National Scientific Center of Traumatology and Orthopaedics named after Academician N.D. Batpenov

Traumatology and Orthopaedics of Kazakhstan

Scientific & Practical journal of the Kazakhstan Association of Trauma Orthopaedists

THE MATERIALS

of the XIII International Scientific and Practical Conference
«Interdisciplinary Traumatology and Orthopedics: From Diagnosis to Rehabilitation»

September 10–11, 2026, Astana city, Kazakhstan

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Astana, 2026

Traumatology and Orthopaedics of Kazakhstan
ISSN - e2789-9640

INNOVATIVE TECHNOLOGIES IN TRAUMATOLOGY AND ORTHOPAEDICS

Comparing the Performance of Robot-Assisted Super-Microvascular Anastomosis in Junior and Senior Surgeons: A Randomized In Vivo Preclinical Trial

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Background. Super-microvascular anastomosis (the vessel's diameter < 1.0 mm) is highly technique-demanding and causes physical fatigue. With the assistance of a microsurgery robot, junior surgeons can achieve good performance comparable to that of the senior surgeons and feel less uncomfortable.

Methods. Three experienced microsurgeons and three junior surgeons without microsurgical experiences were recruited to perform robot-assisted anastomosis of the rat tail artery (diameters = 0.5 mm). Surgical performance was evaluated using the Global Rating Scale for Microvascular Anastomosis (GRSMA). The surgeon's fatigue (in the eyes, neck, hands, and wrists) was also evaluated. One week postoperatively, the repaired vessels were assessed by histological examination for thrombus.

Results. All repaired vessels were patent during the operation, but the patent rate decreased in 1 week. There was no significant difference in the GRSMA score between the junior and senior surgeon groups (20.00 ± 3.77 vs 19.22 ± 3.93). The surgeons observed very mild fatigue in the eye, neck, and back across both groups.

Conclusion. This preclinical trial confirmed the feasibility of a microsurgical robotic system for assisting super-microvascular anastomosis. The performance of the junior surgeons was similar to that of the senior surgeons.

Keywords: Robot-assisted surgery, Super-microvascular anastomosis, Microsurgical training.

First Experience with Robot-Assisted Total Knee Arthroplasty

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Introduction. Total knee arthroplasty is an effective surgical treatment for patients with advanced knee osteoarthritis. Robotic-assisted technology enables surgeons to plan and control implant positioning and restoration of the lower-limb mechanical axis. Assessing alignment accuracy, functional outcomes, and safety in the early postoperative period is important for determining the clinical potential of this approach. This study presents the initial results of robot-assisted total knee arthroplasty using a robotic system.

Objective. To evaluate early radiographic and functional outcomes after robot-assisted total knee arthroplasty (RA-TKA).

Methods. The study included 29 patients who underwent RA-TKA using the Naton robotic-assisted system at the Republican Specialized Scientific and Practical Medical Center of Traumatology and Orthopedics in Tashkent, Uzbekistan, between April and June 2026. The procedures were performed as part of international scientific and clinical collaboration with specialists from Sun Central Hospital, China. The mean patient age was 64.4 ± 4.5 years (range, 59–71 years), and the mean body mass index (BMI) was 29.1 ± 0.4 kg/m². Varus deformity was present in 80% of patients and valgus deformity in 20%. All patients had grade III–IV knee osteoarthritis according to the Kellgren–

Lawrence classification. Comorbidities included hypertension (79.3%), type 2 diabetes mellitus (37.9%), and coronary artery disease (17.2%).

All procedures were performed under spinal anesthesia with cemented fixation. An intraoperative analgesic mixture was used, consisting of 20 mL of 1% lidocaine, 30 mg of ketorolac, and 0.3 mg of epinephrine diluted with 0.9% sodium chloride to a total volume of 60 mL. Antibiotic prophylaxis consisted of intravenous ceftriaxone, 1 g every 8 hours for 24 hours. Rehabilitation began on postoperative day 1 under the supervision of a certified rehabilitation physician and included ankle-pump exercises, straight-leg raises, and knee flexion and extension. During hospitalization, sessions were conducted twice daily. After discharge, patients continued an individualized rehabilitation program under specialist supervision. Follow-up lasted two months. Outcomes were assessed using radiographic parameters (HKA, CFA, TCA, and PTS) and functional measures (VAS, ROM, KSS, WOMAC, OKS, HSS, and FJS).

Results. No patient experienced an intraoperative complication, conversion to the conventional technique, or technical failure of the robotic system. Mean operative time was 112.6 ± 6.4 minutes (range, 105–122 minutes); mean tourniquet time was 64.6 ± 4.3 minutes, and mean intraoperative blood loss was 220.0 ± 21.9 mL.

In all 29 patients (100%), the lower-limb mechanical axis was restored to within ±3° of neutral. The mean HKA deviation was 1.6 ± 0.3° (range, 1.2–2.0°). Posterior tibial slope (PTS) decreased significantly, from 12.60 ± 1.21° preoperatively to 5.40 ± 0.51° postoperatively ($p < 0.01$), with a mean reduction of 7.20 ± 0.72°. The femoral component angle (CFA) was 1.00 ± 0.26°, and the tibial component angle (TCA) was 0.68 ± 0.25°; all measurements were within the accepted limit of ±3°.

All functional measures improved significantly. The VAS pain score decreased from 7.2 ± 0.7 to 2.4 ± 0.5 points (ΔVAS = −4.8 ± 0.7), while range of motion (ROM) increased from 80.0 ± 7.1° to 114.6 ± 4.3° (ΔROM = +34.6 ± 6.2°). The KSS score increased from 41.6 ± 2.4 to 77.8 ± 2.6 points; the WOMAC score decreased from 59.2 ± 4.1 to 22.4 ± 3.0; the OKS increased from 21.2 ± 1.7 to 38.0 ± 1.9; and the HSS score increased from 61.0 ± 2.8 to 80.2 ± 1.9 points. The Forgotten Joint Score (FJS) was 69.6 ± 7.5 points. Mean patient satisfaction was 35.2 ± 1.9 out of 40. No postoperative thrombosis, infection, or neurovascular complications were recorded during follow-up.

Conclusions. The preliminary results of total knee arthroplasty using the Naton robotic-assisted system showed restoration of the mechanical axis to within ±3° in all patients, clinically meaningful improvement across functional measures, and no perioperative complications. These initial findings support the feasibility and safety of introducing robot-assisted arthroplasty into clinical practice.

Keywords: robot-assisted total knee arthroplasty; knee osteoarthritis; total knee replacement; component positioning accuracy; functional outcomes; early postoperative period.

ENDOPROSTHETIC REPLACEMENT OF THE LARGE JOINTS

Endoprosthetics: The Way to Improve the Quality of Life

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Introduction. Total knee replacement has been recognized as the most effective treatment method for eliminating pain and improving physical function in patients with severe degenerative joint diseases. The main reason for endoprosthetics of large joints of the lower extremities is severe pain syndrome. At the same time, over the past

decades, patients' expectations of surgery have changed, and the reason for these operations is not only to eliminate pain, but also to return to an active lifestyle.

Objective. The impact of CS endoprosthetics on the quality of life of patients related to health.

Methods. Determination of the quality of life of patients with osteoarthritis of the knee joint and after knee arthroplasty using the QALY method, determined by a formula that uses, along with two constants, numerical values for assessing human physical functions (P), role functions (R), socio-emotional functions (S) and health problems (H). For each letter The values of P,R,S, and H correspond to specific numeric expressions, which will later be added to the general formula, giving a certain number (from -0.21 to 1) QALYs. The study was conducted for 6 months in the rehabilitation department at the Central City Clinical Hospital in Almaty. All patients who were admitted after knee replacement participated in the sociological survey.

Results. The study found that the patients' average quality of life was 0.88 units of QALYs among men and 0.83 units of QALYs among women. According to the doctor's assessment, the quality of life indicators of those examined with osteoarthritis of the knee before surgery and after arthroplasty ranged from 0.56 to 0.70 among men, from 0.63 to 0.76 among women, differing in those with osteoarthritis before and after surgery. Patients before CS arthroplasty had the lowest value, and patients after CS arthroplasty had the highest values. Moreover, when respondents self–assessed their level of quality of life on an assessment scale, this indicator averaged from 0.44 to 0.71 QALYs units among men and from 0.53 to 0.81 QALYs units among women. According to the results of the study, among the surveyed, the most vulnerable were the socio–emotional state and health problems.

Conclusions. According to the results of the study, there were differences in the average values in the analyzed indicators of quality of life, determined by the doctor according to the assessment scales and by the patient himself according to the assessment scale during the study. Patients after endoprosthetics rated their QOL higher than the doctor.

Thus, endoprosthesis is a factor of the greatest improvement in the quality of life of patients with OA.

Keywords: osteoarthritis, knee replacement, quality of life, pain management

Is it Always Really to Restore Joint Line during Revision Knee Arthroplasty?

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Introduction. According to national registries about 30% the reasons of revision knee arthroplasty (RNA) are concerning with patella femoral joint. Patella baja after primary was marked in literature about 34-38%!

Objective. To evaluate the joint line (JL) and patella height reconstruction possibility during RKA.

Methods. We analyzed 110 RKA from 2022 till 2024 and 31(28%) of them were with patella baja. Among 31 patients were spacers, malposition and loosening as reason for RKA. All relationships in patella-femoral joint were measured by Modified Insall-Salvati (1992) and Caton-Deschamps (1982) before and after surgery. In final evaluation we divided our results as complete joint line restoration, relative and true patella baja. Range of motion (ROM) was evaluated too.

Results. Modified Insall-Salvati can reach maximum 1.41 only in malposition patients, the worst was 1.23 in spacers patients. Caton-Deschamps index can reach 0.76 level only in loosening patients. These results means that closer to normal joint line were patients with loosening. ROM after was the best (1040) in loosening patients and the worst was in spacer patients.

Discussion. According to literature one of the most important point in revision is to restore joint line and components rotation to avoid patella baja and stiffness. Ralf Bieger et al (2013) researched the distance according to Figgie: distance between the tibial tubercle (TT) and the joint line (JL) on a lateral X-ray of the knee after revision TKA

in 69 revisions. KSS score was better after JL restoration. They recommend the epicondylar ratio to calculate the physiological JL rather than JL allocation by a distance. Christian Konig et al (2009) showed that JL Increasing by 15mm stimulate increasing stress on patella-femoral segment. Jong-Keun Seon et al (2016) concluded that JL position can be sufficiently restored with appropriate distal femoral augment reconstruction after revision TKA, but the patellar height cannot be well improved, especially in the septic revision. No correlation was found between the JL position and patellar height to the knee function post revision TKA. In our research we found the possibility to restore JL easy in patients with loosening and very difficult after PJI. According to patella height we can restore its elevation only by one step: baja-relative baja- normal, that was supported by indexes.

Conclusion. Joint line restoration is a challenge in RKA especially after PJI. We can restore it usually by one step: from true baja to relative baja and from relative baja to normal. The real connection presents between joint line restoration and ROM. The ROM is better in the relative baja and normal joint line. The worst results are in PJI patients with spacers.

Keywords: Revision knee arthroplasty, patella baja, joint line restoration, patellar height, periprosthetic joint infection, range of motion.

Patellar Tracking and Anterior Knee Pain after Total Knee Arthroplasty: Analysis of 75 Cases

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I**ntroduction**. Anterior knee pain (AKP) is a leading cause of dissatisfaction after total knee arthroplasty (TKA). It has been reported in 4–49% of cases and may persist despite radiographically accurate component positioning. Abnormal patellar tracking—including lateral tilt, lateral displacement, and subluxation—is considered a potentially modifiable mechanical factor contributing to AKP.

Objective: To assess the association between patellar tracking parameters and the frequency and severity of anterior knee pain after primary TKA.

Methods. Seventy-five patients who underwent primary cemented TKA between 2022 and 2024 were prospectively assessed. The patella was not resurfaced in any case. Intraoperative tracking was evaluated using the no-thumb test. Postoperatively, patellar tilt and lateral shift were measured on axial (skyline) radiographs. Tracking was considered adequate when patellar tilt was ≤5° and lateral shift was ≤3 mm. AKP was assessed using the Visual Analogue Scale (VAS), and patellofemoral function was evaluated using the Feller score (maximum, 30 points). Groups were compared using the χ^2 and Mann–Whitney tests; associations between parameters were assessed using Spearman's correlation. Statistical significance was set at $p < 0.05$.

Results. Abnormal patellar tracking was identified in 16 patients (21.3%). Anterior knee pain (VAS ≥3) was reported by 18 patients (24.0%): 9 of 16 (56.3%) in the abnormal-tracking group and 9 of 59 (15.3%) in the adequate-tracking group ($p < 0.01$). Mean AKP VAS scores were 3.8 ± 1.5 with abnormal tracking and 1.2 ± 1.1 with adequate tracking ($p < 0.001$). Mean Feller scores were 18.9 ± 4.1 and 26.4 ± 3.2, respectively ($p < 0.001$). Patellar tilt was positively correlated with AKP VAS score ($\varrho = 0.52$; $p < 0.001$), while lateral shift showed a weaker correlation ($\varrho = 0.34$; $p = 0.02$).

Conclusion. Abnormal patellar tracking was significantly associated with more frequent and severe anterior knee pain after TKA. Lateral patellar tilt showed the strongest association with pain. Intraoperative assessment of patellar tracking and correction of extensor mechanism balance may help reduce the incidence of AKP.

Keywords: total knee arthroplasty; knee joint; patella; patellar tracking.

Does the Interface between Individual 3D Acetabular Implants and Host Bone Influence the Functional Outcomes in Patients with Severe Bone Loss after Revision Surgery?

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Introduction. There is a wide range of commercially produced revision implants for adequate reconstruction of acetabular large bone defects today, however, it is not always possible to achieve long-term survival of these implants. There is an increasing number of scientific publications concerning the use of custom-designed 3D components, which make it possible not only to achieve stable fixation and connect the pelvic bones but also to restore hip joint biomechanics.

Objectives. To evaluate the positioning of 3D acetabular implants after revision hip arthroplasty and its impact on clinical and functional outcomes.

Methods. We analyzed results in 48 patients with bone defect typesIIIA and IIIB Paprosky types, after revision hip arthroplasty. A prospective study was conducted from 2017 to 2023.Revision arthroplasty due to aseptic loosening of the components was performed in 30 cases and as a second stage of periprosthetic infection treatment in 18 cases.

Results. We did not achieve a statistically significant difference when using additional flanges and clinical and functional results. In 2 cases we faced aseptic loosening in patients using flanges. In no case were we able to install an implant with 100% adherence to porous structure compared to preoperatively planned adherence. According to the WOMAC and VAS scales, increasing the contact area of the components showed a slight statistical difference in the improvement of clinical and functional results and the reduction of pain.

Conclusions. When acetabular 3D components adhered to the bone by more than 68%, we did not register a single complication in the postoperative period, and acetabular 3D components adhered to the bone by less than 68%, a total of 8 (16.6%) complications were registered.

Keywords: Custom-designed components, Hip, Arthroplasty, Bone loss, Revision hip arthroplasty

Clinical Assessment of Patient Satisfaction after Total Knee Arthroplasty

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Introduction. Despite advances in surgical techniques and high implant survivorship, 15–20% of patients remain dissatisfied after total knee arthroplasty (TKA), even when component positioning is radiographically satisfactory. Objective functional scores do not always reflect patients' subjective assessment of their outcome. Objective: To assess patient satisfaction after primary TKA and identify factors associated with dissatisfaction.

Methods. This prospective study included 75 patients who underwent primary cemented TKA for primary knee osteoarthritis between 2022 and 2024. The cohort comprised 53 women (70.7%) and 22 men (29.3%); the mean age was 66.4 ± 7.8 years. Mean follow-up was 18 months (range, 12–30 months). Satisfaction was assessed using a five-point Likert scale. Patients who reported being "satisfied" or "completely satisfied" were classified as satisfied. Functional outcomes were measured using the Oxford Knee Score (OKS) and WOMAC before and after surgery. Anterior knee pain was recorded separately, and anxiety and depression were assessed using the Hospital Anxiety and Depression Scale (HADS). Predictors of dissatisfaction were analyzed using logistic regression. Group differences were assessed using the χ^2 and Mann–Whitney tests. Statistical significance was set at $p < 0.05$.

Results. Sixty-one patients (81.3%) were satisfied with the outcome, while 14 (18.7%) were dissatisfied or uncertain. The mean OKS improved from 20.1 ± 4.6 to 38.7 ± 6.2 points ($p < 0.001$), and the WOMAC score decreased from 58.4 to 19.7 ($p < 0.001$). Independent predictors of dissatisfaction were a mismatch between preoperative

expectations and the actual outcome (OR 3.8; $p < 0.01$), residual anterior knee pain (OR 2.9; $p = 0.02$), and elevated anxiety/depression scores on the HADS (OR 2.4; $p = 0.03$). Age, sex, and BMI were not significantly associated with satisfaction.

Conclusion. Although overall satisfaction was high (81.3%), nearly one in five patients was not satisfied with the outcome of TKA. The main associated factors were unmet preoperative expectations, residual anterior knee pain, and psychological status. These factors may be amenable to intervention. Preoperative expectation management and psychological preparation may help improve patient-reported satisfaction.

Keywords: total knee arthroplasty; knee joint; patient satisfaction.

Proximal Humeral Defect Reconstruction Using 3D Augments in Reverse Shoulder Arthroplasty: Early Results

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Introduction. According to current literature, the size of proximal humeral bone defects correlates with an increased rate of complications and poorer functional outcomes following reverse shoulder arthroplasty (RSA). This underscores the relevance of seeking optimal solutions for proximal humeral reconstruction. However, the necessity and choice of method for managing proximal humeral bone defects during RSA remain debatable, which prompted the need for a study evaluating the effectiveness of personalized 3D augments.

Objective. To conduct a comparative analysis of outcomes following RSA using individualized 3D proximal humeral augments versus conventional arthroplasty techniques in patients with proximal humeral bone defects.

Methods. The study analyzed treatment outcomes of 60 patients with proximal humeral bone defects who underwent RSA between 2021 and 2025 at the S.P. Botkin Municipal Clinical Hospital. Patients were divided into two groups: the main group (29 patients, 48.3%) receiving individualized 3D proximal humeral augments, and the comparison group (31 patients, 51.7%) receiving only standard implant components. Outcome assessment was performed at 3, 6, and 12 months postoperatively using the Visual Analog Scale (VAS), the Disability of the Arm, Shoulder and Hand (DASH) outcome measure, and an integrated shoulder function index. The number of postoperative complications was also analyzed. The mean follow-up period was 2.8 years.

