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Gelişimsel Kalça Displazisinde Uygulanan Pemberton Ve Salter Osteotomilerinin Sonuçlarının Karşılaştırılması

Comparison of the Results of Pemberton and Salter Osteotomies Applied in Developmental Dysplasia of the Hip

Ümit Tuhanioğlu[1], Alper Gültekin[2], Hasan Ulaş Oğur[1], Fırat Seyfettinoğlu[1], Ulaş Serarslan[2]

1Sağlık Bilimleri Üniversitesi Adana Şehir Hastanesi Ortopedi Ve Travmatoloji Kliniği, Adana, Türkiye
2Sağlık Bilimleri Üniversitesi Kocaeli Derince Eğitim Ve Araştırma Hastanesi Ortopedi Ve Travmatoloji Kliniği, Kocaeli, Türkiye

ÖZ

GİRİŞ ve AMAÇ: *Gelişimsel kalça displazisi (Gkd) tedavi edilmediğinde kalıcı fonksiyon bozukluğuna sebep olan çocukluk çağının en önemli ortopedik patolojilerinden biridir. Bu çalışmada 1 yaş üstü gkd tanısı olan hastalarında uygulanan pemberton ve salter osteotomilerinin erken dönem klinik ve radyolojik sonuçlarının ortaya konulması ve değerlendirilmesi amaçlanmıştır*

YÖNTEM ve GEREÇLER: *2014-2016 yılları arasında kliniğimizde gelişimsel kalça displazisi tanısıyla pemberton asetabuloplastisi ve salter osteoromisi uygulanan iki farklı hasta grubu preop ve postop asetabular inklinasyon açıları,preop-postop asetabulum derinliği,alçı içerisindeki abdüksiyon derecesi,son kontroldeki kalça hareket açıklığı ve meydana gelen komplikasyonlar açısından karşılaştırıldı.*

BULGULAR: *1.Grupta 21 2.grupta 18 hasta çalışmaya dahil edildi. Ortalama yaş 1.grupta 24,8 2. Grupta 20,7 ay idi.Ortalama takip süresi 1.grupta 30,2 2. Grupta 32,1 olarak hesaplandı. Klinik değerlendirmede pemberton grubunda 18 hastada mükemmel,2 hastada iyi,1 hastada orta sonuç alınırken,Salter grubunda 15 hastada mükemmel 1 hastada iyi,2 hastada orta sonuç alındı.*

TARTIŞMA ve SONUÇ: *Her iki girişimin birbirine farklı üstünlükleri mevcut olup bizler her iki osteotominin cerrahın seçimi ve tecrübesi doğrultusunda güvenle uygulanabileceği kanaatindeyiz.*

Anahtar Kelimeler: *Kalça, displazi, Salter, Pemberton*

ABSTRACT

INTRODUCTION: *When developmental hip dysplasia (DHD)is not treated, it is one of the most important orthopaedic pathologies in childhood that causes permanent function impairment. The aim of this study was to determine and evaluate the early clinical and radiological results of Pemberton and Salter osteotomies applied to patients aged over 1 year who were diagnosed with DHD.*

METHODS: *Two different patient groups applied with Pemberton acetabuloplasty and Salter osteotomy in our clinic between 2014 and 2016 for a diagnosis of DHD were compared in respect of preoperative and postoperative acetabular inclination angles, preoperative and postoperative acetabulum depth, the degree of abduction in the plaster cast, hip range of movement at the final follow-up examination and complications that developed.*

RESULTS: *Group 1 comprised 21 patients with a mean age of 24.8 months and mean follow-up period of 30.2 months. Group 2 comprised 18 patients with a mean age of 20.7 months and mean follow-up period of 32.1 months. In the clinical evaluation of Group 1, the Pemberton group, 18 patients were evaluated as excellent, 2 as good and 1 as fair, and in Group 2, the Salter group, the results obtained were excellent in 15 patients, good in 1 and fair in 2.*

DISCUSSION AND CONCLUSION: *Both interventions have different advantages and it can be considered that both can be applied safely according to the surgeon's preference and experience.*

