The effect of previous pelvic or proximal femoral osteotomy on the outcomes of total hip arthroplasty in patients with dysplastic coxarthrosis

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ABSTRACT

Objective: This study aimed to evaluate whether a history of a pelvic osteotomy or proximal femoral osteotomy compromises the outcomes of total hip arthroplasty in patients with dysplastic coxarthrosis.

Methods: The results of total hip arthroplasty in 240 hips of 172 patients without previous pelvic osteotomy or proximal femoral osteotomy were compared to 118 hips of 88 patients with a previous pelvic osteotomy or proximal femoral osteotomy (osteotomy group). Technical difficulties and rates of complications during surgery, operative time, estimated blood loss, rates of postoperative complications, and pre- and postoperative Harris Hip Scores and visual analog scale pain scores were compared between the two groups.

Results: In the osteotomy, the rate of complications was higher and the operative time was longer. The estimated blood loss was also higher, and the latest follow-up Harris Hip Scores and visual analog scale pain scores were worse in this group. Total hip arthroplasty was more demanding and the revision rate was higher in the osteotomy group (six vs four revisions).

Conclusion: Our data showed that a previous history of pelvic osteotomy or proximal femoral osteotomy compromised the clinical outcomes of subsequent total hip arthroplasty and is related to an increased rate of complications, prolonged operative time, and increased amount of blood loss.

Level of Evidence: Level III, Therapeutic Study

Developmental dysplasia of the hip (DDH) is a common condition that predisposes patients to early secondary osteoarthritis of the hip joint. Pelvic osteotomies (PO) and proximal femoral osteotomies (PFO) can correct structural deformities, improve the mechanics of the hip, and improve pain and function. These osteotomies are extensively performed in the pediatric and young patient populations with DDH and could prevent the development of osteoarthritis. Excellent results were reported after these osteotomies. These interventions, however, do not always prevent the development of secondary osteoarthritis of the hip, leading some patients to eventually undergo total hip arthroplasty (THA) for continued pain (1-5).

Total hip arthroplasty in patients with DDH is technically demanding due to the structural deformities of the hip. Increased complication rates in these patients compared to THA for primary osteoarthritis has been reported (6-8). THA, following previously failed PO or PFO, is even more demanding due to the worsened and altered bony anatomy of the acetabulum, angulated and mal-rotated femur, soft tissue contractures, damaged muscles, and potential sciatic nerve injury (3, 4, 8-10).

The effect of previous PO or PFO on compromising the results of THA is still controversial. Some studies have reported significantly poorer outcomes of THA after PO or PFO, while others reported the opposite (3, 4, 7-17). Few published studies are evaluating the outcomes of THA after PO or PFO, and most of these studies had small sample sizes and or lacked a comparison group of patients without a previous PO or PFO (2-4, 7-9, 11-13, 15-18). Even the studies that reported similar outcomes between the groups suggested that the operative time and intra- and postoperative blood loss and complication rates were higher in cohorts with previous PO or PFO (3, 4, 9, 10, 18).

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This study's primary objective, therefore, was to evaluate whether THA, performed for osteoarthritis of the hip joint secondary to DDH, with a previous PO or PFO has comparable improvements in clinical outcomes and radiographic results, when compared to THA, performed with the same surgical indication but without a previous PO or PFO. The secondary objective was to reveal the technical difficulties during surgery and the rates of complications and revision THA.

Materials and Methods

Approval of the Bakırköy Dr. Sadi Konuk Training and Research Hospital Review Board was obtained before initiation of this study (13.04.2014 - Approval number: 2014/157). Between December 2010 and December 2015, 380 patients were operated with the diagnosis of coxarthrosis. Patients with a minimum of two years of follow-up were included in the study. Patients with ipsilateral TKA or UKA, with missing radiological or clinical evaluations and those who were lost to follow-ups were excluded. Eventually, clinical and radiographic outcomes of 358 primary THAs (162 unilateral and 98 staged or simultaneous bilateral) in 260 patients with osteoarthritis of the hip secondary to DDH were evaluated retrospectively.

