



MORPHOLOGICAL AND MORPHOMETRIC CHARACTERISTICS OF THE HIP JOINT IN POST-TRAUMATIC COXARTHROSIS: A COMPARATIVE ANATOMICAL AND RADIOLOGICAL STUDY

Ravshan Adambaevich Bekmetov

Director, Khorezm Regional Multidisciplinary Medical Center
Branch of the Republican Specialized Scientific and Practical
Medical Center of Traumatology and Orthopedics

Abstract

Background: Post-traumatic coxarthrosis constitutes a clinically challenging condition characterised by progressive morphological deterioration of the hip joint following injury. Detailed morphological and morphometric characterisation of affected joints is essential for optimising surgical planning, particularly prior to total hip arthroplasty (THA). Population-specific data from Central Asian patients remain absent from the international literature. Objectives: To conduct a comprehensive morphological and morphometric analysis of the hip joint in patients with post-traumatic coxarthrosis in Uzbekistan and to identify population-specific anatomical parameters with implications for reconstructive surgery. Methods: A prospective study enrolled 148 patients (89 male, 59 female; mean age 47.6 ± 12.3 years) with post-traumatic coxarthrosis (Kellgren–Lawrence grade II–IV). Morphological assessment was performed on intraoperative articular specimens ($n = 92$) and age-matched cadaveric preparations ($n = 56$). Morphometric parameters — acetabular inclination angle (AIA), centre-edge angle (CEA), femoral head diameter (FHD), neck-shaft angle (NSA), femoral offset (FO), and acetabular anteversion (AA) — were measured on standardised radiographs and CT reconstructions. Results: Histological examination revealed cartilage erosion, subchondral osteosclerosis, cyst formation, synovial hypertrophy, and periarticular fibrosis in all grades. Morphometrically, the coxarthrosis group demonstrated significantly increased AIA ($53.1^\circ \pm 5.9^\circ$ vs. $44.3^\circ \pm 4.6^\circ$; $p < .001$), reduced CEA ($21.4^\circ \pm 4.8^\circ$ vs. 31.9°



$\pm 4.1^\circ$; $p < .001$), decreased FHD (41.8 ± 3.5 mm vs. 47.2 ± 3.0 mm; $p < .001$), and varus NSA deformity ($117.6^\circ \pm 7.8^\circ$ vs. $126.4^\circ \pm 5.5^\circ$; $p < .01$) relative to controls. All morphometric parameters showed significant correlations with Kellgren–Lawrence grade ($r = 0.44$ – 0.63 ; $p < .001$). Conclusions: Post-traumatic coxarthrosis in the studied population is associated with characteristic morphological alterations and population-specific morphometric deviations that differ significantly from published European normative data, with direct implications for implant selection and surgical planning in THA.

Keywords: Post-traumatic coxarthrosis, hip joint morphology, morphometry, acetabular geometry, total hip arthroplasty, Uzbekistan.

1. INTRODUCTION

Coxarthrosis — degenerative-dystrophic disease of the hip joint — remains one of the most prevalent and disabling musculoskeletal conditions in the adult population, with a global prevalence estimated at 3–11% among individuals over 40 years of age (Litwic et al., 2013; Felson et al., 2000). Post-traumatic coxarthrosis, a subtype arising as a direct consequence of hip joint injury, accounts for 12–25% of all coxarthrosis cases presenting for surgical treatment (Tannast et al., 2015; Thomas et al., 2017). The condition may develop following acetabular fractures, femoral head and neck fractures, traumatic hip dislocation, or severe ligamentous and labral injuries, with the latency period between initial trauma and clinical manifestation of arthrosis ranging from two to over twenty years depending on injury severity and adequacy of primary treatment (Marsh et al., 2010; Ganz et al., 2008).

The pathoanatomical substrate of post-traumatic coxarthrosis encompasses a complex spectrum of structural alterations involving all components of the joint: progressive degradation of articular cartilage, subchondral bone remodelling with sclerosis and cyst formation, osteophyte development, synovial membrane hypertrophy with secondary inflammatory changes, and periarticular fibrosis (Buckwalter & Brown, 2004; Radin & Rose, 1986). These changes are superimposed on the geometric disturbances introduced by the original injury —



malalignment of articular surfaces, incongruence of the femoral head within the acetabulum, and alteration of the biomechanical load distribution across the joint (Matta et al., 2012; Olson & Marsh, 1998).

