

RESEARCH ARTICLE

The Outcomes of Total Hip Arthroplasty in Patients with Hip Dysplasia

Mohamadreza Daryaei, MD; Mahdieh Samei, MSc; Reza Abdi, MD;
Alireza Mousavian, MD; Omid Shahpari, MD

Research performed at Mashhad University of Medical Sciences, Mashhad, Iran

Received: 26 January 2025

Accepted: 24 May 2026

Abstract

Objectives: This study aimed to assess function, patient satisfaction, and quality of life before and after total hip arthroplasty (THA) in patients with different types of dysplastic hips.

Methods: This prospective, single-group, pre-post interventional study included patients with hip dysplasia who underwent THA at Imam Reza and Ghaem hospitals in Mashhad, Iran, between 2018 and 2022. The collected data included surgical details, pain intensity assessed using the visual analog scale (VAS), Hip Disability and Osteoarthritis Outcome Score (HOOS), Harris Hip Score (HHS), quality of life (QOL), leg length discrepancy (LLD), and abductor muscle strength. These variables were evaluated before surgery and at least two years postoperatively. Statistical significance was set at a P-value of less than 0.05.

Results: The study included 43 dysplastic hips. Of the patients, eight (18.60%) were male and 35 (81.40%) were female, with a mean age of 43.28 ± 10 years. Functional outcomes improved significantly after THA compared with the preoperative status, as reflected by improvements in HHS from 45.58 to 84.60 ($P < 0.001$), HOOS from 32.98 to 77.39 ($P < 0.001$), VAS from 74.56 to 0.28 ($P < 0.001$), QOL from 30.35 to 74.56 ($P < 0.001$), and LLD from 2.88 to 0.70 ($P < 0.001$). However, no significant association was observed between preoperative and postoperative complication rates ($P > 0.05$).

Conclusion: The assessment of THA outcomes in patients with developmental dysplasia of the hip (DDH) showed that this procedure improved function, patient satisfaction, and quality of life while substantially reducing pain. However, this analysis did not specifically compare outcomes according to the surgical approach, implant type, or type of shortening osteotomy used.

Level of evidence: IV

Keywords: Developmental dysplasia of the hip, Hip replacement, Outcome, Total hip arthroplasty

Introduction

Developmental dysplasia of the hip (DDH) is a complex condition that commonly affects young individuals, with a reported prevalence ranging widely from 1.5% in the general population to nearly 30% in selected high-risk cohorts.¹⁻³ DDH occurs more frequently in females,^{4,5} and when diagnosed in newborns, prompt management is essential to prevent long-term complications and secondary degenerative arthritis of the hip joint.⁶

The treatment of developmental dysplasia of the hip

(DDH) varies according to the patient's age and the severity of hip involvement. Surgical interventions—including total hip arthroplasty (THA), resurfacing arthroplasty, periacetabular or proximal femoral osteotomy, arthroscopy, and, rarely, hip fusion or resection arthroplasty—are commonly employed to manage severe forms of hip dysplasia.^{5,7} DDH encompasses a spectrum of abnormalities affecting both the acetabulum and femur. Without appropriate management, these conditions can result in hip pain and osteoarthritis, potentially

Corresponding Author: Omid Shahpari, Orthopedics Research Center, Ghaem Hospital, Mashhad University of Medical Sciences, Mashhad, Iran

Email: omidshahparidr@gmail.com



THE ONLINE VERSION OF THIS ARTICLE
ABJS.MUMS.AC.IR



necessitating THA.⁸ Performing THA in patients with dysplastic hips is particularly challenging due to the complex anatomy of the femur and acetabulum. The younger age of patients combined with a wide range of anatomical variations further increases the complexity of the procedure.^{5,9-11} A comprehensive review and meta-analysis comparing THA outcomes in patients with DDH and osteoarthritis reported higher revision rates after THA in patients with DDH compared to those with osteoarthritis.¹² The complexity of THA in dysplastic hips, particularly in cases of high dislocation, is further amplified by morphological variations, technical challenges, and limitations of prosthetic designs. Several complications continue to pose significant challenges in the management of dysplastic hips, including leg length discrepancy (LLD), nonunion at osteotomy sites, nerve injury, postoperative hip dislocation, knee valgus deformities, and aseptic loosening.^{10,13,14} These complications highlight the ongoing need for research and innovation to improve patient outcomes following THA in dysplastic hips.^{5,15}

Total hip arthroplasty (THA) is among the most effective treatment options for adult patients with dysplastic hips and can provide stable long-term outcomes. Therefore, identifying complications associated with THA is essential for improving the management of dysplastic hips and optimizing postoperative outcomes. Accordingly, this study aimed to compare clinical outcomes, including pain, function, patient satisfaction, and quality of life, before and after THA in patients with dysplastic hips.