Results. At 12 months postoperatively, the main group showed statistically non-significant better functional outcomes ($p>0.05$ for all comparisons). The differences between the two groups were as follows: improvement on the integrated shoulder function index — 1%, pain reduction on VAS — 3.2%, and improvement on DASH — 7.8%. In the 3D augment group (n=29), the total number of complications was 3: no dislocations (0), infection occurred in 1 case, periprosthetic fracture in 1 case, and stem loosening in 1 case. In the standard components group (n=31), the total number of complications was 7: dislocations occurred in 5 cases, infection in 2 cases, and no periprosthetic fractures or stem loosening (0). A statistically significant difference was observed only for dislocation rates using the one-tailed Fisher's exact test ($p<0.05$) — 0% in the main group versus 16.1% in the control group. No significant differences were found for other complications ($p>0.05$).

These findings are likely associated with lateralization of the deltoid muscle pivot point and increased joint offset, which provides horizontal stability through tighter compression of the proximal humerus during abduction, thereby preventing dislocations. Additionally, the ability to reattach soft tissues to the proximal humerus via specialized holes in the augment facilitates the creation of a soft-tissue stabilizing mechanism around the joint.

Conclusion. The primary early postoperative complication following reverse shoulder arthroplasty in patients with unreconstructed proximal humeral defects is implant instability (dislocation). A reduction in dislocation rates can be achieved through proximal humeral augmentation and soft-tissue reconstruction of the proximal humerus. The use of individualized 3D augments for proximal humeral defect reconstruction demonstrated a statistically significant

improvement in arthroplasty outcomes by reducing dislocation rates compared to standard reverse arthroplasty techniques. However, further follow-up is required to assess long-term results.

Keywords: proximal humeral bone loss, 3D augments, reverse shoulder arthroplasty.

Total Hip Arthroplasty in Patients with Proximal Femur Pseudarthrosis

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Introduction. The rate of proximal femur fractures (PFF) in the structure of musculoskeletal system injuries among all fractures of long bones ranges from 3.9 to 18%. According to Russian Ministry of Health 2020 data, the incidence of femoral fractures in Russia was up to 61 cases per 100,000 population (90,000 per year); and femoral neck fractures incidence was 4 times higher among people over 75 years of age. The choice of surgical technique and the fixator used depend on many factors, such as fracture location and its nature, the age of the patient, comorbidities, and the quality of bone tissue. Internal osteosynthesis, is the current treatment method of choice for extra-articular proximal femur fracture, but every treatment method has its limitations. a significant number of complications caused by technical errors, vicious union or nonunion with the subsequent development of false joints, the development of femoral head aseptic necrosis, which leads to coxarthrosis and persistent pain syndrome. To solve the above-described problems, it is necessary to use a conversion surgery - total hip replacement

Objectives: long-term analysis of the results of total hip replacement in patients with proximal femur pseudarthrosis.

Methods. The study was based on clinical and laboratory data analysis and on the results of total hip arthroplasty (THA) in 45 patients aged 56 to 84 years (mean age 68.3), including 32 (71.1%) women and 13 (26.1%) men. 12 patients initially received conservative treatment, and 33 patients received initial surgical treatment using various metal osteosynthesis procedures. The time from osteosynthesis or from the moment of injury to admission to the hospital for hip arthroplasty ranged from 12 to 30 months. All patients, before conversion arthroplasty and after discharge, were repeatedly invited to the clinical diagnostic department for a clinical examination and for assessment using rating scales. 3, 6 and 12 months after the surgery, pain syndrome and patient quality of life were assessed using the following questionnaire scales: Harris Hip Score, MOS SF-36, VAS. The maximum follow-up period ranged from 12 to 60 months.

Results. Based on the results obtained, patients of all 4 groups after conversion arthroplasty noted a significant quality of life improvement, a decrease in pain severity and functional results improvement. This was probably due to the presence of a severe limitation of range of movements in the joint, intense pain, absence of support ability of the extremity, as well as low operative efficacy expectations. One patient (2%) developed acute periprosthetic joint infection in the early postoperative period, which progressed to sepsis and death. Outcomes were considered unsatisfactory in four patients (9%); at the 1-year follow-up, they reported pain and limping in the operated joint. Three patients (6%) underwent reduction of a dislocation.

Conclusions. Strict adherence to the recommended treatment algorithm for patients with proximal femur pseudarthrosis made it possible to achieve good treatment results in 90% of surgically treated patients. An important step in the treatment of this patients is a careful preoperative planning with thorough assessment of bone tissue quality and muscles condition in the proximal femur area, allowing to choose the optimal endoprosthesis components.

Keywords: proximal femur pseudarthrosis; proximal femur fractures; conversion arthroplasty; total hip arthroplasty; complications; functional outcomes.

When Should We Use Patient-Specific 3D-Printed Augments in Revision Total Knee Arthroplasty? Limitations of Current Bone Defect Classifications and Early Clinical Experience

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Background. Management of severe bone loss remains one of the major challenges in revision total knee arthroplasty (rTKA). Metaphyseal cones have demonstrated excellent survivorship and have become the standard solution for AORI type 2B and 3 defects. However, the increasing availability of additive manufacturing technologies has enabled the use of patient-specific 3D-printed augments for reconstruction of complex bone defects. Despite the growing use of these implants, current bone defect classification systems provide limited guidance regarding the choice between standard cones and custom-made implants.

Objective. To evaluate the role of patient-specific 3D-printed augments in revision TKA and to analyze whether currently available bone defect classifications adequately support decision-making between metaphyseal cones and custom 3D reconstructions.

Methods. A literature review of contemporary bone defect classifications and reconstruction techniques was performed. Additionally, a retrospective analysis of revision TKA procedures performed between 2021 and 2025 at Botkin hospital Moscow was conducted. Fifteen revision TKAs requiring implantation of 18 patient-specific 3D-printed augments (8 femoral and 10 tibial) were identified. Defect morphology, implant selection, operative parameters, complications, and early clinical outcomes were evaluated and compared with a cohort treated using metaphyseal cones.

Results. Current classification systems do not provide specific recommendations regarding the use of modern reconstructive technologies. Patients with identical AORI classifications frequently demonstrated substantially different defect geometries requiring different surgical solutions. Patient-specific 3D augments were particularly useful in contained and uncontained defects with complex geometry, most commonly involving the tibia. Early clinical results demonstrated restoration of metaphyseal support and implant stability with operative time and blood loss comparable to metaphyseal cone reconstruction. One postoperative dislocation and one periprosthetic joint infection were observed during follow-up. No cases of mechanical failure or implant loosening were identified.

Conclusion. Current bone defect classifications are insufficient for selecting between metaphyseal cones and patient-specific 3D-printed augments in revision TKA. Defect geometry and the ability to achieve stable fixation within the metaphyseal zone appear to be critical factors not adequately captured by existing classification systems. Patient-specific 3D augments represent a promising solution for complex AORI 2B and 3 defects, particularly when standard cones cannot adequately restore anatomy or maximize bone-implant contact. Future classification systems should incorporate three-dimensional defect morphology and fixation-zone principles to guide reconstruction strategy.

Keywords: revision total knee arthroplasty; bone defects; patient-specific 3D-printed augments; metaphyseal cones; AORI classification; additive manufacturing.

Unipolar Hemiarthroplasty for Femoral Neck Fractures

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Introduction. Femoral neck fractures are among the most common injuries in older adults. Their incidence continues to rise, reflecting both increased life expectancy and the high prevalence of osteoporosis. Patients do not always reach a medical facility within the first hours after injury, when osteosynthesis may offer a good chance of fracture healing. In many cases, hours or days pass between injury and admission. The preoperative period may also

be prolonged, often because of the patient's age and chronic comorbidities. In these circumstances, hip arthroplasty—particularly unipolar hemiarthroplasty, as a less extensive procedure—may be an appropriate treatment option. Depending on the clinical situation, orthopedic trauma surgeons use unipolar or bipolar prostheses with either cemented or uncemented fixation.

Objective. To evaluate the outcomes of unipolar hemiarthroplasty for femoral neck fractures in older and very old patients.

Methods. We analyzed treatment outcomes in 150 patients over 70 years of age with femoral neck fractures. Unipolar hemiarthroplasty was performed in 108 patients, while 42 underwent bipolar hemiarthroplasty. The choice of surgical treatment was based on the patient's physical status, pre-injury activity level, ability to perform activities of daily living, and rehabilitation potential. Outcomes were assessed using follow-up radiographs and clinical examinations.

Results. Postoperatively, hypostatic pneumonia was diagnosed in 2.7% of patients. Postoperative delirium occurred in 4% of cases and resolved successfully. Six-month mortality was 16%. A total of 73% of patients returned to an activity level comparable to that before the injury. Among the 87 patients who attended follow-up, radiographs showed no evidence of prosthetic component instability. One prosthetic dislocation occurred and was successfully reduced.

Conclusions. Unipolar hemiarthroplasty for femoral neck fractures in older patients can support early mobilization and help patients return to their usual level of physical activity, while reducing the risk of serious complications associated with immobility.

Keywords: femoral neck fracture; unipolar hemiarthroplasty; bipolar hemiarthroplasty; older adults.

INJURY AND INJURY OF THE VERTEBRAE

Predicting the Risk of Coronal Imbalance Following Surgical Correction of Adult Spinal Deformity

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Introduction. Surgical correction of adult spinal deformity may lead to the development or progression of coronal imbalance, including during long-term follow-up. This complication may adversely affect functional outcomes. Identifying risk factors related to bone health, previous surgery, and lumbosacral alignment is important for surgical planning and for preventing postoperative decompensation.

Objective. To analyze the causes, prevalence, and risk factors for coronal imbalance following correction of spinal deformity with long-segment fusion extending from the thoracic spine to the lower lumbar or sacral spine, with distal fixation to L5, S1, or the ilium.

Methods. This single-center retrospective study analyzed data from 58 patients with spinal deformity. Inclusion criteria were age over 18 years; long-segment fusion with distal fixation to L5, S1, or the pelvis; and availability of standing full-spine radiographs obtained preoperatively, during the early postoperative period, and at long-term follow-up (at least 2 years after surgery). Radiographic parameters included the sagittal vertical axis (SVA; the distance between the C7 plumb line and the center of S1), scoliotic curve magnitude measured using the Cobb method, clavicle angle (CLA), pelvic coronal angle (PCA), thoracic kyphosis (TK), lumbar lordosis (LL), and pelvic parameters (PI, PT, and SS). Coronal imbalance (CI) was considered significant when the distance between the C7 plumb line (C7-VL) and the central sacral line (CSL) exceeded 4 cm. Sagittal imbalance (SI) was considered significant when the SVA exceeded 4 cm anteriorly. Statistical analyses included the paired t-test, chi-square test, and repeated-measures regression

analysis. Variables included demographic characteristics (age, sex, and body mass index); surgical factors (previous surgery, posterior-only versus combined approach, pelvic fixation, decompression, and osteotomy, including osteotomy type according to the Schwab classification); and postoperative factors (complications and fusion length).

Results. Preoperative coronal imbalance was identified in 13 patients (22.4%). At 6 weeks postoperatively, it was present in 11 patients (19%), including 6 who had developed new-onset imbalance. At long-term follow-up, the number of patients with coronal imbalance had increased significantly ($p < 0.001$) to 19 (32.8%); 10 of these patients had not had coronal imbalance preoperatively. Sagittal balance improved significantly after surgery ($p < 0.05$). No significant deterioration in sagittal balance was observed between 6 weeks and 2–5 years after surgery ($p > 0.05$). Loss of correction associated with pseudarthrosis and implant failure occurred in 3 cases (5.2%).

Repeated-measures regression analysis identified osteoporosis, an anterior surgical approach, a history of revision surgery, lumbosacral curve magnitude, and postoperative L5 tilt as significant risk factors for postoperative coronal imbalance ($p < 0.05$).

Conclusions. Coronal decompensation develops in a substantial proportion of patients following surgical correction of spinal deformity. Although some patients regain coronal alignment, many experience gradual progression of coronal decompensation over time. When correction includes fusion of the lumbosacral region, particular attention should be paid to coronal tilt of L5. Patients with osteoporosis, those undergoing an anterior approach, those with a pronounced lumbosacral curve, and those undergoing revision deformity correction are at increased risk of coronal decompensation.

Keywords: adult spinal deformity; coronal imbalance; coronal alignment; surgical correction; long-segment fusion; risk factors; L5 tilt; osteoporosis.

Comparative Evaluation of Osteotomy Methods in Surgical Correction of Kyphotic Spinal Deformity in Patients with Ankylosing Spondylitis

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Background. Ankylosing spondylitis is a chronic inflammatory disease with a mean global prevalence of 23.8 cases per 10,000 population in Europe, 16.7 in Asia, 31.9 in North America, 10.2 in Latin America, and 7.4 in Africa [1]. In the Republic of Kazakhstan, according to official statistics of the Ministry of Health of the Republic of Kazakhstan, the disease prevalence is 19.1 cases per 100,000 population (2014), representing a 66% increase compared to 2010 [2]. At an advanced stage, the disease leads to rigid spinal hyperkyphosis, for which surgical treatment with osteotomies is the only method of correction. The choice between Smith-Petersen osteotomy (SPO), pedicle subtraction osteotomy (PSO), and Ponte osteotomy determines the achievable degree of correction.

Objective. To compare the effectiveness of kyphotic deformity correction using SPO, PSO, and Ponte osteotomy, based on our own experience of surgical treatment of 5 patients with ankylosing spondylitis.

Methods. The outcomes of surgical treatment of 5 patients (aged 32-47) with secondary kyphosis due to ankylosing spondylitis, operated on between 2018 and 2023 at the National Scientific Center for Traumatology and Orthopedics named after Academician N.D. Batpenov, were analyzed. All patients underwent posterior spinal fusion with Chm rod-system correction combined with SPO, PSO, and Ponte osteotomy. All patients were discharged with improvement.

Results. The greatest relative correction was achieved in patient No.4 (79.3° → 18.4°, 76.8%) with a combination of PSO Th8-Th9 and an extended Ponte osteotomy. The smallest was in patient No.3 (55.9%) with a combination of PSO and SPO. In patients with isolated use of Ponte osteotomy over an extended segment (patient No.5), correction was 65.8%, which is lower than when focal PSO was added (patients No.1, 2, 4 — 54.3-76.8%, on average higher when combined with PSO at the apex of the deformity).

Table 1. Radiographic correction by osteotomy strategy

No	Osteotomy method	Level	Angle before, °	Angle after, °	Correction, °	Correction, %
1	PSO Th7, Th10 + SPO L1-L2	Th3-L1	105	48	57	54.3
2	Ponte Th9-L4 + subtraction Th7-Th8	Th2-L4	103	45	58	56.3
3	PSO Th9, L2 + SPO Th6-Th7	—	99	43.7	55.3	55.9
4	PSO Th8-Th9 + Ponte Th11-L5	—	79.3	18.4	60.9	76.8
5	Ponte Th7-L3	—	90	30.8	59.2	65.8

Surgical Timing and Hospitalization. Surgeries were performed between 2018 and 2023. All five patients were discharged with clinical improvement. Surgical dates, discharge dates, and postoperative length of stay are shown in Table 2. The mean postoperative hospital stay was 14.2 days (range, 10–20 days).

Table 2. Surgical dates, discharge dates, and postoperative hospital stay

No	Surgery date	Discharge date	Bed-days post-op	Outcome
1	29.04.2021	11.05.2021	12	improved
2	19.10.2019	31.10.2019	12	improved
3	14.04.2022	01.05.2022	17	improved
4	09.02.2023	01.03.2023	20	improved
5	15.05.2018	25.05.2018	10	improved

The observed advantages and limitations of each osteotomy method are summarized in Table 3. SPO was used as an adjunct to PSO to distribute the correction and did not provide sufficient correction as a standalone procedure in this series. PSO provided focal correction at one or two levels, while Ponte osteotomy was used across longer segments and combined with focal PSO.

Table 3. Advantages and limitations of osteotomy methods in this case series

Method	Advantages (own data)	Disadvantages (own data)
Smith-Petersen (SPO)	Used as an adjunct to PSO to distribute correction; technically simple	Did not provide sufficient correction on its own in any case — used only in combination with PSO
Pedicle subtraction osteotomy (PSO)	Greatest correction at 1-2 levels; maximum correction achieved in patient No.4 (PSO+Ponte) — 76.8%	Applied only focally (1-2 vertebrae), as more extensive use is associated with greater surgical trauma
Ponte osteotomy	Used over long segments (Th7-L3, Th9-L4, Th11-L5); combined well with focal PSO	In isolation (patient No.5) correction was somewhat lower (65.8%) than when combined with PSO

Conclusions. The combination of an extended Ponte osteotomy with a focal pedicle subtraction osteotomy at the apex of the deformity provides the greatest degree of kyphosis correction (up to 76.8% in this series). Isolated Smith-Petersen osteotomy does not provide sufficient correction and is advisable only as an adjunct to PSO. The choice of combination of methods should be determined by the extent and degree of rigidity of the deformity. The mean postoperative hospital stay was 14.2 days, and all patients were discharged with improvement.

Keywords: ankylosing spondylitis; kyphotic spinal deformity; spinal osteotomy; pedicle subtraction osteotomy; Smith–Petersen osteotomy; Ponte osteotomy; deformity correction.

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Surgical Treatment of Cervical Disc Herniation Using Endoscopic Microdiscectomy

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Introduction. Cervical disc herniation is a common cause of chronic pain and cervical radiculopathy, which can substantially impair patients' quality of life. Although established surgical procedures, including anterior cervical discectomy and fusion (ACDF), are effective, they may be associated with complications and reduced mobility of the treated spinal segment. Minimally invasive endoscopic techniques have therefore attracted increasing interest.

Objective. To evaluate the efficacy and safety of endoscopic microdiscectomy for cervical disc herniation.

Methods. By December 2025, 40 patients with cervical disc herniation had undergone surgery. The cohort comprised 24 men and 16 women, with a mean age of 44.8 years. The most commonly affected levels were C5–C6 and C6–C7. In all cases, a uniportal endoscopic technique was used with an endoscope featuring a 5.5-mm working channel and a 15° viewing angle. Outcomes were assessed using the Visual Analogue Scale (VAS) and the Oswestry Disability Index (ODI).

