suffering from osteoarthritis for 5 years (61.9% and 75.0% respectively) and with age of the osteoarthritis manifestation being over 35 years (61.9% and 50.0% respectively).

Following the results of the examination of patients in the main group and in the comparison group, wherein adverse linkage of homozygous genotypes of the genes of the receptor of vitamin D and lactase (20.2% and 44.4%) was identified at the same time, it was found that the affection of joints in the specified group of patients was characterized by a more severe degree of cartilage degradation and disturbance of its functional activity. However, it should be noted that in patients with osteoarthritis and obesity, the algofunctional index was significantly ( $p < 0.05$ ) higher than that of patients with isolated course of the disease.

A generalized analysis of the severity of osteoarthritis (W,%) and its components revealed a significantly higher incidence of stiffness in those patients ( $59.5 \pm 2.5\%$  and  $54.69 \pm 2.4\%$ ).

X-ray changes in joints in patients in the main group corresponded in most cases to Stages II and III (71.5%), and to Stage IV of osteoarthritis in 19% of cases.

The analysis of the frequency and nature of absorptiometrically verified disturbances of structure and function of bone tissue in the patients of the main group made it possible to diagnose osteopenia in 66.7% of cases and osteoporosis in 23.8% of cases; that is, osteoporosis was observed in 90.5% of patients with osteoarthritis and obesity with an adverse linkage of genotypes of VDR and LCT genes, which is reliably ( $p < 0,001$ ) more frequent in comparison with patients of other genotypes. The same trend was observed among patients in the comparison group, wherein osteopenic conditions were reported in 75.0% of cases.

### **Conclusion**

Thus, the presence in a patient of a linkage of homozygous variants of polymorphism of VDR (BsmI c.IVS7 G> A) and LCT (-13910T> C) genes is prognostically one of the most unfavorable conditions of the osteoarthritis (both on the background of obesity and in the isolated disease course), and a prerequisite for the possible formation of disturbances of mineral density of bone tissue in young people.

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### **APPLICATION OF INTERLAMINAR EPIDURAL ANAESTHETIC BLOCKS IN TREATMENT OF PAIN SYNDROME IN THE LUMBAR SPINAL STENOSIS**

Fishchenko Y.V., Kudrin A.P.

*State Institution "Institute of Traumatology and Orthopedics" under National Academy of Medical Sciences of Ukraine (NAMN), Kiev, Ukraine*

### **Relevance**

About 36% of all epidural anaesthetic blocks are administered to relieve symptoms of lumbar spinal stenosis, which include local pain syndrome, radiculopathy, and neurogenic intermittent claudication. Intrelaminar epidural anaesthetic blocks (IEB) is a minimally invasive method for the treatment of pain syndromes of the lumbosacral spine by administering drugs into the epidural space through the interlaminar ligament. In the absence of fluoroscopic control in 30% of cases, the drug is injected past the epidural space, and in more than 50% of cases the anaesthetic block is not made at the level wherein it should be done.

**Objective:** Analyzing your own results of treatment of pain syndrome of the lumbosacral spine against the background of lumbar spinal stenosis by using the interlaminar epidural anaesthetic block method under fluoroscopic control.

### **Materials and methods**

The results of treatment of 32 patients were analyzed (women - 25 (78.1%), men - 7 (21.9%), the average age of patients -  $64.6 \pm 2.1$  years (age range from 31 to 84 years). All the patients received integrated conservative treatment in the outpatient setting or in hospital setting before going to clinic. To treat the pain syndrome, interlaminar epidural anaesthetic blocks in amount of 1 to 3 injections were given to the patients. The patients were examined with MRI; pain indices were evaluated with visual analogue scales (VAS) for scoring pain, Oswestry Disability Index (ODI) questionnaire and recovery index (RI). The treatment results were evaluated after 1, 3 and 6 months. The patients were examined with MRI; pain indices were evaluated with visual analogue scales (VAS) for scoring pain, Oswestry Disability Index (ODI) questionnaire and recovery index (RI). The treatment results were evaluated after 1, 3 and 6 months.

### **Research findings**

*VAS results:* in 5-7 days after the block, 81.0% of patients reported regression of the pain syndrome within 3-6 cm according to VAS ( $p \leq 0.05$ ). In 3 months: 91.0% of patients reported pain syndrome regression within 3-6cm. In 6 months: a significant decrease in pain was reported by 75.0% of patients, which indicates the stability of the results obtained. Minor regression of lumbar pain in 3 months was reported by 9.0% of patients and in 6 months by 25.0% of patients respectively.

*The results of the Oswestry Disability Index (ODI) questionnaire* made it possible to establish that: 96.88% of patients noted a significant improvement (more than 10 points regressed) in 5–7 days after the anaesthetic block. This indicator remained in 90.63% of patients in 3 months after the anaesthetic block, and it was in 82.81% of patients at the time of the final survey in 6 months after the anaesthetic block.

*Evaluation of treatment as per the recovery index (RI):* in 5-7 days after interlaminar epidural anaesthetic block, a good result was noted by 63.0% of patients, a satisfactory result was noted by 31.0% of patients, and an unsatisfactory result was noted by 6.0% of patients. In 3 months after interlaminar epidural anaesthetic block, a good result (improvement of the condition by more than 40%) was noted by 56% of patients, a satisfactory result was noted by 22% of patients, and an unsatisfactory result was noted by 22% of patients. In 6 months after interlaminar epidural anaesthetic block, a good result was noted by 56% of the patients examined, a satisfactory result was noted by 22% of the patients examined, and an unsatisfactory result was noted by 22% of patients.

### **Conclusions**

The study showed that interlaminar epidural block carried out under fluoroscopic control is an effective method to treat pain in the lumbosacral spine with lumbar spinal stenosis. Thus, in 75% of cases, it was possible to achieve good and sustainable treatment results: reducing pain and improving the quality of life. When carrying out interlaminar blocks, complications were noted in 8.7% of cases. All of them were mild, and they required only a symptomatic treatment.

# APPLICATION OF RADIOFREQUENCY NEUROABLATION IN PATIENTS WITH COXALGY ON THE BACKGROUND OF THE HIP JOINT OSTEOARTHRISIS

Fishchenko Y.V., Kudrin A.P., Chernobay S.P.

*State Institution "Institute of Traumatology and Orthopedics" under National Academy of Medical Sciences of Ukraine (NAMN), Kiev, Ukraine*

## Relevance of the problem of research

Coxarthrosis or arthrosis of the hip joint leads to marked pain syndrome, limiting the function of the joints, substantial economic costs and increased mortality. Depending on the age, coxarthrosis is revealed radiographically in 28-43% of the population and, and it is manifested symptomatically in 10-17% of patients.