Materials and Methods

Patient selection

This study was approved by the Ethics Committee of Mashhad University of Medical Sciences (No: IR.MUMS.MEDICAL.REC.1402.027), and all patients provided informed consent to participate. We reviewed the institutional database for THAs performed at Imam Reza and Ghaem hospitals in Mashhad, Iran, between 2018 and 2022. Inclusion criteria comprised patients who underwent THA with a minimum follow-up of two years and who completed preoperative and at least one-year postoperative patient-reported outcome measures (PROMs). Patients who declined participation or had less than two years of follow-up were excluded. Additionally, registry records of all patients who underwent primary THA with a principal diagnosis of DDH and a minimum two-year follow-up were analyzed.

Preoperative demographic data, including age, sex, and side of involvement, were obtained from the hospital clinical records. For each patient, the diagnosis of developmental dysplasia of the hip (DDH) was confirmed according to the Crowe classification system through a review of clinical records and preoperative plain radiographs.¹⁶

Subsequently, surgical details were recorded, including the surgical approach, leg length discrepancy (LLD), abductor muscle strength, and the type of femoral shortening or soft-tissue release performed. Patient-reported outcome measures (PROMs) were assessed using the visual analog scale (VAS), the Hip Disability and Osteoarthritis Outcome Score (HOOS), the Harris Hip Score (HHS), and the quality-of-life (QOL) domain. These measures were collected preoperatively and at a minimum of two years

postoperatively to evaluate clinical outcomes and patient satisfaction after THA. QOL was assessed using the dedicated Quality of Life subscale of the HOOS questionnaire (HOOS-QOL).

Abductor muscle strength was assessed using the Medical Research Council (MRC) manual muscle testing scale. This scale grades muscle strength from 0, indicating no visible contraction, to 5, indicating normal strength, based on the patient's ability to move the limb against gravity and examiner-applied resistance. Leg length discrepancy (LLD) was measured using a measuring tape. True limb length was measured from the anterior superior iliac spine (ASIS) to the medial malleolus to minimize the effect of hip abduction or adduction, which may result in apparent limb length discrepancy.

Surgical Technique

Two main surgical approaches were used for THA in the included patients: the posterolateral approach and the direct lateral (Hardinge) approach.

In the posterolateral approach, the patient was placed in the lateral decubitus position. The gluteus maximus was split, followed by release of the short external rotators and posterior hip capsule to allow posterior dislocation of the femoral head. Meticulous repair of the short external rotators and posterior capsule to their femoral attachment was performed to reduce the risk of postoperative dislocation.

In the direct lateral (Hardinge) approach, the patient was also placed in the lateral decubitus position. The anterior portions of the gluteus medius and gluteus minimus tendons were released while preserving their posterior femoral attachments. The hip was then dislocated anteriorly to facilitate the arthroplasty procedure.

Statistical analysis

Data were analyzed using IBM SPSS Statistics for Windows, version 21.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were reported for quantitative variables as mean, standard deviation, median, and interquartile range, and for qualitative variables as frequencies and percentages. The Kolmogorov-Smirnov test was used to assess the normality of variable distributions. For normally distributed continuous variables, the paired-samples t-test was used to compare preoperative and postoperative values, whereas the Wilcoxon signed-rank test was applied to non-normally distributed variables. The chi-square test was used to analyze qualitative variables. Statistical significance was set at $P < 0.05$.

Results

A total of 43 primary total hip arthroplasties (THAs) were performed in 36 patients diagnosed with developmental dysplasia of the hip (DDH). Of these patients, five (14%) were male and 31 (86%) were female. The mean patient age was 28.43 years (range: 25–63 years), and the mean follow-up period was 3.51 years (range: 2–6 years). Patient clinical and demographic characteristics are summarized in [Tables 1 and 2].