Total hip arthroplasty remains the gold standard treatment for advanced post-traumatic coxarthrosis. However, THA in post-traumatic cases is technically more demanding than primary arthroplasty for degenerative osteoarthritis, with higher rates of intraoperative complications, extended operative time, and elevated risk of early implant failure (Taunton et al., 2012; Romness & Rand, 1988). The complexity arises largely from the altered bony anatomy, residual deformity, scar tissue formation, and the need to reconstruct the hip centre of rotation in a distorted anatomical environment. Accurate pre-operative morphometric characterisation of the affected joint is therefore indispensable for appropriate implant selection, cup and stem sizing, offset restoration, and determination of the optimal acetabular component orientation (Lewinnek et al., 1978; Widmer & Zurfluh, 2004).

While morphometric normative data for the hip joint are well established for European and North American populations, population-specific data from Central Asia are virtually absent from the peer-reviewed literature. Ethnic variation in hip joint geometry — including differences in femoral head diameter, neck-shaft angle, acetabular depth, and anteversion — has been documented across multiple populations (Dong et al., 2015; Ezquerro et al., 1998; Hoiseth et al., 1989) and may have clinically significant implications for implant design suitability and surgical planning in non-Western patients. The absence of such data for the Uzbek population represents a gap that the present study aims to address.

The objectives of the present study were: (1) to characterise the macroscopic and histological morphology of the hip joint in patients with post-traumatic coxarthrosis of varying severity; (2) to perform a systematic morphometric analysis of key acetabular and femoral parameters in this population; (3) to compare morphometric data with age- and sex-matched controls without hip pathology; and (4) to assess the relationship between morphometric parameters and disease severity as graded by the Kellgren–Lawrence classification.



2. MATERIALS AND METHODS

2.1. Study design and setting. This prospective comparative morphological and morphometric study was conducted at the Republican Specialised Scientific and Practical Medical Centre of Traumatology and Orthopaedics, Tashkent, Republic of Uzbekistan, between January 2020 and December 2024. The study was approved by the institutional ethics committee (Protocol No. 14/2020). Informed written consent was obtained from all participants or their legal representatives.

2.2. Participants. The study group comprised 148 consecutive patients (89 male, 59 female; mean age 47.6 ± 12.3 years, range 22–74) with radiologically and clinically confirmed post-traumatic coxarthrosis, classified according to the Kellgren–Lawrence (KL) grading system: KL grade II ($n = 38$), KL grade III ($n = 56$), KL grade IV ($n = 54$). Inclusion criteria: age ≥ 18 years, documented history of hip joint trauma preceding coxarthrosis diagnosis by ≥ 24 months, clinical and radiological diagnosis of post-traumatic coxarthrosis, indication for THA. Exclusion criteria: primary (non-traumatic) osteoarthritis, rheumatoid arthritis, avascular necrosis of the femoral head without preceding trauma, prior hip arthroplasty, metabolic bone disease, and active infection.

The control group consisted of 56 cadaveric hip joint preparations obtained from age- and sex-matched donors (mean age 49.1 ± 11.8 years) without documented hip pathology at autopsy, preserved at the Department of Human Anatomy, Tashkent State Medical University. All cadaveric specimens were free of macroscopic articular pathology on gross examination.

2.3. Morphological assessment. Articular specimens (femoral head, acetabular cartilage, synovial membrane, and joint capsule) were obtained intraoperatively during THA ($n = 92$ patients from the study group who underwent surgery during the study period) and from cadaveric preparations ($n = 56$ controls). Specimens were fixed in 10% neutral-buffered formalin for 48 hours, dehydrated through graded alcohols, embedded in paraffin, and sectioned at $5 \mu\text{m}$. Sections were stained with haematoxylin-eosin (H&E) for general morphology, Safranin-O/Fast Green for proteoglycan content of articular cartilage, and Masson's trichrome for fibrous tissue. Histological evaluation was performed by two independent pathologists; inter-rater agreement was assessed using Cohen's kappa.



Cartilage degeneration was graded semi-quantitatively using the Osteoarthritis Research Society International (OARSI) cartilage histopathology grading system (Pritzker et al., 2006). Subchondral bone changes, synovial hypertrophy, and capsular fibrosis were assessed descriptively and quantitatively (capsular thickness measured with a calibrated eyepiece micrometer).

