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Varus Femoral Osteotomy Mandatory in Developmental Dysplasia of the Hip

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ABSTRACT

Developmental dysplasia of the hip (DDH) is a spectrum of pediatric hip abnormalities in which treatment aims to obtain a stable, concentric reduction while minimizing complications. Proximal femoral varus osteotomy is commonly used when proximal femoral deformity is considered to compromise containment, but it may introduce additional deformity and complications. This retrospective, non-randomized clinical study assessed the outcomes of acetabular reshaping osteotomy combined with mid-shaft femoral derotation osteotomy while preserving the neck-shaft angle in children with idiopathic DDH. Thirteen children involving 17 hips, treated at El Byda Hospital and Tobruk Medical Center between July 2017 and June 2023, were included; teratologic and revision cases were excluded. The reported age range was 18–60 months, and the study group included 12 girls and 1 boy. Acetabular osteotomy and femoral derotation osteotomy were performed in all hips, with concomitant femoral shortening in 14 hips (82.4%); no varus correction was performed. At follow-up, all 17 hips were classified as excellent according to Barrett's modification of McKay's criteria. The mean acetabular index decreased from 38.31 ± 3.79° preoperatively to 22.62 ± 2.17° at three years. No postoperative subluxation, dislocation, or avascular necrosis was reported.

1. INTRODUCTION

Developmental dysplasia of the hip joint (DDH) is a common disease that occurs in 1 in 1000 live births; it involves a wide range of malformations and may be dysplastic acetabulum, subluxation of the femoral head, or frank dislocation (Shapiro, 2019). DDH has undergone a revolution during the past 120 years since Michael Bowker-Howorth's report on this disease. Prenatal, perinatal, and postnatal factors that contribute to dislocation have been identified, and early diagnostic techniques have improved. Newborn screening programs and physician awareness have reduced the rate of untreated hip dislocations in older children (Hung, 2024).

There are two types of DDH, idiopathic and teratologic; the first one is more common, but they share patho-anatomy as acetabular wall deficiency, change of femoral anteversion angle, coxa valga, and soft tissue hypertrophy, laxity and imbalance (Shapiro, 2019). DDH is an age-dependent disease; however, early diagnosis and management are considered the gold standard way of treatment, and the best results are gained if treatment is initiated early (Czubak et al., 2018). The focus of treatment has shifted from forceful manipulation and electrostatic infusion to gentle analgesia and dynamic splinting. Treating DDH after age of walking is effortful and needs open reduction, pelvic osteotomy and/or femoral shortening derotation osteotomy to provide stable concentric femoral head reduction (Czubak et al., 2018). Proximal femoral varus osteotomy (PFVO) is the most commonly used surgery to correct proximal femoral osteology in coronal and axial planes by decreasing neck-shaft and anteversion angles to further contain femoral head within the acetabulum and decrease intra-articular tension (Gettys et al., 2022 Physiologically, at birth the femoral anteversion angle typically ranges between 30–45 degrees, while the neck-shaft angle is usually more than 150 degrees. For both parameters to reach the normal range, normal articulation of the hip joint with adequate soft tissue tension is required (Flynn & Wiesel, 2011). In addition to a shallow and mal-directed acetabulum, DDH pathology also involves proximal femoral deformities, characterized by excessive femoral anteversion in the axial plane and coxa valga (increased neck-shaft angle) in the coronal plane (Staheli, 2006). Proximal femoral varus osteotomy (PFVO) is performed to reorient the femoral head into the acetabulum by decreasing both the neck-shaft angle and the anteversion angle. This procedure is used in various hip conditions, including DDH, Perthes disease, cerebral palsy, and coxa valga (Staheli, 2006). Proximal femoral varus osteotomy (PFVO) represents a reconstructive intervention designed to correct deviations in femoral alignment and rotational profile. The procedure has demonstrated significant value in both pediatric and adult orthopedic practice, particularly in patients with hip instability, abnormal gait mechanics, or persistent pain (Nelitz et al., 2018). By modifying the femoral varus angle in combination with rotational realignment, PFVO effectively restores hip joint biomechanics and improves acetabular coverage of the femoral head (Buly, 2018). The surgical procedure is commonly performed through a lateral approach, with the osteotomy typically carried out at the subtrochanteric or intertrochanteric level. Correction is achieved by adjusting both varus angulation and femoral rotation, followed by stabilization using fixation devices such as plates or intramedullary nails. In pediatric cases, blade plates remain the preferred option, whereas intramedullary nails are more frequently applied in adult patients (Park et al., 2020). To minimize soft-tissue injury and facilitate quicker rehabilitation, less invasive alternatives such as percutaneous derotation osteotomies and external fixation techniques have been introduced (Nelitz et al., 2018). Proximal femoral varus osteotomy is recognized as an effective surgical intervention for the management of developmental dysplasia of the hip (DDH). However, pediatric patients undergoing this procedure may experience complications such as increased distance between the femoral head and the medial acetabular wall, femoral head subluxation or dislocation, and the risk of avascular necrosis (Ding et al., 2021). Despite its well-established role in correcting hip abnormalities, the procedure's long-term influence on angular deformities of the knee and ankle remains debated **(Liu *et al.,* 2022).** The aim was to assess the effectiveness of femoral derotation osteotomy combined with acetabular reshaping osteotomy without proximal femoral varus osteotomy in the management of idiopathic DDH.