The preoperative and postoperative HOOS, HHS, QOL, VAS pain scores, and LLD values are presented in [Table 3]. Postoperatively, the mean abductor muscle strength was

4.47 ± 0.80. Muscle strength ranged from grade 2, indicating movement in a gravity-eliminated position, to grade 5, indicating normal strength. Significant improvements were observed in HOOS, HHS, QOL, VAS pain scores, and LLD after surgery compared with

preoperative values ($P < 0.001$). These findings indicate improved functional outcomes and quality of life, along with reduced pain and leg length discrepancy, following THA.

Table 1. Demographic data of patients	
Parameters	Values
No. of patients (hips)	36 (43)
Gender (male/female)	5/31
Mean age (years) (range, SD)	43.28 (25-63, 10)
Mean follow-up (years) (range, SD)	3.51 (2-6, 1.56)
Crowe classification (cases) (%)	
1	1 (2.3)
2	18 (41.9)
3	10 (23.3)
4	14 (32.6)
Side	
Right	13 (30.2)
Left	16 (37.2)
Bilateral	7 (16.3)

Table 2. The clinical Characteristics of patients with Developmental Dysplasia of the Hip	
Parameters	Values
Approach	
Kocher-Langenbeck (posterior)	27 (62.8)
Direct lateral approach (of Hardinge)	16 (37.2)
Prosthesis brand	
DePuy	25 (51.1)
Zimmer	6 (14.0)
Others	12 (27.9)
Osteotomy type	
Subtrochanteric	5 (11.6)
Distal femur	1 (2.3)
No Osteotomy	37 (86.0)
Soft tissue release	
Adductor	7 (16.3)
Anterior & Adductor	5 (11.6)
Anterior	3 (7.0)
Anterior & Adductor & Hamstring	3 (7.0)
Anterior & Hamstring	2 (4.7)
Sciatica	2 (4.7)
Adductor and Sciatic	1 (2.3)
Acetabuloplasty and Graft	9 (21.0)
Baseline Cup Displacement	
0.5 cm up	3 (7.0)
1.5 cm up	1 (2.3)
1 cm up	4 (9.3)
2 cm up	3 (7.0)

Table 3. Comparison of clinical outcomes pre and postoperative

Parameters	Preoperative	Postoperative	P-value
Harris Hip Scores (HHS) †	45.58 ± 13.01	84.60 ± 5.01	<0.001
HOOS †	32.98 ± 7.41	77.39 ± 9.89	<0.001
Quality of life (QOL)† (%)	30.35 ± 7.29	74.56 ± 11.36	<0.001
Visual Analog Scale (VAS)†	74.56 ± 1.93	0.28 ± 0.59	<0.001
LLD † (cm)	2.88 ± 1.85	0.70 ± 0.91	<0.001

†Mean score (standard error). HOOS, Hip dysfunction, and osteoarthritis outcome score; LLD, Leg length discrepancy

Complications of THA in this patient cohort included one fracture above the lesser trochanter, which was managed with cerclage wiring, and three fractures of the greater trochanter, which were repaired using wires and pins. One patient sustained a distal femoral stem fracture that was stabilized with screws and plates; this patient subsequently experienced a dislocation requiring

revision surgery and acetabular cup replacement. Three additional cases of dislocation were observed: two occurred during the first postoperative week, and one occurred within the first year due to cup loosening. All three patients underwent revision surgery with acetabular cup replacement [Table 4].

Table 4. Comparison of complications rate pre and postoperative

Complication N (%)	No. Patients (%)
Periprosthetic fracture (LT)	5 (12.8)
Dislocation	3 (7.7)
Heterotopic ossification (HO)	4 (10.2)
Early revision (↑ cup head size)	3 (7.7)

Heterotopic ossification (HO) was classified according to Brooker's system, with two patients graded as Brooker II, one as Brooker I, and one as Brooker III. One patient developed peroneal nerve palsy, which gradually improved over six months with physiotherapy and the use of an ankle-foot orthosis. Two cases of stress shielding in the proximal femur and two instances of greater tuberosity (GT) avulsion were observed. Additionally, three patients required revision THA with upsized acetabular cups and femoral heads (from 28 mm to 32 mm) due to joint dislocation.