Results. Mean operative time was 70 minutes, and mean intraoperative blood loss was approximately 50 mL, consistent with the minimally invasive nature of the procedure. Pain decreased substantially: the mean VAS score fell from 7.5 to 2.0, while the ODI decreased from 65% to 17%. These changes indicate improved functional status and ability to perform daily activities. The mean hospital stay was 3–4 days. Postoperative rehabilitation was shorter, and patients returned to work earlier. Endoscopic microdiscectomy was also reported to be associated with a lower frequency and severity of postoperative complications than conventional open surgery, which may be related to reduced soft-tissue injury. Overall, the findings support the clinical efficacy and safety of the technique.

Conclusions. **Endoscopic microdiscectomy is an effective and safe surgical option for cervical disc herniation. Its minimally invasive nature, low blood loss, and substantial reduction in pain support its potential use in clinical practice.**

Keywords: cervical spine; cervical disc herniation; endoscopic microdiscectomy; minimally invasive surgery; radiculopathy.

PELVIC AND HIP JOINT PATHOLOGY

Graf and DDH 45 Years Later: Where are We Now? Is the OX-DB-GRAF Method Truly New or Just an Evolution?

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Introduction. Graf's ultrasound method, introduced in 1980, remains the reference standard for detecting developmental dysplasia of the hip and underpins screening programmes across Europe. Forty five years later, no international consensus exists on the optimal screening strategy: universal ultrasound screening is established in at least six European countries, including Croatia, Austria, Germany, Bosnia and Herzegovina, Poland, Slovenia, and the Czech Republic, while many others rely on selective screening based on risk factors and clinical examination alone, and screening infrastructure in large parts of the world, including much of Central Asia, remains poorly described in

the literature. Persistent variability in technique and timing has been linked to continued late presentation rates even where national consensus statements exist.

The aim of this study was to determine whether the supine position could provide equivalent diagnostic accuracy to the standard lateral setup in Graf's technique, while simplifying the procedure and improving comfort for infants and parents, and to place the resulting OX-DB-GRAF method within the wider forty five year history of Graf's technique.

Methods. Three hundred infants, representing six hundred hips, aged zero to six months, underwent non selective developmental dysplasia of the hip screening at Children's Hospital Zagreb. Each infant was examined by two independent examiners using Graf's method, one in the supine position without a fixation device or assistant, and the other in the standard lateral position with a fixation device and an assistant. The order of examination was alternated to avoid bias related to irritability or fatigue. Infant distress was assessed by the examiner using a five point Visual Analogue Scale, and parental perception of the child's comfort was evaluated using a five point Likert scale.

Results. No statistically significant differences were found in Graf angles or hip classification between the two positions. Supine examination was faster, was associated with lower distress scores, and was associated with higher parental satisfaction. A positive correlation was observed between examiner rated distress and parent reported satisfaction, confirming consistency between clinical and parental assessment.

Conclusions. The supine position is diagnostically equivalent to the standard lateral position in Graf's method, while eliminating the need for a fixation device and an assistant. It simplifies the procedure, reduces infant distress, and improves parental experience. Considered against the forty five year international history of Graf's method and the continued absence of a unified global screening strategy, the OX-DB-GRAF method represents a practical evolution rather than a replacement of a diagnostic standard that remains as relevant today as it was in 1980, and these findings support its consideration in future screening protocols.

Keywords: Developmental Dysplasia of the Hip, Ultrasonography, Hip Joint, Infant, Neonatal Screening, Patient Positioning.

TRAUMATOLOGY AND INJURY SURGERY

Early Outcomes Following Single-Bundle Anterior Cruciate Ligament Reinsertion

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Introduction. Anterior cruciate ligament (ACL) injuries are among the most common orthopedic injuries in athletes. Although tendon autograft reconstruction remains an established approach to stabilizing the knee, contemporary surgical practice increasingly emphasizes preservation of native tissue, including through ACL reinsertion. This technique involves anatomically reattaching the injured ligament directly to its site of avulsion. This report reviews current experience with ACL reinsertion, focusing on indications, technical considerations, and long-term clinical outcomes.

Objective. To assess early functional outcomes after arthroscopic single-bundle ACL reinsertion.

Methods. From November 2025 to May 2026, a prospective study enrolled 12 patients with ACL injuries, predominantly proximal tears, sustained no more than one month before surgery. Knee function was assessed preoperatively and at 3 and 6 months postoperatively using the IKDC 2000 and Lysholm Knee Score scales.

Results. The study included 12 patients. The mean time from injury to surgery was 14 days, and all patients had predominantly proximal ACL avulsions. Concomitant intra-articular injuries included multiligament injuries,

including combined collateral ligament tears, in 17% of patients. An ACL injury was associated with a meniscal root avulsion in 8% of cases, requiring simultaneous anatomic refixation. No chondral defects were identified. Two patients (17%) required potent analgesics postoperatively. There were no cases of fixation failure or repeat ACL surgery. At 3 and 6 months, functional scores had improved significantly from baseline ($p < 0.04$), indicating an overall positive clinical course.

Conclusions. Although ACL reinsertion has several important clinical limitations as a method of knee stabilization, it is associated with statistically more favorable pain scores on the visual analogue scale (VAS) and a shorter postoperative rehabilitation period than conventional tendon autograft reconstruction.

Keywords: anterior cruciate ligament injury; reinsertion; arthroscopy; knee instability.

Our Approach to Shoulder Stabilization in Recurrent Instability and Recurrent Dislocation

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Introduction. Arthroscopic Bankart repair using suture anchors is a widely accepted treatment for shoulder instability when significant bone loss is absent. In the presence of substantial glenoid bone loss or a high predicted risk of recurrence according to validated scoring systems, bone augmentation procedures—particularly the Latarjet procedure—may be indicated. Despite advances in the treatment of recurrent shoulder dislocation and instability, challenges remain, including recurrent instability and postoperative complications. These include the development of osteoarthritis and bone-block resorption after bone augmentation, as well as contracture, restricted joint function, and incomplete functional recovery that may prevent patients from returning to full sporting activity.

These concerns are particularly relevant for athletes whose sports require the arm to be placed in extreme positions, and for patients with congenital or acquired capsular hyperlaxity.

The joint capsule, particularly the regions forming the glenohumeral ligaments, is an important component of the shoulder's stabilizing mechanism. The superior, middle, and inferior glenohumeral ligaments (SGHL, MGHL, and IGHL) are distinguished. The inferior glenohumeral ligament is the strongest and comprises anterior and posterior bands (AIGHL and PIGHL), which form a hammock-like support for the humeral head and stabilize the joint at its extremes of motion. In addition to providing mechanical stability, the capsuloligamentous structures contribute to proprioception and coordinated shoulder-girdle muscle function. Repeated overstretching and microtrauma during maximal arm abduction and rotation may lead to acquired capsular laxity or traumatic capsular injury. Anterior-inferior shoulder dislocations are also almost invariably associated with some degree of capsuloligamentous injury.

Objective. To evaluate the outcomes of surgical treatment in patients with recurrent shoulder dislocation.

Methods. This study draws on the experience of treating 45 patients with recurrent shoulder dislocation in the Arthroscopy Department of the Republican Specialized Scientific and Practical Medical Center of Traumatology and Orthopedics in Tashkent between 2022 and 2024. Patients were aged 16–32 years. The cohort included 38 men (84.4%) and 7 women (15.6%). Sixteen patients underwent Bankart repair (Group 1), and 29 underwent the Latarjet procedure (Group 2).

At initial presentation, all patients reported recurrent shoulder dislocations, dull joint pain, and atrophy of the shoulder and shoulder-girdle soft tissues. MRI was used to determine the location and size of glenoid labral lesions. Multislice computed tomography (MSCT) was used to assess bone loss involving the glenoid and humeral head.

In all patients selected for Bankart repair, imaging showed an anteroinferior glenoid labral detachment, a mild Hill–Sachs lesion, and a glenoid bone defect involving less than 20% of the glenoid surface. Surgery was performed under endotracheal anesthesia with the patient in the lateral decubitus position and the arm secured in a dedicated holder.

The Latarjet procedure was performed in patients with anterior or anteroinferior glenoid bone defects involving more than 20% of the glenoid surface, with or without an associated Hill–Sachs lesion, and in cases with a "pear-shaped" glenoid. MSCT of both the affected and contralateral shoulders was used to assess the extent of bone loss. The procedure involves transferring the coracoid process with its attached muscles to the defect at the anterior glenoid. This restores the missing bone and provides additional dynamic muscular support to help prevent further dislocation. The procedure's high success rate has been attributed to the "triple-blocking effect" described by Didier Patte.

Postoperatively, the arm was immobilized in a removable orthosis for four weeks. Therapeutic exercises to restore shoulder function began 8–10 days after surgery.

Results. No recurrent dislocations were observed. One patient experienced delayed wound healing. One patient who underwent the Latarjet procedure reported intermittent shoulder pain after an incorrect movement during early rehabilitation; the pain resolved within 60 days of surgery.

Conclusion. Surgical treatment was selected according to the following criteria. Bankart repair was used for an anteroinferior glenoid labral detachment, a mild Hill–Sachs lesion, and a glenoid bone defect involving less than 15–20% of the glenoid surface. The Latarjet procedure was indicated for anterior or anteroinferior glenoid defects involving more than 20% of the surface, with or without an associated Hill–Sachs lesion, and for a "pear-shaped" glenoid.

Keywords: recurrent shoulder instability; recurrent shoulder dislocation; Bankart repair; Latarjet procedure; glenoid bone loss; Hill–Sachs lesion.

The role of Transcutaneous Osteosynthesis in Modern Traumatology and Orthopedics

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Introduction. Transosseous osteosynthesis is one of the most effective methods for the treatment of fractures, deformities, and bone defects. The technique is based on the insertion of wires and pins through bone tissue followed by fixation using an external fixation device. The use of the Ilizarov apparatus makes it possible to correct deformities, lengthen limb segments, and replace bone defects. The major advantages of this method include stable fixation of bone fragments, preservation of bone blood supply, and the possibility of early functional weight-bearing, which contributes to accelerated patient rehabilitation.

Materials and Methods. Between 2024 and 2026, eight patients with tibial fractures underwent transosseous osteosynthesis using the Ilizarov apparatus in the surgical department of Zhaksy District Hospital. The study group included 7 men (87.5%) and 1 woman (12.5%). The mean age of the patients was 47.7 years. Fractures were located in the middle third of the tibia in 6 patients and in the distal third in 2 patients. Open fractures were observed in 6 (75.0%) patients, while closed fractures were diagnosed in 2 (25.0%) patients. The evaluated outcomes included fracture union time, restoration of limb weight-bearing function, and the incidence of postoperative complications.

Results. Fracture union was achieved in 7 (87.5%) patients. The mean consolidation period was 3.9 ± 0.8 months. Complete restoration of limb weight-bearing ability was observed in 7 (87.5%) patients. In one case (12.5%), soft tissue inflammation developed at the wire insertion site and was successfully managed with conservative treatment. An unsatisfactory treatment outcome was recorded in one patient due to non-compliance with postoperative recommendations and failure to attend follow-up examinations.

Conclusions. The obtained results demonstrate the high effectiveness of transosseous osteosynthesis in the treatment of complex tibial fractures, particularly open injuries. The method provides reliable fixation of bone fragments, preserves favorable biological conditions for reparative osteogenesis, and ensures good functional outcomes. Despite the need for prolonged treatment and meticulous care of wire insertion sites, transosseous

osteosynthesis remains an important technique in modern traumatology and orthopedics, especially for the management of open and complicated fractures.

Keywords: transosseous osteosynthesis, Ilizarov apparatus, tibial fractures, external fixation, traumatology, orthopedics.

Surgical Management of Long-Bone Fractures in Patients with Polytrauma

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Introduction. Long-bone fractures in patients with polytrauma require a treatment strategy that accounts not only for fracture type and location but also for the patient's overall condition, associated injuries, and risk of complications. Stable fixation may facilitate early mobilization and functional recovery, whereas delayed or inadequate treatment may increase the risk of delayed union, deformity, and restricted movement. The timing of surgery and subsequent rehabilitation also play an important role. Evaluating long-term outcomes after different treatment approaches is therefore essential to optimizing surgical management in patients with polytrauma.

Objective. To improve the outcomes of surgical treatment of long-bone fractures.

Methods. We analyzed the long-term outcomes of 160 patients with upper- and lower-limb long-bone fractures associated with multiple trauma. The patients were treated at the Department of Traumatology and Combined Trauma of the Shifobakhsh National Medical Center, Republic of Tajikistan, between 2024 and 2025. Most patients were young and of working age. The mean age was 25 ± 35 years. Road traffic accidents and falls from height accounted for the majority of injuries (76.7%). Pathological fractures accounted for 27.4% of cases. The cohort included 115 men (71.8%) and 45 women (28.2%).

Surgical treatment was performed in 98 patients (61.2%); 62 patients (38.8%) received conservative treatment, including skeletal traction, orthoses, braces, or casts. Surgical procedures included locked intramedullary nailing of the femur in 43 cases (43.8%) and the humerus in 25 (25.5%); plate fixation of the femur in 12 (12.3%) and the humerus in 8 (8.2%); and Ilizarov compression-distraction fixation of the femur in 6 (6.1%) and the humerus in 4 (4.1%).

Results. Retrospective statistical analysis indicated that surgical treatment may support early recovery of patients' functional capacity. Treatment outcomes and complications were associated with the treatment method, timing of surgery, fixation stability, and medical rehabilitation. Complications occurred in 8 surgically treated patients (8.1%), including postoperative wound infection (n = 2), metallosis-related granuloma (n = 4), and radial nerve neuritis (n = 2). Additional external immobilization was used in 26 surgical patients because of comminuted segmental fractures.

Among patients treated conservatively, complications were reported in 23 (37.1%): malunion in 11 (17.8%), nonunion in 3 (4.9%), limb deformity in 2 (3.2%), and persistent joint contracture in 7 (11.2%).

Conclusion. Early surgical treatment of long-bone fractures using modern fixation devices, combined with timely medical rehabilitation, may promote earlier mobilization and help patients return to their pre-injury social and daily activities.

Keywords: polytrauma; locked intramedullary nailing; reintegration.

Predicting the Risk of Osteoporotic Proximal Femoral Fractures using Frax in Elderly and Senile People

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Background. Among proximal femur fractures (PFF), which account for 1.6 million cases, femoral neck fractures (FNF) are the most common and severe. Approximately 90% of these fractures occur in the elderly due to low-energy trauma. FNF fractures account for approximately 6% of all fractures in humans. Osteoporosis is a strong risk factor for fragility fractures of the cervical spine. Diagnosing osteoporosis is most difficult in the early stages of the disease. Therefore, a growing number of diagnostic methods are being developed to identify risk groups and early bone loss in various population groups. Systems based on various clinical risk factors (FRAX, GARVAN, QFRACTURE, POL-RISK, etc.) have been developed to assess fracture risk. Among these systems, the FRAX (Fracture Risk Assessment Tool) system has become the most widely used. This is because specialists at the University of Sheffield developed this algorithm individually for 78 countries worldwide, including the Republic of Uzbekistan, taking into account population specifics, osteoporosis prevalence, and fracture epidemiology. The FRAX algorithm allows for an assessment of the 10-year risk of an osteoporotic fracture, screening tests, and a diagnosis of osteoporosis, which can then be used to prescribe drug therapy aimed at strengthening bones.

Purpose of the study. To evaluate, through cohort population screening, the FRAX system for predicting osteoporotic fractures in the elderly and senile population, as well as approaches to prevention and treatment of individuals at high fracture risk.

Methods. A total of 200 residents of the Khorezm region of the Republic of Uzbekistan and 54 patients who underwent surgical treatment for hip fractures using total hip arthroplasty and osteosynthesis options at the Republican Scientific Center for Emergency Medical Care of the Khorezm Regional Branch of the Ministry of Health of the Republic of Uzbekistan were examined using the FRAX instrument.

The study includes the results of cohort screening and patients with hip fractures, assessing the 10-year fracture risk using FRAX, assessing low, high, and very high fracture risk; indicators of the risk of complications after surgical treatment; and biochemical and laboratory blood parameters. A screening of 200 residents of a cohort population in the Khorezm region using the FRAX system revealed a high 10-year risk of osteoporotic fractures in 33%.

Results. The screening study revealed that of the 200 individuals, a high and very high risk of fragility fractures was identified: 2.5% in the 50-59 age groups, 13% in the 60-69 age groups, 9% in the 70-79 age groups, and 3.5% in the 80-90 age groups. Among men in two age groups (70-79 and 80-90), a high fracture risk was identified in only 1.5% and 3.5% of patients, respectively. Screening was highly effective in women aged 60-79. Of the 92 women, 44 (47.8%) were found to have a high or very high 10-year risk of fragility fractures.

It was established that patients with low-energy femoral neck fractures have a high to very high risk of 10-year osteoporotic fracture: major fractures in 76% of cases, and 64.7% of cases of low-energy femoral neck fractures.

Algorithms for screening approaches in a population-based study and for femoral neck fractures using the FRAX system were developed.

Conclusion. Thus, the FRAX system, as confirmed in our population, is effective as a basis for population screening to identify individuals at high and very high risk of fractures. Its use in primary care will enable timely treatment decisions to prevent fractures.

Keywords: FRAX; osteoporosis; proximal femoral fractures; femoral neck fracture; older adults; fracture risk assessment; population screening; fracture prevention.

Application of Minimally Invasive Osteosynthesis Techniques in the Management of Pelvic Fractures

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Background. The increasing incidence of pelvic fractures is closely associated with the expansion of high-speed transportation, high-rise construction, and industrial production. Both anterior and posterior pelvic ring structures are affected with comparable frequency. It is well established that primary attention should be directed toward restoring the anatomy of the posterior pelvis - a principle that applies both to pelvic stabilisation for control of intrapelvic haemorrhage and to restoration of the load-bearing function of the pelvic ring. Contemporary theoretical frameworks and clinical algorithms emphasise early, minimally invasive, and biomechanically stable fixation of the posterior pelvic ring as a primary treatment objective. The incidence of pubic ramus fractures is 6.9 per 100,000 in individuals under 60 years of age and 25.6 per 100,000 in patients aged 60 years or older. In younger patients, these injuries are most often caused by high-energy trauma and are frequently associated with concomitant injuries, significantly worsening the general condition and necessitating Damage Control principles with early pelvic stabilisation.

Aim. To evaluate the effectiveness of minimally invasive osteosynthesis in patients with pelvic fractures.