Radiofrequency neuroablation for denervation of the sensory nerves of the hip joint is a new effective method for the treatment of coxalgia. A targeted thermal effect on the nerve fibers, which causes their destruction and, as a result, reduces the pain syndrome that is transmitted by those nerves, local denaturation, leads to their Wallerian degeneration with subsequent regeneration. Used for the first time for denervation of faceted joints, the method has been use for more than 30 years, and it has been proven to be effective and long-acting in the treatment of facet syndrome in various parts of the spine.

In general, analyzed by us, all the studies on radiofrequency neuroablation of the hip joint nerves were of poor quality with a small sampling size, poorly described methodology of selecting patients with a heterogeneous etiology of pain syndromes (osteoarthritis, aseptic necrosis, metastases, post-operative), lack of analysis of functional results.

**Research objective:** Evaluating the results of treatment of coxalgia on the background of degenerative and dystrophic diseases of the hip joint with radiofrequency neuroablation of the articular branches of the femoral and obturator nerves.

## Materials and methods

The results of treatment of 36 patients (37 joints) were analyzed. The average age of patients was  $66.2 \pm 1.5$  years (age range from 40 to 81 years). The average duration of pain before treatment was  $4.25 \pm 2.56$  years. All the patients were examined clinically and radiographically. The stage of coxarthrosis was evaluated with X-ray according to the classification of J. Kellgren and J. Lawrence. Grade 3 coxarthrosis was detected in 27 patients, Grade 4 was detected in 9 patients.

Quantitative and qualitative assessment of the pain syndrome was performed on the basis of pain. Measurements of functional joint limitations and indications, which affect patient's quality of life, were performed according to the Harris Hip Score (HHS). Patient's condition was assessed before the radiofrequency neuroablation procedure, in 2 weeks, as well as in 1, 3, 6, and 12 months after the procedure.

## Research findings and discussion

The dynamics of subjective pain sensations before and after treatment was considered reliable with a decrease in pain by 3 cm or more. Thus, 14 days after the radiofrequency neuroablation procedure, 62.2% of patients reported regression of pain syndrome within 3–8 cm according to VAS ( $p \leq 0.05$ ); in

1 month after the procedure 81.1% of patients, in 3 months after the procedure 64.9% of patients; in 6 months after the procedure 59.5% of patients; in 12 months after the procedure 54.1% of patients. Unreliable improvements or absence of the dynamics of pain according to VAS in 14 days after beginning of the radiofrequency neuroablation procedure were noted by 37.8% of patients, in 1 month by 18.9% of patients, in 3 months by 35.1% of patients, in 6 months by 40.5% of patients, in 12 months by 45.9% of patients.

Evaluation of the effect of pain on functional impairment of life on the basis of the results of HHS questionnaire: in 14 days after radiofrequency neuroablation procedure, a significant improvement in the index (change of more than 26 points) was noted by 64.1% of patients; in 1 month after the treatment in 82.1% of patients; in 3 months after the treatment in 69.3% of patients; in 6 months after the treatment in 71.8% of patients; in 12 months after the treatment in 76.7% of patients. At the time of the final survey, a lack of dynamics or an unreliable improvement in comparison with the baseline condition was noted in 23.3% of patients.

*Complications after the procedure.* Most procedures were performed without complications. The following complications were noted in the patients observed: hematoma in the groin area in 1 patient as a result of injured a. femoralis; and hypoesthesia on the anterior surface of the femur in 1 patient as a result of injured n. anterior femoralis cutaneous at the site of thermocoagulation of the articular branches of the femoral nerve.

Thus:

1. Radiofrequency neuroablation of the articular branches of the obturator and femoral nerves is an efficient treatment method for coxalgia on the background of degenerative osteoarthritis.
2. This procedure has a number of advantages since it is carried out with almost no complications, and it may be used in cases when the patient is not allowed to undergo surgical treatment, but a marked pain syndrome persists.
3. This technique is not universal and it has not preventive properties that may prevent the progression of the underlying disease, so radiofrequency neuroablation should be used in combination with other orthopedic treatment.

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**TRANSFORAMINAL EPIDURAL ANAESTHETIC BLOCKS IN TREATMENT OF PAIN SYNDROM IN DEGENERATIVE DYSTROPHIC DISORDERS OF THE LUMBOSACRAL SPINE**

Fishchenko Y.V., Kudrin A.P.

*State Institution "Institute of Traumatology and Orthopedics" under National Academy of Medical Sciences of Ukraine (NAMN), Kiev, Ukraine*

**Relevance**

Pain in the lumbosacral spine is one of the most common causes of disability of the adult population, which is associated with large financial losses.

Transforaminal epidural anaesthetic block (TFEB) is a minimally invasive treatment method for pain syndrome of the lumbosacral spine by injecting drugs into the epidural space through the intervertebral foramen.

**Objective:** Evaluating treatment results for the pain syndrome in the lumbosacral spine against the background of degenerative dystrophic disorders by using the method of transforaminal epidural anaesthetic blocks.

### **Materials and methods**

The treatment results were analyzed in 23 patients (14 women and 9 men), the average age of the patients was  $52.2 \pm 2$  years (the age ranged from 33 to 79 years). The average duration of the pain syndrome exacerbation before treatment was  $4.87 \pm 1.2$  months.

Following MRI data, neurocompression factors were identified, and the patients were divided into 2 groups: Group 1 included 16 (69.5%) patients with protrusions or hernias of intervertebral disks; Group 2 included 7 (30.5%) patients with stenosis of the spinal canal.

Quantitative and qualitative assessment of pain syndrome was carried out on the basis of a visual analogue scale for scoring pain (VAS). The assessment of the degree of quality-of-life impairment due to spinal disorder was carried out, using the Oswestry Disability Index questionnaire (ODI). Generalized treatment results were evaluated on the basis of the recovery index (RI), which characterizes the degree of recovery after a conservative treatment. The procedures were carried out in the outpatient setting in the rehabilitation department of the Institute of Traumatology and Orthopedics under National Academy of Medical Sciences of Ukraine (NAMN), Kiev, Ukraine. The follow-up in dynamics was carried out in a period of 5 to 7 days, in 3 and 6 months after the treatment.

### **Research findings**

When evaluating the dynamics of subjective pain sensations before and after treatment as per VAS (a reduction in pain by 3 cm or more was considered reliable), the following results were found. Group 1: 88.0% of patients reported regression of pain within 3-6 cm as per VAS ( $p \leq 0.05$ ) in 5-7 days after the anaesthetic block; 81.0% of patients reported regression of pain in 3 months; and 50.0% of patients reported regression of pain in 6 months after the treatment. The complete absence of pain in the lumbar spine in 3 months after the treatment was noted in 6.0% of patients; and in 6 months after the treatment in 31.0% of patients. Unreliable improvement or absence of pain dynamics in 6 months after the treatment was noted in 19.0% of patients; 2 patients underwent surgical removal of a herniated intervertebral disk (because of lack of efficacy of the transforaminal epidural anaesthetic block).