2. METHOD

2.1 Study design and participants

This was a retrospective, non-randomized clinical study conducted at El Byda Hospital and Tobruk medical center from July 2017 to June 2023. The study included 13 children with 17 hip joints. The thesis describes the cohort as children with idiopathic DDH and states that teratologic and revision cases were excluded. The reported age range was 18–60 months. The cohort comprised 12 girls and 1 boy. Six children were reported to have a history of failed closed reduction.

2.2 Clinical and radiological assessment

Preoperative assessment included clinical examination and pelvic radiography. Hip severity was classified according to the International Hip Dysplasia Institute (IHDI) classification. Radiographic assessment included the acetabular index (AI). Postoperative clinical outcome was assessed using Barrett's modification of McKay's criteria, and postoperative radiographs were used to assess hip reduction and the acetabular index.

2.3 Operative technique

Open reduction was performed, followed by temporary fixation of the reduced hip with a Kirschner wire. A direct lateral approach to the femoral shaft was used. The vastus lateralis was retracted while preserving the periosteum. A transverse mid-shaft femoral osteotomy was performed.

Femoral derotation was achieved by externally rotating the distal femoral segment to correct femoral anteversion without changing the neck-shaft angle; femoral shortening was added when required. A reshaping acetabular osteotomy (Dega osteotomy) was performed on the affected side. Femoral fixation was achieved using a 3.5-mm dynamic compression plate. Intraoperative radiographs were obtained to confirm concentric reduction, correction, hardware position, and overall alignment. Postoperatively, a hip spica cast or abduction brace was used with the hip maintained in approximately 45° abduction and 90° flexion.

2.4 Ethical considerations

The thesis reports that participant data were kept confidential, participants were not identified in reports, the purpose and risk–benefit assessment were explained to the parents, and informed consent was obtained from the parents.

2.5 Statistical analysis

Data were analyzed using Statistical Package for the Social Sciences (SPSS). Qualitative variables were expressed as numbers and percentages, while quantitative variables were expressed as mean and standard deviation. The thesis defines $P < 0.05$ as statistically significant. The statistical test used to compare preoperative and postoperative acetabular index is not specified in the supplied methods/results; therefore, no test statistic or P value is reported here.

3. ETHICS APPROVAL

The thesis documents confidentiality and parental informed consent.

4. RESULT

Thirteen children with 17 hips were analyzed. The mean age reported in the results was 37 ± 14.8 months. There was one boy (7.7%) and 12 girls (92.3%). Nine children (69.23%) had unilateral involvement and four (30.8%) had bilateral involvement. Three children (23.07%) were classified as IHDI grade II and ten (76.9%) as grade IV. Six children were reported as having a previously failed closed reduction.