Methods. Between 2021 and 2025, 37 patients with pelvic fractures underwent minimally invasive osteosynthesis, including 25 men and 12 women (mean age 42.0±5 years; range 26-67 years). All patients with overt pelvic ring instability underwent initial stabilisation using rod-type external fixation devices (EFD). In selected cases, a Ganz pelvic C-clamp was additionally used for posterior ring stabilisation. In patients with equivocal instability, pelvic binders were applied or no immobilisation was performed. In the second stage, after haemodynamic stabilisation, definitive minimally invasive osteosynthesis of posterior pelvic ring fractures was performed using cannulated screws, while pubic bone fractures were stabilised with locking fixation devices. In polytrauma patients, injury severity was assessed using the Injury Severity Score (ISS) and AO/OTA classification. Of the total cohort, 32 patients (87.5%) had pelvic ring fractures as part of multiple or combined trauma; 3 patients (8.1%) had concomitant acetabular fractures; and 2 patients (5.4%) had open pelvic fractures. According to AO/OTA classification, type A fractures were identified in 1 patient (2.7%), type B in 16 (43.2%), and type C in 20 (54.3%). External fixation was applied in 30 patients (81.6%). Mechanisms of injury included falls from height (32.4%), road traffic accidents (59.5%), and occupational injuries (8.1%). Laparotomy was performed in 7 patients (18.9%) due to intra-abdominal injuries, and suprapubic cystostomy in 2 patients (5.4%) due to bladder injury. The mean time from admission to pubic bone fixation was 8.10±2.9 days (range 1-14 days), and the mean operative time was 38.5±17.3 minutes.

Results. Mean follow-up was 8.2±4.5 months (range 1-24 months). Mean ISS was 26.2±5.6 (range 12-40). At 6 months, the mean functional outcome score was 92.3±2.7. After implant removal and decompression, neurological complications were observed in 3 patients and resolved with conservative treatment without additional surgical intervention. No wound infection, implant migration, or secondary displacement was observed.

Conclusion. Minimally invasive osteosynthesis techniques in pelvic fractures provide adequate biomechanical stability of fracture fragments and enable early mobilisation and weight-bearing of the lower extremities. Furthermore, this approach allows reliable fracture consolidation and achieves excellent early functional outcomes of the musculoskeletal system.

Keywords: pelvic fractures; pelvic ring injuries; minimally invasive osteosynthesis; external fixation; percutaneous screw fixation; damage control orthopedics; polytrauma; functional outcomes.

The Role of Inflammatory Markers in Determining the Optimal Timing of Surgery for Femoral Fractures in Older Patients

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Background. Determining the optimal timing of surgery for femoral fractures in older and very old patients remains one of the most debated issues in modern traumatology. Performing surgery in the presence of a pronounced systemic inflammatory response increases the risk of infectious and medical complications, whereas an unjustified delay in surgical treatment can lead to poorer functional outcomes and increased mortality. Objective laboratory criteria that can help identify a safe period for surgery are therefore of particular interest.

Objective. To investigate the diagnostic and prognostic value of inflammatory markers in determining the safe timing of surgery in older and very old patients with femoral fractures.

Methods. The study analyzed treatment outcomes in 144 patients. C-reactive protein (CRP), interleukin-6 (IL-6), peripheral blood leukocyte count, and body temperature were assessed. Based on these findings, an algorithm was developed to determine a safe time window for surgery.

Results. The analysis showed that inflammatory markers were highly informative in predicting postoperative complications. IL-6 had the highest diagnostic value, with a sensitivity of 94%, specificity of 88%, and area under the ROC curve of 0.96. For CRP, the corresponding values were 89%, 92%, and 0.91. The sensitivity and specificity of the leukocyte count were 76% and 88%, respectively; those of body temperature were 72% and 90%. Use of the developed algorithm for selecting the timing of surgery reduced the incidence of postoperative complications by a factor of 1.7 compared with the standard approach and was associated with a more favorable postoperative course.

Conclusions. Comprehensive assessment of inflammatory markers can help objectively determine a patient's readiness for surgery, reduce the risk of infectious complications, and improve the effectiveness of surgical treatment for femoral fractures in older and very old patients.

Keywords: femoral fracture; older adults; interleukin-6; C-reactive protein; inflammatory markers; postoperative complications.

Corrective Tibial Osteotomy for Varus Deformity of the Leg Using an External Fixator

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Background. Varus deformity of the leg is a well-recognised cause of knee osteoarthritis, which is highly prevalent in individuals over 50 years of age, occurring in 30-50% of cases. Among the numerous aetiological factors underlying this condition, inadequate load distribution on the medial compartment of the knee joint is of primary importance. In approximately 77% of isolated knee joint pathology, the medial compartment is predominantly affected. Corrective osteotomy aims to normalise the angular relationship between the femur and tibia and, consequently, to restore optimal load distribution across the knee joint compartments. Osteotomy has a history of more than a century and, prior to the era of total knee arthroplasty, was the principal surgical method for correction of deformities, including in patients with gonarthrosis.

Objective. To evaluate the outcomes of corrective osteotomy for varus deformity of the lower extremities in patients with gonarthrosis.

Methods. Surgical treatment, follow-up, and radiographic evaluation were conducted in the trauma and orthopaedics department between 2023 and 2025. The study design was retrospective clinical. The study included 29

patients aged 37-52 years (27 women and 2 men) with bilateral varus deformity and gonarthrosis, all of whom underwent simultaneous bilateral surgery. The treatment protocol consisted of proximal tibial osteotomy with osteosynthesis using an external fixator, postoperative axis correction, and subsequent removal of the external fixator. In all cases, the Ilizarov method of corticotomy was used. Final limb alignment assessment was based on clinical examination and full-length standing radiographs with measurement of reference lines and angles. Rehabilitation was performed in three phases: phase one — walking with a walker; phase two — walking with crutches; phase three — independent walking without assistive devices. Evaluation was performed preoperatively and at 6-12 months postoperatively. Two parameters were used: mechanical axis deviation (MAD) and mechanical medial proximal tibial angle (mMPTA). MAD represents the deviation (in mm) of the mechanical axis of the lower limb from the centre of the knee joint. mMPTA is the angle between the tibial plateau joint surface and the mechanical axis of the tibia in the anteroposterior projection.

Results. Following correction, MAD and mMPTA values were restored to normal ranges in all patients, with statistically significant differences observed between pre- and postoperative values for both parameters. The mean duration of external fixation was 14.2±2.6 weeks (range 10.9-18.4 weeks). Pin and wire site inflammation was observed in 8 segments (27.5%) during follow-up. It should be noted that soft tissue inflammation at pin sites is the most common complication associated with external osteosynthesis; it is classified as a minor complication and does not affect the overall treatment outcome, although it may significantly reduce quality of life, particularly in elderly obese patients.

Conclusion. The use of external fixation devices in the treatment of patients with varus deformity of the lower extremities combined with gonarthrosis represents a technologically advanced surgical intervention aimed at normalising femorotibial alignment and optimising load distribution across the knee joint compartments. The advantages of this method make it highly competitive in orthopaedic practice and justify its wider application in this patient population.

Keywords: tibial varus deformity; corrective tibial osteotomy; external fixation; Ilizarov technique; knee osteoarthritis; mechanical axis deviation; mechanical medial proximal tibial angle.

PEDIATRIC TRAUMATOLOGY AND ORTHOPAEDICS

Assessment of Initial Experience with Low-Temperature Thermoplastic and 3D-Printed Ankle-Foot Orthoses in Children with Cerebral Palsy

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Introduction. Current orthotic management for children with spastic contractures is often ineffective, contributing to severe, irreversible secondary musculoskeletal complications during growth spurts. Data on the effectiveness of ankle-foot orthoses (AFOs) remain unsystematic, tools for assessing their mechanical and kinetic properties are inconsistent, and clear algorithms for orthosis selection based on age and functional level according to the WHO International Classification of Functioning, Disability and Health (ICF) are lacking.

Objective. To develop and evaluate an algorithm for lower-limb AFO management based on the individual ICF functioning level of patients, incorporating international lower-limb orthotics standards and the national characteristics of the Republic of Kazakhstan.

Methods. Design: prospective, single-arm, two-cohort pilot study (June 2024–June 2026) conducted at the ARDI and Ortotis-CA rehabilitation centers, Almaty, Kazakhstan. Sample: 66 children with spastic cerebral palsy, GMFCS I–III, aged 1–15 years (unilateral lesions, n=28; bilateral, n=38), divided into Group 1 (1–3 years, n=52, 82 feet) and Group 2 (over 3–16 years, n=14, 23 feet). Functional status was assessed via GMFCS and WHO ICF domains for muscle

tone and strength, standing, ambulation and gait-phase foot positioning, linked to the sagittal-plane Ankle Angle of the AFO (AA-AFO) and Shank-to-Vertical Angle of the AFO Footplate Complex (SVA-AFOFC); fear of falling was assessed via a caregiver questionnaire (domain d465). Scores were reassessed at 6 months (Group 1) and 6 weeks (Group 2). Group 1 received 82 solid low-temperature-thermoplastic AFOs (express technology, worn 12+ hours/day) targeting AA-AFO of −4 to +5 degrees. Group 2 received 23 3D-printed AFOs (HAFO, GRAFO and Spring AFO models per ISPO recommendations, worn 6+ daytime hours), targeting an SVA-AFOFC of 7–15 degrees forward incline, with combined AA-AFO/SVA-AFOFC targets in GMFCS III.

Results. Orthotic intervention reduced pathological tonic patterns and improved standing and walking posture in both groups. Standardized mean difference (SMD) values indicated meaningful improvement across ICF subdomains: muscle tone and strength (b7603), SMD 0.88 in Group 1 and 2.13 in Group 2; gait-phase foot positioning (b7350, b7300, b7100), SMD 0.26–0.88 in Group 1 and 0.35–1.14 in Group 2. Standing and walking function (d450) improved by SMD 0.21 (Group 1) and 0.64 (Group 2); fear of falling (b152) decreased by SMD 1.89 (Group 1) and 2.43 (Group 2), alongside socio-domestic gains such as more independent hand use during self-care. The 3D-printed orthoses improved dorsiflexion during foot swing and shifted the ground reaction force toward the knee-hip axis, improving stance stability.

Conclusions. A decrease of 1–3 points on WHO ICF qualifier scales across two or more subdomains confirmed the effectiveness of the proposed staged algorithm — low-temperature-thermoplastic solid AFOs followed by 3D-printed dynamic AFOs — in children with cerebral palsy. Target goals and outcome criteria should be differentiated by GMFCS level; in GMFCS III, orthoses alone cannot ensure independent long-term ambulation and serve only as a foundation for further gait skills. Instrumental computerized 3D gait analysis is planned for future follow-up assessment.

Ethics approval and conflict of interest. The study protocol was approved by the Ethics Committee .The authors declare no conflict of interest.

Keywords: Cerebral Palsy, Foot Orthoses, Printing, Three-Dimensional, International Classification of Functioning, Disability and Health, Gait, Child.

Clinical Efficacy of Individualized Staged Orthotic Management in Children with Spastic Diplegia Secondary to Cerebral Palsy

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Introduction. In the postoperative management of children with spastic cerebral palsy (CP), prolonged biomechanical support is critical for mitigating progressive contractures. Conventional off-the-shelf orthoses are often limited by poor anatomical congruency, which may induce pressure injuries and decrease patient adherence to therapy. Consequently, there is an urgent need to develop personalized systems that combine precision stabilization with the potential for dynamic adjustment.

Objective: To evaluate the clinical efficacy and safety profile of an original staged orthotic management protocol utilizing LTT in the postoperative rehabilitation of children with spastic diplegia.

Methods. A prospective study was conducted involving 50 children (aged 4–12 years), divided into two groups of 25 patients each. The groups were matched for gender, age, and GMFCS level. The study group utilized custom-molded modular LTT orthoses (protected by utility model applications and copyright certificates). The design featured a two-module system (ankle-foot and knee orthoses) equipped with a locking mechanism for rigid joint stabilization and a perforated structure. The control group utilized standard off-the-shelf orthoses. The follow-up period was 12 months, with monitoring via the Modified Ashworth Scale (MAS), goniometry, and functional mobility tests (10MWT, 6MWT, TUG). Comprehensive rehabilitation protocols were standardized for both cohorts.

Results. The study group achieved sustained reduction in spasticity (MAS: mean reduction from 3 to 1–1+ points, $p<0.001$), whereas spasticity remained resistant in the control group (2–3 points). Individualized molding significantly increased joint range of motion (11.0°–20.0° gain) compared to the control group (5.0°, $p<0.001$). Functional capacity improved significantly, with a median increase of 45.0 m in the 6MWT distance ($p<0.001$), substantially outperforming the control group (10.0 m). The high ergonomic profile of the original orthotic design minimized the risk of trophic complications; no statistically significant differences in skin reactions were observed between the cohorts ($p>0.05$).

Conclusions. The implementation of an interdisciplinary algorithm for staged LTT orthotic management provides reliable stabilization of the lower extremities and facilitates effective "remodeling" of motor functions. Precise anatomical adaptation of these modules allows for the successful management of soft tissue retraction, ensuring the long-term preservation of surgical outcomes. This methodology represents a highly effective alternative to standardized orthoses and is recommended for widespread integration into neuro-orthopedic practice.

Keywords: cerebral palsy, spastic diplegia, neuro-orthopedics, staged orthotic management, low-temperature thermoplastic, postoperative rehabilitation.

Surgical Treatment of Elbow Joint Contracture in Children with Neglected Fractures of the Lateral Humeral Condyle

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Traumatic contractures are classified according to the tissue predominantly involved in their development into arthrogenic, myogenic, dermato-desmogenic, and neurogenic types. Restricted joint mobility is both the principal complaint of patients (and their parents) and the main clinical manifestation of neglected and nonunited fractures of the lateral humeral condyle. Contracture following lateral humeral condyle fractures ranks second in frequency after contractures associated with supracondylar and transcondylar fractures of the humerus.

The pathogenesis of joint contractures involves pathological anatomical changes in the articular surfaces themselves, including incongruity resulting from fragment displacement, hyperplasia (relative increase in cartilage thickness), cartilage ulceration or necrosis, changes within the joint cavity (fibrous adhesions and scar formation), alterations in the capsuloligamentous structures (capsular contracture), extra-articular changes involving periarticular tissues, transformation of a painful contracture into a habitual reflex contracture due to prolonged muscle spasm, impaired mobility of muscle tissue caused by the formation of a “third point” of attachment, disturbances in tendon-gliding mechanisms, and the development of heterotopic ossifications.

In our patients, the main factors contributing to the development of elbow joint contractures were disruption of articular congruity, injury to the lateral portion of the trochlea, and detachment of the trochlear cartilage during fractures of the lateral humeral condyle. Post-traumatic enlargement of the epiphysis, which we associate with increased activity of the growth plate, was one of the major causes of joint stiffness and narrowing of the joint space. In these patients, the contracture exhibited a typical post-traumatic arthrogenic pattern. Radiographic and multislice computed tomography (MSCT) examinations revealed thickening of the distal humerus, sharpening of the articular end, narrowing and irregularity of the joint space, deformity, flattening of the capitellum, premature closure of the growth plate, and other pathological changes.

Surgical treatment was performed in 34 patients with malunited or nonunited fractures of the lateral humeral condyle. The majority of patients were admitted within three months after injury. In patients presenting long after the initial trauma, elbow arthrolysis was performed in 6 cases, whereas the remaining 28 patients underwent metal

osteosynthesis of the lateral humeral condyle. The six patients treated with elbow arthrolysis sought medical attention one year or more after the injury. Five of these patients were aged 11–14 years, while one patient was a 5-year-old girl.

Outcomes were assessed in all 34 patients with malunited lateral humeral condyle fractures. According to the long-term follow-up evaluation, the results were classified as follows: good in 22 patients (64.7%), satisfactory in 10 patients (29.4%), and unsatisfactory in 2 patients (5.9%).

Keywords: elbow joint contracture; lateral humeral condyle fracture; neglected fracture; children; elbow arthrolysis; osteosynthesis.

First Experience of Knee Arthroscopy in Adolescents

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Introduction. According to various authors, knee injuries in children and adolescents rank among the most common types of musculoskeletal injuries, accounting for 15-25% of the total. This is precisely why the knee joint is the focus of the greatest attention in paediatric traumatology, as the high number of injuries-due to children's high mobility and their active participation in sport-leads to an increased incidence of injuries in this area. X-ray diagnosis provides limited information; imaging techniques such as computed tomography (CT) do not provide a comprehensive assessment of the pathology, and the interpretation of the knee joint structures and their condition is often based on criteria applicable to adults. Magnetic resonance imaging (MRI) is currently one of the main diagnostic methods for knee joint disorders. This non-invasive method enables the detection of more than 90 per cent of meniscus injuries.

Objective: To improve the diagnosis and treatment of knee joint injuries in adolescents using arthroscopy

Methods. Seven arthroscopic operations were performed at the Regional Children's Hospital in the Turkestan Region to address the consequences of injuries and diseases of the knee joint. Of these, six were boys and one was a girl, aged between 15 and 17 years. The indication for surgery was based on medical history, clinical findings and MRI results, which revealed a medial meniscus tear in 5 cases, a lateral meniscus tear in 1 case, and a disease of the synovial membrane – «pigmentary villonodular synovitis», which is a rare benign joint disorder but one characterised by locally aggressive behaviour.

Results. During arthroscopic surgery, out of six cases of meniscal injury, a tear of the medial meniscus was confirmed in two cases, and a tear of the lateral meniscus in one case. In the remaining three cases, no meniscal injury was diagnosed. In two cases, thickening of the medio-patellar ligament was observed; the ligament was removed using a shaver and a vaporiser. In one case, Hoffa's disease was diagnosed, and the fat bodies were removed. In terms of treatment strategies for meniscal injuries, we favoured preserving the integrity of the meniscus in order to prevent the early development of osteoarthritis. There was considerable interest in the surgical treatment of pigmented villonodular synovitis, a condition in which the tissue inside the joint begins to proliferate significantly; in such cases, we performed arthroscopic synovectomy followed by anti-inflammatory treatment.

Conclusion. Arthroscopy is the primary surgical treatment for injuries to joint structures and conditions where a definitive diagnosis can be made and therapeutic measures implemented. MRI also offers a high diagnostic accuracy for injuries; however, discrepancies may arise during arthroscopy due to various factors, including technical issues and differences in the interpretation of the data obtained.

Keywords: knee arthroscopy; adolescents; knee injuries; meniscal tears; pigmented villonodular synovitis; magnetic resonance imaging.

The Ilizarov Method in the Treatment of Post-Osteomyelitic Tibial Defects in Children: A Clinical Analysis

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Introduction. Post-traumatic and post-osteomyelitic bone defects in children represent one of the most challenging problems in pediatric orthopedics. Open fractures complicated by osteomyelitis cause significant bone tissue destruction. Restoring the integrity of the lower extremity, especially in cases of tibial diaphysis defects, requires prolonged surgical treatment. Consequently, bone transplantation, distraction osteogenesis, and transosseous osteosynthesis are widely utilized.