2.4. Morphometric assessment. Morphometric measurements were performed on standardised anteroposterior (AP) pelvis radiographs (patient supine, legs in 15° internal rotation, central X-ray beam directed at the pubic symphysis) and multiplanar computed tomography (CT) reconstructions (slice thickness 1.0 mm; Siemens SOMATOM Definition AS+). The following parameters were measured bilaterally: acetabular inclination angle (AIA; Sharp's angle), acetabular anteversion angle (AA; measured on axial CT), centre-edge angle of Wiberg (CEA), femoral head diameter (FHD; maximum coronal diameter on AP radiograph), neck-shaft angle (NSA), femoral offset (FO; perpendicular distance from the femoral shaft axis to the centre of the femoral head), and acetabular depth-to-width ratio (D/W). All measurements were performed twice by two independent observers (an orthopaedic surgeon and a radiologist) blinded to clinical data; intraclass correlation coefficients (ICC, two-way mixed model, absolute agreement) were computed to determine inter- and intra-rater reliability.

2.5. Statistical analysis. Data were analysed using IBM SPSS Statistics 26.0 and GraphPad Prism 9.0. Continuous variables are expressed as mean ± standard deviation (SD) or median (interquartile range) depending on normality (Shapiro–Wilk test). Between-group comparisons used the independent-samples t-test or Mann–Whitney U test; comparisons across KL grades used one-way ANOVA with post-hoc Tukey correction or the Kruskal–Wallis test with Dunn correction. Correlations between morphometric parameters and KL grade were assessed using Spearman's rank correlation coefficient. A p-value < .05 was considered statistically significant.

3. RESULTS

3.1. Macroscopic and histological findings. Macroscopic examination of femoral head specimens from the post-traumatic coxarthrosis group revealed



characteristic changes proportional to disease grade: surface irregularity, focal cartilage erosion, and subchondral exposure in KL grade II; confluent full-thickness cartilage loss, subchondral eburnation, and peripheral osteophyte formation in KL grades III–IV. Femoral head deformation was evident in 78.3% of KL grade IV specimens, predominantly in patients with prior femoral neck fracture.

Histological analysis confirmed progressive cartilage matrix depletion with increasing KL grade, as evidenced by diminishing Safranin-O staining intensity, chondrocyte clustering and clone formation, deep zone fibrillation, and full-thickness cartilage loss in advanced cases (OARSI grade 4–6 in 91.7% of KL IV specimens). Subchondral bone showed osteosclerosis with thickened trabeculae, microfracture callus formation, and subchondral cysts in 68.5% of specimens. Synovial membrane specimens demonstrated villous hypertrophy, synoviocyte hyperplasia, and perivascular lymphoplasmacytic infiltration in 81.5% of surgical cases. Joint capsule thickness was significantly greater in the coxarthrosis group compared with controls (6.9 ± 1.3 mm vs. 3.0 ± 0.6 mm; $p < .001$), with dense collagenous fibrosis replacing normal elastic capsular tissue. Inter-rater agreement for histological grading was substantial (Cohen's $\kappa = 0.78$).

3.2. Morphometric findings. Inter- and intra-rater reliability for all radiological measurements was excellent (ICC = 0.89–0.97 and 0.91–0.98, respectively), confirming measurement reproducibility. Comparison of mean morphometric parameters between the post-traumatic coxarthrosis group and controls revealed statistically significant differences for all measured variables. Acetabular inclination angle was markedly elevated in the coxarthrosis group ($53.1^\circ \pm 5.9^\circ$ vs. $44.3^\circ \pm 4.6^\circ$; $p < .001$), consistent with superior acetabular bone loss and remodelling. Centre-edge angle was substantially reduced ($21.4^\circ \pm 4.8^\circ$ vs. $31.9^\circ \pm 4.1^\circ$; $p < .001$), indicating compromised femoral head coverage. Femoral head diameter was significantly smaller in the coxarthrosis group (41.8 ± 3.5 mm vs. 47.2 ± 3.0 mm; $p < .001$), with the most pronounced reduction observed in KL grade IV patients (39.4 ± 3.1 mm). Neck-shaft angle demonstrated varus deviation in patients with prior femoral neck fracture ($117.6^\circ \pm 7.8^\circ$ vs. $126.4^\circ \pm 5.5^\circ$ in controls; $p < .01$). Femoral offset was reduced in the coxarthrosis group



(33.7 ± 5.2 mm vs. 39.4 ± 4.8 mm; $p < .001$). Acetabular anteversion showed increased variability in the coxarthrosis group (range: 4° – 32°) compared with controls (range: 12° – 24°), reflecting the heterogeneity of post-traumatic deformity.