The patients were divided into two groups. While Group 1 consisted of patients with no previous PO or PFO, and Group 2 comprised those with a previous PO or PFO. In Group 1, there were 159 women (92.4%) and 13 men (7.6%) with a mean age of 46.88±12.70 (range: 23 to 82 years) at THA. In Group 2, there were 79 women (89.8%) and nine men (10.2%) with a mean age of 40.59±10.45 (range: 23 to 82 years) at THA. The preoperative data that were analyzed included age at THA, gender, time from osteotomy to THA, body mass index (BMI), and the Crowe classification of DDH (19). The intraoperative data that were analyzed included the surgical approach, operative time, estimated blood loss, presence or absence of subtrochanteric shortening osteotomy, and intraoperative complications. The postoperative data that were analyzed included the follow-up period and complications. Both authors evaluated the patients.

The same surgical techniques either via an anterolateral or a posterior approach with standard exposure were used on all patients. All patients had cementless THA (SL-PLUS Cementless Femoral Hip System, ECHELON Primary Hip System or SYNERGY Cementless Hip System; Smith & Nephew, Inc.; Andover, MA, USA). Acetabular components were placed in the true acetabulum with an abduction angle between 40° and 50° and an anteversion of 10° to 20°. All patients obtained a uniform contact between the acetabular component and the acetabular bone and good initial stability. In some patients with significant acetabular dysplasia, up to 20% of the superolateral aspect of the acetabular cup was left uncovered, making it possible to implant an acetabular component with a larger diameter that would allow for a femoral head with a larger diameter. Fixation was secured with one or two screws in all patients. Autograft augmentation was not used. When necessary, a transverse subtrochanteric shortening osteotomy was performed. In the case of a previous Schanz osteotomy, femoral shortening and correction of the angulation of the proximal femur were required. When a shortening osteotomy was performed, prophylactic cerclage of the proximal femur with braided cables was performed below the osteotomy site to prevent an intraoperative fracture during the reaming or impaction of the implant.

Patients were allowed full weight-bearing immediately after the operation with crutches or a walker. Patients with a shortening osteotomy were allowed toe-touch weight-bearing with crutches or a walker, and full weight-bearing was permitted at six weeks. When bilateral THA with shortening was planned, the patient had a staged THA. Clinical outcomes were evaluated by Harris Hip Scores (HHS) and the visual analog scale (VAS) for pain preoperatively and at the final follow-up. Persisting postoperative Trendelenburg gait was noted.

Radiographic analysis was done by a standard anteroposterior view of the pelvis and the hip and a lateral view of the hip. Preoperatively, osteoarthritis of the hip was evaluated, and the Crowe classification of hip dysplasia was determined. Component positioning, loosening, osteolysis or evidence of impending component failure were evaluated at the final follow-up. Preoperative computed tomography scans were obtained in all patients to determine the three-dimensional shape of the acetabulum. The absence of bony healing at the subtrochanteric osteotomy site for longer than six months was accepted as a non-union. The loosening of the acetabular and femoral components was assessed using the criteria suggested by Harris (20).

Data were analyzed using the PASW Statistics 18 software (IBM Corp.; Armonk, NY, USA). Statistical differences regarding the mean age of the patients, BMI, mean estimated blood loss, follow-up periods between the groups, and HHSs between the two groups for preoperative and postoperative periods were evaluated using Levene's test for equality of variances. Statistical differences regarding gender distribution, the surgical approach used, the rate of shortening osteotomy, postoperative complications, and the presence of the Trendelenburg gait between the groups were evaluated using the Pearson's Chi-square test. The Mann-Whitney U-test was employed in evaluating the statistical differences regarding the mean operative time between the groups and the Crowe classification distribution. Statistical differences regarding intraoperative complications,
rate of non-union at the subtrochanteric osteotomy site, and rate of revision between the groups were evaluated with the Fisher’s exact test. While the paired samples t-test was employed in evaluating the statistical differences between the preoperative and postoperative HHSs for each group, the statistical differences regarding VAS pain scores between the pre- and postoperative periods for each group and VAS pain scores between the two groups for preoperative and postoperative periods were evaluated using the Wilcoxon test. Values of p<0.05 were considered significant.

Results

Table 1 shows the patient and surgical data. Group 1 consisted of 240 THAs in 172 patients (104 patients unilaterally, 68 bilaterally) with no previous PO or PFO. Group 2 consisted of 118 THAs in 88 patients (58 patients unilaterally, 30 patients bilaterally) with a previous PO or PFO. The mean age of the patients in Group 2 was significantly younger at the time of THA (Levene’s test, p=0.0001).

Gender distribution was not statistically different between the groups (Pearson’s chi-square test, p=0.464). Again, there was no statistically significant difference between the groups regarding BMI (Levene’s test, p=0.109) (Figure 1).

