Outcome of surgical management of developmental dysplasia of hip in children between 18 and 24 months

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ABSTRACT
Background: Developmental dysplasia of hip (DDH) is a common condition presenting to a pediatric orthopedic surgeon. There is a consensus on the surgical treatment of children with ages ranged from 18 to 24 months where majority agree on open reduction and hip spica. Open reduction was done with an additional pelvic procedure wherever required to get better results and prevent residual acetabular dysplasia (RAD) and early osteoarthritis.

Materials and Methods: 35 children with unilateral DDH were operated between 2002 and 2007 at our institute. Open reduction was performed in all using the standard anterior approach and peroperative test for hip stability was done. Nine children got an additional pelvic procedure in the form of Dega acetabuloplasty. All were followed up for a minimal period of 2 years (range 2-7 years).

Results: No hip got redislocated. At the end of 18 months, there were seven cases of RAD with acetabular index (AI) of 35° and above. These were all from the group where open reduction alone was done.

Conclusion: We feel that a preoperative AI of >40° and a per-operative safe-zone <20° increases the need for supplementary pelvic osteotomy in age group of 18 to 24 months because in such cases, the remodeling capacity of the acetabulum is unable to overcome the dysplasia and to form a relatively normal acetabulum.

Key words: Dega osteotomy, developmental dysplasia of hip, pelvic procedure, children

MeSH terms: Osteotomy, congenital, pediatrics, hip dysplasia

INTRODUCTION
Developmental dysplasia of hip (DDH) is a common condition presenting to a pediatric orthopedic surgeon. Early management is of utmost importance to achieve normal development of hip and prevent residual acetabular dysplasia (RAD). In infants below 6 months of age, Pavlik harness is the gold standard of treatment. Once the child achieves walking age, treatment becomes more extensive. In the management of age group 18-24 months, majority of surgeons agree on open reduction and hip spica and a supplementary procedure like a proximal femoral osteotomy is usually not necessary in this age group.1,2

This study aims to recognize situations where an additional procedure may be required in a patient with DDH between 18 and 24 months to prevent a possible acetabular dysplasia.

MATERIALS AND METHODS
35 children, of which 22 were girls and 13 were boys with aged between 18 and 24 months with unilateral DDH were operated between 2002 and 2007 at our institute. All patients received conservative treatment prior to their presentation at our center. All the patients presenting to us who had dislocations were included and those with mere subluxations or dysplasia were excluded from the study. Teratological dislocations were also excluded.

Radiological preoperative assessment included the extent of dislocation, acetabular index (AI), size of femoral ossification nucleus, sourcil and the tear drop development.

Operative procedure
Percutaneous adductor tenotomy was performed in all patients prior to open reduction. All were operated using the standard bikini incision. The hip joint was approached superficially between sartorius and tensor fascia lata when the sartorius was detached from anterior superior iliac spine to improve exposure. The deep dissection was between...
the hip abductors and rectus where the later was detached from the anterior inferior iliac spine (AIIS) to improve the exposure. The anteromedial capsule was adequately incised to remove the obstacle to reduction. The femoral head was identified and ligamentum teres cut and traced to the acetabulum. The hypertrophic ligamentum teres was completely excised. The psoas tendon was identified and tenotomy done to improve access to the acetabulum. The acetabular labrum was identified and care was taken to keep it intact and undamaged. The transverse acetabular ligament identified and incised in order to remove the inferior obstacle to reduction. The acetabulum was cleared of fibrocartilaginous tissue and femoral head was reduced into the acetabulum. All patients were subjected to peri-operative test for hip stability using the “safe zone” concept. The hip was abducted and adducted and the zone of abduction and adduction in which the femoral head remains reduced in the acetabulum (maximum safe abduction taken as 60°) was determined. This zone is termed the “safe zone.” In cases when peri-operative safe zone ≤20° (nine children) an additional pelvic procedure was performed in the form of Dega’s acetaluboplasty. No separate incision was required and same incision was extended posteriorly to an adequate extent and used for pelvic osteotomy.

