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## Is the surgery safe for DDH in a walking child? Analysis of approach and medium-term outcomes of surgical management of DDH in walking children

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### Abstract

**Background:** Developmental dysplasia of the hip (DDH) is one of the common paediatric orthopaedic condition. Although a set protocol is in place to detect this problem during neonatal period, a majority of which goes unnoticed and present at very late age when the child is walking. The outcomes of survival of femoral head and the morphology of hip in the long term mainly depend on the time of intervention to contain the femoral head in the acetabulum. Our hospital being a tertiary referral centre often deals with late presenting DDH. We present our approach in managing untreated DDH in a walking child.

**Materials and methods:** This study included a total number of 64 children with 85 hips were treated and evaluated between the periods 2006 to 2015 with a minimum follow up of one year. Children with hip dysplasia due to cerebral palsy, myopathies, connective tissue disorders and teratological dislocations were excluded from the study. All children were treated with open reduction and capsulorrhaphy through a standard anterior approach to the hip. Femoral shortening and an acetabuloplasty were done as and when needed for the coverage of the femoral head. The children were evaluated clinically and radiologically for a minimum period of one year.

**Results:** Open reduction with capsulorrhaphy was done in all children and this was combined with an additional acetabuloplasty in 15 children, femoral shortening osteotomy in 15 children and both procedures were done in 10 children. 75% of the patients had hip stiffness during early postoperative period which resolved in 6 months and inferior subluxation was noted in one patient. Re dislocation was seen in 4 hips, and avascular necrosis of femoral head was observed in 3 hips. Superficial wound infection was observed in 3 children which was treated conservatively.

**Conclusion:** DDH in a walking child can be managed with open reduction to give good functional outcome but carries more complication rates than early intervention. An additional procedure of acetabuloplasty, femoral shortening osteotomy in selected patients is necessary for good concentric reduction of the hip joint and to minimise the complications.

**Keywords:** DDH, open reduction, containment

### Introduction

Developmental dysplasia of the hip (DDH) describes the spectrum of structural abnormalities that involve the morphology of the growing hip. Developmental dysplasia of the hip is a common problem faced by a Paediatric Orthopaedician and is a challenging problem. Early diagnosis and treatment is critical to provide the best possible functional outcome<sup>[1]</sup>. Rates of incidence of DDH in new-born infants have been reported to vary between 1 and 20 per 1000 births, making it common congenital malformation of the musculoskeletal system<sup>[4]</sup>. Persistence of hip dysplasia into adolescence and adulthood may result in abnormal gait, decreased strength and increased rate of degenerative hip and knee joint disease. Despite efforts to recognize and treat all cases of DDH soon after birth, diagnosis is delayed in some children. The reason of delay in diagnosis is due to a low index of suspicion at the primary screening physician.

The children often present with a painless limp and limb length discrepancy which is often progressive and ambulating child might have a Trendelenburg gait. In children with bilateral dislocation, the diagnosis is more challenging; however, the Trendelenburg sign, waddling gait, and symmetrical but decreased hip abduction might be noticed<sup>[2]</sup>.

Though it is a common notion that DDH can be a cause of delayed walking in children, it was noted that these children walked within the expected time [3] and the delay was clinically insignificant.

We at Indira Gandhi Institute of Child health (IGICH) being a tertiary care centre, commonly encounter delayed presentations of DDH. Most of these children require surgical intervention in the form of open reduction and osteotomies around the hip. Later the presentations, complex are the surgeries and they carry a significant risk of arthritis and avascular necrosis (AVN) of the femoral head. Nevertheless, these hips have to be contained which gives quality of life to the child and delays the presentation of secondary complications of dysplasia. We present our experience in managing such children with untreated DDH presenting to us at late stage when the child is already walking with a limp.

### Materials and Methods

The study was done in the department of orthopaedics at Indira Gandhi Institute of Child Health. Any child with a chief complaint suspicious of DDH in the form of limb length discrepancy, painless limp was assessed clinically and radiologically for further management. This is a review of a

consecutive case series of primary open reduction for DDH in children who presented after they started walking which were performed at our centre in the nine year period from 2006 to 2015.

