Single-stage surgical treatment for late presenting developmental dysplasia of the hip in children older than 7 years of age: a midterm results

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Background
Treatment of late presenting developmental dysplasia of the hip (DDH) in older children is a challenge due to adaptive shortening of the surrounding soft tissues, acetabular dysplasia (1). This study aims to evaluate the outcome of surgical treatment for DDH presenting in children older than 7 years.
Patients and methods
Twenty-five patients (32 hips) a mean age at the time of surgery was 9.5 years (range 7.3–14.9 years) were treated using Dega osteotomy, or triple pelvic osteotomy. Femoral shortening and derotation osteotomy were done for all patients. A spica cast was applied postoperative for 6 weeks, and allowed mobilization exercises of the hip joint 2 weeks after the cast removal. All patients were followed for an average of 5.9 years (range 4.5–9.9 years) after surgery. According to the McKay criteria and Severin criteria, the satisfactory results were 67 and 53%, respectively. There was one case of postoperative stiffness managed by physical. A green stick supracondylar femoral fracture occurred in one case. The results revealed improvement in Sharp's acetabular angle and centre edge angle. Avascular necrosis of the femoral head was observed in two cases.
Conclusion
Reconstruction for late presenting DDH in children older than 7 years can give a satisfactory result both clinical and radiological. Although the concern of postoperative stiffness and avascular necrosis is still there but this can be managed with prolonged physical therapy and prevented with shortening of the femur, respectively.

Keywords:
developmental hip dislocation, hip reconstruction, walking age

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Introduction

There is no consensus on the definition of neglected developmental dysplasia of the hip (DDH). What is available in the literature depends on the Iowa long-term studies which concluded that beyond the age of 18 months is considered neglected with less satisfaction and increased incidence of complication. The 3 main complications were postoperative stiffness, residual dysplasia, and Avascular necrosis (AVN) which is titled nowadays in the literature with proximal femur growth disturbance. In our community with a lack of screening programs for DDH, lack of awareness of the parents, and economic causes we still see DDH older than 7 years [1,2].

The available literature for the late presenting DDH originates from the developing world as a case series with different results and recommendations [3–5].

Some authors have recommended nonoperative interference for such cases [6–9]. However, others reported that reconstruction of the hip will result in a satisfactory results and allow the remodeling of the acetabulum [10–14].

Patients and methods

Between January 2008 and January 2013, 226 patients with DDH were treated in our institute, 35 patients were older than 7 years. Only 25 patients fulfilled the inclusion criteria of our study.

Inclusion criteria included patients with DDH older than 7 years, had no previous surgical procedure for DDH, and followed up for at least 4 years.

Exclusion criteria included patients with known neuromuscular disorder, not available for follow-up for at least 4 years, and those with previous surgical procedures of a pelvic or a femoral osteotomy.

Indication for surgery was limping gait in all patients. Of the 25 patients 32 hips included in the current study, eight (10 hips) were boys and 17 (22 hips) were girls; 18 had unilateral DDH (left eight, right 10), and seven had bilateral DDH. The mean age of the patients was 9.5 (range, 7.3–14.9) years.

According to Tonnis classification [15] the degree of dislocation severity (preoperatively), were two (6.3%) hip in grade 1, four (12.5%) in grade 2, 14 (43.8%) in grade 3, and 12 (37.5%) grade 4.

Severin's grading system [16] was used to evaluate the patient radiologically.

Gait pattern, pain symptoms, presence of Trendelenburg sign and range of hip joint motion were recorded for each patient preoperatively and at the latest follow-up using the modified McKay's criteria [17]. Kalamachi and MacEwan criteria [18] was used for the diagnosis of AVN.

The operative procedure started with adductor tenotomy– performed through a small incision given directly over the tight adductors in the inguinal region. The Smith–Petterson approach was used to expose the hip joint for open reduction, capsuloraphy, and pelvic osteotomy.

The femur is exposed with a separate incision and femoral osteotomy in the mid-diaphyseal area. The amount of shortening is known by how much the overlap of both ends is. Shortening is done in all cases with derotation and fixation with 8-hole small dynamic compression plate. Pelvic osteotomy was done in this study 20 patients (26 hips) were treated with Dega osteotomy and five patients (6 hips), with triple pelvic osteotomy (i.e. iliac, pubic, and ischial osteotomy). An iliac bone graft was inserted into the pelvic osteotomy. The type of pelvic osteotomy was made depending on the age and the degree of dysplasia. Patients with bilateral dysplasia experienced the procedure on both hips at an interval of 6 weeks.