The orientation of the osteotomy is first marked on the lateral cortex of the ilium. The direction of the osteotomy is curvilinear when viewed from the lateral cortex, starting just above the anterior inferior iliac spine, curving gently cephalad and posteriorly to reach a point superior to the midpoint of the acetabulum, and then continuing posteriorly to end approximately 1-1.5 cm in front of the sciatic notch. The most cephalad extent of the osteotomy is in the middle of the acetabulum. A guide wire is inserted under fluoroscopic control at the most cephalad point of the curvilinear marking line, directed caudally and medially to ensure that the osteotomy will exit at the appropriate level just above the horizontal limb of the triradiate cartilage. A straight 0.25 or 0.5-inch osteotome is used to perform the bone cut, which extends obliquely medially and inferiorly, paralleling the guid wire to exit through the inner cortex just above the iliopubic and ilioischial limbs of the triradiate cartilage, leaving the posterior one-third of the inner cortex intact. If predominantly anterior coverage is desired, the medial (inner) cortex is cut over the anterior and middle portion, leaving only the posterior sciatic notch hinge intact. If more lateral coverage is desired, more of the medial cortex is left intact, resulting in a posteromedial hinge based on the posteromedial inner cortex and the entire sciatic notch. The osteotomy site is kept open by inserting two correctly sized bone grafts. The grafts are fashioned from a bicortical segment of the iliac crest bone. Metallic internal fixation is not necessary. All patients were given one and a half hip spica (spica extending just above the malleoli on the affected side and above the knee on the unaffected side) after surgery with the hip in 30° flexion, approximately 20° of internal rotation and 20-30° of abduction for 12 weeks, with one change at 6 weeks under general anesthesia (GA). The primary senior surgeon was present in all cases of postoperative spica application to ensure maintenance of reduction and utmost care was taken in molding the posterolateral aspect of the hip region. They were all followed up for a minimum period of 2 years (range 2-7 years). Postoperatively only X-rays were done and an overlap of the proximal femoral epiphysis on the ischial tuberosity was considered to be a good indicator for an adequate reduction. Magnetic resonance imaging and computed tomography (CT) were not performed because of cost factor as well as the amount of radiation involved in case of a CT.

**RESULTS**

All results were evaluated by the primary surgeon (NR). Patients were divided into two groups. Group A - those who underwent only open reduction and adductor tenotomy (n = 26) [Figure 1] and Group B - those who underwent additional Dega’s acetaluboplasty (n = 9) [Figure 2]. In Group A - 19 cases did well with good femoral and acetabular development, seven cases had RAD with AI of 35° and above at the end of 18 months [Figure 3]. In Group B - no hip got dislocated and all cases did well. They had no symptoms like waddling, limp, shortening or any pain after 6 months of spica removal. Spica soiling in 1 case necessitated spica change at 3 weeks postoperative under GA. Suction drain got stuck in one case which necessitated spica change under GA in immediate postoperative period. Perineal edema in nine cases in the immediate postoperative period which subsided in a week’s time.

All patients with RAD were advised a pelvic osteotomy. Out of them one patient refused a second procedure. Six patients underwent a secondary procedure out of which five were doing well at a later followup and one was lost to followup.

**DISCUSSION**

Classically, DDH in children between 18 and 24 months is treated by open or closed reduction followed by hip spica immobilization. According to a study by Zionts and Macewen (1986), secondary procedures on the hip were indicated only when residual subluxation was noted after bracing had been discontinued and the child had resumed
walking. Prereduction AI appeared to have little or no influence on the need for secondary procedures. Moreover, the center edge (C-E) angle of Wiberg was considered of little value in children who were <3 years old. The chances of postoperative RAD are difficult to predict. Acetabular cartilage index is a better indicator of acetabular dysplasia than AI.5 Harris et al.,6 concluded that if congruity is obtained by primary manipulation and maintained without deformation of the femoral head, acetabuloplasty should not be necessary, in children under the age of four. According to Trevor et al., it is very rarely necessary in children under 2-year-old.7 Conventionally, additional pelvic procedures are reserved in older children with RAD after open or closed reduction. RAD is considered to be one of the most frequent causes of degeneration of the hip, leading to end stage osteoarthritis in 25-50% of cases by the age of 50 years.8 However, lately, more and more emphasis is being laid on acetabuloplasty as a primary procedure in addition to the reduction. In a study
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by Karashima et al., a periacetabular osteotomy as a primary procedure gives excellent results in severely dysplastic hips (C-E angle < 0°) and mild dysplastic hips (C-E angle 3.3-14.5°). In their study including 71 patients, Spence et al. concluded that open reduction and pelvic osteotomy is more effective for reversing acetabular dysplasia and maintaining hip stability than open reduction combined with a femoral varus derotation osteotomy. There is nearly 50% chance of secondary procedure to ensure better hip stability between 12 and 24 months ago with decreasing acetabular response to concentric reduction after 18 months age. According to Brougham et al., average age at which acetabulum stops developing is 5 years, ranging from 17 months to 8 years, hence necessitating early pelvic procedure in case of severe dysplasia. They also suggested that the best predictor of RAD was the failure to obtain concentric reduction or migration of the femoral head after reduction. Early concentric reduction of a dysplastic hip remains the primary factor influencing normal hip development and is required to optimize the development of the hip with the minimum number of operations.

The limitations of study are that this is a retrospective preliminary study with a relatively short followup. All cases who did not undergo Dega’s osteotomy and did well, had a peroperative safe zone of ≥35° after open reduction and a preoperative AI < 40°. All seven “failed” cases who did not undergo Dega osteotomy had per-operative safe-zone between 20° and 30° after open reduction. Out of these patients six had preoperative AI ≥ 40°.

We feel that a preoperative AI of >40° and a per-operative safe-zone <20° increases the need for supplementary pelvic osteotomy in age group of 18 to 24 months because in such cases, the remodeling capacity of the acetabulum is unable to overcome the dysplasia and to form a relatively normal acetabulum.

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