A total number of 64 children with 85 hips were treated by open reduction. Children with teratological dislocations, DDH associated with neuromuscular disorders like cerebral palsies, myopathies and other syndromic children were excluded from the study. All of these children had received no treatment for the hip dysplasia earlier.

**Surgical technique:** The modified Smith-Petersen anterolateral approach was used in all cases with a bikini incision as it allows for a capsulorrhaphy, concomitant pelvic osteotomy and usually a shorter period in a Spica. Therefore, it is usually the procedure of choice in children older than 18 months [2, 5, 6]. The tendinous part of psoas was released at the brim. The capsule was opened in T shape and the Ligamentum teres was excised completely, the pulvinar tissue in the acetabulum was cleared and transverse acetabular ligament was cut opened. Radial incisions were made in the inverted limb to contain the head better. Head was reduced and the ease of reduction was assessed.



**Fig 1(A):** Draping and positioning of the patient **(B)** Skin marking for the bikini incision



**Fig 2(A):** Capsulotomy and excision of ligamentum Teres **(B):** capsulorrhaphy after open reduction of the Hip

All children underwent open reduction and capsulorrhaphy under general anaesthesia augmented by Epidural Analgesia. The need for acetabuloplasty and/or femoral Shortening of proximal femur with or without derotation was decided pre operatively and per operatively based on stability and the ease of reduction. The femoral osteotomy was done by lateral approach to the proximal femur and the osteotomy was fixed with a DCP. The coverage of femoral head was assessed and a Dega osteotomy was made if more coverage was needed. The wound was closed usually without a drain and using

absorbable sutures.

**Post-operative protocol:** All children were immobilised for a total period of three months. The mode of immobilisation was either hip Spica or an abduction cast which was decided based on stability and the age of the patient. After initial 6 weeks after surgery, the Spica was removed under anaesthesia and stability was checked both clinically and radiologically and an abduction cast or a Spica was applied for another 6 weeks.



**Fig 3(a, b):** Application of Hip Spica with hip in flexion and abduction position.

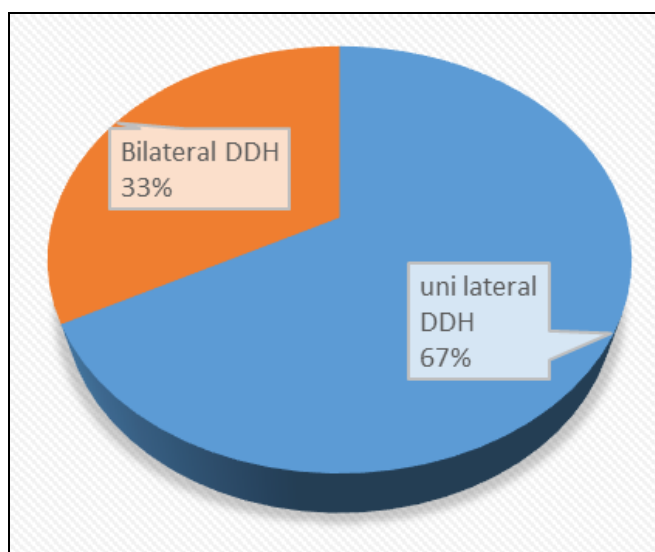
After 12-14 weeks post-operative the plaster was removed and after an x-ray the children were advised hip strengthening and range of motion exercises and the children were mobilised with a walker.

Full weight bearing and independent walking was allowed after 14 weeks/ osteotomy site union. These children were asked to come for follow up once in 3 months to look for containment and morphology of hip, avascular necrosis of femoral head and union of osteotomy of femur. Implant removal was done minimum after 1 year after union was confirmed. At the latest follow - up radiological results were evaluated according to Severin's classification [7].