Representative Radiological Findings

To illustrate the range of deformities and surgical outcomes, preoperative and postoperative radiographs from three representative patients are presented.

Case 1: A 30-year-old male patient with bilateral Crowe type IV DDH underwent THA via the posterolateral approach [Figure 1].

Case 2: A 53-year-old female patient with bilateral Crowe type III DDH underwent THA via the posterolateral approach [Figure 2].

Case 3: A 42-year-old female patient with right Crowe type I and left Crowe type III DDH underwent THA via the direct lateral (Hardinge) approach on the more severely affected side [Figure 3].

These figures demonstrate restoration of the hip center, correction of leg length discrepancy, and stable implant positioning across different surgical approaches and Crowe classification types.

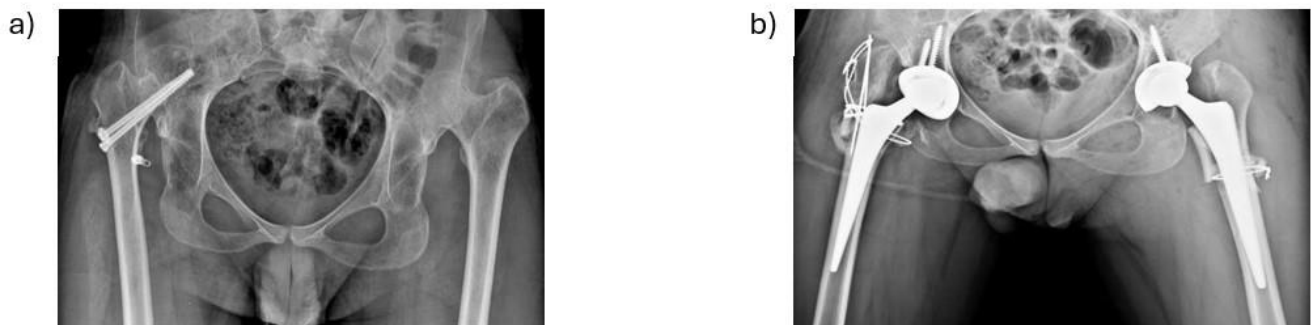


Figure 1. Preoperative (a) and postoperative (b) anteroposterior pelvic radiographs of a patient with bilateral Crowe type IV DDH. This patient underwent bilateral THA using the posterolateral approach. The preoperative image shows high dislocation of both femoral heads with absence of the true acetabulum and severe proximal femoral migration. The postoperative image demonstrates successful restoration of the bilateral hip centers at the level of the true acetabulum, stable placement of cementless femoral stems, correction of leg length discrepancy, and no evidence of loosening, dislocation, or periprosthetic fracture at final follow-up

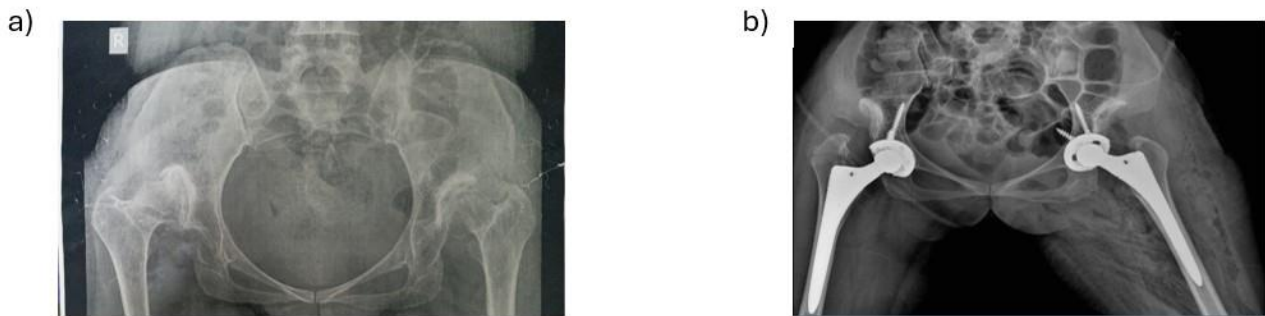


Figure 2. Preoperative (a) and postoperative (b) anteroposterior pelvic radiographs of a patient with bilateral Crowe type III DDH who underwent bilateral THA via the posterolateral approach. The preoperative view reveals moderate proximal femoral migration with partial formation of a false acetabulum bilaterally. The postoperative image shows well positioned acetabular components at the anatomic hip center, stable bilateral cementless femoral stems, complete correction of preoperative proximal migration, symmetric reconstruction of both hip joints, and no radiological signs of loosening, osteolysis, or dislocation at two years after surgery

