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Research Article

Significant Clinical Improvement After Trochanteric Transfer (Mean 6-Year Follow-Up)

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Abstract

Objectives: Premature closure of the proximal femoral physis may occur as a sequel to the treatment of Perthes disease, slipped capital femoral epiphysis, septic arthritis and developmental dysplasia of the hip. The discontinuation of longitudinal growth in the proximal femoral physis and the continued growth of the trochanter result in a short femoral neck and a relatively enlarged great trochanter. Decrease in the articulotrochanteric distance may lead to shortening of the adductor force arm. Therefore, positive Trandelenburg's sign can be seen in patients secondary to a decrease in abductor function. The main objective in trochanteric transfer surgery is to increase the abductor force arm to eliminate the disruption and to improve hip functions. We have aim to evaluate clinical and radiological results of trochanteric transfer surgery.

Methods: 8 patients who underwent trochanteric transfer surgery between June 2011 and June 2014 were evaluated retrospectively. Age, gender, skeletal maturity status at the time of surgery, additional surgeries, side, postoperative follow-up time and symptom duration has recorded. Range of motion degrees of hip, abductor muscle strength, leg length discrepancy and Harris Hip Score(HHS) has measured both preoperative and postoperative period. Radiological evaluations were made on posteroanterior pelvis and lateral hip radiographs.

Results: The mean age of the patients was found to be 17.63 (13–32 years) at the time of surgery. Patients were followed for at least 36 months. The mean follow-up period was 74.75 months (36–92 months). There was a statistically significant chance in HHS ($p<0.05$). The increase in hip abduction muscle strength, ATD, beck-shaft angle, articulotrochanteric distance, tip of trochanter - femoral head center distance and lever arm ratio (L/D) was also statistically significant ($p<0.05$).

Conclusion: Results of our study suggest that trochanteric transfer provides a significant improvement in clinical scores, has a positive effect on the hip range of motion, abductor muscle strength, ATD and lever arm ratio.

Keywords: Trochanteric overgrowth, trochanteric transfer surgery, Legg-Calve-Perthes disease

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Premature closure of the proximal femoral physis may occur as a sequel to the treatment of Perthes disease, slipped capital femoral epiphysis, septic arthritis and developmental dysplasia of the hip. The discontinuation of longitudinal growth in the proximal femoral physis and the continued growth of the trochanter result in a short femoral neck and a relatively enlarged great trochanter. The length of the abductor muscles is shortened due to the shortened femoral neck. This anatomical difference is thought to lead to a weakening in the abductor muscles of the hip and an increase in hip reaction forces.[1-3]

Patients with clinically trochanteric overgrowth may have

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a positive Trendelenburg's sign, gait abnormality, pain and fatigue after a long walk. Many different surgical techniques have been developed for the trochanteric overgrowth problem so far. The main objective in all of these techniques is to restore the disrupted hip biomechanics. The greater trochanteric epiphysiodesis (GTE) may be preferred as a surgical option in the early stages of development.[2, 3] Trochanteric transfer surgery is thought to be able to contribute to the treatment by restoring the hip biomechanics in the patient group who has completed their musculoskeletal development. Decrease in the articulotrochanteric distance may lead to shortening of the adductor force arm. Therefore, positive Trandelenburg's sign can be seen in patients secondary to a decrease in abductor function. The main objective in trochanteric transfer surgery is to increase the abductor force arm to eliminate the disruption and to improve hip functions. Quite pleasing results have been obtained in the early publications on the trochanteric transfer.[1, 4-6] However, since trochanteric overgrowth is a secondary finding, the effects of the underlying etiology on the results were not investigated in these studies. Besides the etiological factors, demographic variables, accompanying arthrosis, and additional surgical interventions may also have an effect on trochanteric transfer. Furthermore, parameters such as head and neck angle may be different in the patients whose development continues particularly after the surgical procedure. This study evaluated the pre- and postoperative radiological data of adolescent patients.

Methods

After the approval of Local Ethics Committee was obtained, eight patients who underwent trochanteric transfer surgery between June 2011 and June 2014 were evaluated retrospectively.

Surgical indications were:

1. Positive Trendelenburg's sign
2. Decrease in articulorocanteric distance
3. Advanced abductor muscle weakness

Demographical and Clinical Patient Assessment

Age, gender, skeletal maturity status at the time of surgery, additional surgeries, side, postoperative follow-up time and symptom duration has recorded.