Keywords: *Hip, dysplasia, Salter, Pemberton*

İletişim / Correspondence:

Ümit Tuhanioğlu
Sağlık Bilimleri Üniversitesi Adana Şehir Hastanesi Ortopedi Ve Travmatoloji Kliniği, Adana, Türkiye
E-mail: umittuhanioglu@gmail.com
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INTRODUCTION

Developmental dysplasia of the hip (DDH) is a term that defines hip anomalies in a broad spectrum ranging from mild dysplasia to high dislocation. When DDH is not treated it causes permanent function impairment, and is one of the most important orthopaedic pathologies in childhood (1, 2). In both acetabular dysplasia and reduced full dislocations, obtaining healthy development and shape of the femoral head is associated with the acetabulum and femoral head remaining within a compatible relationship and sufficient coverage of the femoral head by the acetabulum (3). In this sense, acetabular procedures are interventions which may be necessary in the treatment of all pathologies within the term of DDH. The most frequently used acetabular procedures are the Salter, Pemberton and Dega osteotomies.

Acetabular interventions may be required in 55% of patients with DDH aged 1 year and older (4). These interventions, which aim to increase femoral head coverage, are routinely recommended in primary DDH over the age of 18 months (5). Although there are different opinions about the lower age limit when applying acetabular procedures, it has been reported that generally these procedures can be applied at walking age (6-7).

The procedure identified as Pemberton periacetabular acetabuloplasty (PA) is an incomplete osteotomy in which the acetabulum is re-shaped. In this procedure, the horizontal leg of y cartilage uses as a hinge (8) **(Figures 1a, b, c).**

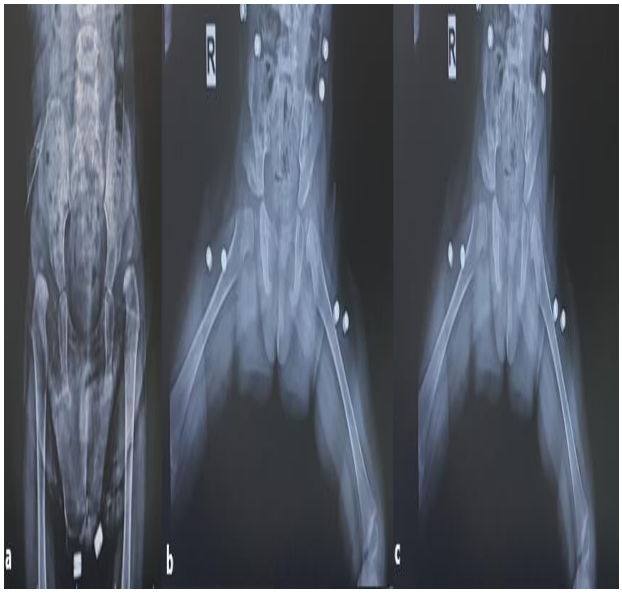

Figure 1. *An 18-month old female patient applied with open reduction + Pemberton acetabuloplasty (a-Preop,b-Postop 3rd month,c-Postop 1st year radiographs)*

The Salter innominate osteotomy (SIO) is a complete osteotomy that re-orienting the acetabulum, and the aim of both procedures is to obtain a good acetabulum-femur relationship by providing sufficient femoral head coverage (9) **(Figures 2a, b, c).**