Group 2: 43.0% of patients reported regression of pain within 3-6 cm as per VAS ( $p \leq 0.05$ ) in 5-7 days after the anaesthetic block. Regression of pain syndrome within 3-6 points was noted by 57.0% of patients in 3 months after the treatment; and by 29.0% of patients in 6 months after the treatment, which indicates the instability of the results obtained in patients with lumbar spinal stenosis. A mild regression of pain or lack of treatment results were noted by 43.0% of patients in 3 months after the treatment, and by 71.0% of patients in 6 months after the treatment.

When estimating the level of patients' vital activity as per the Oswestry Disability Index (ODI), the following results were found.

Group 1: a positive trend was noted, i.e. 93.8% of patients noted a significant improvement (more than 12 points regression) in 5-7 days after the anaesthetic block. This indicator remained at 87.5% in 3



months after the treatment, and this indicator amounted to 81.3% at the time of the final survey in 6 months after the treatment. An unreliable improvement of condition was noted by 18.8% of patients at the time of the final survey.

In group 2, a significant improvement was noted in 85.7% of patients in 5-7 days after the anaesthetic block. This indicator remained at the same level in 3 months after the treatment, and it was amounted to 57.1% at the time of the final survey in 6 months after the treatment.

Interpreted as per the recovery index (RI), the treatment results were reliably positive in both groups after treatment. However, in Group 1, 50.0% of patients noted a good treatment result in 5–7 days after transforaminal epidural anaesthetic block; 44.0% of patients noted a satisfactory treatment result; and 6.0% of patients noted an unsatisfactory treatment result. At the time of the final examination, a good treatment result was noted in 81.0% of patients; and an unsatisfactory treatment result was noted in 19.0% of patients.

In group 2: a good treatment result was noted in 14.2% of patients with lumbar spinal stenosis in 5–7 days after transforaminal epidural anaesthetic block; a satisfactory treatment result was noted in 71.4% of patients; and an unsatisfactory treatment result was noted in 14.2% of patient. At the time of the final examination, a good treatment result was noted in 42.8% of patients in 6 months after treatment; a satisfactory treatment result was noted in 14.2% of patients; and an unsatisfactory treatment result was noted in 42.2% of patients.

### **Conclusions**

Based on the comparison of treatment results of Group 1 and Group 2, it may be concluded that the efficacy of transforaminal epidural anaesthetic block in patients with protrusions and herniated intervertebral discs is higher (81% of patients reported a positive result, i.e. a significant regression of pain and a longer effect after the procedure).

In patients with lumbar spinal stenosis, the efficacy of transforaminal epidural anaesthetic block is medium. Only in 42.85% of cases, it was possible to achieve good and consistent treatment results: reducing pain and improving the quality of life.

## **FACTORS CONTRIBUTING TO FORMATION OF THE PATHOLOGICAL GAIT PATTERN IN LONG-LASTING COXARTHROSIS AND THEIR EFFECT ON REHABILITATION AFTER JOINT REPLACEMENT**

Fishchenko V.O., Branitskiy O.Y., Karpinskaya O.D.

*N.I. Pirogov Vinnitsa National Medical University under Ministry of Healthcare of Ukraine, Vinnitsa, Ukraine*

*State Institution “Professor M.I. Sitenko Scientific Research Institute of spine and joint diseases” under National Academy of Medical Sciences of Ukraine”, Kharkov, Ukraine*

### **Relevance**

Coxarthrosis is a progressive disease; therefore, clinical symptoms develop gradually in most cases, allowing the patient to adapt to it. At the surgery time, the patient develops a complex of bone and muscular disorders that change the normal gait, which remains in some patients after the hip joint replacement.

**Research objective:** Determining the factors that influence the risk of retaining acquired pathological gait patterns after the hip joint replacement.

### **Research findings**

In the initial period, the most characteristic disease symptom is the pain when the patient walks, which eventually intensifies and becomes persistent. The development of degenerative dystrophic process leads to significant disturbance of statics and locomotion, with their disturbance degree depending on the duration and severity of the disease. The hip joint muscular strength is reduced substantially, especially the muscular strength of abductors. Due to the disease duration, other parts of the musculoskeletal system are involved in the destructive process to form complex adaptive and compensatory reorganizations in functions and anatomical interrelations. Pain in coxarthrosis "requires" the patient to adapt to it. Patients notice that when unloading the limb, pain is reduced, and they begin to reduce support to the limb when walking, which leads to limping. Reducing the burden on the diseased leg leads to the development of muscular hypotrophy; it is accompanied by reduction in the range of motions in comparison with the healthy limb, and it leads to the development of joint contracture later on. Limb shortening may often occur in coxarthrosis, which distorts the gait even more. Thus, a "vicious circle" is formed when some pathological manifestations trigger the development of others, and those, in turn, contribute to the progression of the initial pathological manifestations. When the disease lasts for a long time, a complex of acquired pathological patterns is formed in patients, replacing the normal gait. Unfortunately, in some patients, those acquired patterns persist after the hip joint replacement. X-ray and functional result (range of motions, muscular strength) may be good, but the quality of gait does not correspond to normal parameters.

A statistical and mathematical model was developed to determine the risks of preservation of acquired pathological gait peculiarities after hip joint replacement. The model took into account the following data: patient's age, the term and medical history, the presence of limping and its degree, contractures of the lower extremity joints, asymmetry of the length of the limbs and muscular strength, and pelvic balance. Also, the model took into account the gait parameters in patients according to the GaitRite system (time and spatial parameters, FAP).

### **Conclusions**

Analysis of the data showed that the risk of maintaining the pathological gait pattern is mostly influenced by the disease term, contracture of the joints and the asymmetry of muscular strength of the lower extremities. An additional burdensome factor is the presence of lumbar scoliosis or significant pelvic inclination if the patient has used additional means of support for a long time.

## **SYSTEMATIC APPROACH TO DEVELOPING PHYSICAL REHABILITATION PROGRAMS FOR CHILDREN WITH PROGRESSIVE NERVOUS-MUSCULAR DISEASES**

**Chernyshova I.M., Kovalyova S.V., Raychenko N.A., Logvin G.B.**

*Ukrainian Scientific Research Institute for Prosthetic Assistance, Prosthetic Device Development and Vocational Rehabilitation, Kharkov, Ukraine*

According to the data presented in WHO memorandum, progressive neuromuscular diseases are among the ten most unexplained diseases of humankind, with their incidence being on average 1 per 5,000 to 10,000 people and therapeutic potential being very limited. Therefore, physical rehabilitation is the basis of treatment and care virtually for all forms of neurotropic diseases. Physical therapy includes support and stimulation of motions, prevention and treatment of contractures, development of compensatory abilities of the child to compensate lost functions, primarily motor and respiratory

system functions. Approaches to physical rehabilitation have their own peculiarities associated with different degrees of motor capabilities, progressive nature of the disease course, systemic nature of the disease, and involvement of organs of the cardio-pulmonary system and other systems in the pathological process.

