ACTA
ORTHOPAEDICA
et
TRAUMATOLOGICA
TURCICA

Author's translation
Acta Orthop Traumatol Turc 2007;41 Suppl 1:68-73

Current approaches to the treatmentof developmental dysplasia of the hip

Gelişimsel kalça displazisi tedavisinde güncel yaklaşımlar

Muharrem INAN

Yeditepe Üniversity Medical Faculty Orthopedic and Traumatology Department

Gelişimsel kalça displazisinde tedavi yaklaşımları çeşitlilik göstermektedir. Bebeklerde konservatif tedavi seçeneği çoğu yazar tarafından desteklenmektedir. Ancak, cerrahinin hangi yaş grubunda ve hangi tip osteotomi ile yapılacağı konusun - da henüz fikir birliği oluşmamıştır. Tedavide, bilinen klasik yaklaşımlar yanı sıra değişik deneysel ve klinik uygulamala - ra da rastlamaktayız. Bu yazıda klasik bilgiler ışığında uygu - lanan yeni tedavi yaklaşımlarından bahsedilecektir.

Treatment modalities for developmental dysplasia of the hip are variable. Many authors advocate conservative treatment for infants. However, controversy arises as to the type and timing of osteotomies for older age groups. Besides classic treatment methods, different experimental and clinical studies have been performed. This article aims to summarize new treatment methods in the light of our classical knowledge.

Treatment modalities for developmental dysplasia of the hip are variable. Many authors advocate conservative treatment for newborns. However, controversy arises as to the type and timing of osteotomies for older age groups. Besides classic treatment methods; different experimental and clinical studies have been performed. This article aims to summarize new treatment methods in the light of our classical knowledge.

Early diagnosis and treatment are the constant elements of success in the treatment of developmental dysplasia of the hip (DDH). Despite all the developments in technology, we still have patients who need treatment for DDH in their older ages. In literature, we saw that harnesses are commonly used treatment modalities in early ages and surgical treatment is usually saved for older ages. Previous studies have shown that all these methods are not safe, avascular necrosis, redislocations, joint stiffnes and extremity discrepancies are seen among the complications in varying rates.[1-5] Today, unfortunately there is no treatment a method reported which does not eliminate these complications. Researchers are studying on the treatment methods which might increase the success of the therapy. In this paper current approaches to treatment of DDH will be discussed and classic approach, experimental and clinical studies will be mentioned.

Experimental studies

Experimental studies are based on the stimulation of acetabular growth plate cartilage and stimulation of development of the acetabulum. For this purpose, shock wave's and osetotomy's effect on the acetabulum was studied. Basic mechanism in both methods is to increase the vasculature and accelerate proliferation in the growth plate.

Saisu et al[6] studied if shock waves induces acetabular roof development . In that study acetabulum development of schock wave given baby rabbits were evaluated on 4th and 8th weeks. In 4th week internal callus formation and an increase in acetabular roof development was detected in shock wave

Correspondence to: Dr. Muharrem Inan. Yeditepe Üniversity Medical Faculty Orthopedic and Traumatology Department, 34752 Kozyatagi, Istanbul.
Phone:+90216 - 578 40 00 Fax: +90216 - 469 37 96 e-mail: muharreminan@hotmail.com

applied region, in 8th week woven bone formation was disappeared and a significant increase in the breadth of the acetabular roof at coronary plane was observed. Authors concluded that shock wave treatment might be applied for the treatment of acetabular dysplasia.

Shim et al[7] studied biological changes in the hip joint following iliac osteotomies. The circulatory and vascular changes in the hip following Salter-type innominate osteotomy were studied in dogs and they used microangiography and radioisotopic methods to detect the changes in the hip joint. Microangiographically they showed increased vascularity in the femoral head, in acetabulum and at the osteotomy site at the 4th month. Radioactive studies demonstrated 30 % increase in the vascularity of the femoral head circulation at 3 months, which returns to normal limits at 4th month. Researchers tried to show beneficial effects of osteotomy on the femoral head circulation with this study and they tried to determine the efficiency of the treatment. With our current knowledge from the literature, we know that osteotomy or trauma causes an increase in the vascularity and accelerates the growth. In our study we observed an increase in proliferation and thickening of the growth plate close to the area which trauma is applied nearby to growth plate (unpublished data). Based on the data stimulation of growth by microtrauma and treatment of acetabular dysplasia with minimally invasive methods could be possible in the future.