This study aims to analyze the efficacy of surgical treatment for such defects in children based on three clinical cases.

Methods. The study included 3 children with post-traumatic lower extremity bone defects after multiple surgeries. Patient A.S. (5 years old): tibial diaphysis defect, chronic osteomyelitis in remission; underwent Ilizarov osteosynthesis and fibular transposition. Patient T.A. (8 years old): neglected fractures, osteomyelitic tibial defect (7 cm), soft tissue and nerve injuries; underwent necrectomy, autotransplantation, skin grafting, and Ilizarov fixation. Patient M.K. (11 years old): tibial defect (5 cm), soft tissue scarring; underwent debridement, autografting, and Ilizarov fixation. Time to consolidation, limb length restoration, complications, and SF-36 scores were evaluated.

Results. Positive outcomes were achieved in all 3 patients: the average time to graft consolidation was 7 months, and limb length was fully restored (3 out of 3 patients). Despite a history of chronic osteomyelitis, the rate of infectious complications was 0%. Quality of life based on the SF-36 scale improved by 65%. Dynamic radiography confirmed adequate graft incorporation and the absence of osteomyelitis recurrence.

Discussion. The results confirm the high efficacy of combined treatment for tibial defects in children. Autologous fibular and bone transplantation combined with Ilizarov apparatus fixation restores both the anatomical integrity and functionality of the segment. This method is safe for complex post-osteomyelitic defects. Fibular transposition and autografting are preferable for extensive injuries as they ensure mechanical strength, eliminate the need for synthetic implants, and reduce the risk of graft resorption.

Conclusion. The comprehensive surgical approach (necrectomy, autologous bone transposition/grafting, and Ilizarov apparatus fixation) enabled complete reconstruction of severe bone defects in children. The method demonstrated high clinical efficacy, restoring the anatomical structure and limb functions. The implementation of this technique into practice can significantly improve the quality of treatment for this category of patients.

Keywords: pediatric bone defects; tibial defect; chronic osteomyelitis; fibular transposition; autologous bone grafting; Ilizarov technique; limb reconstruction; SF-36.

Classification of Proximal Femoral Deformities in Children with Avascular Necrosis of the Femoral Head and Rationale for Surgical Strategy

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Introduction. Avascular necrosis of the femoral head (AVN), developing after treatment of developmental dislocation of the hip, remains one of the most challenging problems in pediatric orthopedics. Salter et al. demonstrated that excessive hip abduction and rotation can compress the medial circumflex femoral vessels. Impaired

growth and development of the proximal femur are associated with premature closure of the growth plate, either across its entire extent or in a particular region, following closed reduction of developmental hip dislocation. These abnormalities may lead to articular cartilage destruction and, consequently, dysplastic coxarthrosis. The lack of a standardized approach creates methodological difficulties in comparing study outcomes and establishing indications for reconstructive surgery. Accordingly, there is a need for a classification that accounts for the morphological and biomechanical features of proximal femoral deformities and supports the selection of an appropriate corrective procedure.

Objective. To develop a clinical and functional classification of proximal femoral deformities in children with AVN of the femoral head and assess its value in selecting a surgical strategy.

Methods. The study included 100 patients aged 3–18 years with proximal femoral deformities resulting from AVN of the femoral head after treatment of developmental hip dislocation. The patients were treated at the Department of Hip Joint Disorders of the Republican Center of Pediatric Orthopedics, Ministry of Health of the Republic of Uzbekistan, between 2010 and 2025. The assessment included clinical examination, radiography, radiographic measurements, magnetic resonance imaging (MRI), multislice computed tomography (MSCT), and statistical analysis. Patients were evaluated before surgery, immediately after surgery, and at 1.5, 3, and 6 months postoperatively. Functional outcomes were assessed using the Harris Hip Score.

Results. A classification comprising four deformity types was developed. The classification considers femoral head shape and structure, the condition of the femoral neck, the position of the greater trochanter, and the degree of femoral head containment within the acetabulum. Unlike the Kalamchi–MacEwen classification, the proposed system accounts for secondary deformities, reflects biomechanical features, and is designed to guide surgical decision-making. Treatment outcomes were significantly associated with deformity type ($p < 0.01$).

Based on a comprehensive analysis, four deformity types were identified: Type I (n = 24), femoral head deformity without substantial femoral neck involvement; Type II (n = 32), femoral head deformity combined with femoral neck shortening and/or coxa vara; Type III (n = 28), deformity of the femoral head and neck with a high-riding greater trochanter; and Type IV (n = 16), multicomponent deformity with femoral head decentration or subluxation.

Surgical procedures were selected according to deformity type: joint-preserving femoral head reshaping procedures for Type I; corrective femoral osteotomies for Type II; osteotomies combined with correction of the greater trochanter position for Type III; and combined reconstructive procedures for Type IV. This differentiated approach helped restore the center of rotation, improve load distribution, reduce the severity of limping, and improve hip function. The best outcomes were observed in patients with Type I and II deformities, while residual impairment remained a risk in Type IV cases. Functional scores improved from 56.3 ± 8.7 to 82.4 ± 9.1 points ($p < 0.001$).

Conclusion. Proximal femoral deformities associated with AVN of the femoral head are multifactorial and involve substantial structural abnormalities. The proposed classification systematizes these deformities according to their clinical and functional significance and supports the selection of an appropriate surgical treatment. Classifying deformities into the four types described above, based on the location of damage to the femoral head ossification nucleus and the femoral neck growth plate, may help predict hip development during the first year after reduction. It also supports an individualized approach to comprehensive treatment, including determination of the optimal femoral position to achieve maximal containment, treatment timing, and indications for surgery—such as containment-enhancing corrective femoral osteotomy, epiphysiodesis, or distalization of the greater trochanter—in light of the anticipated progression of deformity. A differentiated surgical approach improves anatomical and functional outcomes.

Keywords: avascular necrosis of the femoral head; proximal femoral deformity; developmental dislocation of the hip; pediatric orthopedics; classification; corrective femoral osteotomy; greater trochanter; hip containment.

Surgical Treatment of Congenital Contracture of the Gluteus Maximus Tendons in Children

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Introduction. Congenital contracture of the tendons of the gluteus maximus muscles in children is a rare condition characterised by the occurrence of a «clicking» sound when the hip is flexed at the hip joint with external rotation and abduction, and by the repetition of the «click» as the hip returns to its initial position, creating the false impression of «dislocation» and «reduction» of the femoral head. Fibrosis and tension in the iliotibial tract are accompanied by a characteristic «clicking» sound, which necessitates careful differentiation from congenital hip dislocation. Congenital contracture of the gluteus maximus tendons in children has been described under various names: «gluteal fibrosis», «clicking hip» and «hyperextension-abduction contracture of the hip joint», and remains one of the least studied problems in pediatric orthopedics.

Objective: to improve the outcomes of surgical treatment for congenital contracture of the gluteus maximus tendon.

Methods. This study is based on the results of the diagnosis and treatment of 25 patients with this condition, aged between 2 and 13 years, who underwent surgical treatment in the Department of Traumatology and Orthopaedics at the Regional Children's Hospital in the Turkestan Region between 2019 and 2025. The parents of the children who underwent surgery signed a voluntary informed consent form authorising the processing of data relating to their treatment for scientific purposes. The largest number of children were aged 2–6 years – 13 children (52%). This is because greater attention has come to be paid to the diagnosis of this condition; followed by those aged 7–10 years – 8 (32%) and 11–13 years – 4 (16%).

Results. Among the children who underwent surgery, there were 15 boys (60%) and 10 girls (40%); 17 (68%) had unilateral pathology and 8 (32%) had bilateral pathology; All patients underwent elective surgery under general anaesthesia with endotracheal intubation. Surgical technique. The patient is positioned on their side. Along the projection of the greater trochanter, the broad fascia of the thigh is exposed via a longitudinal or semi-oval incision, and the 'clicking' area is identified intraoperatively. In the space between the gluteus maximus muscle and the tensor fasciae latae muscle, the broad fascia is incised and the altered synovial bursa of the greater trochanter is excised. In cases of marked fibrosis and tension in the iliotibial tract, the tendon of the tensor fasciae latae is transected transversely at the level of the greater trochanter; the proximal segment is dissected and sutured without tension to the gluteus maximus muscle, thereby freeing the greater trochanter. Test movements are performed in the hip joint to check for «clicking»; if no «clicking» is detected, the wound is sutured layer by layer. The leg is placed on a Beller splint and immobilised in a position of moderate abduction. After 4 weeks, patients are required to undergo a course of rehabilitation therapy to restore joint function. No recurrences of the condition have been observed.

Conclusion. Thus, the mandatory elimination of all factors involved in the pathological process, combined with appropriate rehabilitation treatment, enables the best possible treatment outcomes to be achieved and improves children's quality of life.

Keywords: congenital gluteus maximus tendon contracture; snapping hip; iliotibial tract; children; surgical treatment; rehabilitation.

ARTHROSCOPY AND MINIMALLY INVASIVE SURGERY

Diagnostic Significance of Radiological Changes in Discoid Meniscus and Outcomes of Arthroscopic Treatment

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Introduction. Discoid meniscus is a congenital developmental anomaly characterized by the formation of a disc-shaped meniscus instead of the normal semilunar shape. This pathology most commonly affects the lateral meniscus and usually begins to manifest clinically during childhood and adolescence. 1Active sports activities contribute to meniscal injury, leading to biomechanical alterations of the joint and the development of degenerative processes.

Objective. To study the clinical manifestations of discoid meniscus, modern surgical treatment methods, and the development of radiological changes from the onset of clinical symptoms.2

Methods. The study was conducted based on data from 32 patients diagnosed with discoid meniscus and treated arthroscopically at the Republican Specialized Scientific and Practical Medical Center of Traumatology and Orthopedics. The study had a prospective design, and patients' clinical, radiological, and magnetic resonance imaging (MRI) findings were analyzed. The age of the patients ranged from 4 to 28 years; 17 were males and 15 were females. Among the 32 patients, 29 had lateral discoid meniscus and 3 had medial discoid meniscus. In one of the cases with medial meniscus involvement, the pathology was bilateral. All patients underwent radiography and MRI before surgery. MRI findings demonstrated that 4 patients with symptomatic discoid meniscus had no significant structural changes in the meniscal body, whereas radiological signs were clearly evident in the remaining 28 patients with meniscal injury and degenerative changes.

Results. Radiological examination revealed widening of the joint space on the side of the discoid meniscus, narrowing of the space between the tibial eminences and the lateral and medial femoral condyles, flattening of the articular surface of the lateral femoral condyle, and signs of sclerosis in the subchondral region of the tibial articular surface. These findings were observed more frequently in patients with meniscal injuries.

At one month after surgery, a significant reduction in knee pain was noted in the majority of patients. The mean VAS score was +4.5 before surgery and increased to +7.6 postoperatively. After two months of a specialized rehabilitation program, full restoration of knee joint range of motion was achieved in all patients, although pain syndrome persisted in 4 patients.

According to the six-month follow-up results, periodic knee pain persisted in 2 of the 32 patients. Radiological examination of these patients revealed osteochondral and degenerative changes, suggesting that the persistence of pain was associated with these pathological findings.

Conclusion. Radiological changes in discoid meniscus are closely associated with the degree of structural meniscal damage. Narrowing of the joint space, flattening of the femoral condyle, and the presence of subchondral sclerosis are important diagnostic indicators of the disease. Arthroscopic treatment combined with stepwise rehabilitation provided favorable functional outcomes in the majority of patients.

Keywords: discoid meniscus, radiography, MRI, arthroscopy.

Computer-Navigated Knee Arthroplasty Data-Base Analysis: Phenotypes and Deformation

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Introduction. Coronal alignment and joint-line obliquity vary between patients undergoing total knee arthroplasty (TKA), and the degree of preoperative deformity can influence bone resection and soft-tissue balancing. The Coronal Plane Alignment of the Knee (CPAK) classification describes knee phenotypes using arithmetic hip–knee–ankle angle and joint-line obliquity, providing a framework for characterizing this variation. Computer navigation enables quantitative intraoperative assessment of limb alignment and correction. Analysis of large navigation datasets may therefore help clarify the patterns of preoperative and residual deformity, the contribution of soft-tissue release to correction, and the distribution of CPAK phenotypes in patients undergoing TKA.

Objective. To evaluate a large navigation database of TKA procedures, focusing on preoperative and residual coronal deformities, the role of soft-tissue release in alignment correction, and the distribution of knee phenotypes according to the CPAK classification.

Methods. A retrospective single-center study included 941 TKAs performed using Stryker Navigation between 2008 and 2024. The analyzed parameters comprised coronal alignment, maximum extension and flexion, bone resection measurements, and calculated intraoperative angles (MPTA, LDFA, aHKA, and JLO). A simplified model was applied to estimate the relative contributions of bone resections and soft-tissue release to frontal plane deformity correction. Baseline knee alignment data were subsequently mapped to the CPAK classification.

Results. Varus deformity was the predominant pattern (91%), in agreement with previously reported epidemiological findings. A significant positive correlation was observed between the severity of varus deformity and flexion contracture ($r = 0.25$, $p < 0.001$). In the majority of cases, postoperative mechanical alignment was restored within ±2°, demonstrating the high accuracy of computer navigation. The magnitude of medial soft-tissue release increased progressively with deformity severity and was greatest in knees presenting with varus alignment greater than 15°. The distribution of CPAK phenotypes differed substantially from that reported in radiographic studies, which may be attributable to the use of intraoperative navigation-based measurements.

Conclusion. Navigation-derived data provide valuable quantitative insight into the interplay between deformity correction, bone resection, and soft-tissue balancing. Computer navigation remains a highly accurate and reproducible method for achieving coronal alignment correction, while its integration with robotic technologies may further facilitate individualized alignment strategies in TKA.

Keywords: total knee arthroplasty, computer navigation, CPAK, coronal deformity, soft-tissue release, varus, valgus.

DEFORMITIES AND PATHOLOGY OF THE LIMBS

Surgical Correction of Lower-Limb Deformities in Young Adults: Aesthetic or Orthopedic?

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Background. Lower-limb deformities are a common reason for young adults to seek specialized orthopedic care. Although patients are often primarily concerned about the appearance of their legs, mechanical-axis deformities may

also impair gait biomechanics, increase joint loading, and raise the risk of degenerative changes. Determining the relative importance of aesthetic and orthopedic factors is therefore essential when selecting a surgical treatment strategy.

Objective. To assess the functional and aesthetic outcomes of surgical correction of lower-limb deformities in young patients.

Methods. We retrospectively analyzed treatment outcomes in 450 patients aged 18–35 years with lower-limb deformities. Based on deformity severity and the primary indication for surgery, patients were divided into three groups: Group I included 180 patients (40%) with predominantly aesthetic concerns and minor mechanical-axis deviations; Group II included 190 (42.2%) with moderate deformities and functional symptoms, including easy fatigability, discomfort while walking, and pain after physical activity; and Group III included 80 (17.8%) with severe deformities and objectively confirmed biomechanical impairment. All patients underwent a clinical examination, lower-limb radiography with assessment of the mechanical axis, and a questionnaire-based assessment of functional and aesthetic satisfaction after treatment.

Results. Restoration of the normal mechanical axis was achieved in 432 patients (96%). Functional symptoms decreased or resolved completely in 287 of the 270 patients in Groups II and III (84.4%). High satisfaction with the aesthetic outcome was reported by 414 patients (92%). Further analysis showed that 118 patients in Group I (65.6%) had preoperative functional impairments that they had not previously recognized as orthopedic problems. Overall satisfaction with treatment was 94.2%.

Conclusions. Surgical correction of lower-limb deformities in young adults has both aesthetic and orthopedic value. Even among patients seeking treatment for cosmetic reasons, functional impairments requiring orthopedic correction may be present. Restoring proper limb alignment can improve lower-limb biomechanics and quality of life while also providing a high level of aesthetic satisfaction.

Keywords: lower-limb deformities; young adults; surgical correction; lower-limb mechanical axis; gait biomechanics; aesthetic satisfaction.

Modern Approaches to the Diagnosis of Synovial Chondromatosis of the Knee

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Introduction. Synovial chondromatosis is a rare benign condition in which cartilaginous nodules form in the synovial membrane. As the disease progresses, these nodules may detach and become intra-articular loose bodies. The knee is the joint most commonly affected. Clinical manifestations—including pain, swelling, restricted range of motion, and episodes of mechanical locking—are nonspecific and may also occur in other joint disorders.

Diagnosis can be challenging in the early stages, when the cartilaginous bodies have not yet calcified and may therefore be invisible on radiographs. Magnetic resonance imaging (MRI) can detect these bodies and assess the synovial membrane and surrounding joint structures, while computed tomography (CT) provides detailed visualization of calcification and ossification. Arthroscopy enables direct visualization of intra-articular changes and allows tissue sampling for histological examination. Accordingly, combining clinical, imaging, arthroscopic, and histological methods is important for confirming the diagnosis and determining the extent of disease.

Objective. To evaluate the diagnostic performance of contemporary methods for investigating synovial chondromatosis of the knee, including imaging and arthroscopic visualization, and to determine their diagnostic yield and role in confirming the diagnosis.

Methods. A comprehensive assessment of clinical and instrumental findings was performed in patients with synovial chondromatosis of the knee. The diagnostic algorithm included clinical examination, radiography, ultrasonography, MRI, CT, and diagnostic arthroscopy. The number, size, and distribution of intra-articular

cartilaginous bodies were assessed, along with the condition of the synovial membrane, articular cartilage, and subchondral bone.

During arthroscopy, intra-articular structures were directly visualized. The assessment included the extent and distribution of synovial metaplasia; the number and location of cartilaginous bodies; their mobility; and their relationship to the synovial membrane. Abnormal tissues and formations removed during surgery were subsequently examined histologically to confirm the diagnosis.

Results. The clinical presentation of synovial chondromatosis of the knee was characterized by pain, intermittent joint swelling, restricted range of motion, and, in some cases, a sensation of mechanical locking. The most informative radiographic findings were multiple round or oval intra-articular bodies with varying degrees of calcification. MRI detected both calcified and non-calcified cartilaginous bodies, determined their number and location, and assessed the synovial membrane, articular cartilage, and subchondral bone. CT was highly informative for detecting calcified and ossified intra-articular bodies.