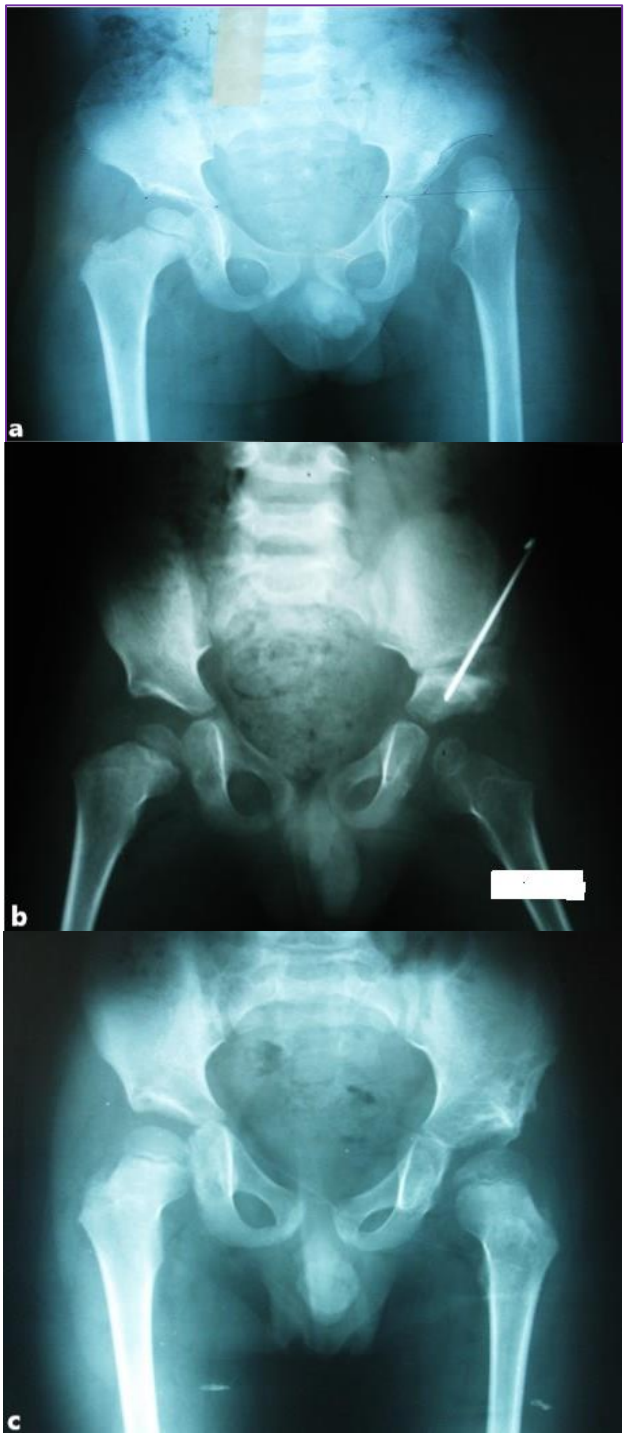

Figure 2. 20-month old patient applied with open reduction + Salter osteotomy to the left hip (a-Preop, b-Postop 3rd month, c-Postop 1st year radiographs)

The aim of this study was to determine and evalute the early -stage clinical and radiological

results of Pemberton acetabuloplasty and Salter osteotomy applied additional to open reduction in patients aged 1 year and older who were diagnosed with DDH.

MATERIAL AND METHODS

A retrospective evaluation was made of 32 patients applied with Pemberton acetabuloplasty (PA) and 28 patients applied with Salter osteotomy (SO) for a diagnosis of DDH in 2 different centres between 2014 and 2016. Patients were excluded if the diagnosis was not primary DDH, if they had previously undergone hip surgery, were applied with additional femoral shortening and/or derotation osteotomy, did not require open reduction and were only applied with pelvic osteotomy, or had a neuromuscular etiology. The patients included in the study were applied with PA or SO additional to open reduction. Group 1 comprised 21 patients applied with PA additional to open reduction and Group 2 comprised 18 patients applied with SO and open reduction. The patients in both groups were evaluated in respect of the clinical and functional scores and radiological parameters at the final follow-up examination. The groups were compared in respect of preoperative and postoperative acetabular inclination angles, preoperative and postoperative acetabulum depth, the degree of abduction within the plaster cast, hip range of movement at the final follow-up examination, and any complications that developed. In the clinical evaluation, the McKay modification of the Berkeley classification was used (10) **(Table 1).**

Table 1: The McKay modification of the Berkeley classification: clinical evaluation of the hip joint.
Grade I -Excellent : pain-free, stable hip, no limp, internal rotation >15˚
Grade II- Good: pain-free, stable hip, slight limp or restriction of movement, negative Trendelenburg sign
Grade III - Fair: Minimum pain, moderate degree of restricted movement, positive Trendelenburg sign
Grade IV- Poor: severe pain