There were 103 POs and 20 PFOs. Previous POs were identified as Salter osteotomy in 38 hips (36.9%), Chiari osteotomy in 36 (35%), Pemberton osteotomy in 22 (21.4%), shelf acetabuloplasty in five (4.9%), and triple innominate osteotomy in two (1.9%). Previous PFOs were identified as Schanz valgus osteotomy in 15 hips (75%) and varus-derotation PFO in five (25%). The five hips with varus-derotation PFO had undergone combined Chiari osteotomy in two patients and Salter osteotomy in three patients. The mean time between the osteotomy and THA was 29.5 (range: 3 to 53) years (Figure 2).

Preoperatively, the hips in Group 1 were classified as Crowe Type I in 59 patients (24.6%), Crowe Type 2 in 34 (14.2%), Crowe Type 3 in 41 (17.1%), and Crowe Type 4 in 106 (44.2%). In Group 2,
Table 1. Surgical data of the patients

|                                | Group 1 (without PO/PFO) | Group 2 (with PO/PFO) | p     |
|--------------------------------|--------------------------|-----------------------|-------|
| Number of hips                 | 240                      | 118                   |       |
| Number of patients             | 172                      | 88                    |       |
| Male: female ratio             | 13: 159                  | 9: 79                 | 0.464 |
| Crowe classification           |                          |                       |       |
| Grade 1                        | 59 (24.6%)               | 73 (61.9%)            | 0.0001|
| Grade 2                        | 34 (14.2%)               | 27 (22.9%)            |       |
| Grade 3                        | 41 (17.1%)               | 2 (1.7%)              |       |
| Grade 4                        | 106 (44.2%)              | 16 (13.6%)            |       |
| Age at THA (years)             | 46.88±12.70 (23-82)      | 40.59±10.45 (23-82)   | 0.0001|
| BMI (kg/m²)                    | 26.3±7.55 (20.2-29.4)    | 26.9±7.25 (21.1-29.8) | 0.109 |
| Osteotomy type (number of hips)|                          |                       |       |
| PO                             | 103                      |                       |       |
| Salter                         | 38 (36.9%)               |                       |       |
| Chiari                          | 36 (35.0%)               |                       |       |
| Pemberton                      | 22 (21.4%)               |                       |       |
| Shelf acetabuloplasty          | 5 (4.9%)                 |                       |       |
| Triple innominate              | 2 (1.9%)                 |                       |       |
| PFO                            | 20                       |                       |       |
| Schanz                         | 15 (75%)                 |                       |       |
| Varus-derotation               | 5 (25%)                  |                       |       |
| Surgical approach              |                          |                       |       |
| Anterolateral                  | 184 (76.7%)              | 81 (68.6%)            | 0.104 |
| Posterior                      | 56 (23.3%)               | 37 (31.4%)            |       |
| Operative time (minutes)       | 100.5±25.6 (65-225)      | 112.9±24.2 (65-210)   | 0.0001|
| Blood loss (ml)                | 635±186.2 (300-1550)     | 876±181.6 (250-1400)  | 0.0001|
| Shortening osteotomy (hips)    | 96 (40%)                 | 30 (25.4%)            | 0.007 |
| Intraoperative complications   | 3 (1.3%)                 | 9 (7.6%)              | 0.003 |
| Major trochanter fracture      | 2                        | 6                     |       |
| Femoral diaphysis              | 1                        | 3                     |       |
| Follow-up (months)             | 43.2±1.4 (24-74)         | 41±1.2 (24-76)        | 0.235 |
| Postoperative complications    | 13 (5.4%)                | 11 (9.3%)             | 0.165 |
| Dislocation                    | 1                        | 2                     |       |
| Foot drop                      | 8                        | 2                     |       |
| Nonunion at the subtrochanter osteotomy site | 3 | 6 | 0.064 |
| Acetabular component migration | 1                        | -                     |       |
| Late femoral diaphysis fracture| -                        | 1                     |       |
| Persisting Trendelenburg gait  | 18 (7.5%)                | 5 (4.2%)              | 0.237 |
| Postoperative Harris hip score | 91.9±6.41 (60-100)       | 87.46±8.08 (70-100)   | 0.0001|
| VAS pain score                 | 1.4±0.6 (0-4)            | 1.2±0.4 (1-3)         | 0.034 |
| Revision THA                   |                          |                       |       |
| Femoral component              | 3 (1.3%)                 | 6 (5.1%)              | 0.087 |
| Acetabular component           | 1 (0.4%)                 |                       |       |

BMI: body mass index; PO: pelvic osteotomy; PFO: proximal femoral osteotomy; THA: total hip arthroplasty; VAS: visual analog scale.

