ACTA
ORTHOPAEDICA
et
TRAUMATOLOGICA
TURCICA

Author's translation
Acta Orthop Traumatol Turc 2007;41(2):104-107

Comparison of K-wire fixation methods in terms of stability in Salter iliac osteotomies

Salter iliyak osteotomisinde K-teli ile yapılan tespit yöntemlerinin stabilite açısından karşılaştırılması

Hakan SENARAN, M. Nazım KARALEZLI, Sezgin SIMSEK, Mehmet ARAZI, M. I. Safa KAPICIOGLU

Selcuk University, Meram Faculty of Medicine Department of Orthopaedics and Traumatology

Amaç: Gelişimsel kalça displazisinde (GKD) uygulanan Salter iliyak osteotomisinde K-teli ile yapılan fiksasyon yöntemlerinin stabiliteleri karşılaştırıldı ve asetabuler fragmanın pozisyonunun korunması için en uygun yöntem araştırıldı.

Çalışma planı: Çalışmaya GKD nedeniyle Salter'in tanımladığı endikasyonlara uygun olarak ameliyat edilen 331 hastanın (63 erkek, 268 kız; ort. yaş 23.3 ay; 17-35 ay) 425 kalçası alındı. Tüm hastalarda osteotomi bölgesine yerleştirilen greftin tespiti amacıyla bir ya da iki adet K-teli kullanıldı ve ameliyattan sonra pelvipedal alçı yapılmadan önce ve alçı çıkarıldıktan sonra ön-arka pelvis grafileri çekildi. Hastalar uygulanan fiksasyon yöntemine göre (tek veya çift K-teli kullanımıyla Y kıkırdağa doğru veya asetabulumun superior duvarına doğru yönlendirme) dört gruba ayrıldı. Ameliyat sonrası erken dönem ve alçı çıkarıldıktan sonraki pelvis grafilerinde osteotomi proksimali ile distali arasındaki ilişki, greftin osteotomi bölgesindeki pozisyonu, siyatik çentikte distal köşenin proksimal köşeye göre medialize olup olmadığı ve femur başı örtünmesi değerlendirildi.

Sonuçlar: Çift K-teli kullanılan hastaların hiçbirinde pozisyon kaybı gözlenmedi. Tek K-teli kullanılan 381 kalçanın 15'inde (%3.9) osteotomi bölgesinde tespit yetmezliğine bağlı pozisyon kaybına rastlandı. Bunların sekizinde (%2.9) Y kıkırdağa doğru, yedisinde (%6.4) asetabulumun superior duvarına doğru yönlendirme yapılmıştı. Gruplar arasındaki karşılaştırmada, K-teli ile fiksasyonun stabilitesi açısından anlamlı farklılık bulunmadı.

Çıkarımlar: Çift K-teli ile pozisyon kaybına rastlanmaması, Salter osteotomisinde greft stabilizasyonunun bu şekilde yapılmasının daha uygun olduğunu düşündürmektedir.

Anahtar sözcükler: Kalça çıkığı, doğuştan/cerrahi; kalça eklemi/radyografi; osteotomi/yöntem.

Objectives: We compared the stability of K-wire fixation methods used in Salter iliac osteotomies in developmental dysplasia of the hip (DDH) to determine the most appropriate method for stabilization of the acetabular fragment.

Methods: The study included 425 hips of 331 patients (63 boys, 268 girls; mean age 23.3 months; range 17 to 35 months) who underwent iliac osteotomies for DDH with appropriate indications described by Salter. Fixation of the graft was made with the use of one or two K-wires. All the patients were assessed postoperatively with anteroposterior pelvic radiographs obtained before a hip spica cast was applied and after it was removed. The patients were divided into four groups based on the fixation methods used, namely, one or two K-wires directed either to the triradiate cartilage or to the roof of the acetabulum. On postoperative pelvic radiographs, we assessed the relation between the proximal and distal iliac fragments, position of the graft in the osteotomy area, medialization of the distal iliac bone corner at the sciatic notch, and coverage of the femoral head.

Results: Fixation with two K-wires resulted in no graft displacement. Of 381 hips in which a single K-wire was used, 15 hips (3.9%) exhibited graft displacement due to fixation instability. Orientation of the K-wire fixation was toward the triradiate cartilage in eight hips (2.9%), and toward the roof of the acetabulum in seven hips (6.4%). No significant differences were found between the four groups in terms of fixation instability.

Conclusions: The absence of fixation failure with the use of two K-wires suggests that this method provides a more stable fixation of iliac osteotomy and bone graft.

Key words: Hip dislocation, congenital/surgery; hip joint/radiography; osteotomy/methods.