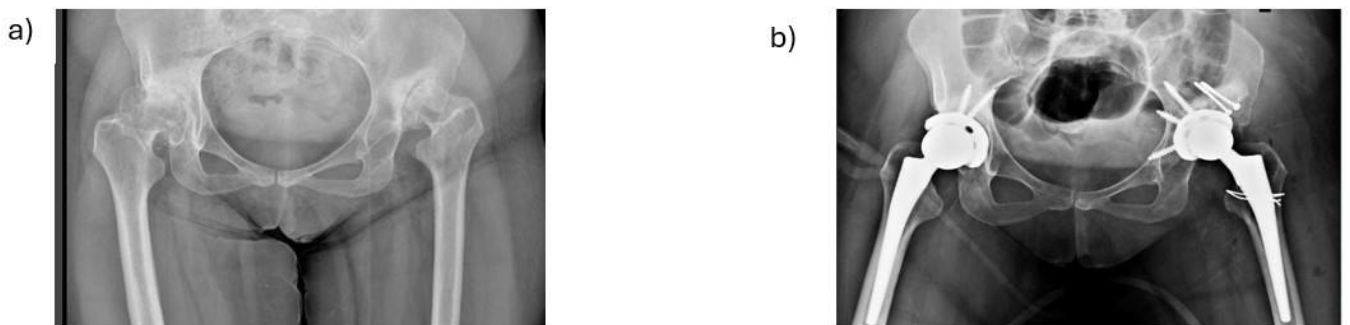


Figure 3. Preoperative (a) and postoperative (b) anteroposterior pelvic radiographs of a patient with right Crowe type I and left Crowe type III DDH. The left hip (more severe, Crowe type III) underwent THA via the direct lateral (Hardinge) approach. The preoperative image shows mild subluxation on the right side (Crowe I) and moderate proximal femoral migration with false acetabulum formation on the left side (Crowe III). The postoperative radiograph demonstrates successful placement of the acetabular component at the true acetabulum on the left side, stable femoral stem alignment, restoration of the hip center, and correction of the preoperative deformity. The right hip (Crowe I) was managed conservatively and shows preserved joint space without progression of osteoarthritis at follow up

Discussion

This study evaluated changes in functional outcomes and quality of life in patients with developmental dysplasia of the hip (DDH) before and after total hip arthroplasty (THA). Postoperative assessments demonstrated significant improvements in function, patient satisfaction, pain (VAS), and quality of life, as measured by the HOOS, HHS, QoL, and VAS scores. Although some subjective perceptions of function may differ preoperatively, validated scoring systems consistently indicated significant improvements following surgery.

It is noteworthy that the majority of patients in our cohort were female, which aligns with epidemiological data indicating that DDH is significantly more prevalent in women. This sex-related predisposition has been attributed to hormonal influences, intrauterine positioning, and genetic factors. Female patients often present with smaller acetabular and femoral dimensions, which may increase the technical complexity of THA. However, our findings, consistent with previous reports, indicate that sex does not adversely affect postoperative outcomes.¹⁷

Previous studies have demonstrated the effectiveness of

THA in improving outcomes in patients with developmental dysplasia of the hip (DDH). Vigdorchik et al. reported significant improvements in pain relief, function, and overall quality of life after THA in this patient population.¹⁸ Similarly, Koutalos et al. observed notable postoperative improvements in the general, physical, and psychosocial aspects of patients' quality of life compared with their preoperative status.¹⁹ Chang et al. further supported these findings by reporting favorable patient-reported quality-of-life outcomes after THA.²⁰ In line with these studies, the present study confirmed improvements in function and quality of life after THA in patients with DDH.