Surgical approaches

Percutaneous osteotomies

Recently, minimally invasive interventions which use smaller incisions have been more commonly used in orthopaedic surgery. For this purpose Paley et al developed femoral, tibial, and foot osteotomies which are performed by using a Gigli and they are widespread all over the world in a very short time[8]. Orthopaedic surgeons have not preferred such osteotomies in hip surgery due to vital neurovascular structures in hip. However, they tried to perform osteotomies using smaller incisions. Lehman et al[9] used mini adductor and bikini incisions in triple pelvic osteotomy. The patients in that study were between 6-14 years of age and all had an acetabular dysplasia. Authors advocated that this mini incision technique is easy to learn and cosmetically acceptable. On the other hand the surgeon who is going to practice the mini incision techniques had to have enough experience with the classical methods.

In proximal femur percutaneous osteotomies are used ,n a combination with external fixators. An advantage of this method is indicated as a small scar which is cosmetic and possibility of a three dimentional correction with external fixator.

Arthroscopic interventions

Arthroscopic interventions are commonly used in examination and treatment of joint disease. As hip arthroscopy is more commonly used, the idea of using it in the treatment of early stage DDH was inevitably raised. Main aim of treatment with hip arthroscopy is excision of soft tissues which avoids hip reduction and obtains concentric reduction. In literature, a small patient study was published by Bulut et al.[14] In this study hip artroscopy was applied to 4 girls who are aged between 11-14 months. Although the follow up duration was short, as a result of the study internal structures of acetabulum (hypertrophic ligamentum teres, transverse acetabular ligament and pulvinare tissue) which avoids hip reduction was eliminated successfully by arthroscopic technique. In that study researchers also applied adductor and iliopsoas reduction by classical method along with arthroscopy. To bring in arthroscopy in to the daily practice of orthopaedics, we need new studies on it is usage as an assistance to classic method or alone by itself.

External fixator

External fixator was firstly used by Ilizarov in treatment of developmental dysplasia of hip.[15]

He achieved closed reduction by using his external fixator. But no information was given about the details of the technique and the folow up results of patients who received external fixator treatment. Later on in the following years external fixator was applied to fixation of osteotomies in proximal femur. Early mobilization, three dimensional correction, percutaneous applied osteotomy and elimination of the need of a second operation to remove of internal fixation can be counted as the advantages of the technique.

Owing to these given reasons above, we used an external fixator in the classical treatment of DDH.

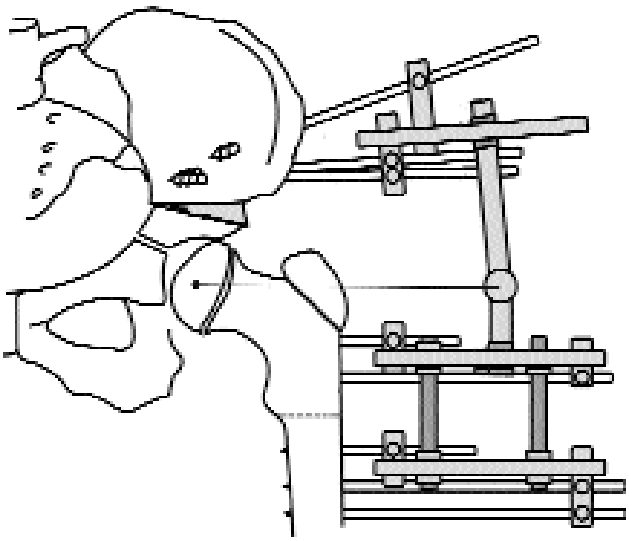

Figure 1. Drawing shows construction of external fixator and identification of the hinge point after surgery.