Clinical Assesment

Hip abduction, adduction, flexion, extension, internal rotation, external rotation has measured both preoperative and postoperative period. Abductor muscle strength, leg length discrepancy and Harris Hip Score (HHS) has also evaluated and recorded both preoperative-postoperative period.

Radiological Assessment

Radiological evaluations were made on posteroanterior pelvis and lateral hip radiographs. Radiological criteria evaluated in patients were the neck-shaft angle,[7] articulotrochanteric distance,[8] acetabular index,[9] femoral head diameter, Wiberg's lateral central edge angle (LCEA),[10] ACM angle,[11] and lever arm ratio (L/D) (Fig. 1).[12]

Surgical Technique

The patients were prepared in the supine position and the lateral longitudinal hip approach was preferred. After the great trochanter was osteotomized over guide K-wires, the distal transfer of the great trochanter was confirmed with the help of fluoroscopy. Before the great trochanter was transferred to the distal, the area where the great trochanter was to be transferred distally was decorticated using osteotome and curette. The trochanteric transfer was then detected by two cannulated screws with a diameter of 6.5 mm.

Periacetabular osteotomy and shelf acetabuloplasty were performed simultaneously in two patients and one patient, respectively (Fig. 2).

Postoperative Follow-up

The abduction pillow was applied for six weeks during rest for 6 weeks after surgery. Mobilization with full load was restricted for 6 weeks. At the postoperative sixth week, control radiograph was taken and full weight-bearing walking started. All patients were evaluated clinically and radiologically at the 3rd postoperative month to check union in the osteotomy line. Subsequently, all patients were followed up for a minimum of 3 years with annual controls (Fig. 3).

Statistical Analysis

Descriptive analyses were conducted to provide information about the general characteristics of the study groups.

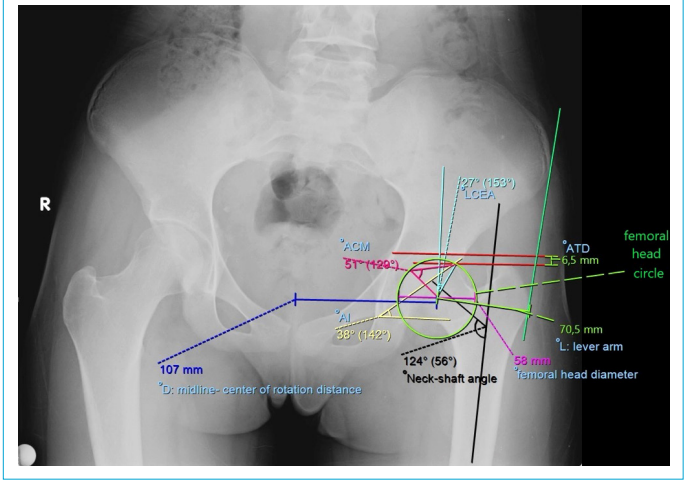

Figure 1. Measurement of radiological evaluation criteria.