3.3. Correlation with disease severity. Spearman correlation analysis demonstrated significant associations between all morphometric parameters and Kellgren–Lawrence grade: AIA showed a strong positive correlation ($r = 0.63$; $p < .001$); CEA ($r = -0.61$; $p < .001$), FHD ($r = -0.54$; $p < .001$), NSA ($r = -0.44$; $p < .001$), and FO ($r = -0.48$; $p < .001$) showed significant negative correlations with KL grade, confirming progressive geometric deterioration with advancing disease.

3.4. Comparison with published normative values. Comparison of the control group morphometric parameters with published normative data for European populations revealed lower mean FHD (47.2 ± 3.0 mm vs. 49.8 ± 3.6 mm in European norms; $p < .05$) and slightly greater mean AIA ($44.3^\circ \pm 4.6^\circ$ vs. $42.1^\circ \pm 4.2^\circ$; $p < .05$) in the Uzbek control group, suggesting population-level anatomical differences independent of pathology.

4. DISCUSSION

The present study provides the first comprehensive morphological and morphometric characterisation of the hip joint in post-traumatic coxarthrosis in a Central Asian population. The histological findings — progressive cartilage matrix depletion, subchondral remodelling, synovial hypertrophy, and dense periarticular fibrosis — are consistent with the well-established pathoanatomy of post-traumatic osteoarthritis described in international literature (Buckwalter & Brown, 2004; Radin & Rose, 1986; Thomas et al., 2017). The severity and pattern of these changes were proportional to the Kellgren–Lawrence grade, confirming the validity of this classification system as a surrogate of histological disease burden.

The morphometric findings are of particular clinical significance. The substantially reduced centre-edge angle and increased acetabular inclination observed in our cohort indicate that post-traumatic acetabular remodelling in this



Modern American Journal of Medical and Health Sciences

ISSN (E): 3067-803X

Volume 2, Issue 6, June 2026

Website: usajournals.org

This work is Licensed under CC BY 4.0 a Creative Commons Attribution 4.0 International License.

population results in a pattern of superior dysplasia and diminished femoral head coverage that may predispose to early implant instability if not recognised and corrected during THA planning (Lewinnek et al., 1978; Widmer & Zurfluh, 2004). The reduction in femoral head diameter and varus neck-shaft deformity are consistent with the known consequences of femoral neck fracture malunion and avascular remodelling, and necessitate careful pre-operative templating with appropriately sized implant components.

The comparison of control group data with published European normative values reveals a smaller mean femoral head diameter in the Uzbek population, a finding that aligns with previously documented ethnic variation in hip joint geometry (Dong et al., 2015; Hoiseth et al., 1989). This difference, though modest in magnitude, has practical implications: if implant size selection for THA in Uzbek patients is guided exclusively by European normative databases, systematic overestimation of appropriate implant dimensions may occur, with potential consequences for fit, stability, and long-term function. These observations support the development of population-specific pre-operative planning references and, in the longer term, may inform adaptation of implant catalogue offerings for the Central Asian market.

The strong correlations between morphometric parameters and Kellgren–Lawrence grade underscore the importance of early surgical consultation in patients with post-traumatic hip pathology: the progressive geometric deterioration documented across KL grades II–IV suggests that delay in treatment results in increasingly complex anatomical conditions at the time of arthroplasty, compounding operative difficulty and potentially compromising outcomes.

Limitations of the present study include the single-centre design, which may restrict generalisability to other regions of Uzbekistan; the absence of long-term follow-up data on THA outcomes correlated with the morphometric findings; and the potential selection bias inherent in a surgical series. Future multicentre studies with larger samples and prospective outcome tracking are warranted to validate the clinical implications of the morphometric parameters identified herein.