Table 1. Surgical procedures performed in the study cohort.

Surgical procedure	Hips (n=17)	Percentage
Acetabular osteotomy	17	100%
Femoral derotation osteotomy	17	100%
Femoral derotation + shortening	14	82.35%
Change in neck-shaft angle	0	0%

Table 2. Demographic and clinical characteristics of the study cohort.

Characteristic	Number	Percentage
Boys	1	7.7%
Girls	12	92.3%
Unilateral involvement	9	69.23%
Bilateral involvement	4	30.8%
IHDI grade II	3	23.07%
IHDI grade IV	10	76.9%
History of failed closed reduction	6	35.29%

Table 3. Clinical outcome according to Barrett's modification of McKay's criteria.

Barrett modification of McKay category	Hips	Percentage
Excellent	17	100%
Good	0	0%
Fair	0	0%
Poor	0	0%

Table 4. Preoperative and postoperative acetabular index.

Radiological variable	Mean ± SD
Preoperative acetabular index	38.31 ± 3.79°
Postoperative acetabular index at 3 years	22.62 ± 2.17°

Table 5. Reported major postoperative complications.

Postoperative complication	Hips affected	Percentage
Subluxation	0	0%
Dislocation	0	0%
Avascular necrosis	0	0%
Total reported major complications	0	0%

The mean acetabular index decreased from 38.31 ± 3.79° before surgery to 22.62 ± 2.17° at three-year follow-up. The thesis describes this reduction as statistically significant, but does not report the statistical test or exact P value. All 17 hips were reported as excellent according to Barrett's modification of McKay's criteria. No postoperative subluxation, dislocation, or avascular necrosis was reported.

5. DISCUSSION

The central finding of this study is that reconstruction using acetabular reshaping osteotomy and mid-shaft femoral derotation, with preservation of the neck-shaft angle, was associated with favorable clinical and radiological results in this small cohort. The acetabular index improved substantially, and all treated hips were reported as excellent according to Barrett's modification of McKay's criteria.

The rationale for avoiding routine proximal femoral varus osteotomy is supported in the thesis by concerns regarding its potential effects on proximal femoral growth and biomechanics. Previous literature cited in the thesis describes risks including proximal femoral epiphyseal separation, altered growth of the proximal femur, and avascular necrosis. The thesis also notes that the need for femoral osteotomy may depend on the severity of dislocation and the specific femoral and acetabular morphology.

The findings are broadly consistent with the study by Jawad and Saadoon, which reported that open reduction with derotation osteotomy without pelvic osteotomy could restore stability in selected children younger than 2.5 years. In contrast, other studies cited in the thesis, including Mazloumi et al., Chen et al., and Paul et al., reported favorable results using combined femoral and pelvic procedures. Castañeda et al. reported that femoral osteotomy was more often added in cases with high dislocation. These differences emphasize that femoral correction should be individualized rather than automatically applied or omitted in every patient.

The present results should therefore be interpreted as evidence supporting a selective, morphology-based approach. The study does not directly compare varus osteotomy with preservation of the neck-shaft angle, because all hips included underwent the latter strategy and there was no control group. Consequently, the data demonstrate the outcomes of the selected reconstructive technique but cannot establish that varus osteotomy is never indicated.

The reported absence of avascular necrosis, redislocation, and subluxation is encouraging; however, the sample consisted of only 17 hips. A zero-event observation in a small cohort does not establish that the true complication risk is zero. Larger comparative studies with standardized radiological and functional follow-up are required.

6. CONCLUSION

In this retrospective series of 13 children (17 hips) with idiopathic DDH, acetabular reshaping osteotomy combined with mid-shaft femoral derotation osteotomy while preserving the neck-shaft angle was associated with excellent reported clinical outcomes, improvement in acetabular index, and no reported postoperative subluxation, dislocation, or avascular necrosis. The findings suggest that proximal femoral varus osteotomy does not need to be routinely added when adequate concentric reduction and acetabular correction can be achieved. The conclusion should be limited to appropriately selected patients because the study was small, retrospective, non-comparative, and included no varus-osteotomy control group

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