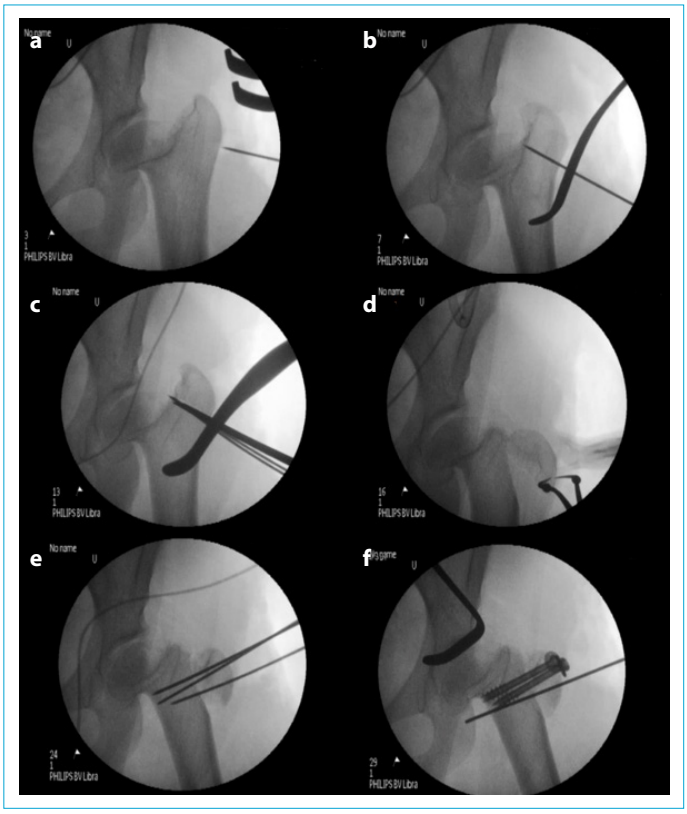

Figure 2. Stages of the surgical technique.

Descriptive data were expressed mean and standard deviation whereas categorical variables were expressed as numbers (n) and percentages (%). Paired Samples t-Test was used to compare the significance level of the difference between the mean preoperative and postoperative measurement results of the quantitative variables. A p value of <0.05 was considered statistically significant. Statistical analysis was performed using SPSS Statistics version 19 software (IBM Corporation, Somers, NY).

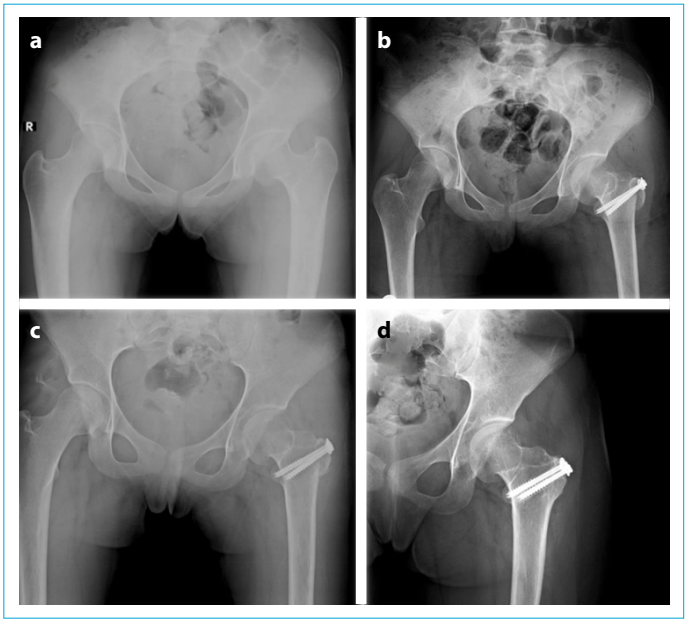

Figure 3. Hip radiographs of patient; **(a)** preoperative, **(b)** early postoperative, **(c)** postoperative 3rd month, **(d)** postopertive 3rd year.

Results

Patient Population

The mean age of the patients was found to be 17.63 (13–32 years) at the time of surgery. Patients were followed for at least 36 months. The mean follow-up period was 74.75 months (36–92 months).Two patients were male and six were female. Five of the patients (62.5%) were operated before the skeletal maturity (Table 1).

The mean hip abduction degree was found as 20.62 (10-30) preoperatively. The hip abduction muscle strength of four patients was 3/5 in the preoperative period, while the muscle strength was 4/5 and 5/5 in three patients and one patient, respectively. Preoperative mean leg length discrepancy was found to be 2.0 (0-3) while postoperative mean leg length discrepancy was 1.5 (0-3).

All radiological and clinical values evaluated before and after the operation were processed on the computer and analyzed statistically (Table 2).

The mean pre- and postoperative Harris Hip scores of the patients were found to be 69.18 (49.8-90) and 77.31 (65.8-93), respectively. Three of the patients had poor results, one patient had reasonable results, two patients had good results and two patients had excellent results in terms of HHS assessment. There was a statistically significant chance in HHS ($p<0.05$).