Papachristou et al. demonstrated that THA results in sustained improvements in pain relief, functional capacity, return to daily activities, and reduced complication rates.²¹ Similarly, Sanei et al. reported a significant reduction in pain, supporting the effectiveness of this procedure in pain management.²² The findings of the present study are consistent with these reports, showing a significant postoperative decrease in VAS scores, which indicates effective pain reduction and improved patient comfort. This reduction in pain, together with functional improvement, contributed to a

marked enhancement in overall quality of life. Patients were able to resume daily activities that may have been substantially limited before surgery. The increase in postoperative QoL scores further supports this improvement.

Previous studies have consistently demonstrated significant improvements in HHS following THA in patients with developmental dysplasia of the hip (DDH).^{22,23} Additionally, the Hip Disability and Osteoarthritis Outcome Score (HOOS) is a valuable tool for assessing THA efficacy in this population, providing a comprehensive evaluation of postoperative pain, physical function, and quality of life.²⁴ Sutton et al. further emphasized the predictive value of preoperative patient-reported outcome measures, including HOOS, for forecasting functional improvement after THA.²⁵ The present study corroborates these findings, showing significant improvements in both HHS and HOOS scores following THA. These results highlight the utility of tools such as HOOS in evaluating patient-reported outcomes in patients with DDH undergoing THA. Although HOOS and HHS have been widely used to assess surgical outcomes in hip osteoarthritis, there remains a lack of focused research validating their application specifically in patients with DDH. Future studies should address this gap, including the use of short-form HOOS and HHS in this population.

Complications following THA in patients with developmental dysplasia of the hip (DDH) have been investigated in several long-term studies. A 21-year follow-up reported that most complications occurred within the first decade, including 17% implant failures, 7% dislocations, 1% periprosthetic infections, 1% prosthesis fractures, and severe heterotopic ossification requiring surgical removal.^{21,26} A systematic review of 24 studies reported an average dislocation rate of 5.8%, heterotopic ossification (HO) rate of 11.1%, and fracture rate of 2.9% in this patient population.³ The present study is consistent with these findings, identifying periprosthetic fractures (12.8%) as the most common complication. Other complications, including heterotopic ossification (10.2%), dislocation (7.7%), and revision surgeries (7.7%), were less frequent. Importantly, no surgical site infections around the prosthesis were observed. These results reflect advances in surgical techniques and implant design, which have contributed to improved safety and reduced complication rates in THA for patients with DDH.

Limitations and Suggestions

Despite extensive research on functional outcomes and quality of life in patients with DDH undergoing THA, several knowledge gaps remain that warrant further investigation. The limitations of this study include a small sample size, lack of evaluation of alternative surgical approaches, absence of standardized assessment tools for all patients, and exclusion of concurrent medical conditions. Additionally, aggregated outcome reporting in the literature precluded stratified analysis of the effects of key prognostic factors, such as the severity of dysplasia (Crowe classification), on functional

scores and complication rates. Future research should investigate the impact of specific comorbidities on postoperative outcomes to optimize interventions and enhance patient care.

Conclusion

The assessment of THA outcomes in patients with DDH demonstrated that this procedure results in improved function, increased patient satisfaction, and enhanced quality of life, while concurrently reducing pain. However, our analysis did not specifically compare outcomes based on the surgical approach, prosthesis type, or the type of femoral shortening osteotomy performed. Additionally, these benefits are achieved through effective pain relief without introducing unique complications.

Acknowledgement

N/A

Authors Contribution: Authors who Conceived and designed the analysis: Mohamadreza Daryaei, Mahdieh Samei, Reza Abdi, Alireza Mousavian, Omid Shahpari/ Authors who Collected the data: Mohamadreza Daryaei, Mahdieh Samei, Reza Abdi, Alireza Mousavian, Omid Shahpari/ Authors who Contributed data or analysis tools: Mahdieh Samei, Alireza Mousavian, Omid Shahpari/ Authors who Performed the analysis: Omid Shahpari/ Authors who Wrote the paper: Mohamadreza Daryaei, Mahdieh Samei, Reza Abdi, Omid Shahpari/ Other contribution: Mohamadreza Daryaei, Mahdieh Samei, Reza Abdi, Alireza Mousavian, Omid Shahpari

Declaration of Conflict of Interest: The author(s) do NOT have any potential conflicts of interest for this manuscript.