Femoral and iliac osteotomies are used in treatment of DDH in older ages and they are frequently combined with open reduction. Because of this hip reduction obtained by osteotomies should be preserved. In the studies we have performed an external fixation to provide adequate fixation. In our first applications, we constructed the system statically and early walking was achieved without starting early mobilization. As we gained experience, we placed a hinge between iliac ring and the ring placed on femur proximal and we started early motion to hip joint. (Fig1). Purpose of early hip motion is to avoid joint stiffness which can occur after operation. We published results of 11 patients and our surgical technique.[1] According to this study, external fixator which is designed to begin early hip joint motion was applied to 12 hips of 11 patients. Mean age was 8.2 years (4-11 year). Femoral and iliac osteotomies were applied to all patients. Mean fixator removal time was 52 days for iliac osteotomy and 89 days for femoral osteotomy. At the last follow up visit, excellent and good hip function was obtained at 11 out of 12 hips. The point which should be highlighted, open reduction and osteotomies performed in DDH treatment is applied clinging to classical method and treatment algorithms. The aim of this technique is to start early hip motion and early mobilization of children, and elimination of cast and internal fixation. Another important point is this treatment option should be applied by an orthopedics surgeon who is experienced with external fixation. Indications of external fixator in DDH treatment can be summarized as:

1- Sufficient iliac wing development for fixator application (4 years and older in our study)

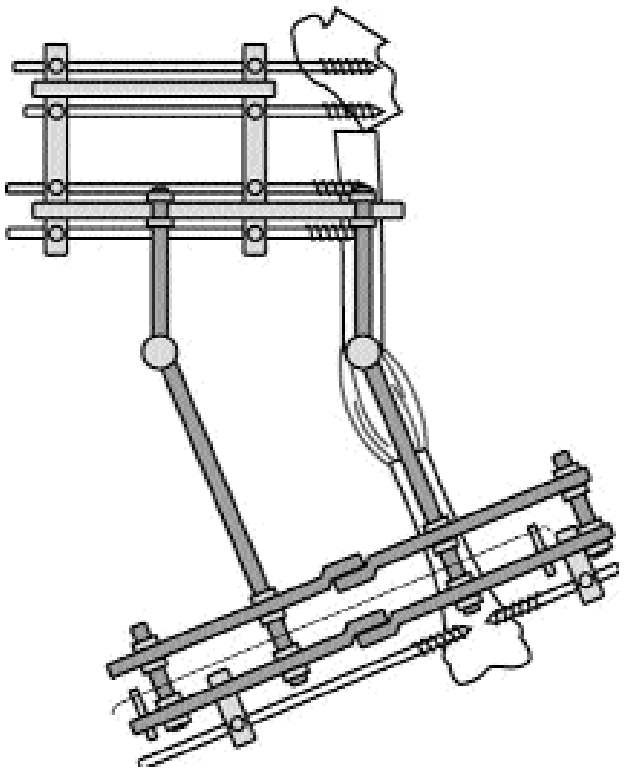

Figure 2. Schematic drawing of the classic ılizarov eksternal fiksator in the Pelvic support osteotomy

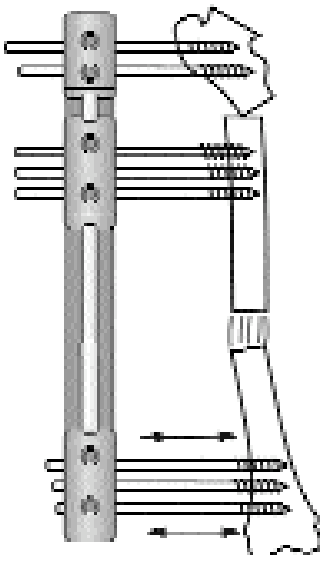

Figure 3. Schematic drawing of the monolateral eksternal fiksator in the pelvic support osteotomy.