Arthroscopy enabled direct visualization of the abnormal synovial membrane and intra-articular cartilaginous bodies, including those without marked calcification that may be difficult to detect on standard radiographs. Arthroscopic examination also established the number, size, shape, and location of the bodies and the extent of articular cartilage involvement. Material obtained during arthroscopy enabled histological confirmation of the diagnosis.

Conclusion. The diagnostic evaluation of synovial chondromatosis of the knee should take into account the combined findings from clinical examination, imaging, arthroscopy, and histological confirmation. Radiography is effective for detecting intra-articular bodies with evidence of calcification or ossification. MRI is highly valuable for detecting non-calcified cartilaginous bodies and assessing the synovial membrane and articular cartilage. CT provides more detailed visualization of the structure and degree of mineralization of abnormal formations.

Arthroscopy allows direct examination of intra-articular structures and assessment of the nature and extent of pathological changes. When indicated, it also permits biopsy or removal of abnormal tissue for subsequent histological examination. Thus, combining diagnostic methods can improve diagnostic accuracy, clarify the stage and extent of disease, and support informed selection of further treatment.

Keywords: synovial chondromatosis; knee; diagnosis; diagnostic imaging; magnetic resonance imaging; computed tomography; arthroscopy; histological confirmation.

Medialization of the Distal Fragment in the Correction of Tibial Varus Deformity: Functional and Aesthetic Significance

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Background. Correction of tibial varus deformity aims not only to restore the mechanical axis of the lower limb but also to achieve an optimal aesthetic outcome. In recent years, patient satisfaction with the appearance of the lower limbs has become an important measure of treatment effectiveness. Medialization of the distal fragment during corrective osteotomy is one approach to improving the aesthetic result.

Objective. To assess the effect of distal fragment medialization on the functional and aesthetic outcomes of surgical correction of tibial varus deformity.

Methods. We conducted a retrospective analysis of treatment outcomes in 450 patients with tibial varus deformity who underwent corrective osteotomy. Patients were divided into two groups. The study group included 360 patients (80%) who underwent distal fragment medialization during deformity correction. The control group comprised 90 patients (20%) whose deformity was corrected without medialization. Outcomes were assessed by

clinical examination, radiographic measurements, analysis of the limb mechanical axis, and patient questionnaires on satisfaction with the aesthetic result.

Results. Adequate correction of the lower-limb axis was achieved in both groups. However, patients in the study group reported greater satisfaction with the aesthetic outcome, associated with a more harmonious contour of the lower leg and reduced residual lateral soft-tissue prominence. Most patients who underwent medialization reported a high level of satisfaction. In the control group, approximately 20% of patients were only moderately satisfied with the outcome despite successful orthopedic correction. This was mainly associated with persistent aesthetic features of the lower-leg shape.

Conclusions. Medialization of the distal fragment in the correction of tibial varus deformity can restore proper segment alignment and substantially improve the aesthetic outcome. The technique may increase patient satisfaction and should be considered an important part of preoperative planning, particularly for younger patients with high aesthetic expectations.

Keywords: tibial varus deformity; corrective osteotomy; distal fragment medialization; lower-limb alignment; mechanical axis; aesthetic outcome; patient satisfaction.

Assessment of Core Decompression Combined with Stromal Vascular Fraction in Patients with Osteonecrosis of the Femoral Head

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Background. Treatment of osteonecrosis of the femoral head (ONFH) at early stages (ARCO stages II–III) remains a major challenge in modern orthopedics. The search for effective joint-preserving procedures that can slow bone destruction and delay total hip arthroplasty (THA) has led to the increasing use of cell-based therapies combined with conventional core decompression.

Objective. To assess the medium-term (5-year) clinical and functional outcomes of femoral head core decompression combined with stromal vascular fraction (SVF) injection in patients with stage II–III ONFH.

Methods. We analyzed treatment outcomes for 68 hip joints in patients aged 30–60 years with stage II–III ONFH according to the ARCO classification. All patients underwent femoral head core decompression followed by SVF injection. Pain intensity was assessed using the visual analogue scale (VAS) before surgery and over the 5-year postoperative follow-up period.

Results. The mean preoperative VAS pain score was 7.4. At 5 years after surgery, the mean pain score across the cohort had decreased to 3.1, representing an overall reduction of 4.3 points and indicating a sustained clinical benefit. At 5 years, the joint-preservation rate was 95.6% (65 hip joints). Disease progression and an unsatisfactory outcome requiring subsequent THA between 2 and 5 years after surgery occurred in 4.4% of cases (3 hip joints): one in a 36-year-old man with ARCO stage II disease and two in women aged 42 and 50 years with ARCO stage III disease.

Conclusions. The combined approach of mechanical decompression of the necrotic lesion (core drilling) and biological stimulation of regeneration using SVF is an effective joint-preserving treatment for stage II–III ONFH. It can substantially relieve pain and prevent or considerably delay the need for THA in 95.6% of treated hip joints over 5 years of follow-up.

Keywords: osteonecrosis of the femoral head; avascular necrosis; core decompression; stromal vascular fraction; ARCO classification; joint-preserving surgery; total hip arthroplasty.

BUGS AND COMPLICATIONS

Early Periprosthetic Joint Infection: Outcomes of Dair in a Specialized Bone and Joint Infection Center

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Introduction. Periprosthetic joint infection (PJI) remains one of the most serious complications of total joint arthroplasty and is a leading cause of revision surgery. In acute PJI, debridement, antibiotics, and implant retention (DAIR) is considered the preferred implant-preserving treatment strategy before maturation of bacterial biofilm. However, treatment success remains highly variable, ranging from 30% to 80%, and largely depends on patient selection, microbiological factors, and timing of surgical intervention.

Objective. To evaluate the clinical outcomes of DAIR for acute periprosthetic joint infection and to analyze factors potentially influencing treatment success in a specialized referral center.

Methods. A retrospective analysis was performed in a tertiary bone and joint infection center. Between 2020 and 2025, 2,488 primary and revision hip and knee arthroplasties were performed. Acute PJI was diagnosed in 51 patients, including 42 hip and 9 knee arthroplasties; 17 infections occurred after revision procedures. Diagnosis was established according to international consensus criteria. All patients underwent DAIR with extensive debridement, irrigation, microbiological sampling, and targeted antimicrobial therapy.

Results. The mean interval between symptom onset and surgical debridement was 14.5 days. Infection eradication with implant retention was achieved in 34 patients (66%). Five patients (10%) required subsequent two-stage revision arthroplasty because of persistent infection. Two patients (4%) died during follow-up, while outcome data were unavailable for ten patients (20%).

Coagulase-negative staphylococci were the most common pathogens (n=20), followed by Staphylococcus aureus (n=13). Culture-negative infection was observed in 10 cases. Additional microorganisms included Enterococcus faecium, Acinetobacter baumannii, Klebsiella pneumoniae, and Pseudomonas aeruginosa.

Conclusions. DAIR is an effective treatment option for acute periprosthetic joint infection, allowing implant retention in two-thirds of patients. The observed success rate was lower than that reported in studies where DAIR was performed within the first days after symptom onset. Our findings support current recommendations emphasizing early diagnosis, rapid referral to specialized centers, and prompt surgical intervention as critical factors for successful infection control. A multidisciplinary approach involving orthopedic surgeons, microbiologists, and infectious disease specialists remains essential for optimizing outcomes in acute PJI.

Keywords: periprosthetic joint infection, DAIR, acute infection, implant retention, debridement, antimicrobial therapy.

From Aspiration to Revision: An Optimized Algorithm for the Diagnosis and Treatment of Deep Periprosthetic Hip Joint Infection

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Introduction. The differential diagnosis between aseptic loosening and chronic periprosthetic joint infection (PJI) prior to revision hip arthroplasty (RHA) remains a complex clinical challenge. Standard inflammatory markers (CRP,

ESR) have insufficient specificity, and cases caused by low-virulence organisms (Cutibacterium acnes, coagulase-negative staphylococci) often remain undetected.

Objective. To evaluate the diagnostic performance of an extended biomarker panel compared with the standard algorithm for preoperative PJI diagnosis in patients scheduled for RHA.

Methods. This prospective study (2021–2025) included 450 patients. Group 1 (n=218) underwent the standard algorithm (aspiration + CRP + ESR). Group 2 (n=232) underwent an extended algorithm (additional IL-6, fibrinogen, D-dimer, and synovial fluid cytology). Threshold values followed ICM 2018 criteria (IL-6 ≥10 pg/mL). ROC analysis was performed. Intraoperative microbiological examination served as the reference standard.

Results. PJI was confirmed preoperatively in 29.3% of patients (Group 1: 25.7% vs. Group 2: 32.8%; p=0.02). The combined AUC for the optimal panel (CRP, IL-6, ESR, synovial cytosis) was 0.91, significantly higher than that of the standard algorithm (AUC 0.83; $p<0.05$). The rate of unexpected positive intraoperative cultures (UPIC) was lower in Group 2 (7.1% vs. 11.1% in Group 1; p=0.04). The proportion of UPIC cases caused by low-virulence microorganisms was 83.3% in Group 1 vs. 45.5% in Group 2 (p=0.04).

Conclusion. The optimal panel of the extended diagnostic algorithm significantly improves preoperative PJI detection, particularly for low-virulence infections, and reduces the UPIC rate. This algorithm is recommended for routine preoperative workup in patients with suspected PJI before revision RHA.

Keywords: periprosthetic joint infection (PJI), revision hip arthroplasty, biomarkers, IL-6, unexpected positive intraoperative culture (UPIC).

The Hidden Dimensions of Medical Error

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Problem description. Diagnostic errors are the most common type of medical error. In traumatology, the high sensitivity of radiography means that diagnostic errors occur considerably less often than errors in treatment planning and technique. The latter have a decisive influence on treatment outcomes. Analysis of different types of error suggests that diagnostic, planning, and technical errors share a common underlying mechanism.

Human thinking operates in two modes, commonly referred to as System 1 and System 2.

System 1 is fast and automatic, conserving the brain's resources wherever possible. Like other living beings, people instinctively seek shortcuts: we cut across a lawn, recognize a word as a whole rather than sounding it out letter by letter, and identify a familiar clinical presentation instantly from a few recognizable features, without examining every detail.

In most cases, System 1 is right. It saves time and effort, and the more often it leads to a successful outcome, the more firmly the habit of acting automatically becomes established.

The difficulty is that in some cases—estimates range from one in ten to one in five—a familiar set of features conceals an atypical presentation. When System 1 detects something that does not fit, System 2 may engage. It is slower and requires effort: it compares information, looks for inconsistencies, and tests alternative explanations.

The problem is that System 1 engages automatically, whereas the shift to System 2 does not. Sometimes the discrepancy goes unnoticed, and the clinician follows a familiar pattern in a situation where it does not apply. This is how an error can arise.

System 1 relies on several common mechanisms: stereotypes, analogy, suggestion, and emotion. Logic also plays a role, but not always as a means of checking a decision. It can instead rationalize a decision that System 1 has already made, supplying supporting arguments and creating the impression that the choice was carefully considered. Logic can therefore either defend a System 1 decision or help challenge it when System 2 is engaged, where it serves as a key tool. This dual role of logic may be one reason human thinking is so complex. Knowledge and experience gained

through the analysis and discussion of errors help determine whether logic contributes to an error or supports a sound decision.

Analysis of errors shows that a key step in reaching an incorrect decision is the misjudgment of one or more clinical facts, such as a symptom, a detail in the patient's history, or a laboratory or imaging result. Misjudgment—whether overestimation, underestimation, or misinterpretation—can be driven by the mechanisms described above: stereotypes, analogy, suggestion, emotion, and logic. In each case, the combination of the clinical fact, the type of misjudgment, and the mechanism contributing to it is unique.

The ability to notice how one's own thinking works, recognize its weak points, and interrupt System 1 when necessary is called metacognition: the capacity to be aware of and regulate one's own thought processes.

Metacognition is not easy to put into practice. It is difficult to monitor processes that operate automatically, especially when they are successful most of the time. Yet understanding how thinking works can itself create an opportunity to pause and reconsider.

Next steps. Every error, adverse outcome, and complication should be analyzed through the lens of Systems 1 and 2, with the mechanism behind the error identified. Each mechanism of failure uncovered through such analysis helps strengthen metacognition and build experience, reducing the likelihood of similar or analogous errors in the future.

Keywords: medical errors; diagnostic errors; clinical reasoning; cognitive biases; metacognition.

Diagnostic Accuracy of Synovial Fluid Cytology and Bacterial Culture in Periprosthetic Joint Infection

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Introduction. The growing number of joint replacement procedures makes accurate differentiation between aseptic loosening and infectious complications increasingly important, as these conditions require fundamentally different treatment strategies. Diagnosing periprosthetic joint infection (PJI) requires assessment of the local joint findings because systemic markers, including leukocytosis, C-reactive protein (CRP), and procalcitonin, lack sufficient specificity. According to the 2018 International Consensus Meeting (ICM) criteria, key diagnostic findings include an elevated synovial fluid leukocyte count (>2,000–3,000 cells/μL) with neutrophilia, a positive leukocyte esterase test, and identification of a pathogen by bacterial culture.

Objective. To compare the diagnostic value of synovial fluid leukocyte count and microbiological testing in the diagnosis of PJI.

Methods. Between 2021 and 2025, 230 synovial fluid samples were analyzed. Positive results were obtained in 159 cases (69.2%), indicating an inflammatory process in the joint. The annual numbers of samples tested and positive results, respectively, were as follows: 2021, 16/12; 2022, 27/22; 2023, 40/29; 2024, 63/45; and 2025, 84/51. Overall, 159 of the 230 samples analyzed over the five-year period (69.1%) were positive. Based on clinical and laboratory findings, PJI was suspected in 69.1% of patients; cytological analysis in these patients was supplemented by bacterial culture. Synovial fluid aspirates from patients with suspected PJI were examined. Leukocyte esterase (LE) testing was performed in 47 cases among the 84 synovial fluid samples collected from 78 patients in 2025.

Results. LE levels ranged from 15 to 500 units. In all cases, values above 25 units were associated with a positive bacterial culture. LE levels varied according to pathogen type: borderline values (15–25 units) were characteristic of Gram-negative organisms, whereas higher levels (25–500 units) were observed with Gram-positive organisms. Among the Gram-positive isolates, 50% were resistant to beta-lactams. An elevated synovial fluid leukocyte count was found in 60.7% of cases (51/84 samples), ranging from 2,900 to 32,000 cells/μL; the highest values were associated with marked inflammatory activity.

Higher cell counts were accompanied by pronounced neutrophilia, with neutrophils accounting for 76–95% of the leukocytes—findings consistent with international criteria for septic processes.

Microbiological monitoring (n = 4,324). The mean annual proportion of negative cultures was 31.8%. Of the 2,937 pathogen isolates identified, Staphylococcus spp. predominated, accounting for 64.4%. Changes in the distribution of staphylococcal species were observed: the proportion of Staphylococcus aureus ranged from 20% to 32.7%, while the proportion of coagulase-negative staphylococci decreased from 42% to 30%.

Gram-negative pathogens. Pseudomonas aeruginosa was identified as the second most common PJI pathogen, accounting for 13.4% (393 isolates), with annual proportions ranging from 8.9% to 15.6%. Members of the order Enterobacteriales accounted for 11.7% (344 isolates), with annual proportions ranging from 7.9% to 16.1%.

Rare pathogens and mixed infections. Other microorganisms, including Enterococcus spp., Streptococcus spp., and Candida spp., accounted for 8.44% (248 cases), with proportions ranging from 3.5% to 12.6%. Anaerobes were detected least frequently, accounting for 0.04% (7 isolates); they were recorded only during the final three years of monitoring.

Conclusions. Synovial fluid cytology—specifically, a leukocyte count above 2,900 cells/μL with 76–95% neutrophils—is a highly sensitive predictor of PJI and can confirm inflammation before bacterial culture results become available. An LE level above 25 units was associated with a positive bacterial culture in 100% of cases. LE levels varied by pathogen type: values of 25–500 units were characteristic of Gram-positive organisms, while borderline values of 15–25 units were characteristic of Gram-negative organisms. The five-year microbial profile, with a predominance of Staphylococcus spp., is consistent with findings reported in international studies in this field.

Keywords: periprosthetic joint infection; synovial fluid cytology; synovial leukocyte count; leukocyte esterase; bacterial culture; antimicrobial resistance; microbial profile.

Etiology of Chronic Periprosthetic Hip Infection as a Determinant of Revision Strategy

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Background. Periprosthetic joint infection (PJI) of the hip remains one of the most serious complications of arthroplasty, potentially leading to disability and substantial healthcare costs. The volume of joint replacement surgery in the Russian Federation is high: in 2019, 147,061 primary knee and hip arthroplasties and 7,770 revision procedures were performed. In the same year, 6,606 patients received treatment for severe implant-associated infection, including 4,282 cases (2.91% of primary procedures) involving complications of large-joint arthroplasty. The characteristics of Gram-negative and Gram-positive organisms, including their ability to form biofilms and invade bone tissue, directly affect surgical outcomes. However, criteria for choosing between one-stage and two-stage revision arthroplasty according to bacterial etiology remain insufficiently systematized. This provided the rationale for the present study.

Methods. We analyzed treatment outcomes in 100 patients with chronic monomicrobial PJI of the hip treated between 2016 and 2024. Patients were divided into a Gram-positive infection group (n = 64) and a Gram-negative infection group (n = 36). Within the Gram-positive group, outcomes were compared between patients who underwent one-stage revision arthroplasty (n = 20) and those who underwent two-stage revision arthroplasty (n = 44). The groups were compared by recurrence rate (Fisher's exact test), functional outcomes (Harris Hip Score [HHS]; Mann–Whitney U test), 5-year survival free from revision for infection (Kaplan–Meier method; log-rank test), length of hospital stay, and direct medical costs. Statistical significance was set at $p < 0.05$.

Results. Compared with patients with Gram-positive infection, those with chronic Gram-negative PJI represented a more complex clinical group. They had undergone more previous hip procedures (median, 4 vs. 3; p = 0.005), had more extensive tissue damage in the form of osteonecrosis (77.8% vs. 58.8%; p = 0.116), more severe type II femoral defects (42.42% vs. 18.18%; p = 0.019), and more frequent type III–IV acetabular defects according to Paprosky

(30.3% vs. 18.2%; p = 0.184). Osteonecrosis, which was more common in Gram-negative infections, was identified as a key independent risk factor for infection recurrence: recurrence occurred in 31.3% of patients with osteonecrosis, compared with 0% of those with fibrotic changes (p = 0.0036).