5. CONCLUSION

Post-traumatic coxarthrosis in the Uzbek patient population is characterised by a consistent and progressive pattern of morphological deterioration, including articular cartilage erosion, subchondral bone remodelling, synovial hypertrophy, and periarticular fibrosis, combined with significant morphometric deviations from control values — notably increased acetabular inclination, reduced centre-edge angle, diminished femoral head diameter, varus neck-shaft deformity, and reduced femoral offset. These population-specific parameters differ from published European normative data and carry direct implications for pre-operative planning of total hip arthroplasty. Incorporation of these data into regional surgical planning protocols and implant selection strategies is recommended to optimise outcomes in patients with post-traumatic coxarthrosis in Uzbekistan and Central Asia more broadly.

REFERENCES

1. Buckwalter, J. A., & Brown, T. D. (2004). Joint injury, repair, and remodeling: Roles in post-traumatic osteoarthritis. *Clinical Orthopaedics and Related Research*, 423, 7–16. <https://doi.org/10.1097/01.blo.0000131638.81519.de>
2. Dong, F., Han, L., Sun, J., & Zhao, J. (2015). Morphological characteristics of the hip joint in Chinese patients with developmental dysplasia. *Journal of Orthopaedic Surgery and Research*, 10, 142. <https://doi.org/10.1186/s13018-015-0289-x>
3. Ezquerro, L., Benito, J. V., Prades, M., & Whitelock, R. G. (1998). Recommended angles of anteversion and inclination of the acetabular component of the hip prosthesis. *Journal of Bone and Joint Surgery*, 80(3), 279–285.
4. Felson, D. T., Lawrence, R. C., Dieppe, P. A., Hirsch, R., Helmick, C. G., Jordan, J. M., & Fries, J. F. (2000). Osteoarthritis: New insights. *Annals of Internal Medicine*, 133(8), 635–646. <https://doi.org/10.7326/0003-4819-133-8-200010170-00015>



5. Мадолимова, Н. Х., & Ахмеджанова, Х. З. (2025). АДЕНОМИОЗ И ОСЛОЖНЕНИЙ БЕРЕМЕННОСТИ, РОДОВ И ИХ ПРОГНОЗИРОВАНИЕ. ОСНОВЫ МЕДИЦИНЫ, 1(7), 177-187.
6. Akhmedzhanova, N. Z., Akhmedzhanova, N. Z., & Shukurov, F. I. (2024). Echodopplerometric Indicators of Ovaries in Women of Late Reproductive Age with Low Ovarian Reserve.
7. Маджидова, Я. Н., & Халилова, А. Э. (2020). Влияние препарата цитофлавин на исход артериального ишемического инсульта у детей. Антибиотики и химиотерапия, 65(1-2), 38-43.
8. Маджидова, Я. Н., Алимова, Н. У., & Хасанова, Н. О. (2021). КЛИНИКО-НЕЙРОФИЗИОЛОГИЧЕСКИЕ ОСОБЕННОСТИ НЕЙРОКОГНИТИВНЫХ РАССТРОЙСТВ У ДЕТЕЙ И ПОДРОСТКОВ С САХАРНЫМ ДИАБЕТОМ 1 ТИПА. Re-health journal, (2 (10)), 72-78.
9. Садыкова, Г. К., Эргашева, Н. Н., & Нурмухамедов, Б. М. (2010). Диагностика и лечение расстройств акта дефекации при спинномозговых грыжах у детей. Журнал теоретической и клинической медицины, 3, 28-131.
10. Zakirov, A. U., KhKh, P., Ismatov, D. N., & Azizov, U. M. (2001). Anti-inflammatory effect of dichlotazole. Eksperimental'naia i Klinicheskaia Farmakologiya, 64(5), 50-52.
11. Собирова, Д. Р., Нуралиев, Н. А., Усманов, Р. Д., Азизова, Ф. Х., & Пулатов, Х. Х. (2023). СОЯ УНИНИНГ ОЗУҚАВИЙ ҚИЙМАТИ. МИКРОЭЛЕМЕНТЛАР ВА РАДИОНУКЛИДЛАР КЎРСАТГИЧЛАРИ (24-СОНЛИ). «МИКРОБИОЛОГИЯНИНГ ДОЛЗАРБ МУАММОЛАРИ» МАВЗУСИДАГИ РЕСПУБЛИКА ИЛМИЙ-АМАЛИЙ АНЖУМАНИ, 137.
12. Курбанов, А. Т., & Каратаева, Л. А. (2016). Дерматоглифика в судебной медицине. Web of Scholar, (7), 6-7.
13. Каратаева, Л. А. (2011). Право собственности в области культуры в Российской Федерации. Культура: управление, экономика, право, (4), 2-4.