Values are expressed either as means with ranges in parentheses, or as numbers with percentages in parentheses. Significant p-values are typed in bold.
the hips were classified as Crowe Type 1 in 73 patients (61.9%), Crowe Type 2 in 27 (22.9%), Crowe Type 3 in two (1.7%), and Crowe Type 4 in 16 (13.6%). All 16 hips with a previous Schanz osteotomy were classified as Crowe Type 4, and the hips with a varus-derotation osteotomy as Crowe Type 2. There was a statistically significant difference in terms of the Crowe classification distribution between the two groups (Mann-Whitney U-test, p=0.0001).

In Group 1, an anterolateral approach was used in 184 hips (76.7%) and posterior approach in 56 hips (23.3%). In Group 2, an anterolateral approach was used in 81 hips (68.6%) and posterior approach in 37 hips (31.4%). No statistically significant difference was detected between the groups (Pearson's chi-square test, p=0.104).

The mean operative time was 100.5±25.6 (range: 65 to 225) minutes in Group 1 and 112.9±24.2 (range: 65 to 210) minutes in Group 2. The mean operative time was significantly higher in Group 2 (Mann-Whitney U-test, p=0.0001).

In Group 1, the mean estimated blood loss was 635±186.2 (range: 300 to 1550) mL. In Group 2, the mean estimated blood loss was 876±181.6 (range: 250 to 1400) mL. The mean estimated blood loss was significantly higher in Group 2 (Levene's test, p=0.0001).

Shortening osteotomy was performed 96 times (40%) in Group 1 and 30 times (25.4%) in Group 2. The rate of shortening osteotomy was significantly higher in Group 1 (Pearson's chi-square test, p=0.007). The mean amount of shortening in Group 1 was 3.8 (range: 2 to 6) cm in Group 1 and 3.4 (range: 2 to 5) cm in Group 2.

Intraoperative complications were encountered three times (1.3%) in Group 1 and nine times (7.6%) in Group 2. Intraoperatively, there were two major trochanters and one femoral diaphysis fractures in Group 1, and internal fixation was performed simultaneously. In Group 2, there were six major trochanters (Figure 3, 4) and three femoral diaphysis fractures, and internal fixation was performed simultaneously. The rate of intraoperative complications was significantly higher in Group 2 (Fisher's exact test, p=0.003).

The mean follow-up time of the patients in Group 1 was 43.2±1.4 (range: 24 to 74) months and 41±1.17 (range: 24 to 76) months in Group 2. There was no significant difference between the groups (Levene's test, p=0.235).

Thirteen postoperative complications were observed in Group 1 (5.4%) and 11 in Group 2 (9.3%). There was one dislocation, eight foot drops, and three non-unions at the subtrochanteric osteotomy site (Figure 3), and one acetabular component migration (Figure 5).
The dislocation was managed by closed reduction, whereas the non-unions at the subtrochanteric osteotomy site were managed by femoral component revision and bone grafting. Of the eight foot drops, three resolved spontaneously, two were treated with tendon transfer, and three were managed conservatively. Acetabular component migration was managed by acetabular component revision with an acetabular cage, cemented acetabular component, and allograft bone.

There were two dislocations, two foot drops, six non-unions, late-onset instability at the subtrochanteric shortening osteotomy site, and one late femoral diaphysis fracture in Group 2. The dislocations were managed by closed reduction and the femoral diaphysis fracture by open reduction and internal fixation. Tendon transfer was performed for the foot drops. Instability at the shortening subtrochanteric osteotomy site was managed by femoral component revision and bone grafting. Although the rate of postoperative complications was higher in Group 2 (5.4% vs 9.3%), the difference was statistically insignificant (Pearson's chi-square test, p=0.165).

Nonunion at the subtrochanteric osteotomy site occurred three times (1.3%) in Group 1 and six times (5.1%) in Group 2. All patients were treated with the revision of the femoral stem and autogenous iliac bone grafting. Although the rate of nonunion at the subtrochanteric osteotomy site was higher in Group 2 (1.3% vs 5.1%), the difference was not statistically significant (Fisher's exact test, p=0.064).