Patients with Gram-negative infection had poorer baseline function according to the HHS (median, 50 vs. 59 points; p = 0.018). PJI recurrence was significantly more frequent in the Gram-negative group (33.3%, 12/36) than in the Gram-positive group (4.7%, 3/64; p < 0.001). Five-year survival free from revision for infection was 93.7% in the Gram-positive group and 57.5% in the Gram-negative group (log-rank p < 0.001).

Among patients with Gram-positive infection, infection control was comparable between the one-stage (n = 20) and two-stage (n = 44) revision groups. Recurrence occurred in 5.0% (1/20) of patients after one-stage revision and 4.5% (2/44) after two-stage revision (p = 1.000). Five-year survival free from recurrence was 95.0% and 95.5%, respectively (log-rank p = 0.910). The rate of non-infectious complications did not differ significantly between groups (5.0% vs. 9.1%; p = 0.628). However, one-stage revision was associated with significantly better functional outcomes (median HHS, 86 vs. 82; p = 0.012), a shorter hospital stay (median, 18 vs. 32 days; p < 0.001), and lower direct costs (median, RUB 281,000 vs. RUB 534,000; p < 0.001).

Conclusion. Gram-negative etiology of hip PJI is an independent predictor of an unfavorable treatment outcome and is associated with extensive tissue destruction and a high risk of recurrence, supporting the use of a two-stage surgical approach. In monomicrobial Gram-positive hip PJI, one-stage revision arthroplasty provides infection control comparable to that of the two-stage approach, while offering better functional outcomes, shorter treatment duration, and substantial economic advantages.

Keywords: periprosthetic joint infection; hip; revision arthroplasty; infection etiology; one-stage revision; two-stage revision.

OTHER

Analysis of Burn Trauma the Aktobe from 2021 to 2025

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Introduction. Burn injuries remain an important public health and healthcare challenge because severe cases can require prolonged hospitalization, repeated surgical procedures, and rehabilitation, placing a substantial burden on patients and health services. Analysis of the causes, demographic patterns, severity, and annual trends of burn injuries can help characterize the needs of a local population and inform the organization of specialized care and prevention efforts. This study analyzes burn-related admissions to the trauma department of City Multidisciplinary Hospital No. 1 in Aktobe from 2021 to 2025.

Purpose of the study: To analyze the medical history of victims with thermal trauma admitted to the trauma department of the City Multidisciplinary Hospital No.1.

Methods. We studied 384 medical histories of patients with thermal burns over the past five years. The age of patients ranged from 16 to 65 years, of which the proportion of women was 126 (33%), men 255 (67%). The main etiological factors were: burns with boiling water -182 (47%), flame -168 (44%), much less often by contact - 34 (9%). By type of injury: household -346 (90%), production -38 (10%). Skin burns were received by 312 (81%) patients, in combination with burns of the upper respiratory tract 69 (18%) and combined injuries 3 (0.8%). By the depth of burns: mild and moderate degrees (II-IIIA degrees) were present in 310 (81%), deep (IIIB-IV degrees) in 74 (19%) victims. According to the affected area, burns spread as follows: up to 10% of the body surface -219 (57%); up to 20-30% -89 (23%) and 30-50% -76 (20%) burned. 76 (19%) patients with a large area of burns and severe degrees were admitted to the clinic in a state of burn shock. The average hospital stay was 18.2 days. The total number of victims treated in the

trauma department in 2021 was 66 patients, in 2022 67 patients, in 2023 70 patients, in 2024 87 patients, in 2025 93 patients.

Results. Our study revealed that men aged 26-53 years prevail in the structure of a burn injury, most often patients receive burns with boiling water and flames. Domestic injuries are dominated nine times by industrial injuries. Compared to previous years, there has been an increase in the number of deep burns and burns of the upper respiratory tract.

Conclusions. Analyzing, we concluded that burn injury tends to grow steadily. At the same time, the most able-bodied population suffers. Huge funds are spent on the treatment and rehabilitation of such patients by the state. Therefore, determining ways to improve the provision of specialized care for burn injury, improving its quality and efficiency, optimizing its volume and using advanced technologies at the moment remains relevant.

Key words: thermal injury, burn injury analysis, burn shock.

Microsurgical Training at Yasargil Training Center: A Four-Stage Progression from Basics to Flap Transplantation

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Background. Since the late 19th century, microsurgery has advanced significantly through breakthroughs in engineering, surgical tools, and medicine. Presently, the use of microvascular techniques in hand, plastic, and reconstructive surgery has led to major advances in allotransplantation, replantation, and tissue transplantation. Professor M. Gazi Yasargil (1925–2025) was a pioneer, establishing training centers worldwide, including the first in Beijing in 2001. The Urumqi center, opened in 2004, is the second in China and the first in Northwest China.

Objective: To describe the four-step curriculum and assess its effectiveness in structured microsurgical training.

Methods. This descriptive study details the structured training program at the Yasargil Microsurgical Training Center, established in 2004 at the First Affiliated Hospital of Xinjiang Medical University in Urumqi. The four-stage curriculum was analyzed, consisting of: Step I (suturing with latex gloves to improve hand-eye coordination), Step IIA (end-to-end aortic anastomosis in rats), Step IIB (end-to-end inferior vena cava anastomosis), Step III (kidney transplantation between mice), and Step IV (free flap transplantation from the lower limb to the cervical region). Training outcomes were evaluated based on center accreditation status, the number of trained microsurgeons, and competitive performance metrics. The three fundamental microvascular anastomosis techniques—end-to-end, end-to-side, and side-to-side—were examined in relation to their clinical application and progression of training.

Results. The Yasargil Training Center in Urumqi has become a nationally acclaimed institution, accredited by the Chinese College of Surgeons. As of 2025, the center has trained 976 microsurgeons and 45 international students. The progressive four-step model addresses increasing technical challenges, including variations in vessel wall thickness, diameter mismatches, and the integration of multiple microsurgical techniques into a single operative procedure. End-to-end anastomosis demonstrated excellent patency rates in experimental models, while end-to-side and side-to-side techniques provided essential alternatives for clinical cases with diameter discrepancy or flow-preservation requirements.

Conclusion. The Yasargil Microsurgical Training Center in Urumqi is an important part of the global microsurgical education network, successfully continuing the respected legacy of Professor Gazi Yasargil. The center's proven training capability, competitive excellence, and international presence demonstrate the effectiveness of structured, step-by-step microsurgical education. Its comprehensive four-stage curriculum systematically builds the technical skills and clinical knowledge needed for modern microsurgery. This model offers a valuable guide for institutions looking to create or improve microsurgical training programs, especially in regions where such specialized education is still developing.

Keywords: microsurgery, surgical education, free flap transplantation.

Oncological Vigilance in Pathological Fractures: Diagnostic Algorithms for Bone Tumors

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Introduction. Pathological fracture is a clinical manifestation of malignant bone tumors or metastases in 15–20% of patients. At the same time, up to 30% of fractures occurring against the background of metastatic disease are initially misinterpreted as domestic or traumatic injuries. The lack of oncological vigilance at the primary diagnostic stage leads to loss of valuable time, non-radical surgeries, and worsened prognosis. Standard procedures such as intramedullary nailing or plate osteosynthesis performed without preoperative biopsy in cases of malignant tumors reduce survival, increase the risk of tumor dissemination, and may render limb-sparing treatment impossible. The implementation of clear algorithms is a mandatory prerequisite for providing specialized care.

Objective. To develop and implement algorithms for oncological vigilance in pathological fractures that allow differentiation between metastatic, primary tumor-related, and post-traumatic fracture etiology at the pre-hospital and primary inpatient stages.

Methods. A retrospective analysis was performed on 48 cases of pathological fractures of long bones in patients admitted to the Department of Onco-Orthopedics at the Kazakh Research Institute of Oncology and Radiology during the period 2020–2025. Inclusion criteria: fractures occurring spontaneously or after minimal trauma, against the background of a previously undiagnosed tumor process or with verified metastatic or primary bone lesions. The developed algorithm consisted of three stages: 1) screening questionnaire (Vancouver index, presence of night pain, palpable mass, prior oncological history); 2) mandatory CT or MRI with evaluation of the destruction zone, lytic, mixed, or blastic pattern; 3) performance of closed core-needle biopsy or open incisional biopsy prior to any stabilizing surgery.

Results. Of 47 patients, 39 (83%) had pathological fractures caused by metastases (breast cancer – 29%, lung cancer – 18%, kidney cancer – 15%, multiple myeloma – 12%), while 8 (17%) had primary malignant tumors (osteosarcoma – 10, chondrosarcoma – 8, Ewing's sarcoma – 6). In 41% of cases (19 patients), the fracture was initially regarded as traumatic; osteosynthesis without biopsy was performed in 7 patients (36%). When comparing groups: in the group without preoperative biopsy before stabilization, implant-associated tumor dissemination along the metal construct developed after primary osteosynthesis, making subsequent limb-sparing surgery impossible and necessitating mutilating procedures in 4 of these patients. In 1 patient, surgery became infeasible due to disease generalization.

Conclusions. Every spontaneous or low-energy fracture in an adult patient requires exclusion of malignant bone involvement before deciding on the fixation method. Biopsy of the destruction zone before any osteosynthesis is mandatory if a benign etiology of the fracture has not been confirmed. The lack of oncological vigilance leads to non-radical surgeries, worsened survival, and loss of opportunities for limb-sparing treatment. Implementation of mandatory imaging with MRI or CT with intravenous contrast in patients over 40 years of age with any atypical fracture is recommended.

Keywords. Pathological fracture, oncological vigilance, osteosarcoma, bone metastases, incisional biopsy.

Can Multisegmental Bone Lengthening Achieve Rapid Bone Lengthening?

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Background. Single-segment tibial bone transport and limb lengthening can facilitate bone and soft tissue regeneration for the reconstruction of large segmental bone defects and lower limb length discrepancies. However, this approach is associated with prolonged treatment courses and a heavy burden of external fixation. By establishing

additional osteogenesis centers and shortening the distraction distance of each traction zone, multisegmental bone lengthening can theoretically reduce external fixation time (EFT) and external fixation index (EFI). Nevertheless, its clinical efficacy and complications still require systematic evaluation.

Methods. A total of 161 patients who underwent tibial lengthening or bone transport at the First Affiliated Hospital of Xinjiang Medical University between January 2012 and March 2023 were retrospectively enrolled. According to predefined primary analysis criteria, patients were divided into four groups: the in-situ group (22 cases), single-segment group (83 cases), bifocal group (38 cases), and trifocal or above group (18 cases). Continuous variables were presented as medians with interquartile ranges (IQR). The Kruskal-Wallis test was used for intergroup comparisons, and the Dunn's test with Holm correction was adopted for pairwise comparisons. The Spearman rank correlation was used to assess the monotonic correlation between continuous variables and the number of segments (a 7-level ordinal variable). Categorical variables were analyzed using the Chi-square test or Fisher's exact test, and the effect size was reported as Cramer's V.

Results. As the number of segments increased, the length of bone defects became larger (rho = 0.268, $P < 0.001$), and the transport speed rose significantly: 1 mm/day in the in situ and single-segment groups, 2 mm/day in the bifocal group, and 4 mm/day in the trifocal and above group ($P < 0.001$; rho = 0.885). The duration of external fixation decreased markedly, with median values of 333 days for the in-situ group, 411 days for the single-segment group, 290 days for the bifocal group, and 212 days for the trifocal and above group ($P < 0.001$; rho = -0.391). The EFI decreased synchronously, with median values of 65.88, 64.41, 38.23, and 27.59 days/cm, respectively ($P < 0.001$; rho = -0.763). Paley problems and obstacles were predominantly observed in the single-segment group, and the number of complications was negatively correlated with the number of segments (rho = -0.279, $P < 0.001$). No significant intergroup differences were found in the ASAMI bone score ($P = 0.757$) and functional score ($P = 0.126$).

Conclusion. With rigorous preoperative planning and standardized application strategies of external fixators, multisegmental tibial bone lengthening can significantly shorten external fixation time and reduce EFI without increasing complications or compromising bone healing and functional outcomes. It enables rapid reconstruction of large segmental bone defects.

Keywords: Multisegmental bone lengthening; Limb lengthening; Bone defect; External fixation; Bone regeneration

Level of Evidence: Therapeutic study, Level III Foot Arthroereisis: Does the Extra vs. Intra-Articular Division Still Matter in 2026?

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Subtalar arthroereisis is a widely used surgical option for symptomatic flexible flatfoot in children, yet the field remains divided by a terminology that has not kept pace with anatomical understanding. Implants are conventionally labelled intra-articular or extra-articular, a binary distinction commonly used to compare outcomes and guide implant selection, even though it does not reliably describe where or how a given device actually acts. In practice, three distinct implant families have emerged historically: joint-surface blocks, sinus tarsi plugs of the endosinotarsal type, and calcaneal or talar stop-screws such as the subtalar extra-articular screw arthroereisis technique. All of these devices operate within the sinus tarsi and canalis tarsi, a middle compartment of the subtalar joint complex that is anatomically distinct from the true anterior and posterior articular facets but is not, strictly speaking, extra-articular in the sense the label implies.

This review revisits the extra- versus intra-articular division through the lens of anatomical location, implant family, and corrective mechanism, drawing on the historical evolution of arthroereisis techniques from 1946 to current designs.

Particular attention is given to the endosinotarsal, sinus tarsi implant concept, which follows the natural axis of the interosseous tunnel and achieves correction largely through tunnel occupancy and proprioceptive stimulation rather than direct bony impingement, in contrast with stop-screw techniques that rely on a screw head abutting the lateral talar process. This mechanical difference is proposed as a plausible explanation for the comparatively lower rates of talar contact-related discomfort and postoperative pain reported with sinus tarsi implants, while stop-screw techniques show their own distinct advantages, including lower migration rates. The review concludes that the conventional intra- versus extra-articular dichotomy obscures more than it clarifies, and that reporting outcomes by anatomical level and corrective mechanism, rather than by this binary label, would allow more meaningful comparison between implant families and better-informed technique selection in paediatric flatfoot surgery.

Keywords: Flatfoot, Subtalar Joint, Orthopedic Procedures, Prostheses and Implants, Child, Postoperative Pain.

ZANE - Zagreb Accessory Navicular Excision: A Novel, Anatomically-Driven Technique for Accessory Navicular Bone Surgery

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Background. The accessory navicular bone is a common source of medial foot pain in paediatric patients. Although often regarded as a routine condition, standard excision techniques frequently overlook the anatomical and biomechanical complexity of the navicular region, and in particular the presence and location of true synchondrosis between the accessory bone and the main navicular bone are rarely confirmed intraoperatively, which may compromise surgical outcomes.

The aim of this study was to evaluate the effectiveness of the Zagreb Accessory Navicular Excision method, a tangential excision technique designed to achieve intraoperative confirmation of synchondrosis and to improve clinical outcomes through targeted volume modulation of the navicular body.

Methods. A prospective series of thirty paediatric patients with symptomatic accessory navicular syndrome underwent surgery using the Zagreb Accessory Navicular Excision method. The procedure began with careful exposure of the posterior tibial tendon and its fascial layers. Tangential excision was performed at the level of the first cuneiform bone, allowing direct visualisation of synchondrosis through the vertical chondral stripe, confirming type two morphology, and targeted volumetric reduction of a hypertrophic navicular body, which could mimic type three anatomy despite a radiological type two classification. Pain scores were recorded using a visual analogue scale before surgery and at follow up. Descriptive statistics were used to analyse changes in pain and activity levels, and radiological assessment focused on confirmation of accessory bone removal.

Results. Intraoperative confirmation of true synchondrosis was achieved in more than eighty percent of cases, and navicular hypertrophy was present in the majority of patients, supporting the need for volume modulation. Mean pain scores improved from 6.8 before surgery to 1.2 at final follow up, which was conducted over twelve months. Ninety three percent of patients returned to full activity within six weeks. Radiological improvement was observed in all cases, confirming complete removal of the accessory navicular bone, and no complications or recurrences were recorded.

Conclusion. The Zagreb Accessory Navicular Excision method redefines accessory navicular excision as a precise, anatomy guided intervention. Intraoperative confirmation of synchondrosis and targeted resection of navicular hypertrophy appear essential for optimal outcomes. Compared with conventional techniques, this method offers greater anatomical clarity and consistent clinical recovery, and provides a reproducible model for improving results in paediatric foot surgery that merits broader adoption in clinical practice.

Keywords: Foot Deformities, Congenital; Tarsal Bones; Osteotomy; Child; Foot Pain; Treatment Outcome.

Morphological Aspects of Using Allostatic Connective Materials for Tendon Grafting

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Background. The use of tendon allografts is a very promising strategy for restoring and preserving the mechanical characteristics of a tendon or ligament until the consequences of injury are fully healed.

The aim of the paper is to evaluate the morphological characteristics of the regeneration process in a damaged tendon when using an allostatic connective tissue graft as a reinforcing material in an animal experiment.

Methods. In this experiment, the tendon of a rabbit was utilized to produce tendon threads at the Alloplant tissue conservation laboratory according to certified technological regulations.

The study was conducted on two groups of experimental animals. The rabbit Achilles tendon was used to model a cross tendon injury followed by application of sutures to restore its integrity.

Suturing was carried out with a prepared allostatic thread, and with a FiberWire thread in the main series and in the comparison series, respectively. 1-month and 3-month observational study for both groups was followed by the removal of a fragment of the Achilles tendon of the animal with a section of the surrounding suturing-regeneration zone.

The results of light and polarization microscopy of histological preparations obtained from an experimental allostatic tendon grafting show that the intercellular matrix of an allotendon thread undergoes biodegradation in real time and replacement of own connective tissue with participation of macrophagal and fibroblastic elements and slow ingrowth of microcirculatory vessels. This morphological pattern implicitly suggests that the biomechanical properties of an allostatic material persist for a long time, sufficient to heal a wound in the tendon. This is the reason why allograft tendons should be used as a reinforcing material.

The use of synthetic thread for sutures was not accompanied by a strong vascular reaction, and the connective tissue scar had a coarser structure.

Key words: tendon rupture model, tendon suture, allograft, graft morphological assessment.

Reconstruction of Post-Osteomyelitis Defects of the Forearm Bones Using Modified Autologous Fibular Transplantation

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Introduction. Large segmental defects of long bones forming after radical sequestrectomy in postoperative osteomyelitis present a serious challenge for orthopedic traumatologists, especially when the defect is combined with

a chronic purulent fistula and soft-tissue deficiency caused by multiple interventions. Post-osteomyelitis segmental defects of the forearm diaphyses are accompanied by a high recurrence rate of infection and functional loss, which makes the choice of reconstructive tactics a clinically and socially significant task.