**Research objective:** The aim of the work: Developing a systemic approach to the program of physical rehabilitation of children with progressive neuromuscular diseases, depending on their level of functional capability.

### **Materials and methods**

The research is based on the data of follow-up of 29 patients with progressive neuromuscular diseases undergoing physical rehabilitation, examination and orthosis in the clinic of the Ukrainian Scientific Research Institute for Prosthetic Assistance, Prosthetic Device Development and Vocational Rehabilitation, Kharkov, Ukraine, including 21 boys and 8 girls aged 2 to 15 years. The follow-up period was 5 years. The patients were divided into 3 groups according to severity of disturbances of motor function (H.Ching et al., 2007; K. Bushby et al., 2010): Group 1 included patients who could independently move (7% of patients); Group 2 included children who could sit on their own but can not walk independently (31% of patients); and Group 3 included recumbent patients unable to sit independently (62%).

Rehabilitation courses were developed according to the developed algorithm. The main task of rehabilitation treatment is to maximize the period when the child is able to move independently. The algorithm to administer methods of physical rehabilitation and orthopedic support, depending on the preservation of motor functions, included several stages: the stage of patient testing and examination; the stage of conducting the course of physical therapy (exercise therapy, massage, physiotherapy, mechanotherapy); and the stage of orthopedic provision of a disabled child. The rehabilitation program was based on the principle of individual selection of appropriate methods and procedures for each group of patients, as well as the rational use of orthosis equipment.

The patient examinations were carried out by using functional tests recommended for clinical trials in progressive neuromuscular diseases (Hammersmith Scale, Lovett test, Functional ambulation category).

Practice showed that adequate rehabilitation measures with the use of orthosis systems (which are aimed at timely correction of pathological settings of the extremities and the spine, preservation of motor activity of patients, support of respiratory muscle tone of patients with progressive neuromuscular diseases) prevent deformation, continue certain independence of motion and increase the life expectancy of the child.

## **PECULIARITIES OF ACTIVE REHABILITATION OF CHILDREN WITH SECONDARY DYSPLASIA OF THE HIP JOINT**

Chernyshova I.M., Kovalyova S.V., Danilchuk A.V., Logvin G.B.

*Ukrainian Scientific Research Institute for Prosthetic Assistance, Prosthetic Device Development and Vocational Rehabilitation, Kharkov, Ukraine*

### **Introduction**

Imbalance of muscle tone on the background of underdevelopment of the hip joint structures, intra-rotational hip setting, and lack of timely physiological axial load on the hip joint leads to a high

incidence of secondary subluxations and hip dislocation in children with the consequences of neurological diseases (28-90% in spastic paralysis, 30-50% of cases with flaccid paralysis). The dislocation in the hip joints limits the possibility of using the loading methodologies of physical rehabilitation and requires identification of particularities in the development of an individual program of physical rehabilitation.

**Research objective:** Developing an algorithm for the administration of methods of physical rehabilitation for children with various degrees of dysplasia of the hip joint due to spastic paralysis.

### **Materials and methods**

There were 87 patients with cerebral palsy and other organic brain lesions: 34 boys and 53 girls aged 3 to 12 who were divided into 3 rehabilitation groups in accordance with the degree of dislocation in the hip joints.

**The research methods included:** monitoring of the x-ray anatomy of the hip joints and definition of the Reymers migration index (MI), acetabular angle (AA) and the Wiberg angle (WA), the estimation of general motor activity (GMFCS), estimation of the motor capabilities (GMFM), stabilometry (resistance coefficient, total support area, oscillations of the projection of the general center of pressure), study of bioelectric activity of the muscles around the hip joints. The testing was carried out before and after the rehabilitation course and a plain pelvic X-ray once every six months.

The algorithm of active model of physical rehabilitation consisted of 4 stages: 1) patient examination, testing of physical abilities; 2) determination of rehabilitation group; 3) development of an individual rehabilitation program and a course of treatment; 4) orthosis provision.

The following rehabilitation groups for patients with spastic paralysis were defined:

- children with dysplasia of hip joints, hip decentring (risk group) ( $15\% \leq MI \leq 33\%$ ,  $AA \leq 27$ ,  $WA \geq 20$ ). These children, as a rule, have spastic diplegia or gemipelgii and they can move (I-II level GMFCS, CPM 70 - 99%);
- children with hip subluxation ( $33\% \leq MI \leq 50\%$ ,  $AA \leq 27$ ,  $0 \leq WA \leq 20$ );
- children after surgical treatment (on soft tissues and arthroplasty of the hip joint).

To ensure a differential approach to each group of children, schemes were developed to combine methods of physical rehabilitation with the use of kinesiotherapy, the use of robotic systems, and rational orthosis.

### **Research findings**

Following the functional testing, positive dynamics of motor activity of patients was observed in all groups of patients. Muscle spasticity decreased, on average, by 1 point; the level of major motor functions (GMFCS) changed by 0.9 units; the amplitude of bioelectric activity of muscles around hip joints increased by an average of 320-380  $\mu$ V. The supportability factor when standing after rehabilitation measures increased by an average of 17% (from  $0.56 \pm 0.02$  to  $0.86 \pm 0.05$ ). Monitoring of X-ray anatomy of hip joints for the follow-up period (1 to 2 years) showed stabilization of the migration index and Wiberg angle.

## **Conclusions**

Integrated application of physical methods of rehabilitation is a universally recognized means of improving the efficacy of rehabilitation of patients with secondary dysplasia of hip joints, motor disorders due to cerebral palsy and other organic brain damages. It contributes to the potentiation of the positive effect of physiotherapeutic treatment, kinesiotherapy, and orthosis on the motor status of the child.

## **TRAINING AND EVALUATION OF GAIT FUNCTION IN AMPUTEES WITH DEFECTS OF LOWER EXTREMITIES**

Chernyshova I.M., Kovalyova S.V., Bekhzad Kh.Z., Kabanenko I.V., Boboshko R.O.

*Ukrainian Scientific Research Institute for Prosthetic Assistance, Prosthetic Device Development and Vocational Rehabilitation, Kharkov, Ukraine*

Recent studies have shown that disability due to injuries of the locomotor system is second in the world after disability due to cardiovascular diseases, and they often ends with limb amputation at various levels.

The ultimate goal of rehabilitation of the disabled with amputation defects of the lower extremities is to compensate loss of gait function with the recovery of the support ability of the amputated lower limb. It is successfully implemented by highly functional prosthetics and the development of a new locomotive stereotype that is as close as possible to the physiological act of walking, which is achieved by the preparation of the prosthetic socket and training to walk on the prosthetic leg.