Postoperative care

A hip spica cast with both lower extremities in moderate flexion 10–15 internal rotation and 20–30 abduction was applied postoperation for 6 weeks. Progressive flexion and extension exercises of the hip joint were initiated 2 weeks after cast removal.

After removal of the cast, the patients performed some exercises on the bed for two weeks before weight bearing. Internal fixation was removed after 6 months.

The patients were examined clinically and radiologically at 3-month intervals for 2 years then every 6 months yearly. The results reflect data collected from the last follow-up. (Figs 1 and 2).

Results

The mean follow-up duration was 5.9 (range, 4.5–9.9) years.

Postoperatively, according to modified Severin classification [16] four (12.5%), 13 (40.6%), 11 (34.4%), and four (12.5%) were classified as Severin grade I, II, III, and IV, respectively. No patients were classified as grade V.

According to the Mackay's scoring system. The clinical results were satisfactory. The results were excellent in six (24%) patients, good in 13 (52%) patients, fair in four (16%), and poor in two (8%) patients.

AVN was observed in two cases and was graded as grade II according to Kalamchi and MacEwen classification [18].

Results revealed improvement in Sharp's acetabular angle and centre edge angle. The mean Sharp acetabular angle was 39° (range, 30–46°) before surgery and 18° (range, 12–40°) at final follow-up. The mean centre edge angle at the final follow-up was 35° (range, 13–50°).

The mean of femoral shortening was 2.3 cm (range from 1.5 to 3.5 cm).

Discussion

Treatment of DDH for older children is a challenge [4]. On reviewing the literature, a few authors reported on the management of late, neglected DDH presenting after the age of 7 years, probably because there are so few cases of the condition in the developed world [6].

A few authors have recommended that surgical treatment in neglected cases is not advisable or is even dangerous, but without presenting strong clinical evidence [6–9]. Others do accept the surgical option and reported satisfactory results but suggest that the results worsen as age increases [10–15]. Treatment of a

Figure 1

A 9-year-old female with bilateral developmental dysplasia of the hip operated with open reduction and pelvic osteotomy with shortening radiography after removal of the plate with clinical pictures.

large series of neglected DDH was presented by Klisic *et al.* [10], Galpin *et al.*[11], and Ashley *et al.* [19] who advocate open reduction with concurrent shortening of the femur and report satisfactory results in comparison to the alternative.

We think that untreated DDH may present with limp and abnormal gait which will affect the quality of life. Also, operative interference of DDH in old children may result in a near normal hip or even a more easier hip replacement if needed in the future.