Methods. This prospective study (2019–2025) included 13 patients (9 men, 4 women; median age: 29 years) with defects measuring 6.4 ± 1.1 cm following radical sequestrectomy. A two-stage strategy was applied: (1) sequestr 先進 necrectomy and extra-focal transosseous fixation using the Ilizarov apparatus for 4–5 weeks to eradicate the infection; (2) defect reconstruction using an avascular fibular graft with intramedullary Kirschner wire stabilization and re-application of the Ilizarov frame. Bone consolidation was evaluated radiographically, quality of life via the SF-36 questionnaire, and function using the Mayo Elbow Performance Score (MEPS).

Results. Complete bone consolidation was achieved in all patients, with an external fixation index of 48 ± 6 days/cm and a median follow-up period of 24 months. The median SF-36 score was 80 (range: 65–95). At 12 months, MEPS scores ranged between 50 and 69, indicating satisfactory functional outcomes. No infection recurrences, osteolysis, or graft fractures were recorded.

Conclusion. Reconstruction of post-osteomyelitis segmental defects of the forearm diaphyses remains a clinical challenge, requiring a balance between radical infection eradication, anatomical length preservation, and early functional recovery. The two-stage protocol of "extra-focal fixation → avascular fibular autografting → intramedullary stabilization" ensures a high consolidation rate without severe complications and improves the quality of life for defects up to 10 cm. This method is cost-effective and can be considered a preferred option in resource-limited settings, though it requires further validation in multicenter controlled studies.

Keywords: post-osteomyelitis defects; forearm diaphysis; fibular autograft; Ilizarov apparatus; intramedullary fixation; distraction osteogenesis; quality of life.

Treatment of Chronic Hematogenous Osteomyelitis of the Femur Using Gentamicin-Loaded Cement Beads

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Introduction. Chronic hematogenous osteomyelitis is a challenging inflammatory bone disease characterized by a prolonged course, recurrent episodes, and sinus tract formation. Standard treatment includes surgical debridement of the infection site and systemic and/or local antimicrobial therapy. Gentamicin-loaded cement beads are one treatment option; they deliver a high local concentration of antibiotic to the affected area while limiting systemic exposure. This report describes the treatment of a 65-year-old patient with long-standing chronic hematogenous osteomyelitis of the right femur. The use of gentamicin-loaded cement beads was followed by clinical improvement, cessation of purulent drainage, and stabilization of radiographic findings.

Objective. To describe the experience of using gentamicin-loaded cement beads as part of the comprehensive treatment of chronic femoral osteomyelitis.

Case Presentation. A 65-year-old male patient with chronic osteomyelitis of the right femur since childhood was admitted following an exacerbation. Treatment was performed in two stages: Sequestrectomy and debridement of the infection site, followed by placement of gentamicin-loaded cement beads (240 mg of gentamicin per 40 g of cement). Two months later, removal of the cement implants and revision of the infection site. The patient underwent laboratory and radiographic monitoring. Bacterial cultures showed no growth. Antimicrobial therapy consisted of cefazolin followed by amoxicillin/clavulanate.

Results. Treatment resulted in sustained clinical and radiographic remission, with resolution of purulent drainage, improvement in inflammatory changes on radiographs, and normalization of blood test results. The sinus tract closed, and the patient regained independent mobility. His overall condition was satisfactory.

Conclusion. In this case, gentamicin-loaded cement beads were associated with a favorable clinical outcome in the treatment of chronic hematogenous osteomyelitis of the femur. This approach enabled targeted local antimicrobial therapy and may help limit systemic antibiotic exposure and support sustained disease remission.

Keywords: chronic osteomyelitis; femur; gentamicin-loaded cement beads; local antibiotic therapy; sequestrectomy.

Long-Term Treatment Outcomes of Patients with Post-Osteomyelitic Defects of Long Tubular Bones

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Introduction. Injuries of long tubular bones in adults, complicated by defects and osteomyelitis, frequently lead to disability. Ilizarov distraction osteogenesis remains the primary treatment method; however, the management of traditional devices is quite complex and not always effective. To improve fixation stability, accelerate bone regeneration, expand outpatient treatment options, and reduce the rate of complications, a new distraction-fixation module (DFM) has been developed.

Methods. The study was conducted at the Samarkand Branch of the RSNPMCTO between 2017 and 2024. It included 66 patients (aged 18–64 years) with long tubular bone defects. The primary group (n=30) was treated using the DFM within the Ilizarov apparatus, while the control group (n=36) received the traditional method. Evaluation criteria included bone regenerate formation time (radiologically), duration of inpatient treatment, functional outcomes (SF-36), and the rate of postoperative complications.

Results. The use of the DFM accelerated bone regenerate formation to 1.7 ± 0.3 months, which is 29.2% faster than in the control group (2.4 ± 0.4 months, $p<0.05$). The average hospitalization period in the primary group was reduced by 32%, amounting to 42 ± 6 days versus 62 ± 8 days in the control group. Quality of life based on the SF-36 scale improved by 47% ($p<0.01$). The infection rate decreased by 50% (1 patient versus 2), and fixation instability decreased by 66.7% (1 case versus 3).

Discussion. The obtained results demonstrate that the application of the developed DFM as part of the Ilizarov apparatus improves fixation stability, accelerates osteogenesis, and reduces the risk of postoperative complications. The primary advantages of the module include uniform distribution of distraction load, more reliable stabilization of bone fragments, and increased overall treatment effectiveness. Optimization of surgical tactics using the DFM can be of significant clinical importance for the treatment of adults with severe bone defects, especially in cases where traditional methods prove insufficiently effective.

Conclusion. The developed distraction-fixation module demonstrated high clinical efficacy in the treatment of long tubular bone defects in adults. Its use reduced the time of bone regeneration, shortened the duration of inpatient care, and lowered the rate of postoperative complications. The introduction of this technology into clinical practice can contribute to improving the quality of orthopedic care and reducing the rehabilitation period for patients with severe bone pathologies.

Keywords: post-osteomyelitic bone defects; long bones; distraction osteogenesis; Ilizarov technique; distraction-fixation module; bone regeneration.

Low-Energy Fractures in the Setting of Combined Trauma: Causes and Consequences?

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Introduction. Osteoporosis reduces bone strength and increases the risk of fractures following even minor trauma. These injuries are more common among older women and may affect several skeletal sites, including the proximal humerus, distal radius, femoral neck, and vertebrae. In patients with combined trauma, osteoporosis and comorbidities may complicate treatment planning, fracture fixation, and functional recovery. Delayed diagnosis of impaired bone metabolism and inadequate fixation stability may increase the risk of delayed union, deformity, and restricted mobility. Evaluating the outcomes of conservative and surgical treatment of low-energy fractures is therefore important for improving care.

Objective. To evaluate the outcomes of prevention and treatment of osteoporosis-related low-energy fractures.

Methods. This retrospective study analyzed the short- and long-term outcomes of conservative and surgical treatment in 250 patients admitted to the Department of Traumatology and Combined Trauma at the Shifobakhsh National Medical Center, Republic of Tajikistan, between 2024 and 2025. Patients received routine trauma care, including assessment, diagnosis, treatment, rehabilitation, and evaluation of short- and long-term outcomes. Women constituted the majority of the cohort (n = 183; 73.2%), with most aged 55–60 years; 67 patients (26.8%) were men. Clinical assessment was based on patient-reported symptoms, examination findings, injury mechanism, age, and comorbidities.

Conservative treatment, including skeletal traction and cast immobilization, was provided to 88 patients (35.2%); 162 patients (64.8%) underwent surgery. Surgical procedures included locked intramedullary nailing (n = 65; 40.1%), plate osteosynthesis using an LSP plate (n = 32; 19.7%), arthroplasty (n = 57; 35.1%), and closed reduction with fixation using an Ilizarov apparatus (n = 8; 4.9%).

Results. The analysis indicated that complications were multifactorial and associated with patient age and comorbidities, the quality of hospital care, and the choice of treatment method. Complications were reported in 12 surgically treated patients (11.2%), including postoperative wound infection in 3 (2.8%) and metallosis-related granuloma in 9 (8.4%). Changes in bone structure associated with impaired bone metabolism were identified as the underlying cause of the fractures. In most cases reported among women (81; 82.6%), fractures occurred after minor trauma and during the postmenopausal period. The most common fracture sites were the surgical neck of the humerus, the distal radius, the femoral neck, the vertebral bodies, and the malleolar region. In view of compromised bone quality, older patients received additional postoperative external support, including casts and braces.

Complications among patients treated conservatively included nonunion in 6 cases (13.9%), limb deformity in 3 (6.9%), malunion in 4 (9.3%), and persistent joint contracture in 7 (16.2%).

Conclusion. Analysis of short- and long-term outcomes indicated that surgical treatment using various stable fixation techniques can support early restoration of structural integrity and function in patients with low-energy fractures and impaired bone metabolism. Stable functional osteosynthesis remains an important treatment option for isolated and multiple long-bone injuries, sequential fractures, and low-energy trauma.

Keywords: combined trauma; osteoporosis; low-energy fractures.

Optimization of Preoperative Preparation in Older and Very Elderly Patients with Femoral Fractures

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Background. Femoral fractures in older and very elderly patients are among the most serious musculoskeletal injuries and are associated with high rates of postoperative complications, disability, and mortality. Current literature indicates that multiple comorbidities can substantially worsen surgical outcomes, making an individualized approach to preoperative preparation essential. Developing effective methods for assessing perioperative risk is therefore a pressing challenge in modern traumatology and orthopedics.

Objective. To improve the effectiveness of surgical treatment for femoral fractures in older and very elderly patients by optimizing preoperative preparation through comprehensive perioperative risk assessment.

Methods. The study included 144 older and very elderly patients with femoral fractures who were treated in the Emergency Traumatology Department of the Multidisciplinary Clinic at Tashkent State Medical University between 2020 and 2025. Clinical, laboratory, and instrumental data were analyzed. A dedicated questionnaire was developed to assess surgical risk and included key clinical indicators and comorbid conditions. Factors associated with postoperative complications and length of hospital stay were also examined.

Results. The study identified 43 clinically significant comorbidity-related factors affecting the postoperative course. The proposed risk-assessment system enabled patients to be stratified by surgical risk and helped identify those at high risk in a timely manner. Individualized preoperative preparation supported more appropriate surgical planning and perioperative management. Implementation of this approach reduced the average length of hospital stay by three days and improved treatment effectiveness in patients with severe comorbidities.

Conclusions. Comprehensive perioperative risk assessment based on clinical and comorbidity-related factors is an effective tool for personalized care and may improve the safety of surgical treatment in older and very elderly patients with femoral fractures.

Keywords: femoral fracture; older adults; comorbidity; surgical risk; preoperative preparation.

Maintaining Oncologic Suspicion in Pathological Fractures: Diagnostic Algorithms for Bone Tumors

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Background. A pathological fracture is a presenting manifestation of a primary malignant bone tumor or bone metastasis in 15–20% of patients. Conversely, up to 30% of fractures associated with metastatic disease are initially attributed to everyday activities or trauma. Failure to suspect malignancy during the initial assessment can delay diagnosis, lead to non-oncologic surgery, and worsen prognosis. In patients with a malignant bone tumor, procedures such as intramedullary or plate fixation performed without a preoperative biopsy may compromise survival, increase the risk of tumor dissemination, and preclude limb-sparing treatment. Clear diagnostic algorithms are therefore essential to the delivery of specialized care.

Objective. To develop and implement diagnostic algorithms for maintaining oncologic suspicion in patients with pathological fractures, enabling differentiation of metastatic or primary tumor-related fractures from traumatic fractures at the prehospital and initial inpatient stages.

Methods. We retrospectively analyzed 48 cases of pathological fractures of long bones in patients admitted to the Onco-Orthopedics Department of the Kazakh Institute of Oncology and Radiology between 2020 and 2025. Inclusion criteria were a fracture occurring spontaneously or after minimal trauma in a patient with either a previously undiagnosed tumor or a confirmed primary bone malignancy or bone metastasis.

The proposed algorithm consisted of three stages: (1) a screening questionnaire addressing the Vancouver index, night pain, a palpable mass, and a history of cancer; (2) mandatory CT or MRI to assess the area of bone destruction and determine whether the lesion was lytic, mixed, or blastic; and (3) closed core-needle or open incisional biopsy before any fracture-stabilization procedure.

Results. Of 47 patients, 39 (83%) had fractures caused by metastases (breast cancer, 29%; lung cancer, 18%; renal cancer, 15%; and multiple myeloma, 12%). Primary malignant bone tumors accounted for 17% of cases; the reported diagnoses included osteosarcoma (n = 10), chondrosarcoma (n = 8), and Ewing sarcoma (n = 6).

In 41% of cases (19 patients), the fracture was initially classified as traumatic. Seven patients (36%, as reported) underwent osteosynthesis without prior biopsy. In the group that did not undergo biopsy before stabilization, tumor dissemination along the implant tract occurred after initial fixation, precluding subsequent limb-sparing surgery and necessitating mutilating procedures in four patients. One patient was unable to undergo surgery because of disease progression.

Conclusions. Every spontaneous or low-energy fracture in an adult should prompt evaluation for malignant bone involvement before a fixation method is selected. Unless a benign cause has been confirmed, biopsy of the lesion should be performed before osteosynthesis. Failure to suspect malignancy can result in non-oncologic surgery, poorer survival, and loss of the opportunity for limb-sparing treatment. The authors recommend mandatory contrast-enhanced MRI or CT for patients over 40 years of age presenting with an atypical fracture.

Keywords: pathological fracture; oncologic suspicion; osteosarcoma; bone metastases; incisional biopsy.

The Role of the Orthopedic Trauma Surgeon in Polytrauma

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Problem description. Polytrauma is one of the most complex areas of medical care. Determining who should lead the trauma team is challenging because the composition of the on-call team varies and its members have different levels of experience. Ideally, an experienced surgeon would coordinate the team. When this is not possible, leadership may fall to the most experienced physician on duty—an intensivist, an orthopedic trauma surgeon, or a neurosurgeon. This creates uncertainty about who should lead the team and what criteria, beyond individual experience, should guide that decision.

Immediate Cause of Death. Hemorrhage is a leading immediate cause of death in patients with polytrauma. Its recognition and management involve intensivists, surgeons, and orthopedic trauma surgeons; as a result, blood loss may not be assessed or treated promptly. Hemorrhage control and transfusion may be delayed, increasing the risk of progression to refractory shock and multiple organ failure.

Role of the Orthopedic Trauma Surgeon. Polytrauma often involves multiple or combined skeletal fractures. The orthopedic trauma surgeon may begin treatment with splinting or external fixation and, once the patient has been stabilized, may continue to provide longitudinal care, performing fracture fixation in one or more stages. Because this is a common clinical pathway, surgeons may regard polytrauma as primarily the domain of orthopedic trauma specialists. However, given the immediate threat posed by hemorrhage, the general surgeon may play a decisive role in saving the patient's life. Hemorrhage assessment, hemostatic interventions, and decisions about transfusion fall within the scope of surgical practice. Surgeons routinely manage internal and external bleeding and perform a range of hemostatic procedures. During the limited "golden hour," and in the context of a patient's critical condition, the surgeon may be particularly well placed to manage the central life-threatening problem: blood loss and its replacement.

The first Russian-language recommendations on combined trauma were developed by the Russian Society of Surgeons. Their emphasis on hemorrhage as a leading immediate cause of death is important in defining the surgeon's role. What, then, is the orthopedic trauma surgeon's role in managing hemorrhage? A primary task is to make an initial estimate of cumulative blood loss associated with all fractures. Combined with the surgeon's assessment, this can help determine whether transfusion is needed. In patients with suspected unstable pelvic fractures or open femoral fractures, hemodynamic instability, and high-dose vasopressor requirements, the orthopedic trauma surgeon should be prepared to initiate a massive transfusion protocol based on estimated blood loss and the TRASH (Trauma-Associated Severe Hemorrhage) score. Stabilizing long-bone and/or pelvic fractures with external fixation is a damage-control procedure: it limits movement of bone fragments, which may contribute to bleeding and perpetuate shock. The orthopedic trauma surgeon should also assess the need for, and be prepared to perform, emergency extraperitoneal pelvic packing.

Next Steps. Rapid estimation of fracture-related blood loss, use of the TRASH score, application of external fixation, and performance of extraperitoneal pelvic packing constitute essential skills for orthopedic trauma surgeons involved in polytrauma care. Training and practical rehearsal of these skills should be included in orthopedic trauma education.

Keywords: orthopedic trauma surgeon; polytrauma; trauma care.

The BelCD Spinal System for the Surgical Treatment of Spinal Deformities

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Modern surgical techniques for spinal deformity correction rely on specialized implantable constructs to achieve the planned intraoperative correction and stabilization of the spine.

For more than 30 years, spinal deformities in patients in the Republic of Belarus have been treated surgically using purpose-designed spinal correction and fixation devices branded BelCD. The name is an abbreviation of "Belorussian Corrector Deformation," meaning "Belarusian Deformity Corrector," and identifies the device as a domestically developed product from the Republic of Belarus.

Over the past three decades, the BelCD design has undergone a number of technical improvements and modifications while retaining its original brand name. Under the completed Union State Program, Development of New Spinal Systems Using Prototyping Technologies for the Surgical Treatment of Children with Severe Congenital Spinal Deformities and Injuries (research and development phase: 2017–2020; implementation phase: 2021–2023), the Belarusian team developed modular versions of implantable spinal correction and fixation devices. These spinal systems were designed to meet the following medical and technical requirements:

Enable corrective and stabilizing surgery across all spinal regions for injuries and deformities of any etiology.

Allow the implant configuration to be tailored to the individual patient, following the principle that the construct should be designed for the patient, not the patient for the construct.

Be suitable for patients of all age groups.

Support staged and revision surgery.

The anatomical and functional implantation sites for the spinal system are the paired posterolateral triangular-prismatic spaces of the spine. On axial cross-section, the triangle is defined by three landmarks: the tip of the spinous process, the center of its base, and the tip of the transverse process. These spaces extend across the cervical, thoracic, lumbar, and sacral regions, with intrapedicular and extrapedicular bony pathways to the corresponding vertebral bodies. The system also includes components and assemblies for combined corrective action on the rib cage.

The BelCD spinal system comprises more than 30 components and assemblies, each available in 3 to 40 sizes and manufactured from titanium alloys. The range of component dimensions includes load-bearing rods with diameters from 4 to 7 mm. Dedicated assembly and insertion instruments have been developed to place the implants and perform corrective maneuvers.

Keywords: BelCD spinal system; spinal deformity; spinal instrumentation; deformity correction; spinal stabilization; modular implants; titanium alloy.