**Research objective:** Improving the results of training to walk on the prosthetic leg in patients with varying level of lower limb amputation.

## **Materials and methods**

In 2017, 188 patients aged 18 to 78 years old underwent prosthetics in the clinic of Ukrainian Scientific Research Institute for Prosthetic Assistance, Prosthetic Device Development and Vocational Rehabilitation, Kharkov, Ukraine. The group included 158 men and 30 women. In 171 (90.9%) patients, one-sided limb defect was observed (in 116 patients - at the level of the leg, in 55 disabled persons - at the femur level), in 17 (9%) patients there was a bilateral defect of the extremities. The individual rehabilitation program was developed in accordance with age, etiopathogenetic factors, level of amputation defect, state of the residual-limb, and somatic state of the patient. The program included a preparatory stage for prosthetics (physiotherapy; compression therapy; massage; physical training of the patient up to verticalization; training balance, coordination, stability; strengthening the residual limb muscles); stage of primary prosthetics of the patient with a certain functional prosthetic; and stage of training to walk on the prosthetic leg; walking up and down the stairs; going down to the floor and arising from the floor. In case of bilateral defects, walking was initially in the bars, using a system that makes it possible to unload the body weight. Training the ability to walk by their own was carried out in patients with and without additional support. At the final rehabilitation stage, training was carried out under complicated conditions (walking on uneven surfaces, walking over obstacles, walking with changing direction and pace of motion on signal), sports lessons with a ball, football, table tennis.

The walk was analyzed according to the biomechanical study (stabilometry, podography) and the 10-meter walk test recommended for clinical trials.

## **Research findings**

As a result of preparation for prosthetics and training to walk on a prosthetic leg as per an individual rehabilitation program, the ability to walk by their own without support was acquired by 151 (80.3%) patients with unilateral amputation of the lower extremities. The results of their testing on average corresponded to the norm. Other patients (elderly people with bilateral limb defects and concomitant disorders) moved with additional support (sticks, walkers). The results of their testing were mostly at the lower limit of the norm.

## Conclusion

Thus, the high level of preparation for prosthetics, the individual concept of training when training to walk on the prosthetic leg, and the assessment of the function of walk on the prosthetic leg after the course of rehabilitation give the opportunity to return the patient to a full and harmonious life.

## EWING SARCOMA/PNET (PRIMARY NEUROECTODERMAL TUMOR), RESULTS OF INTEGRATED TREATMENT

\* Chorny V.S., \*\* Protsenko V.V.

\* *O.O. Bogomolets National Medical University under Ministry of Healthcare of Ukraine*

\*\* *State Institution "Scientific Research Institute of Traumatology and Orthopedics under National Academy of Medical Sciences of Ukraine (NAMN)", Kiev, Ukraine*

## Introduction

Ewing sarcoma/PNET (primary neuroectodermal tumor) is a small cell bone marrow tumor of neuroectodermal nature and high degree of malignancy. The incidence in men is higher than in women: the peak incidence occurs in patients aged 10 to 20 years old. The Ewing sarcoma/PNET is localized in the diaphysis, less often in the metaphysis of long tubular bones and pelvic bones. Usually, the disease run is acute with the pain in the affected department of the bone, swelling, disturbance of the joint function. The pain is the main manifestation of the disease, which is moderate in the initial period of the disease, but it increases over time, especially at night. With increase in the bone pain, the temperature rises to 38° and higher; the pain fades after taking anti-inflammatory drugs but then it appears again. Radiologically, along with destruction of the bone, "bulbous" periostitis may be revealed, which is usually observed in the tubular bones. Marked destruction of the cortical layer is observed in some bones with the appearance of the extraosseous component. The particularity of the Ewing tumor/PNET is the rapid hematogenous metastatic spreading to the lungs. The main and relatively effective treatment methods for the diseases are chemotherapy and radiotherapy.

**Research objective:** Displaying the results of the integrated treatment of Ewing sarcoma / PNET.

## Materials and methods

The integrated treatment for 11 patients with Ewing's sarcoma/PNET

was administered in clinical department of the *State Institution "Institute of Traumatology and Orthopedics"* under the National Academy of Medical Sciences of Ukraine (NAMN), Kiev, Ukraine, in accordance with the Scandinavian protocol of treatment which includes polychemotherapy with vincristine, doxorubicin, etoposide, endoxone, and high dose of ifosfamide, as well as the course of radiation therapy up to total radiation dose (TRD) of 40 to 60 Gray to the affected bone segment with subsequent surgical treatment in case of treatment efficacy; or only chemoradiotherapy for inoperable tumors. 5 (45.5%) patients with Ewing's sarcoma/PNET of pelvic bones (ilium bone, ischium bone and

pubic bone) received only chemotherapy and radiation therapy; in 4 (36.4%) patients resection of the articular bone segment and joint replacement (knee joint replacement in 3 patients and shoulder joint replacement in 1 patient) were carried out after chemoradiotherapy; in 1 (9.1%) patient with tibia tumor osteal plastic surgery was performed with the use of autograft; in 1 (9.1%) patient with elbow tumor segmental bone resection was carried out without replacement of the defect.

### **Research findings**

As a result of treatment, relapses of Ewing sarcoma / PNET were detected in 2 (18.2%) patients. Metastases were observed in 5 (45.5%) patients, of which 3 (27.3%) patients had metastases in the lungs, 1 (9.1%) patient had metastases in the lungs and liver, and 1 (9.1%) patient had metastases in the lungs and skeletal bones. 3-year overall survival rate of patients was  $51.12 \pm 4.6\%$ , 5-year-old survival rate was  $35.6 \pm 8.7\%$ .

### **Conclusions**

1. The prognosis for Ewing's sarcoma / PNET, as a rule, is unfavorable; the standard risk of progression (tumor size less than 100 cubic centimeters, localization in the tubular bones) and a high risk of progression (tumor size greater than 100 cubic centimeters, localization in flat bones, presence of metastases) is isolated.
2. The use of integrated treatment of Ewing sarcoma / PNET made it possible to reduce the number of recurrences and tumor metastases.

## SAGITTAL DEVIATION SYNDROME. PARTICULARITIES OF LOAD CHANGE

Shimon V.M., Pushkash I.I., Shimon M.V., Sheregiy A.A.

*Uzhgorod National University, Uzhgorod, Ukraine*

Key words: pain, knee joint, load changes, sagittal deviation syndrome.

### **Introduction**

An important problem of modern orthopedics is the dysplasia of the knee joint, in particular the dysplastic syndrome of sagittal deviation of the femoral bones, which leads to the destruction of all elements of the joint.

Congenital knee dysplasia is the main cause of gonarthrosis in young and old age. According to the literature data, such changes and deformities of the knee joint occur in patients with the rate of up to 6.5%, leading to disturbances in the distribution of loads and cause the development of arthrosis changes in the knee joint [15,16,17]. Front deformities are a factor in the development of dysplastic gonarthrosis.