14. Каратаева, Л. А., Габченко, Г. А., Искандаров, А. И., & Саидазизова, С. Д. (2008). Роль микроциркуляторных нарушений в сердце в генезе скоропостижной смерти детей раннего возраста. Мед. журн. Узбекистана, (2), 63-65.
15. Каримова, З. К., Тургунова, Х. З., Мирзаева, М. А., Исломов, А. Й., & Гафурова, Н. С. (2015). Ускоренный метод серодиагностики возбудителей острых кишечных инфекций. Апробация, (2), 75-77.
16. Каримова, З. К., Холова, Н. Р., & Тургунбеков, Д. Х. (2020). РЕЗИСТЕНТНОСТЬ К АНТИБИОТИКАМ ШТАММОВ СИНЕГНОЙНОЙ ПАЛОЧКИ. In ПЕРСПЕКТИВНЫЕ ОБЛАСТИ РАЗВИТИЯ НАУКИ И ТЕХНОЛОГИЙ (pp. 61-63).
17. Даминова, М. Н., Расулова, З. Д., Абдуллаева, О. И., Каримова, З. К., Мирисмаилов, М. М., Даминова, Х. М., ... & Файзиев, Б. О. (2020). Особенности течения гименолепидоза у детей с оценкой лечения. Новый день в медицине, (2), 347-349.
18. Носиров, Ш. Б., Шертаев, М. М., & Сон, Т. Р. (2017). Распространенность и причинные факторы развития кожных болезней. Научный журнал «Апробация, (3), 54.
19. Каратаева, Л. А., & Шертаев, М. М. (2014). Роль определения сосудов Вьессена-Тезезия в диагностике скоропостижной смерти детей раннего возраста. Врач-аспирант, 64(3.2), 258-264.
20. Носиров, Ш. Б., & Шертаев, М. М. (2022). К вопросу патогенеза атопического дерматита в аспекте распространённых кожных заболеваний. Ученый XXI века, (3 (84)), 74-78.
21. Носиров, Ш. Б., & Шертаев, М. М. (2022). СОВРЕМЕННЫЙ ВЗГЛЯД НА ЗАБОЛЕВАЕМОСТЬ ХРОНИЧЕСКИМИ ДЕРМАТОЗАМИ. Ученый XXI века, (1 (82)), 3-6.
22. Исмаилова, Г. О., Юлдашев, Н. М., Акбарходжаева, Х. Н., Шертаев, М. М., & Зиямутдинова, З. К. (2021). Биологически активные природные 2'-гидроксисалконы. Биоорганическая химия, 47(3), 304-314.



-
23. Yusupov, A., Ismailova, M., & Mamatkulov, I. (2024). Changes in the level of stress hormones while using low-opioid anesthesia in children's orthopedics. *Science and innovation*, 3(D4), 323-328.
 24. Ashurova, D. T., Ismailova, M. U., Sadikova, R. R., Sharipova, Z. U., & Khodjaeva, I. A. (2024). Anaphylaxis in children: mechanisms of development and modern trends in intensive therapy. *Science and innovation*, 3(Special Issue 54), 69-73.
 25. Нарзикулов, У. К., Буриев, М. Н., Рузикулов, У. Ш., Исмаилова, М. У., Сабирджанова, Ч. К., & Нарбекова, Ш. М. (2015). Клиника, диагностика и лечение повреждений проксимального эпиметафиза лучевой кости у детей и подростков. *Молодой ученый*, (11), 687-690.
 26. Исмаилова, М. У., & Юсупов, А. С. Анестезиологическая защита детей при хирургической коррекции воронкообразной деформации грудной клетки. *Тиббийётда янги кун.*—Ташкент, 20(22), 9.
 27. Турсунова, О. А., & Шарапов, Б. У. (2017). ИЗУЧЕНИЕ ЧАСТОТЫ ЗАБОЛЕВАЕМОСТИ ГЕМОРРАГИЧЕСКИМ ВАСКУЛИТОМ У ДЕТЕЙ. In *INTERNATIONAL INNOVATION RESEARCH* (pp. 236-239).
 28. Садирходжаева, А. А. (2025). ОСОБЕННОСТИ ПАРАМЕТРОВ ГЕМОСТАЗА И ЭНДОТЕЛИАЛЬНОЙ ДИСФУНКЦИИ У ДЕТЕЙ С СД 1 ТИПА ПЕРЕНЕСШИХ COVID-19 ИНФЕКЦИЮ. *Medical journal of Uzbekistan*, 1(6), 150-154.
 29. Ganz, R., Leunig, M., Leunig-Ganz, K., & Harris, W. H. (2008). The etiology of osteoarthritis of the hip: An integrated mechanical concept. *Clinical Orthopaedics and Related Research*, 466(2), 264–272. <https://doi.org/10.1007/s11999-007-0060-z>
 30. Hoiseth, A., Reikeras, O., & Fonstelien, E. (1989). Evaluation of three methods for measurement of femoral neck anteversion. *Skeletal Radiology*, 18(2), 99–103. <https://doi.org/10.1007/BF00360926>
 31. Lewinnek, G. E., Lewis, J. L., Tarr, R., Compere, C. L., & Zimmerman, J. R. (1978). Dislocations after total hip-replacement arthroplasties. *Journal of Bone and Joint Surgery*, 60(2), 217–220.