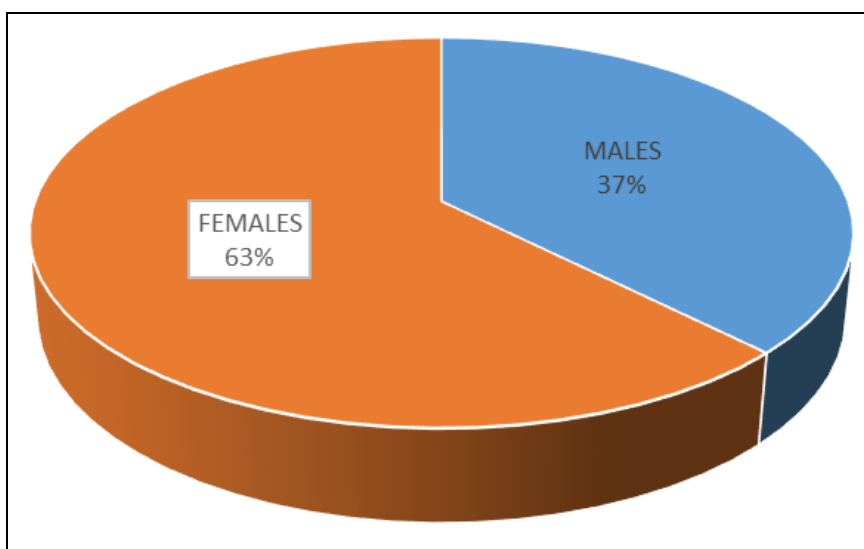
**Results**

Overall 85 hips in 64 children were primarily treated in our centre in the 9 year period. 40 children (62.5%) were females and the rest were males indicating that the incidence was more in females. The mean age of presentation was 60 months (30-120 months) of which 43 children (67.1%) had unilateral and 21 children (32.9%) had bilateral dislocation. The left side was involved in 21 children (48.8%) and right

side in 22 children (51.2%).



**Chart 1:** distribution of unilateral and bilateral cases:

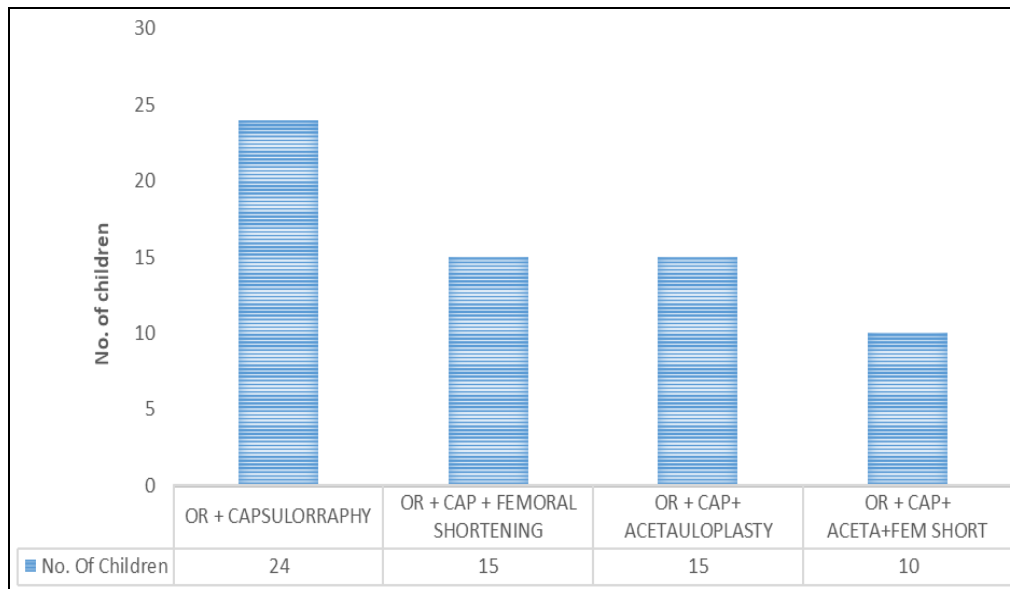


**Chart 2:** Sex distribution of DDH incidence.

Open reduction with capsulorrhaphy was done as the only procedure in 24 children (37.5%). An additional femoral shortening osteotomy was done in 15 children (23.5%). In addition to an open reduction with capsulorrhaphy and

acetabulopalsty was done in 15 children (23.5%). 10 children (15.5%) underwent open reduction with capsulorrhaphy, acetabulopalsty and a femoral shortening osteotomy as shown in chart number 3.