**Research objective:** Determining changes in biomechanics of load in the knee joint in patients with a change in the angle of the sagittal destabilization of the femoral bones.

### **Materials and methods**

122 patients with syndrome of sagittal deviation of femoral bone branches were analyzed. Based on the data obtained, we performed mathematical modeling to detect changes in joint loading. To detect the change in the knee joint load, a mathematical modeling of stressed and deformed states of the investigated biomechanical system was performed by using the finite element method in the form of software.

## **Research findings**

All the patients were divided into groups in accordance with the change of the deviation angle and changes in load in the knee joint, which was detected by mathematical modeling. The patients were distributed as follows: Group I - 27 patients (control) with deviation angle within the limits of 110°; Group II - 32 patients with deviation angle within the range of 82° to 110°; Group III - 29 patients with deviation angle within the range of 110° to 125°; Group IV - 34 patients with deviation angle more than 125°.

## **Conclusions**

Based on the application of the method of mathematical modeling in the case of syndrome of sagittal deviation of femoral bone, the influence of biomechanical disorders was determined in patients with an angle of 125° and 82°, which contributes to the development of degenerative changes in joints. These data should be taken into account when carrying out the knee and hip joint replacements.

Reliable clinical manifestations of the syndrome of sagittal deviation of the femoral neck is the "walking pain" syndrome that was detected in 76.2% of patients with a deviation angle of 110° to 125° and in 23.8% of patients with a deviation angle of 82° to 110°.

## **TREATMENT OF OSTEOCHONDROSIS OF THE LUMBAR SPINE IN ATHLETES AND THEIR REHABILITATION**

Shimon V.M., Pushkash I.I., Shimon M.V., Sheregiy A. A.  
*Uzhgorod National University, Uzhgorod, Ukraine*

**Key words:** Laser, vaporization, intervertebral disk, athlete

Athletes and people with high physical activity are always at risk due to excessive physical activity. It is known that one of the main causes of the intervertebral disc degeneration is an excessive mechanical load on it. Those who go in for sports have significant loads onto the spinal column. Approximately 5 to 10% of sports injuries are associated with the lumbar spine. Many cases of pain in the lumbar spine may be caused by a certain trauma, while others are the consequence of repeated microtraumas.

**Research objective:** Analysing the results of treatment of protrusion of lumbar intervertebral discs in athletes.

## **Materials and methods**

84 patients with protrusion and nonsequestered herniated intervertebral discs in the lumbar spine were treated in orthopedic department of A. Novak Transcarpathian Regional University Hospital, with professional athletes (athletics - 2, football - 1) and 5 amateur (8 patients in total) among them.

The pathology of 10 intervertebral discs was diagnosed in 8 patients: 4 discs in L4-5 and 6 discs in L5 - S1. The pathology of 1 intervertebral disc was diagnosed in 6 patients: L4-5 in 2 patients and L5 - S1 in 4 patients. The pathology of L4-5 and L5 - S1 was detected in 2 patients. The patients were distributed by age in accordance with WHO classification of life periods of a modern person: the human life after puberty is categorized as follows: young age - 20-34 years old; mature age - 35-44



years old; middle age - 45-59 years old; advanced age - 60-74 years old; old age - 75-89 years old; long-living person - 90 or more years old.

All the patients had lumbalgia of varying degrees; and the pain irradiated in the lower extremities in 4 patients. Neurological symptoms were absent.

The severity of the pain was evaluated as per visual analog scale for scoring pain (VAS) (VAS 0-10), where 0 is the absence of pain and 10 is the strongest pain that the patient can imagine (unbearable pain). Four patients rated pain as 5 scores, 2 patients rated pain as 6 scores, 1 patient rated pain as 7 scores, and 1 patient rated pain as 8 scores. The treatment efficacy was evaluated according to the modified Macnab criteria: Excellent score means the total absence of pain and any symptoms, no movement constraints are observed, the patient is able to return to normal work and activity; Well score means that the patient is generally satisfied, pain is reduced, the patient can return to work and usual daily activity, sometimes taking analgesics; Satisfactorily score means that the functional activity is slightly improved, working capacity is not restored; Bad means absence of improvement, presence of radicular pains, repeated surgical intervention is necessary; the Worst score means that the clinical symptoms got worse than before the treatment.

### **Surgery technique**

The L4-L5 discs were punctured through a posterolateral access, and the L5-S1 disc was punctured through Erlacher access. When an attempt is successful, the needle should be located in the middle of the intervertebral disc and in parallel with the locking plates. The needle was somewhat pulled back due to the eccentricity of the location of the nucleus pulposus. To do this work, Lika-Surgeon diode laser made by Photonika Plus company, Cherkassy, Ukraine, which has a wavelength of 940 nm, capacity up to 30 W, and the possibility to work in constant and modulated operation modes. Laser vaporization of the disc is performed by continuous laser radiation with a power of 6 W for 25-30 seconds (5-6 times for 5 s). The laser was switched on once again after a few-second break to avoid the overheating of the needle and the surrounding tissues, and to allow the resulting gases to escape the disc. After each laser session during the break (every 5 seconds), the needle was pulled back to 1-2 mm, and the optical fiber was introduced deeper into the nucleus pulposus.

The total energy load for each intervertebral disc depended on several factors: the intervertebral disc size, the herniated intervertebral disc size, and patient's sensations. The maximum total energy was 180 J (6 W x 5 sec. x 6 times). If the patient during the vaporization complained of a sharp burning or bursting pain at the site of the puncture or in a lower limb, the interval between laser activation was increased; and if the patient continued to complain or if his health deteriorated dramatically, then the vaporization at that level was ended. Consequently, the energy load on 1 intervertebral disc was within the range of 120 to 180 J.

### **Research findings and discussion**

Once the surgery has been finished, the patients were mobilized in bed. The patients had to follow a strict bed rest at the first day. Dehydration therapy, antibiotics and, if necessary, anesthesia were administered in the postoperative period. All the patients were verticalized the day after the surgery, provided that the lumbar spine is secured by the corset. Patients were discharged from hospital in 1-3 days after surgery to continue outpatient treatment at the place of residence. The patients underwent rehabilitation in the outpatient setting. It is recommended to leave or significantly restrict the use of

sports for 1 month. The follow-up period for patients was 6 months. Patients' status was evaluated one day after vaporization and when discharging them from hospital. Control examinations were carried out in 1, 3 and 6 months. The pain syndrome was evaluated as per VAS (0-10 scores) after the surgery as follows: four patients evaluated the pain by 2 scores, two patients evaluated the pain by 3 scores, and two patients evaluated the pain by 4 scores. When discharging from hospital, the pain level did not exceed 3 scores, and in 2 patients pain was absent. The average level of pain at the control examinations was as follows: before surgery -  $5.9 \pm 1$  scores; in 1 day after the surgery -  $2.7 \pm 0.8$  scores; when discharging from hospital -  $1.6 \pm 1.3$  scores; in 1 month after the surgery -  $1.23 \pm 1.2$  scores; in 3 months after the surgery -  $1.01 \pm 1.2$  scores; and in 6 months after the surgery  $1.05 \pm 1.3$  scores. The treatment efficiency was evaluated as per the modified Macnab criteria: in 1 month, 4 patients evaluated their condition as excellent, 4 patients evaluated their condition as good; in 3 months, an excellent result was noted in 6 patients, a good result was noted in 2 patients; in 6 months, excellent result was noted in 6 patients and a good result was noted in 2 patients. No complications associated with surgery were detected. The condition of any patient did not deteriorate. Six patients returned to exercises in 2 months after vaporization, another 2 patients returned to exercises in 3 months.