Declaration of Funding: The author(s) received NO financial support for the preparation, research, authorship, and publication of this manuscript.

Declaration of Ethical Approval for Study: The Ethics Committee of Mashhad University of Medical Sciences (IR.MUMS.MEDICAL.REC.1402.027)

Declaration of Informed Consent: No information (names, initials, hospital identification numbers, or photographs) in the submitted manuscript can be used to identify patients. All information in this manuscript has been deidentified.

Mohamadreza Daryaei MD ¹

Mahdieh Samei MSc ¹

Reza Abdi MD ²

Alireza Mousavian MD ²

Omid Shahpari MD ¹

1 Orthopedics Research Center, Ghaem Hospital, Mashhad University of Medical Sciences, Mashhad, Iran

2 Orthopedics Research Center, Mashhad University of Medical Sciences, Mashhad, Iran

References

1. Qian H, Wang X, Wang P, et al. Total Hip Arthroplasty in Patients with Crowe III/IV Developmental Dysplasia of the Hip: Acetabular Morphology and Reconstruction Techniques. *Orthopaedic Surgery*. 2023;15(6):1468–1476. doi: 10.1111/os.13733.
2. Cheng VK, Hasegawa M, Hattori T, et al. Prevalence of radiographic hip dysplasia in Japanese population-based study. *Mod Rheumatol*. 2022;32(2):438–443. doi: 10.1080/14397595.2021.1918884.
3. Poursalehian M, Hassanzadeh A, Shafiei SH, Mortazavi SJ. Mid-term to Long-term Outcomes and Complications of Total Hip Arthroplasty in Patients Who Have Crowe IV Developmental Dysplasia of the Hip: A Systematic Review and Meta-Analysis. *J Arthroplasty*. 2025;40(2):530–9. doi: 10.1016/j.arth.2024.08.026.
4. Chen AW, Steffes MJ, Laseter JR, et al. How has arthroscopic management of the iliopsoas evolved, and why? A survey of high-volume arthroscopic hip surgeons. *J Hip Preserv Surg*. 2020;7(2):322–328. doi: 10.1093/jhps/hnaa023.
5. Boyle MJ, Singleton N, Frampton CM, Muir D. Functional response to total hip arthroplasty in patients with hip dysplasia. *ANZ J Surg*. 2013;83(7-8):554–8. doi: 10.1111/j.1445-2197.2012.06198.x.
6. Isshiki K, Jinno T, Aizawa J, et al. Asymmetry of the cross-sectional area of the gluteus medius muscle persists eight years after total hip arthroplasty for osteoarthritis of the hip. *Prog Rehabil Med*. 2021;6:20210052. doi: 10.2490/prm.20210052.
7. Boyle MJ, Frampton CM, Crawford HA. Early results of total hip arthroplasty in patients with developmental dysplasia of the hip compared with patients with osteoarthritis. *J Arthroplasty*. 2012;27(3):386–90. doi: 10.1016/j.arth.2011.06.024.
8. Gambling TS, Long A. Psycho-social impact of developmental dysplasia of the hip and of differential access to early diagnosis and treatment: a narrative study of young adults. *SAGE Open Med*. 2019;7:2050312119836010. doi: 10.1177/2050312119836010.
9. Juan AS, Grayhack JJ. Fibular Hemimelia/Congenital Short Femur/LLE Deformity. In: *In Orthopaedics for the Newborn and Young Child: a Practical Clinical Guide*. Springer International Publishing. 1st ed. Sarwark JF, Carl RL, eds. USA, Springer Cham; 2022.
10. Suksathien Y, Tippimanchai T, Akkraseng T, Ruangboon C. Mid-term results of short-stem total hip arthroplasty in patients with Crowe type I and II developmental dysplasia of the hip. *Eur J Orthop Surg Traumatol*. 2021;31(2):319–25. doi: 10.1007/s00590-020-02777-1.
11. Di Martino A, Castagnini F, Stefanini N, et al. Survival rates and reasons for revision of different stem designs in total hip arthroplasty for developmental dysplasia: a regional registry study. *J Orthop Traumatol*. 2021;22(1):29. doi: 10.1186/s10195-021-00590-y.