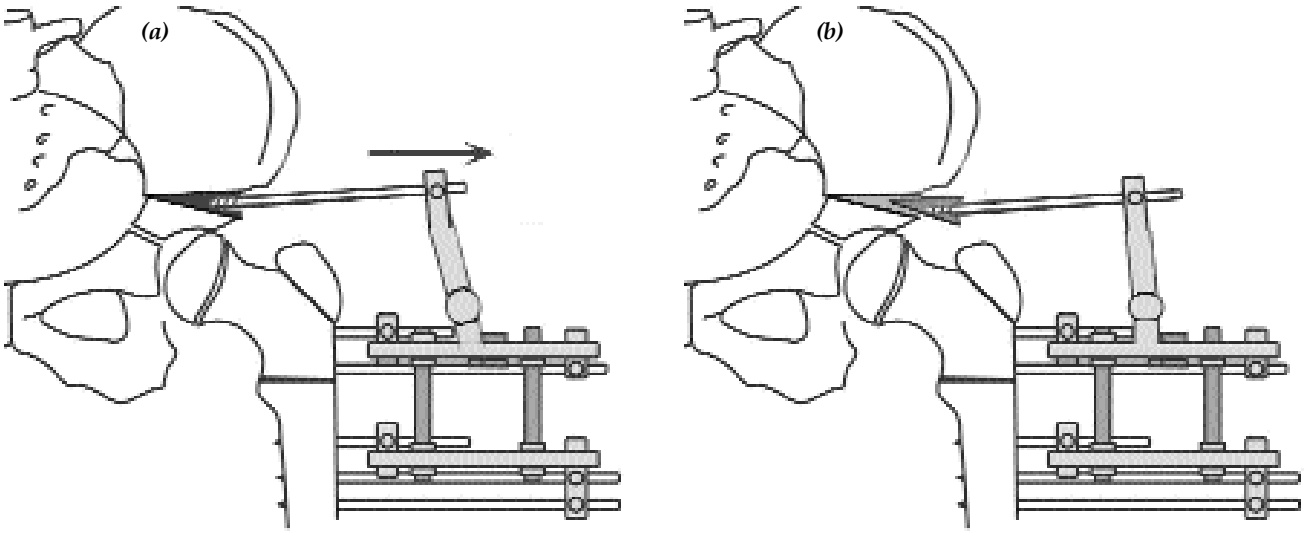

Figure 4. (a) Drawing shows fixation of the proximal femoral osteotomy with an external fixator and fixation of the iliac osteotomy performed between spina iliaca anterior and inferior by using a schanz pin. **(b)** Lateralization of the bone graft with a Schanz pin.

2-Cases which Open reduction with Femoral and iliac osteotomy were applied together

3-If internal fixation is contraindicated

4-Especially in school children, make the child return to school quickly.

External Fixator Contraindications

1-Mentally Retarded Children

2-Patients who could not come to follow ups due to transportation difficulties

3-If surgeon does not have enough experience with the application of external fixators

We experienced some difficulties in treatment of developmental dysplasia of hip due to application of external fixation. Radiolocation occurred in one patient due to insufficient constriction of the hinges. Patient was reoperated and close reduction was applied. In follow up an excellent result was obtained. The most common problem in treatment with external fixation is pin tract infections. However in our study grade 3 pin tract infections occurred at the two pins site and they recovered without requiring surgical treatment. Children's compatibility to external fixator was achieved in a very short time and they were walking without crutches in two weeks after the surgery.