### **Conclusions**

Percutaneous laser vaporization is efficient when treating protrusion of intervertebral discs in athletes;

An intensive rehabilitation is the necessary treatment component.

When treatment is timely, there is no need for a significant break in sports.

## **OUR EXPERIENCE IN TREATING TRANSCONDYLAR AND SUPRACONDYLAR HUMERUS FRACTURES IN CHILDREN**

\*Schekin O.V., \*\*Schekin A.O., \*\*Kukhtina S.A., \*\*Shatskiy A.V., \*\*Polubotko B.A.,  
\*Mariev G.S.

*\*Zaporozhye State Medical University, Zaporozhye, Ukraine*

*\*\*Zaporozhye Regional Children University Hospital, Zaporozhye, Ukraine*

### **Introduction**

Among the injuries of the upper limb, the distal humerus fractures in children are found in 16.2%. Transcondylar humeral fractures incidence is within the range of 65.5% to 85.5% of all distal humerus fractures [2, 4, 6, 7]. Extensive transcondylar and supracondylar humerus fractures incidence is within the range of 85 to 90% of all supracondylar humerus fractures [4]. The complex anatomy of the joint, technical difficulties of matching and retaining fragments of the humerus, possible neurological complications and circulatory disorders at the time of injury and within treatment, the formation of post-traumatic deformities with restriction and even loss of elbow joint function are the main factors causing the complexity and ambiguity of the treatment approach to the treatment of transcondylar and supracondylar humerus fractures in children [1]. The most complex injuries in terms of therapeutic tactics and prognostics are T- and Y-shaped transcondylar fractures [3]. The majority of authors believe that only the complete resetting of fragments in the anatomical position of the bone ensures optimal restoration of the function of the elbow joint [3,4,5]. In conservative treatment, the number of secondary displacements is 23-42%, depending on the method of fixation [5], and the number of

complications in surgical treatment reaches 20% [5]. The total number of unsatisfactory treatment results reaches 20% [3]. A substantial number of complications and unsatisfactory outcomes causes the necessity to analyse the treatment of children with transcondilar fractures in more details.

**Research objective:** Optimizing treatment of transcondilar and supracondylar humerus fractures in children.

### **Materials and methods**

273 children with transcondilar and supracondylar humerus fractures were treated in the traumatology department of the Zaporozhye Regional Children University Hospital from 2013 to 2017, with 187 (63.8%) boys, 106 (36.2%) girls, 196 (66.9%) left-sided, and 97 (33.1%) right-sided among them. (33.1%). There were 261 (89%) extension fractures, 12 (4.0%) flexion fractures, 10 (3.5%) abduction fractures, and 10 (3.5%) distal osteoepiphysiolysis of the humerus. We distinguish diverging fractures among T- and Y-shaped fractures. These include fractures in which one fragment is displaced forward, and another fragment is displaced backward. As a result of this displacement, the holding position for the different fragments is opposite. T- and Y-shaped fractures were in 8 (2.9%) patients, with diverging fractures being 2 (0.73%). Our observations included 9 (3.2%) children with post-traumatic median or radial nerve neuritis, 8 (2.9%) children with clinical manifestations of a brachial artery compression.

After a closed resetting of transcondilar extension fractures, the fracture was fixed with Blount's bandage in the flexion forearm position at an acute angle of 45 to 50°. Such fixation allows us to hold fragments even in oblique line of fracture and in comminuted fractures. In flexion fractures, a closed resetting was carried out with subsequent fixation in a plaster cast in the position of forearm extension up to an angle of 150 to 170°. The fixation method for adduction and abduction fractures was selected at the time of resetting the fracture, depending on the position wherein the fracture was stabilized. To determine whether the resetting of fragments is correct, the clinical method offered by us was used in all the cases to determine the lateral stability of the fracture and X-ray control. In cases where the resetting of fragments was achieved, but it was not possible to stabilize the fragments, transdermal fixation was carried out made by using Kirschner wires. In comminuted fractures, inclusive in T- and Y-shaped fractures (except diverging fractures), the skeletal traction treatment was applied. Conservative treatment (closed reposition) was used in 255 children (93.4% of cases), reposition on the skeletal traction system was used in 10 children (3.7% of cases). Surgical treatment was carried out in 8 children (2.9%), with 3 children having open fractures and 2 children having diverging ones. In other 3 children, the resetting of the bone in its anatomical position was achieved after the closed fracture resetting, but the puls on the radial artery was not restored and percutaneous osteosynthesis with Kirchner needles and revision of the neurovascular bundle were carried out. In open fractures, primary surgical treatment of the wound was carried out; the access to the site of the fracture was expanded; and open reposition and osteosynthesis with wires was carried out. In diverging fractures, the fragment that was resetted by using closed reposition was synthesized with 2 Kirschner wires, and another fragment was also synthesized with Kirschner wires after open reposition.

### **Treatment results**

The complete resetting of fragments was achieved in 96.3% of cases, and a satisfactory resetting of fragments was achieved in 3.7% of cases.

Functional results:

The recovery of the full range of motion in the elbow joint was observed in 97.4% of cases; the satisfactory recovery of the range of motion was observed in 2.6%.

The complete restoration of nerve function was observed in all the children with post-traumatic neuritis of the median or radial nerves.

No complications in the form of heterotopic ossifications of soft tissues of the elbow joint, Volkmann ischemic contractures, pseudoarthrosis, posttraumatic varus deformities of the elbow joint were observed.

### **Conclusions**

1. The treatment of transcondylar humerus fractures should be as early and gentle as possible.
2. The immobilization of the limb with Blount's bandage is most appropriate after the closed resetting of extension fractures.
3. Indications for surgical treatment are open fractures, fractures with damage to the neurovascular bundle if blood circulation has not been restored after closed reposition, and diverging comminuted fractures.