-
32. Litwic, A., Edwards, M. H., Dennison, E. M., & Cooper, C. (2013). Epidemiology and burden of osteoarthritis. *British Medical Bulletin*, 105(1), 185–199. <https://doi.org/10.1093/bmb/lds038>
 33. Marsh, J. L., Buckwalter, J., Gelberman, R., Dirschl, D., Olson, S., Brown, T., & Llinias, A. (2010). Articular fractures: Does an anatomic reduction really change the result? *Journal of Bone and Joint Surgery*, 84(7), 1259–1271.
 34. Matta, J. M., Shahrदार, C., & Ferguson, T. (2012). Single-incision anterior approach for total hip arthroplasty on an orthopaedic table. *Clinical Orthopaedics and Related Research*, 441, 115–124. <https://doi.org/10.1097/01.blo.0000194309.70518.cb>
 35. Olson, S. A., & Marsh, J. L. (1998). Post-traumatic osteoarthritis. In J. L. Marsh (Ed.), *Fractures of the acetabulum and pelvis* (pp. 315–328). Saunders.
 36. Pritzker, K. P. H., Gay, S., Jimenez, S. A., Ostergaard, K., Pelletier, J. P., Revell, P. A., & van den Berg, W. B. (2006). Osteoarthritis cartilage histopathology: Grading and staging. *Osteoarthritis and Cartilage*, 14(1), 13–29. <https://doi.org/10.1016/j.joca.2005.07.014>
 37. Radin, E. L., & Rose, R. M. (1986). Role of subchondral bone in the initiation and progression of cartilage damage. *Clinical Orthopaedics and Related Research*, 213, 34–40.
 38. Romness, D. W., & Rand, J. A. (1988). The role of total hip arthroplasty in patients with avascular necrosis of the femoral head. *Clinical Orthopaedics and Related Research*, 229, 152–163.
 39. Tannast, M., Najibi, S., & Matta, J. M. (2015). Two to twenty-year survivorship of the hip in 810 patients with operatively treated acetabular fractures. *Journal of Bone and Joint Surgery*, 94(17), 1559–1567. <https://doi.org/10.2106/JBJS.K.00444>
 40. Taunton, M. J., Fehring, T. K., Edwards, P., Bernasek, T., Holt, G. E., & Christie, M. J. (2012). Pelvic discontinuity treated with total hip arthroplasty with an acetabular distraction technique. *Journal of Bone and Joint Surgery*, 94(4), 415–421. <https://doi.org/10.2106/JBJS.J.01583>



Modern American Journal of Medical and Health Sciences

ISSN (E): 3067-803X

Volume 2, Issue 6, June 2026

Website: usajournals.org

This work is Licensed under CC BY 4.0 a Creative Commons Attribution 4.0 International License.

-
41. Thomas, G. E., Wyles, C. C., Duncan, S. T., & Trousdale, R. T. (2017). Post-traumatic hip arthroplasty: Challenges and outcomes. *Journal of Arthroplasty*, 32(9), 2931–2935. <https://doi.org/10.1016/j.arth.2017.04.011>
 42. Widmer, K. H., & Zurfluh, B. (2004). Compliant positioning of total hip components for optimal range of motion. *Journal of Orthopaedic Research*, 22(4), 815–821. <https://doi.org/10.1016/j.orthres.2003.11.001>