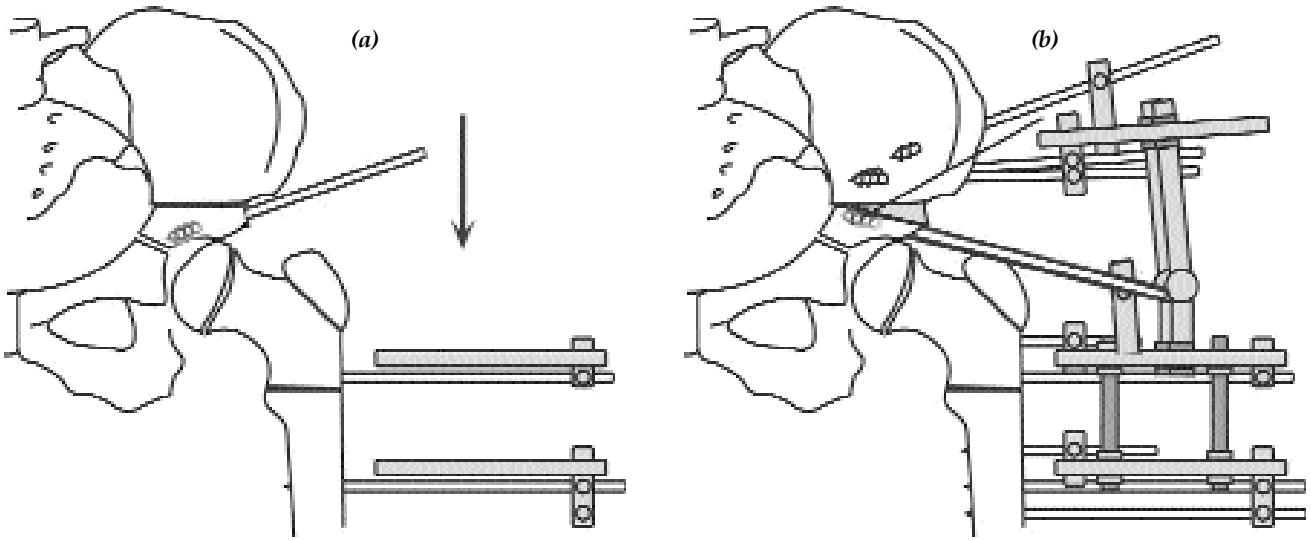

Figure 5. (a) Schematic drawing of the pin used between iliac osteotomy and acetabulum. **(b)** Reoriantation of the acetabulum with a distal shifted pin.

Early return to their normal enviroment after treatmen with external fixator was shown to have a positive psychological effect.[17,18] This should be considered when choosing external fixator as the treatment method.

In adult, DDH treatment with an external fixators is a new option. Periacetabular osteotomies are the primary choice of treatment in cases which acetabular dysplasia presents without dislocation of the hip. However it is not possible to perform this treatment modality in highly dislocated hips. Arthroplasty may be a controversial treatment option. Even though it is not broadly used, pelvic support osteotomies (PSO) which are developed by Ilizarov is accepted as alternative treatment to arthroplasty (Figure 2). In literature we see the results of 11 patients who successfully treated with Ilizarov method by Kocaoğlu et al[19]

Those patients were treated by classical Ilizarov method, using circular external fixator. Initially we performed PSO by using a circular external fixator. However high rates of patient discomfort and difficulties with rehabilitation of knee joint motions we developed PSO with monolateral fixator clinging to classical rules (Figure 3).[11] When we compared this method to classical, we concluded that the method which uses monolateral external fixator can be preferred due to lower rate of pin tract infection and higher patient comfort,

Our studies on application of external fixation and gradual distraction on hip joint is still continuing. For this purpose our research is focused on the theory of application of percutaneous osteotomies and gradual distraction methods .In the coming year's time will show us the successfulness of these methods.

Computer Assisted Surgery

Today's surgeons are using computer assisted surgery most commonly in hip and knee arthroplasty. Studies focusing on usage of computer assisted surgery on different fields of orthopaedics are still continuing. At prevention of complications due to excessive or insufficient correction, Computer assisted surgery has an important role in the treatment of acetabular dysplasia. In their study Jager et al[20] indicated that they adjusted better correction angles in the operations they performed with computer assistance. Due to cost-effectivity the authors favor this technique for corrective surgery of complex acetabular deformities. Mayman et al[21] generated a 3D model of acetabular osteotomy. 3D position of acetabulum during osteotomy was also manifested by this model. They indicated that there were no acetabular positioning errors in eight patients who were operated using this method. Computer assisted usage of imaging modalities during operations will certainly decrease the rate of complications occurring in operations but due to the expensiveness of this technology it will take time before it gets in to universal usage.

Overall, a better understanding of hip joint pathologies and development of new treatment methods together with flourishing technology is inevitable. The unchanged aims are to develop less invasive techniques and to decrease complication rate.