12. Salman LA, Alzobi OZ, Al-Ani A, Hantouly AT, Al-Juboory M, Ahmed G. The outcomes of total hip arthroplasty in developmental dysplasia of hip versus osteoarthritis: a systematic review and meta-analysis. *Eur J Orthop Surg Traumatol*. 2024;34(1):1–8. doi:10.1007/s00590-023-03635-6.
13. Khaled B, Alsiddiky AM, Mohamed Z, Alzain KO, Alhuzaimi FS, Zulqurnain R. Developmental Dysplasia of the Hip (DDH): Etiology, Diagnosis, and Management. *Cureus*. 2023;15(8):e43207.
14. Sevilla Jr CA, Lopez V, Allala R, et al. Outcomes Following Total Hip Arthroplasty for Hip Dysplasia in Older Adults. Are They Comparable to Those with Osteoarthritis? *BMC Musculoskeletal Disorders*. 2023.
15. Zhang J, Li Z, Li E, Zhang Y. Direct Anterior Approach Total Hip Arthroplasty for Managing Complicated DDH: Not Just Minimally Invasive in Nature. *J Surgery*. 2022;2(2):1072.
16. Crowe JF, Mani VJ, Ranawat CS. Total hip replacement in congenital dislocation and dysplasia of the hip. *J Bone Joint Surg Am*. 1979;61(1):15–23.
17. O'Connor KP, Marshall BJ, Davison J, Clohisy JC, Willey MC. Prevalence of radiographic hip dysplasia in the general adult population: a systematic review. *The Iowa orthopaedic journal*. 2024;44(1):145.
18. Vigdorchik JM, Sharma AK, Aggarwal VK, Carroll KM, Jerabek SA. The use of robotic-assisted total hip arthroplasty in developmental dysplasia of the hip. *Arthroplasty Today*. 2020;6(4):770–776. doi: 10.1016/j.artd.2020.07.022.
19. Koutalos AA, Varitimidis S, Malizos KN, Karachalios T. Revision total hip arthroplasty for aseptic loosening compared with primary total hip arthroplasty for osteoarthritis: long-term clinical, functional and quality of life outcome data. *Hip Int*. 2023;33(5):889–898. doi: 10.1177/1120700022115354.
20. Chang J, Fu M, Cao P, Ding C, Wang D. Patient-reported quality of life before and after total knee arthroplasty: a multicenter observational study. *Patient Prefer Adherence*. 2022;737–748. doi: 10.2147/PPA.S357632.
21. Papachristou GC, Pappa E, Chytas D, Masouros PT, Nikolaou VS, Papachristou G. Total hip replacement in developmental hip dysplasia: A narrative review. *Cureus*. 2021;13(4):e14763. doi: 10.7759/cureus.14763.
22. Sane'i F, Jamebozorgi AA, Irani A, Akbarzade Baghban A, Qoreishi M. Comparing the quality of life before and after total hip arthroplasty operation in patients with developmental dysplasia of the hip. *Physical Treatments-Specific Physical Therapy Journal*. 2016;5(4):219–24.
23. Yildirim T, Guclu B, Karaguvun D, Kaya A, Akan B, Cetin I. Cementless total hip arthroplasty in developmental dysplasia of the hip with end stage osteoarthritis: 2-7 years' clinical results. *Hip Int*. 2015;25(5):442–6. doi: 10.5301/hipint.5000240.
24. Tanghe KK, Beiene ZA, McLawhorn AS, MacLean CH, Gausden EB. Metrics of clinically important changes in total hip arthroplasty: a systematic review. *J Arthroplasty*. 2023;38(2):383–388. doi: 10.1016/j.arth.2022.09.007.
25. Sutton RM, Baker CM, D'Amore T, Krueger CA, Courtney PM. The Appropriateness of Preoperative Patient Reported Outcome Measures as an Indication for Total Hip Arthroplasty. *J Arthroplasty*. 2023;38(7):S252–S257. doi: 10.1016/j.arth.2022.09.004.
26. Fahlbusch H, Budin M, Volk A, et al. Long-term outcomes of total hip arthroplasty in patients with developmental dysplasia of the hip: a minimum 21-year follow-up. *Arch Orthop Trauma Surg*. 2023;143(11):6609–6616. doi: 10.1007/s00402-023-04970-3.