Overall, there were three femoral and one acetabular component revisions (1.7%) in Group 1 and six femoral component revisions (5.1%) in Group 2. The rate of nonunion at the subtrochanteric osteotomy site was higher in Group 2 (1.7% vs 5.1%). The difference, however, was statistically insignificant (Fisher's exact test, p=0.087).

Persisting postoperative Trendelenburg gait was present in 18 hips (7.5%) in Group 1 and five hips (4.2%) in Group 2. Although the rate of persisting postoperative Trendelenburg gait was higher in Group 1 (7.5% vs 4.2%), the difference was insignificant (Pearson's chi-square test, p=0.237).

Harris Hip Scores significantly improved in both groups. The preoperative and final follow-up HHS were 41.9±10.8 (range: 19 to 80) and 91.9±6.4 (range: 60 to 100), respectively in Group 1 (paired samples t-test, p=0.0001) and 43.9±13.1 (range: 21 to 71) and 87.5±8.1 (range: 70 to 100), respectively in Group 2 (paired samples t-test, p=0.0001). There was no significant difference between the preoperative HHSs of the groups (paired samples t-test, p=0.134). The HHS at the final follow-up, however, was significantly higher in Group 1 (paired samples t-test, p=0.0001).

Similarly, VAS pain scores significantly improved in both groups. The preoperative and final follow-up VAS pain scores were 8.4±1.3 (range: 4 to 10) and 1.4±0.6 (range: 0 to 4), respectively in Group 1 (Wilcoxon test, p=0.0001) and 8.1±1.9 (range: 3 to 10) and 1.2±0.4 (range: 1 to 3), respectively in Group 2 (Wilcoxon test, p=0.0001). There was no significant difference between the preoperative VAS pain scores of the groups (Wilcoxon test, p=0.915). The VAS pain score at the final follow-up, however, was significantly higher in Group 2 (Wilcoxon test, p=0.034).

Radiographic analysis at the final follow-up revealed no loosening, osteolysis, or evidence of impending component failure except the mentioned cases that underwent revision. Two acetabular component migrations were managed by component revision, and two femoral component revisions were performed due to instability at the subtrochanteric shortening osteotomy site.

**Discussion**

Pelvic and proximal femoral osteotomies are inevitable in pediatric patients with DDH, especially in the case of a dislocated hip. These interventions are promising treatment options in young patients with DDH with a symptomatic but pre-arthritic hip (1, 79)
On the other hand, it is widely accepted that THA in patients with DDH is technically more demanding, the clinical outcomes and survivorship compared to primary osteoarthrosis are worse, and the complication rates are increased (6-8, 19). Structural deformities of the acetabulum with anterolateral bone deficiency and of the proximal femur with narrow intramedullary canal and mal-rotation, and soft tissue contractures and potential sciatic nerve injuries are well-known challenges for the surgeon. Leg length discrepancy is another important consideration in these patients.

Total hip arthroplasty following a failed PO or PFO is expected to be even more demanding due to the worsened bony anatomy of the acetabulum, the angulated and mal-rotated femur, more severe soft tissue contractures, and damaged muscles. Infection rates could also be expected to be higher. Naturally, worse clinical and radiographic outcomes and higher complication rates are presumed in these patients when compared to patients without PO or PFO. The literature, however, does not always support this prediction (7, 8, 10, 15-17). A recent systematic review showed that previous PO did not compromise the success of THA compared to patients without a previous PO and that the complication rates were similar (9). The authors, however, admit that the available literature is limited, and the paucity of available studies lead to an underpowered analysis. We, too, agree with this conclusion.

This study, therefore, was conducted to evaluate the THA outcomes and complications following previous PO or PFO and compare them to THA without previous PO or PFO to determine if differences exist in DDH patients. Our data showed that a previous PO or PFO do compromise the clinical outcomes of subsequent THA and intra- and postoperative complications occurred more often with this patient group. Some previous studies also reported significantly poorer outcomes of THA after PO or PFO (3, 4, 11-14, 18). Apart from the difficulties posed by the severely dysplastic and misdirected acetabula, using cementless stems also cause serious complications. Since they need direct contact and anchoring with bone, cementless stems confer a higher risk of periprosthetic fracture than cemented stems do. In one study, the incidence of periprosthetic fracture was significantly higher in patients with a previous varus or valgus femoral osteotomy (18).