References

1. Brougham DI, Broughton NS, Cole WG, Menelaus MB. Avascular necrosis following closed reduction of congenital dislocation of the hip. Review of influencing factors and long-term follow-up. J Bone Joint Surg [Br] 1990;72:557-62.
2. Binnet MS, Chakirgil GS, Adiyaman S, Ates Y. The relationship between the treatment of congenital dislocation of the hip and avascular necrosis. Orthopedics 1992;15:73-81.
3. Buchanan JR, Greer RB 3rd, Cotler JM. Management strategy for prevention of avascular necrosis during treatment of congenital dislocation of the hip. J Bone Joint Surg [Am] 1981;63:140-6.
4. Karakas ES, Baktir A, Argun M, Turk CY. One-stage treatment of congenital dislocation of the hip in older children. J Pediatr Orthop 1995;15:330-6.
5. Lalonde FD, Frick SL, Wenger DR. Surgical correction of residual hip dysplasia in two pediatric age-groups. J Bone Joint Surg [Am] 2002;84:1148-56.
6. Saisu T, Kamegaya M, Wada Y, Takahashi K, Mitsuhashi S, Moriya H, et al. Acetabular augmentation induced by extracorporeal shock waves in rabbits. J Pediatr Orthop B 2005; 14:162-7.
7. Shim SS, Day B, Leung G. Circulatory and vascular changes in the hip following innominate osteotomy: an experimental study. Clin Orthop Relat Res 1981;(160):258-67.
8. Paley D. Hip joint considerations. In: Paley D, editor. Principles of deformity correction. 1st ed. Berlin: Springer Verlag; 2002. p. 689-94.
9. Lehman WB, Mohaideen A, Madan S, Atar D, Feldman DS, Scher D. Surgical technique for an 'almost' percutaneous triple pelvic osteotomy for femoral head coverage in children 6-14 years of age. J Pediatr Orthop B 2004;13:57-62.
10. Colyer RA. Compression external fixation after biplane femoral trochanteric osteotomy for severe slipped capital femoral epiphysis. J Bone Joint Surg [Am] 1980;62:557-60.
11. Inan M, Bowen RJ. A pelvic support osteotomy and femoral lengthening with monolateral fixator. Clin Orthop Relat Res 2005;440:192-8.
12. Ito H, Minami A, Suzuki K, Matsuno T. Three-dimensionally corrective external fixator system for proximal femoral

osteotomy. J Pediatr Orthop 2001;21:652-6.
13. Rehm A, Divekar A, Conybeare ME. External fixation for femoral derotation osteotomy in developmental dysplasia of the hip. J Pediatr Orthop B 2003;12:319-27.
14. Bulut O, Ozturk H, Tezeren G, Bulut S. Arthroscopic-assisted surgical treatment for developmental dislocation of the hip. Arthroscopy 2005;21:574-9.
15. Ilizarov G. Treatment of disorders of the hip. In: SA G, editor. Transosseous osteosynthesis. 1st ed. Berlin: Springer Verlag; 1992. p. 668-96.
16. Inan M, Harma A, Ertem K, Germen B, Bowen RJ. Successful treatment of high congenital dislocated hips in older children by open reduction, pelvic and femoral osteotomy with external fixator stabilization (average 8.2 years of age). J Pediatr Orthop B 2005;14:405-9.
17. Hughes BF, Sponseller PD, Thompson JD. Pediatric femur fractures: effects of spica cast treatment on family and community. J Pediatr Orthop 1995;15:457-60.
18. Streissguth AP, Streissguth DM. Planning for the psychological needs of a young child in a double spica cast. Including a plan for construction of a scooter. Clin Pediatr (Phila) 1978;17:277-83.
19. Kocaoglu M, Eralp L, Sen C, Dincyurek H. The Ilizarov hip reconstruction osteotomy for hip dislocation: outcome after 4-7 years in 14 young patients. Acta Orthop Scand 2002; 73:432-8.
20. Jager M, Westhoff B, Wild A, Krauspe R. Computer-assisted periacetabular triple osteotomy for treatment of dysplasia of the hip. [Article in German] Z Orthop Ihre Grenzgeb 2004;142:51-9.
21. Mayman DJ, Rudan J, Yach J, Ellis R. The Kingston periacetabular osteotomy utilizing computer enhancement: a new technique. Comput Aided Surg 2002;7:179-86.