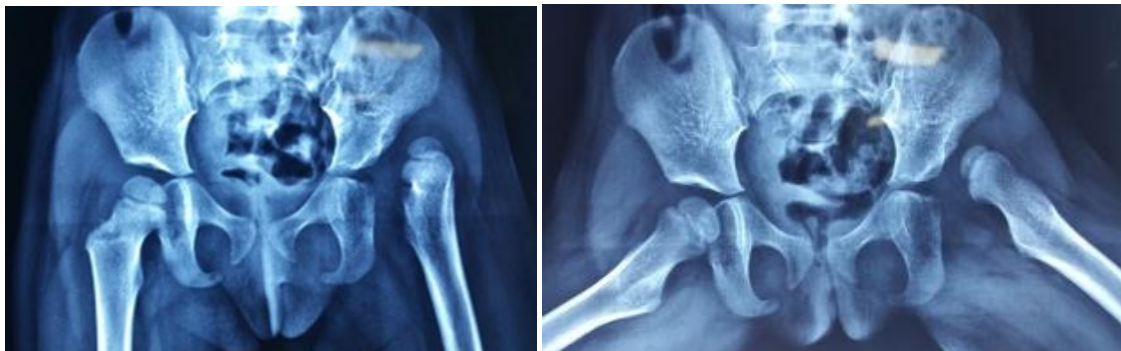
**Chart 3:** different type of surgeries done in patients with DDH.

In our series, Redislocation of hip was seen in 4 patients and avascular necrosis of femur head was seen in 3 patients. Inferior subluxation was seen in one hip.

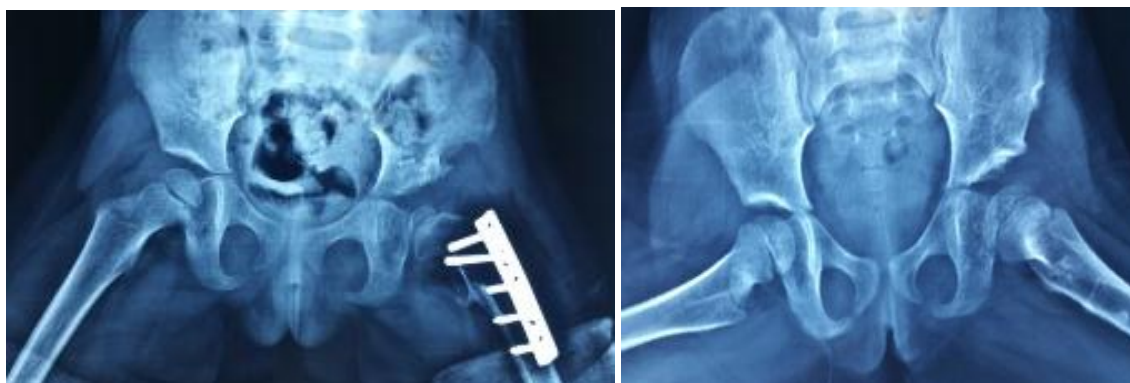
3 children required additional procedures like an acetabulopalsty and/or a femoral rotation osteotomy at a later date. 75% children had initial hip stiffness which was noticed after plaster removal which gradually resolved within 6 weeks

of mobilization. Superficial infection was noted in 3 children which was treated conservatively. We did not have any deep infection or implant failure or non-union of osteotomy site.