The increase in hip abduction muscle strength, ATD, beck-shaft angle, articulotrochanteric distance, tip of trochanter - femoral head center distance and lever arm ratio (L/D)

Table 1. Distribution of variables

Variable	n (%)
Gender	
Male	2 (25)
Female	6 (75)
Additional surgery	
Periaacetabular osteotomy	2 (25)
Shelf Procedure	1 (12,5)
N/A	5 (62,5)
Side	
Right	2 (25)
Left	6 (75)
Age (avg.±SD)	17.63±6 year
Postoperative follow-up time (avg.±SD)	74.75±16.8 month
Symptom duration (avg.±SD)	24.75±12.19 month

Table 2. Change of variables after surgery

Variable	Preoperative	Postoperative	p
Hip flexion º	123.88±11.68	122.25±9.51	0.492
Hip extansion º	13.75±4.43	15±4.63	0.598
Hip abduction º	20±7.56	20.63±8.63	0.763
Hip adduction º	15±5.35	13.13±3.72	0.402
Hip internal rotation º	20±7.56	21.25±7.91	0.626
Hip external rotation º	25±9.26	23.75±10.61	0.351
Shortness (cm)	2±1.07	1.5±0.93	0.104
Abductor Muscle Strength	3.63±0.74	4.13±0.35	0.033
Neck-shaft angle º	124.63±8.88	133.63±9.75	0.013
Articulo-trochanteric distance (mm)	6.13±10.68	23.75±7.11	0.002
Acetabular index º	48±7.82	43.75±9.68	0.238
Tip of trochanter - femoral head center distance (mm)	31.25±7.38	42.38±14.5	0.006
Femoral head diamater (mm)	54.75±7.11	54.88±7.06	0.351
LCE Angle º	16.13±8.51	21±8.35	0.144
ACM Angle º	56.63±11.07	51.25±10.29	0.112
Lever arm ratio (L/D)	2.16±0.62	2.71±0.54	0.025
Harris hip score (HHS)	69.19±14.49	79.56±10.86	0.007

The significance test of the difference between the two partners was used. *p<0.05 is statistically significant.

was also statistically significant (p<0.05).

Control radiographs taken at the 3rd month revealed that there was bone union in all patients. None of the patients had wound site infection and implant failure.

Discussion

There might be different etiological factors underlying the development of trochanteric overgrowth in childhood and adolescence. Trochanteric transfer surgery aims to improve hip biomechanics by increasing the abductor lever arm and reducing the tendency to impingement in abduction.

We believe that the abductor muscle moment contributes to hip biomechanics considering the statistically significant increase in articulotrochanteric distance and abductor muscle strength and the significant contribution of abductor muscle moment to the reduction of compressive loads on the hip joint.[1, 12-14]

Although a statistically significant improvement in the Harris hip score suggests that patients benefit from the surgery clinically, it is confusing that Harris hip scores of three patients were evaluated as poor at the last follow-up. These poor results might be attributed to the presence of acetabular dysplasia during trochanteric transfer. This possibility should also be considered in these patients (periacetabular osteotomy, shelf osteotomy) for whom an additional surgery was performed.

There were no statistically significant changes in many of the radiological parameters studied, however, the increase in femoral head and neck angle was quite significant. Considering the mean age of the patients (17.63 [13-12]) and their distribution, most of the patients are seen to be in the adolescent period. This statistical finding suggested trochanterc transfer could be benefical for devolepment in angular relationship between femoral shaft and neck in this patient group. Considering the fact that this increase in head and neck angle following the trochanteric transfer has a positive effect on hip biomechanics, the significant increase in hip scores may not be limited only structural rearrangement of the lever arm.

The main limitation of our study is the small sample size. It was not possible to make a comparison between etiological groups due to the small sample size. In other studies in the literature, a comparison was made between different etiological reasons.[1, 15, 16]

Although there is a significant improvement in HHS scores in the surgical problem, three patients (2 periacetabular osteotomy, 1 shelf osteotomy) were evaluated to be poor at the last follow-up control. This finding has suggested that restoring the lever arm in cases with acetabular insufficiency may not always be enough.

Conclusion

In conclusion, the results of our study suggest that trochanteric transfer provides a significant improvement in clinical scores, has a positive effect on the hip range of motion, abductor muscle strength, ATD and lever arm ratio.

In addition to the radiological criteria related to the position of the trochanter, the increased neck-shaft angle made us think that its effect on anatomical remodeling in the patient with growth potential may not be limited to the trochanter.

Disclosures

Ethics Committee Approval: After the approval of Local Ethics Committee was obtained, eight patients who underwent trochanteric transfer surgery between June 2011 and June 2014 were evaluated retrospectively.

Peer-review: Externally peer-reviewed.

Conflict of Interest: The authors declares that there is no conflict of interest regarding the publication of this article.

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