Correspondence to: Dr. Hakan Şenaran. Selcuk University, Meram Faculty of Medicine Department of Orthopaedics and Traumatology, Konya Turkey
Phone: +90 332 - 223 68 59 Fax: +90 332 - 223 61 81 e-mail: senaran@selcuk.edu.tr

Received: 21.06.2006 **Accepted:**02.02.2007

There are different treatment modalities in developmental dysplasia of the hip (DDH) which change according to the age of the child and the severity of the dysplasia. The innominate osteotomy, described by Salter, is one of the most popular treatment methods for children with DDH over 18 months of age.[1] Long term follow up studies revealed that Salter innominate osteotomy is safe and effective to treat DDH.[2-5] However, there are some complications which occur in children at whom the described technique was not correctly performed or was modified.[1]

After the osteotomy, autogenous corticocancellous graft was placed between the proximal iliac and the distal acetabular fragments and secure with K wire. The improper insertion of K wire causes the displacement of the graft and the instability of the distal fragment with loss of reduction.[4] There are different articles in the literature about the type and the number of the fixation material, however the stability of these methods were not clearly evaluated. The aim of this study is to compare the stability of different fixation methods used in Salter innominate osteotomy.

Materials and methods

The children with DDH who underwent innominate osteotomy between 1982 and 2004 were reviewed. The inclusion criteria are: 1) the children who fullfills the criteria described by Salter, 2) children at whom K wire was used as a fixation material, 3) children who had both pelvis radiographs at immediate postoperative period and after the hip spica was removed.

The patients were divided into 4 groups according to the fixation method used. Group 1; single K wire directed to the triradiate cartilage, group 2; single K wire directed to the roof of acetabulum, group 3; double K wires directed to triradiate cartilage, group 4; double K wires directed to the acetabular roof. To describe the stability of the fixation method, the position of the graft and the medial displacement of the acetabular fragment were evaluated in both radiographs. The position of the graft and the distal acetabular fragmant was same relative to the proximal iliac fragment in both radiographs at children with stable fixation.

At the children with unstable fixation, the relationship between the proximal iliac and distal acetabular fragments was disturbed, graft was displaced laterally, distal acetabular fragment was medialized and the coverage of the femoral head by the acetabulum is decreased.(Figure 1)

Chi square test was used for statistical analysis.

Results

331 patients met the inclusion criteria (63 male, 268 female, mean age 23.3 months, range 17-35 months) and 425 hips with DDH which underwent Salter innominate osteotomy were retrospectively evaluated. DDH was unilateral in 237 children and bilateral in 94 children. According to the fixation method used 272 hips were in group 1, 109 hips were in group 2, 31 hips were in group 3 and 13 hips were in group 4. Fixation methods at eight hips in group 1 (2.9%) and 7 hips in group 2 (6.4%) were described as unstable and medial displacement of the acetabular fragment was demonstrated at radiographs which were taken after hip spica removal. None of the hips secured with double K wires developed instability at the osteotomy site.

There was no statistical difference between groups in terms of stability when Chi square test was used.

Discussion

Innominate osteotomies used in treatment of DDH were grouped as complete and incomplete. Complete osteotomies (e.g. Salter) cause pelvic instability and stable fixation following osteotomy is necessary. Incomplete osteotomies (e.g. Pemberton, Dega) do not disturb pelvic stability and can be performed bilaterally.[6-8] At Salter innominate osteotomy, distal acetabular fragment is repositioned anteriorly and laterally without any significant displacement at siatic notch. Iliac tricortical autograft is inserted at osteotomy site and fixed by K wire. Child is immobilized by hip spica for 6-8 weeks to obtain bony union and soft tissue healing.

The long term results of Salter innominate osteotomy are satisfactory.[2-5] Avascular necrosis of the femoral head, recurrent dislocation of the hip and hip joint degeneration at long term follow up are among the complications of osteotomy. If the stable