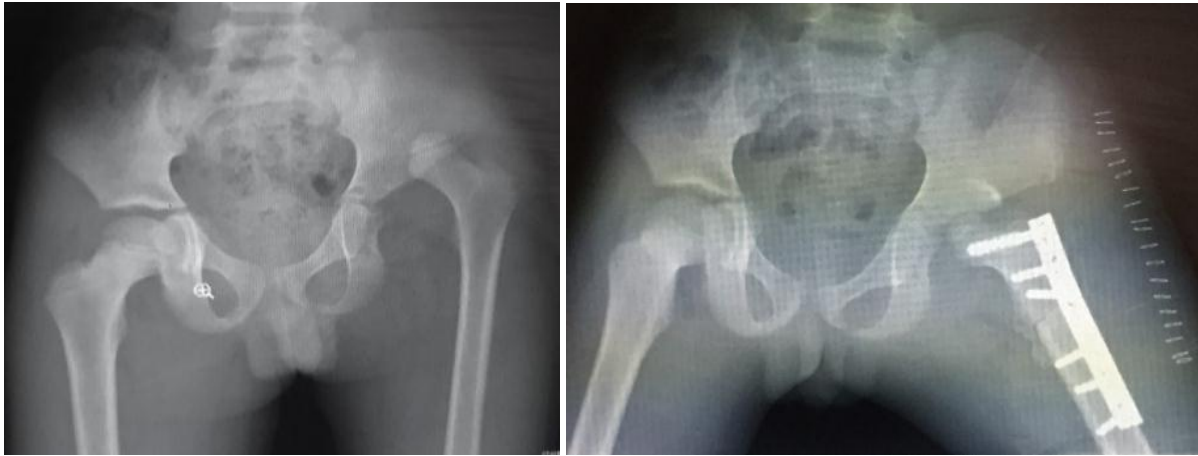
In the latest follow up, Severin criteria was used for evaluation of radiographic results. 85.9% were type I and II while 14.1% showed type III and IV, no hips were rated as Severin's group V or VI.



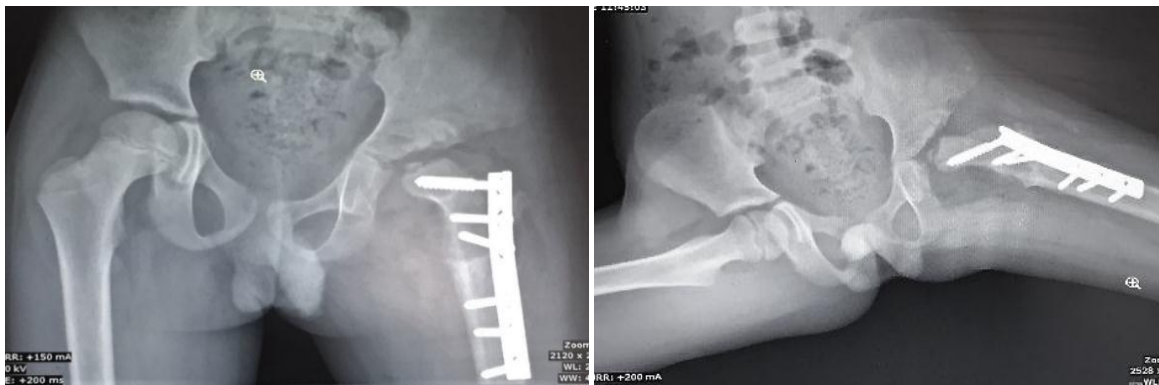
**Fig 4(a, b):** pre operative x-rays of 3 ½ years old child with left DDH



**Fig 4(c):** immediate post-operative x-ray after open reduction, capsulorrhaphy and femoral shortening osteotomy. (d): 2 years post-surgery after implant removal showing concentric reduction with good containment of head with no signs of AVN.



**Fig 5(a, b):** pre and post-operative x-rays of a 6 years old child with left DDH after open reduction, capsulorrhaphy and femoral shortening osteotomy.



**Fig 5(c):** AVN of left hip after 3 months after surgery.

## Discussion

The normal development of the child's hip relies on congruency and stability of the femoral head within the acetabulum. Early diagnosis and treatment of DDH is critical to provide the best possible functional outcome. The acetabular changes in DDH are well recognized.

The late presentation of DDH warrants a necessity of open reduction with or without additional procedures.

The osteotomies around the hip provide anterolateral coverage of the femoral head that allows the acetabulum to develop and the hip joint to stabilize. It had been thought that innominate osteotomy should be performed in children older than 18 months of age and it usually provides correction of acetabular direction in terms of the acetabular index. The osteotomy will correct the acetabular index [8]. The best time to perform an osteotomy of the acetabulum for DDH patients is still a concern [9]. Saleh *et al.* [10] demonstrated the remodelling of acetabulum after the Salter innominate osteotomy in a range of age groups. Many studies found that it could be done safely for children between 12 and 18 months of age without major disadvantages [11]. The advantages of immediate acetabular alignment include the probability that stability will be enhanced if a careful capsulorrhaphy is carried out after the open reduction, and that later surgery will be avoided [15].