Surgical Technique:

The operations were performed by two separate surgeons. Adductor tenotomy, iliopsoas tendon loosening, open reduction and pelvic osteotomy were applied to all hips. First, the percutaneusly adductor longus tenotomy was applied. Then the hip was entered with a bikini incision. Using cleavage between the sartorius and tensor fascia lata, the long head of the rectus femoris was raised from the attachment site and the iliopsoas was tenotomizedi.Capsule was opened, the ligamentum teres and pulvinar were excised and the ligamentum transversum was cut. After reduction of the hip joint, the stability of the hip, the coverage of the femoral head and relationship of the femoral head and the acetabulum were evaluated. Then, according to the preference of the surgeon, PA or SO was applied. By applying capsulorraphy, the layers were appropriately closed in order and a pelvipedal plaster cast was applied.

STATISTICAL ANALYSIS

The data obtained in the study were analysed using SPSS vn 20 software. In the evaluation of the conformity to normal distribution of the variables, the Shapiro Wilk test was used because of the unit numbers. In the examination of the differences between groups, the Mann Whitney U-test was used as the variables did not conform to normal distribution. Chi-square analysis was applied in the examination of relationships of nominal variables betweeen the groups. In the examination of differences between two dependent variables, the Wilcoxon test was applied as the variables did not conform to normal distribution. When interpreting the results, 0.05 was accepted as the level of statistical significance. Thus a value of $p<0.05$ indicated a statistically significant difference and $p>0.05$ indicated that the difference was not statistically significant.

RESULTS

Group 1 comprised 21 patients with a mean age of 24.8 months and a mean follow-up period of 30.2 months. Group 2 comprised 18 patients with a mean age of 20.7 months and a mean follow-up period of 32.1 months. **(Table 2).**

The mean decrease in acetabulum inclination angle was 26.24˚ in Group 1 and 22.63˚ in Group 2.

The mean increase in acetabular depth was determined as 0.36cm in Group 1 and 0.15cm in Group 2. The improvement in both parameters was greater in the PA group but the difference was not statistically significant **(Table 2).**

Table 2: Distribution of the groups according to the values of the parameters examined

		Group							
		n	Mean	Median	Min	Max	SD	z	p
Age (months)	Group 1	21	24.80	23	14	47	8.28	-0.452	0.225
	Group 2	18	20.70	21	17	42	6.35		
Follow-up period (mths)	Group 1	21	30.21	33	18	41	5.88	-1.118	0.316
	Group 2	18	32.18	44	20	43	4.18		
Preoperative Inclination Angle	Group 1	21	40.36	38	34	49	5.54	0.712	0.412
	Group 2	18	38.88	38	34	46	3.56		
Postoperative Inclination Angle	Group 1	21	14.12	13	8	23	5.36	-1.043	0.145
	Group 2	18	16.25	17	8	25	6.29		
Preoperative Depth (cm)	Group 1	21	0.76	0.77	0.58	1.02	0.13	-0.114	0.776
	Group 2	18	0.79	0.81	0.59	0.93	0.11		
Postoperative Depth (cm)	Group 1	21	1.12	1.10	0.66	1.24	0.20	-1.110	0.081
	Group 2	18	0.94	0.93	0.69	1.21	0.19		
Plaster Cast Abduction Degree	Group 1	21	44.51	45	33	56	6.35	-1.996	0.114
	Group 2	18	42.18	44	30	51	6.11		

No statistically significant difference was determined between the groups in respect of the abduction angle within the plaster cast. In the clinical evaluation, the PA group were evaluated as 18 excellent, 2 good and 1 fair, and in the SO group, the results were 15 excellent, 1 good and 2 fair.

In respect of complications, redislocation occurred in 1 patient (4.74%) in Group 1 and 2 (11.11%) patients in Group 2. In each group avascular necrosis was observed in 2 patients. **(Table 3).** In the evaluation of range of movement (ROM) of the hip joint, ROM of <30˚ was determined in 2 patients in Group 1 and 1 patient in Group 2.