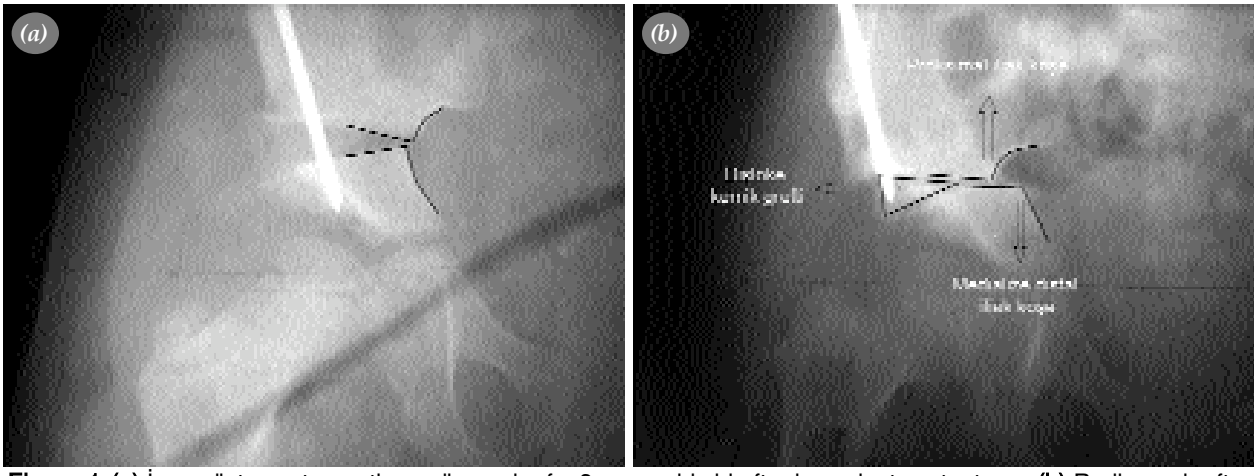

Figure 1. **(a)** İmmediate postoperative radiograph of a 3 years old girl after innominate osteotomy, **(b)** Radiograph after hip spica removal demonstrates medial displacement of actabular fragment and graft dislocation

fixation of the osteotomy site can not be performed, displacement of the bone graft, medial displacement of the acetabular fragment and intraarticular migration of K wire can be seen. The medialization of the acetabular fragment causes insufficient coverage of the femoral head and revision surgery may be necessary.[9]

The complications of innominate osteotomy are not detailly discussed in the literature. Morin et al. retrospectively evaluated skeletally mature patients who had innominate osteotomy.[4]

They reported 6 patients with displacement of the acetabular fragment and bone graft, but only one patient required revision surgery. Another patient presented with limited hip motion due to the intraarticular migration of the K wire, but long term results of these patients with medial displacement of the acetabular fragment and K wire migration were not discussed. Salter suggested double K wire fixation in his original article.

His technique was modified and some authors used single K wire or cortical screw. With a proximal oblique modification of iliac osteotomy, stability could be obtained without any implant fixation. (Abdullah Eren, personal communication) Morin et al. reported that double K wire fixation did not cause any fixation failure and medial acetabular displacement.[4]

There are no long term studies about the prognosis of the hips which were not operated according to the originally described technique or with complications, such as medial displacement of acetabular fragment or intraarticular migration of K wire.

In conclusion, no fixation failure or displacement at the osteotomy site were observed in the hips fixated by double K wires. The failure to demonstrate statistical difference may be due to the difference between the number of patients at each group. We suggest double K wire fixation for stable fixation of the osteotomy site at Salter innominate osteotomy.

References

1. Salter RB. Role of innominate osteotomy in the treatment of congenital dislocation and subluxation of the hip in the older child. J Bone Joint Surg [Am] 1966;48:1413-39.
2. Barrett WP, Staheli LT, Chew DE. The effectiveness of the Salter innominate osteotomy in the treatment of congenital dislocation of the hip. J Bone Joint Surg [Am] 1986;68:79-87.
3. Gulman B, Tuncay IC, Dabak N, Karaismailoglu N. Salter's innominate osteotomy in the treatment of congenital hip dislocation: a long-term review. J Pediatr Orthop 1994;14:662-6.
4. Morin C, Rabay G, Morel G. Retrospective review at skeletal maturity of the factors affecting the efficacy of Salter's innominate osteotomy in congenital dislocated, subluxed, and dysplastic hips. J Pediatr Orthop 1998;18:246-53.
5. Vengust R, Antolic V, Srakar F. Salter osteotomy for treatment of acetabular dysplasia in developmental dysplasia of the hip in patients under 10 years. J Pediatr Orthop B 2001; 10:30-6.
6. Zorer G, Bagatur AE. Single-stage bilateral Pemberton's pericapsular osteotomy in bilateral developmental dysplasia of the hip. [Article in Turkish] Acta Orthop Traumatol Turc 2002;36:288-94.
7. Pemberton PA. Pericapsular osteotomy of the ilium for treatment of congenital subluxation and dislocation of the hip. J Bone Joint Surg [Am] 1965;47:65-86.

8. Grudziak JS, Ward WT. Dega osteotomy for the treatment of congenital dysplasia of the hip. J Bone Joint Surg [Am] 2001; 83:845-54.

9. Salter RB, Dubos JP. The first fifteen year's personal experience with innominate osteotomy in the treatment of congenital dislocation and subluxation of the hip. Clin Orthop Relat Res 1974;(98):72-103.