To decide whether osteotomy is necessary in addition to open reduction, we use intraoperative stability as a reference. In our series pelvic osteotomies were required in 25 children (39.1%). This shows that over 60% of patients do not require an additional acetabular procedure and a well done capsulorrhaphy with or without a femoral shortening procedure is sufficient to maintain the concentric reduction of

the hip.

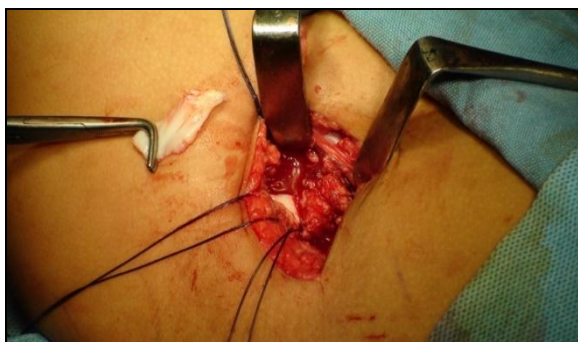
Re-dislocation following open reduction is an important problem with a variable incidence. Frequently, the failure of a primary open reduction is due to errors in surgical technique, like insufficient release of the antero-medial capsule and the inferior articular structures. A common finding in a re-dislocated hip following open reduction is an intact transverse acetabular ligament which was not fully released at the initial procedure. The presence of a stump of the Ligamentum Teres causing Redislocation is also reported. This stresses the importance of complete removal of all obstacles to reduction including the need for complete release of the transverse acetabular ligament [2, 12, 13]. Risk factors for failed open reduction are not thoroughly evaluated. A recent retrospective match-controlled study examined those risk factors which were: right side (or bilateral) involvement, greater pubic width, and decreased abduction in the Spica cast. In several cases, dysplasia of the femoral head or an insufficiently corrected femoral version were thought to be the reason for the failure of the primary surgery [14].

In our series the cases which had re-dislocation were mainly due to the presence of stump of Ligamentum Teres or a poorly performed capsulorrhaphy which was corrected in the immediate post-operative period. One case of re-dislocation was due to a deficient posterior wall which was corrected by a femoral rotation osteotomy and correction of anteversion of the femur and application of a Spica cast.

Re-dislocation is also a complication of improper immobilization which is due to a bad Spica cast or an ill maintained Spica cast. We advise parents and teach them toileting techniques and mobilization of the child with the Spica to prevent these factors as a cause for re-dislocation.

Retroversion is an iatrogenic complication which is due to over enthusiastic correction of anteversion which results and is a known cause for re-dislocation which can be prevented by only shortening of the femur and not correcting the anteversion of the femur.

Avascular necrosis (AVN) is a not well understood but a clear complication of the surgery of DDH. AVN in DDH is almost always iatrogenic and is a common complication in elderly children. MacEwen reports that in his series open reduction performed alone had the highest AVN rate [16]. Read et al. [17] suggests that the addition of a Salter osteotomy at the time of anterior open reduction does not further increase the incidence of AVN from 8% [18]. The femoral shortening osteotomy has the most beneficial effect on reducing the incidence of AVN and should be done without any hesitation in conjunction with an open reduction.



### Conclusion

In our experience the late presenting DDH itself is an indication for an open reduction and along with a capsulorrhaphy. A femoral shortening osteotomy improves the stability and reduces the tension in the joint thereby reducing the incidence of re-dislocations and AVN of the femoral head. An acetabuloplasty is not a must for improving stability or coverage but it helps in remodelling of the acetabulum which has been devoid of the head for all those years. The acetabular osteotomy is a simple procedure and can be done by the same incision.

Anteversion should be corrected judiciously and over correction results in retroversion which is again a cause for re-dislocation. In fact, we suggest leaving the ante version as it is as the hip remodels over a period.

In cases of bilateral dislocations surgeries can be carried out on both hips in the same sitting to yield good results and reducing the burden of another surgery on the child.

Giving a child a concentric functional hip is almost always possible even in cases of untreated DDH in a walking child.

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