Table 3. Demographic characteristics and complications of the groups

		Group 1(Pemberton)		Group 2(Salter)		Chi-square	p
		n	%	n	%		
Gender	Male	4	19.04	3	20.00	Fisher's exact	1..02
	Female	17	80.96	15	80.00		
	Total	21	100	18	100		
Side	Right	11	52.38	11	61.11	0.66	0.412
	Left	10	47.62	7	38.89		
	Total	21	100	18	100		
Avascular necrosis	Present	2	9.52	2	11.11	0.86	0.523
Late Trendelenburg	Present	1	4.76	1	5.56	-	-
Redislocation	Present	1	4.76	2	11.11	-	-

DISCUSSION

Both PA and SO have been used for many years in the treatment of DDH and are methods that have been comprehensively described. The aim of both procedures is to create a healthy, compatible femoral head-acetabulum relationship by increasing both anterior and lateral coverage of the femoral head. A stable hip obtained with sufficient coverage of the femoral head provides a positive contribution both to weight-bearing and to the remodelling of the dysplastic acetabulum (11).

The degree of correction in the inclination angle of the acetabulum has been reported to be higher in PA than in SO (12, 13). Therefore, in patients with a preoperative inclination angle of >35˚, the application of PA is generally preferred to SO. In the current study, the indication selection was not made according to this criteria but was applied according to the surgeon's preference. However, although no statistically significant difference was determined in the difference, the degree of correction obtained was observed to be greater in the PA group. According to this result, the selection of PA rather than SO should be considered in

patients with a high preoperative acetabular angle of inclination.

When compared with SO, that no graft fixation is required in PA is an additional advantagge (12, 5). The reason for this advantage is that in patients applied with fixation, implant removal may be necessary in the future (14). Even if the outcome of the operation is successful in patients undergoing surgery because of DDH, they are candidate patients for future operations, such as additional hip-preserving osteotomy or prosthesis replantation (15). Implants which are not removed may be a cause of technical difficulties in surgical operations which may be performed in the future. Therefore, in all the cases of the current study that were applied with SO, the implant was removed. That no additional surgical intervention is required in the future, such as implant removal, can be considered to be an advantage of PA compared to SO.

Avascular necrosis is a complication frequently seen after treatment of DDH that has a significant negative effect on results (16). Factors such as the type of acetabular osteotomy, soft tissue loosening, shortening, plaster cast position, etc, are known to have negative effects on femoral head bleeding and these factors are associated with avascular necrosis (17, 18). Furthermore, in some studies, a higher rate of avascular necrosis after PA has been related to the relatively inferior displacement rate of the acetabulum (5). In the current study, no statistically significant difference was determined in the short term between the PA and SO groups in respect of the development of avascular necrosis. However, there can be considered to be a need for further studies with more extensive series and longer follow-up periods to be able to report more robust results in respect of the development of avascular necrosis following DDH treatment.

In various studies, the redislocation rate after PA has been reported to be low (13, 19). In the current study, although the difference was not statistically significant, redislocation was determined at a lower rate in the PA group. This result suggests that better stability has been obtained with better coverage of the femoral head.

Compared to Salter osteotomy, the Pemberton acetabuloplasty provides better anterior and lateral coverage, a more stable hip reduction is obtained in terms of redislocation, and there is no requirement for internal fixation and it can therefore be considered more advantageous. In addition, because the osteotomy applied in the Pemberton technique is an incomplete osteotomy, there is a lesser negative effect on the biomechanics of the pelvis. On the other hand, the Salter osteotomy, which is of historical importance, is an osteotomy which has been reported with positive long-term results in literature and is still successfully applied by many authors (13, 20, 21). As a result no superiority of either technique was seen statisticaly in the radiological and functional results of the current study. Therefore, it can be concluded that both osteotomies can be safely applied according to the preference and experience of the surgeon.

REFERENCES

1. Konya MN, Tuhanioğlu Ü, Aslan A, Yıldırım T, Bursalı A, Şahin V, et al. A comparison of short-term clinical and radiological results of Tönnis and Steel pelvic osteotomies in patients with acetabular dysplasia. Eklem Hastalik Cerrahisi 2013; 24: 96-101.