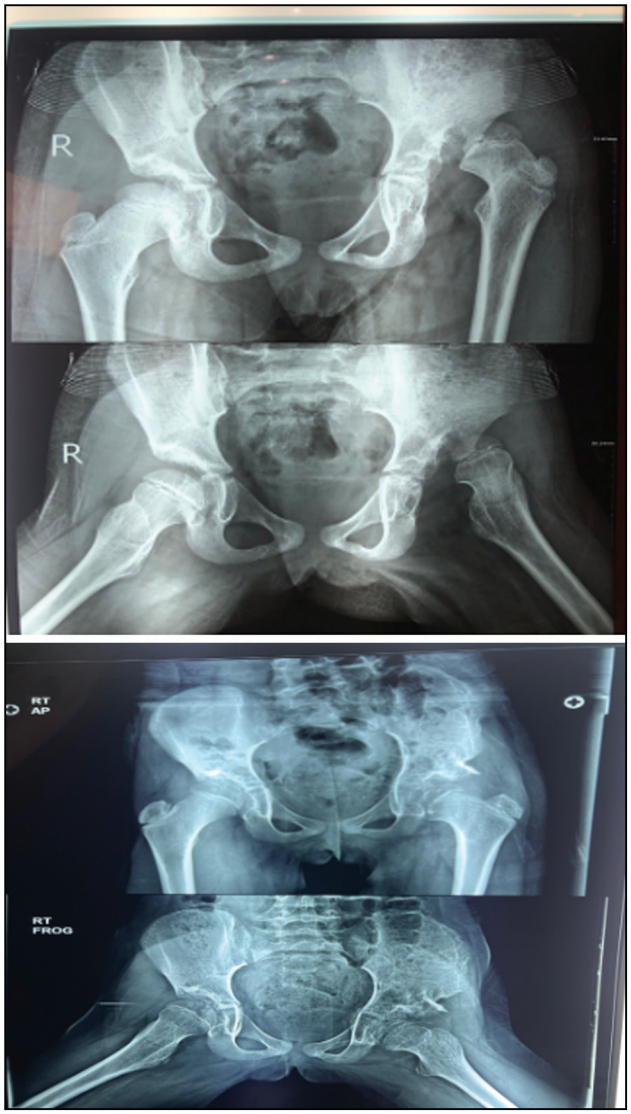
In our study, the age range was 7.3–14.9 years, with an average of 9.5 years. The mean follow up 5.9 years, the results was satisfactory in 76% of our cases this is comparable with Karakas *et al.* [20] who obtained good or excellent clinical and radiographic outcomes–according to McKay's and Severin's criteria, respectively, in 67 and 65% of 55 hips with a one-stage operation. Papavasiliou *et al.*, [12] obtained satisfactory results both clinically and radiologically with one stage operation on patients in preadolescent age after a mean follow up of 7.8 years. Ryan *et al.* [13] suggest that a one-stage operative procedure consisting of open reduction, femoral shortening, and pelvic osteotomy (when indicated) in neglected DDH cases in children between 3 and 10 years of age can result in remodeling of the acetabulum and the formation of a functional hip joint.

Reduction may be hindered by soft tissue contracture with undue pressure on the femoral head. This may result in poor development of hip joint and AVN of the femoral head [4,7]. Shortening did not exceed 2 cm [1] or 1.5 cm [14]. In the current study, femoral shortening reached up to 3.5 cm this is explained by the older age of our patients. Vallamshetla *et al.* recommended the shortening to be enough to have a tension free reduction [15]. We agree with this concept since overpressure will lead to AVN and postoperative stiffness. Limb length discrepancy is not a problem because this can be compensated with this young age population.

Joint stiffness, AVN, and subluxation or redislocation are common postoperative complications after management of unrecognized DDH in older children. The most important target is to reduce the incidence of complications by strictly controlling operational indications. In our study, only two patients (6.3%) developed AVN, which is a lower incidence than that reported in others [13,21]. This might be attributed to the adequate femoral shortening, and early mobilization of hip joint.

Ok *et al.* [22] used Chiari osteotomy in only 3 out of 11 hips 8–17 years old. Their procedure involve open reduction, shortening and varus osteotomy. Some authors [12,22] prefer to do varization osteotomy in the current

Figure 2



8-year-old female with left developmental dysplasia of the hip operated by open reduction, shortening, and pelvic osteotomy. Radiography pre and post after plate removal.

study, we did not attempt to do varization of neck shaft angle since this may result in a Trendelenburg gait.

The mean follow up in the current study was 5.9 years. This is comparable with other studies in which the mean follow up period was 5.3 [23], 6.2 [15], and 7.1 [22] years. This follow up period is not a long enough for evolving osteoarthritic changes.

The limitation of the study were the different age of presentation of the cases with different degree of dislocation. We are planning to follow those patients during the adult life for a long term results.

Conclusion

Open reduction of DDH in older children provides satisfactory clinical and radiological results.

There is no evidence to support the presence of any osteoarthritic changes in such hips. If this happens in the future, hip replacement will be easier.

Acknowledgments

Authors fulfill the criteria for authorship.

Authors contribution

K.Z. performed the procedure, study design, performed measurements, and manuscript preparation; W.A.A. contributed to study design, performed measurements, manuscript preparation; A.S. contributed to study design, statistical analysis, and manuscript preparation; A.A.F. contributed to study design, performed measurements, and manuscript preparation; B.A. contributed to study design and manuscript preparation.

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Conflicts of interest

There are no conflicts of interest.

Data availability statement

The data presented in this study are available upon request from the corresponding author.

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