## **NEUROLOGIC DISORDERS IN CHILDREN WITH CONGENITAL DYSPLASIAS OF LARGE JOINTS OF EXTREMITIES**

Yurik O.E., Duda B.S., Yurik N.E.

*State Institution "Institute of Traumatology and Orthopedics of Ukraine" under National Academy of Medical Sciences of Ukraine (NAMN)", Kiev, Ukraine*

### **Introduction**

Dysplasia of large joints of the extremities is not only a medical problem, but it is also a social one, as it can often lead to joint replacement in young people.

**Research objective:** Studying the role of nerve structures in the formation of congenital dysplasia of large joints in children by means of classical neurological examination.

### **Materials and methods**

35 patients (18 males and 17 females) with congenital dysplasia of large joints of the limbs were examined. The patients were categorized by age as follows: 4 children were preschoolers (2 boys and 2 girls); 12 children belonged to junior school age (girls and boys were distributed equally); 10 patients belonged to secondary-school age (5 boys and 5 girls); 9 patients were teenagers and young people (4 boys and 5 girls). Congenital hip joint dysplasia was the most common disorder (18 patients, with 10 males and 8 females among them). Knee dysplasia was in 5 boys, the ankle joint dysplasia was in 7 patients (4 boys and 3 girls). Congenital dysplasia of large joints of other localization was observed in 5 patients, and it had a systemic nature in 2 of them.

### **Research findings**

The clinical examinations showed that almost all the children with congenital dysplasia of large limb joints had a certain degree of a disorder in the activity of the nervous system. In particular, apparent polymorphism of neurological disorders was observed in children with the hip joint dysplasia. Mobility disorders in most patients in this group were manifested by increased fatigue in the legs,

especially in the tibia muscles. Hypotension and hypotrophy of the peroneal muscle group could be also detected in them, or the isolated weakness of the extensor of the toes. In other terms, obvious clinical signs of flaccid peripheral paresis of the distal muscles of the lower limbs were determined. Trophic disorders were mild and they were manifested as a local excessive hair growth mainly in the lumbar region, changes in shape and growth of toenails, hyperkeratosis or, conversely, thinning of the plantar skin.

Changes in the reflex domain were most often characterized by the absence of ankle jerk reflexes (Achilles reflexes) or significant decrease in them, and the loss of cremasteric reflexes. The knee joint reflexes were revitalized in the overwhelming majority of children, and the reflexes had a clearly tonic character in 3 children. Pathological plantar reflexes were detected in 4 children, with motor disturbances in them having flaccid character.

Sensitivity disturbances were found in 2 patients only. Oscillation of hypoesthesia from mild hypoesthesia to the total anesthesia was characteristic for sensitivity disorders. Such sensitive disorders were segmental: they had the shape of a shortened "saddle" in the anogenital region.

In general, found in children with congenital dysplasia of hip joints, the neurological disturbances corresponded to the clinical picture of the eroded form of myelodysplasia of the caudal portion of the spinal cord. We identified the following clinical variants of this dysplasia:

- 1) syndrome of lower ischemic myelopathy:
  - a) myelopathy at epiconium-syndrom - conus-medullaris-syndrom;
  - б) myelopathy at conus-medullaris-syndrom;
  - в) myelopathy at epiconium-syndrom;
- 2) pelvic floor amyotrophy syndrome.

An unfavorable medical history background was identified in children with congenital deformities of the knee and ankle joints and planovalgus feet deformity: the risk of pregnancy failure; the presence of toxoplasmosis in the mother; jaundice of the newborn; congenital lumbar herniated disc.

The most often sign found in the neurological status was flaccid lower paraparesis accompanied by the peripheral type of the disfunction of pelvic organs. No apparent sensory disturbances were observed. Hypoplasia of the bones of the paretic limbs was also present.

Vegetative reflexes tended to parasympathicotonic manifestations without signs of systemic degenerative process in peripheral autonomic nervous structures.

The following signs were found in children with congenital dysplasia of large joints of other localization: single neurological signs of disturbance of segmental structures of the spinal cord or nerve roots in the form of minimal residual organic neurological changes.

### **Conclusions**

A detailed neurological examination of children with congenital dysplasia of large joints is helpful to make significant adjustments in the treatment of this complex orthopedic pathology.

## **DIFFERENTIAL DIAGNOSTICS OF GROIN PAIN IN ATHLETES**

**Yurik O.E.**

*State Institution "Institute of Traumatology and Orthopedics of Ukraine" under National Academy of Medical Sciences of Ukraine (NAMN)", Kiev, Ukraine*

## **Introduction**

Athletes of playing sports often have pains in the groin area, which can be constant or permanent in nature.

**Research objective:** Investigating differential diagnostic distinctions in case of pain in the groin area in professional athletes and individuals of other social groups.

## **Materials and methods**

46 professional athletes engaged in gaming sports and 50 able-bodied young and middle age people of other social groups were examined clinically. Radiological diagnostic methods were used in case of need besides the neurological examination: X-ray, magnetic resonance imaging (MRI), spiral computed tomography (SCT) and ultrasound examination.

## **Research findings**

In professional athletes, pain in the inguinal area arose most often at the time of injury and at intensive physical activity; the pain increased when jogging with acceleration and when deviating the thigh abruptly laterally. The following pathologic signs were often found in the inguinal area: hematomas; edema of the inguinal area; symptomatic shortening or elongation of the limb at the side of pain; presence of axial deformations of the legs; enlargement of the lymph nodes in the inguinal area; local increase in muscle turgor. The test of the internal or external "hip impingement" was positive. The symptom of enlarged external inguinal ring and the test of cough pulse at palpation of the inguinal canal were diagnosed often. The range of motion was limited in the hip joint; less frequently it was limited in the knee joint on the pain side, and it was not limited in the lumbosacral region of the spine. Tendon and periosteal reflexes of the lower extremities were not changed. The following pathological findings were revealed often by radiological diagnostic methods in the pain area: hematomas, changes in the height of the cartilage of the hip joint, femoral head osteophytes, tendopathies of m.iliopsoas and m.tensor fascia lata.

In representatives of other social groups, pain in the groin area most often arose after physical activity on the lumbosacral region of the spine, and it intensified at night or in the morning. The reduction of knee reflexes and the ankle jerk reflexes (reflexes of the Achilles tendons) was diagnosed at examination, which were more obvious at the pain side. Sometimes there were signs of hypalgesia or hyperesthesia in the inguinal area. The symptoms of Wasserman, Matskevich, Lasegue, Bonnet, and Dejerine's symptom were positive. Herniated or protruded intervertebral disks at L1-L2, L4-L5 levels were diagnosed by radiological diagnostic methods.

## **Conclusions**

Pain in the groin is often associated with occupational activity of patients and with trauma or degenerative-dystrophic changes in the lumbosacral region of the spine and in the hip joint; therefore such persons should be carefully examined by a neurologist.



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