2. Noordin S, Umer M, Hafeez K, Nawaz H. Developmental dysplasia of the hip. Orthop Rev 2010; 2: 19

3. Wang CW, Wu KW, Wang TM, Huang SC, Kuo KN. Comparison of acetabular anterior coverage after Salter osteotomy and Pemberton acetabuloplasty: a long-term follow up. Clin Orthop Relat Res. 2014 Mar;472:1001-9

4-Berkeley ME. Dickson JH, Cain TE, Donovan MM. Surgical therapy for congenital dislocation of the hip in patients who are twelve to thirty-six months old. J Bone Joint Surg Am. 1984:66:412 20.

5. Kuan-Wen Wu, MD, Ting-Ming Wang, MD, PhD, Shier-Chieg Huang, MD, PhD, Ken N. Kuo, MD, and Chi-Wen Chen, MS. Analysis of Osteonecrosis Following Pemberton Acetabuloplasty in Developmental Dysplasia of the Hip Long-Term Results . J Bone Jolnt Surg Am. 2010;92:2083-94

6.Zionts LE, MacEwen GD. Treatment of congenital dislocation of the hip in children between the ages of one and three years.J Bone Joint Surg Am. 1986 Jul;68(6):829-46.

7.Huang SC, Wang JH. A comparative study of nonoperative versus operative treatment of developmental dysplasia of the hip in patients of walking age.J Pediatr Orthop. 1997;17:181-8

8.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.

9. Salter RB. Innominate osteotomy in the treatment of congenital dislocation and subluxation of the hip. J Bone Joint Surg Br 43:518–539

10. Barret WP, Staheli LT, Chew DE. The effectiveness of the Salter innominate osteotomy in the treatment of the congenital dislocation of the hip. J Bone Joint Surg 1986; 68: 79-87.

11. Wang CW, Wang TM, Wu KW, Huang SC, Kuo KN Bone Joint J. The comparative, long-term effect of the Salter osteotomy and Pemberton acetabuloplasty on pelvic height, scoliosis and functional outcome. Bone Joint J. 2016 ;98:1145-50.

12. Wada A, Fujii T, Takamura K, Yanagida H, Taketa M, Nakamura T.J Pediatr Orthop.

Pemberton osteotomy for developmental dysplasia of the hip in older children.

2003;23:508-13.

13. Cove R. Outcome at forty-five years after open reduction and innominate osteotomy for late-presenting developmental dislocation of the hip.J Bone Joint Surg Am. 2009;91:2772.

14. Ezirmik N, Yildiz KA. Biomechanical Comparison between Salter Innominate Osteotomy and Pemberton Pericapsular Osteotomy. Eurasian J Med. 2012;44:40-2.

15.Jacobsen S, Sonne-Holm S, Søballe K, Gebuhr P, Lund B. Hip dysplasia and osteoarthrosis: a survey of 4151 subjects from the Osteoarthrosis Substudy of the Copenhagen City Heart Study. Acta Orthop 2005; 76:149–158.

16.Herring JA. Developmental dysplasia of the hip. In: Herring JA, editor. Tachdjian's pediatric orthopaedics. 4th ed. Philadelphia: WB Saunders;2008. 637–770

17. Tönnis D. Ischemic necrosis as a complication of treatment of C.D.H.Acta Orthop Belg. 1990;56:195-206.

18.Böhm P, Brzuske A. Salter innominate osteotomy for the treatment of developmental dysplasia of the hip in children: results of seventy-three consecutive osteotomies after twenty-six to thirty-five years of follow-up. J Bone Joint Surg Am. 2002:84:178-56

19. Bursali A, Tonbul M. How are outcomes affected by combining the Pemberton and Salter osteotomies. Clin Orthop Relat Res. 2008;466:837-46.

20. Pekmezci M, Yazici M. Salter osteotomy: an overview . Acta Orthop Traumatol Turc. 2007;41:37-46.

21. Atik OŞ, Daldal İ. Salter innominate osteotomy for the treatment of developmental dysplasia of the hip: 37 years of follow-up.Eklem Hastalik Cerrahisi. 2015;26:168-70.