Gender, BMI, surgical approach type, and follow-up periods were not determining factors, as no differences were detected between the groups. The clinical outcomes, however, were worse and there were more intraoperative complications in patients with a previous PO or PFO even though they were significantly younger than the other group. Furthermore, there were more technical difficulties during surgery for patients with a previous PO or PFO, as revealed by the prolonged operative time and estimated blood loss. Preoperatively, the hips in Group 1, however, seemed more challenging and surgically more demanding than the hips in Group 2, as there were 106 (44.2%) Crowe Type 4 hips in Group 1 versus 16 (13.6%) Crowe Type 4 hips in Group 2. But that was not the case.

On the other hand, the mean operative time and estimated blood loss were significantly higher in Group 2. Although the rate of subtrochanteric shortening osteotomy was higher in Group 1, the rate of nonunion at the osteotomy site was higher in Group 2. We presumed this was due to the muscle damage around the proximal femur that occurred during PO or PFO. Again, the rate of intraoperative complications was significantly higher in Group 2. Although the rate of postoperative complications was higher in Group 2, the difference was statistically insignificant.

HHS and VAS pain scores significantly improved in both groups. In patients with a previous PO or PFO, improvements in functional outcomes evaluated with the HHS, however, were worse and the VAS pain scores were significantly higher after THA. Technical difficulties during surgery were also more evident in patients with a previous PO or PFO.

On the other hand, our study population is different from those of the reported studies that claim similar results with or without PO or PFO. Cohorts in most of these study groups consisted of patients with a previous Bernese periacetabular osteotomy, rotational acetabular osteotomy, Chiari osteotomy, or shelf acetabuloplasty (5, 7, 12, 16, 17, 22, 23). The time between PO and THA was short and POs were performed in the adult patient populations. Most of our patient population with a previous PO, however, underwent Salter (36.9%), Pemberton (21.4%), and triple innominate osteotomies (1.9%). There were no Bernese periacetabular or rotational acetabular osteotomies in which most studies reported similar outcomes with patient populations without a previous PO. Besides, in our patient group, the mean time from PO to subsequent THA was long, with a mean of 29.5 years, and POs were mostly performed in young children, sometimes infant populations.

We observed more severe soft tissue contractures in patients with previous Salter and Pemberton osteotomies who had considerable tight hips, probably due to the opening of the joint capsule and reduction of the femoral head into the acetabulum during PO. The joint capsule is not opened during Bernese periacetabular, rotational acetabular, or Chiari osteotomies. We believe that these are significant unfavorable factors. Furthermore, the tendon of the iliopsoas muscle is divided into Salter, Pemberton, and triple innominate osteotomies, which could weaken the hip flexion strength and might negatively affect the functional outcomes evaluated with HHS. Furthermore, a previous PO could lead to acetabular retroversion leading to wrong acetabular component positioning and increasing the risk of postoperative dislocation. In one study on THA, after failed triple innominate osteotomy, clinical outcomes of THA were negatively affected (11).
The only study that reported the effect of a previous Salter or Chiari osteotomy on THA showed that previous PO did not lead to a higher perioperative complication rate, higher revision rate, compromised HSS, or shortened survivorship (8). In this study, however, patients with a previous Salter osteotomy had more complications than those with a Chiari osteotomy. Again, there is only one study reporting THA after a previous triple innominate osteotomy (15). This study also showed that complications and functional outcomes were not equivalent to the results in patients who underwent THA without a previous triple innominate osteotomy. The literature does not hold any study reporting THA following a previous Pemberton osteotomy.

Previous Schanz osteotomies also posed problems. Although all 16 hips with Schanz osteotomies were Crowe Type 4 hips, which would have needed femoral shortening anyway, the angulation of the femur needed to be addressed separately, which always prolonged the operative time. Although follow-up periods in either groups were not long enough to draw a conclusion about the survival of THA in these groups of patients, the rate of revision was significantly higher in Group 2.

There were some limitations to the current study. First, this was a retrospective study. Second, only short- or mid-term follow-up data were obtained. THA following a PO or PFO, however, is relatively uncommon, which makes this study necessary. Naturally, further investigation is needed from multiple centers to determine longer-term clinical and radiologic results. Finally, we did not have a power analysis and the patients in Group 2 were not homogeneous.

In conclusion, PO or PFO compromises the clinical outcomes of subsequent THA, as shown by the HHS and VAS pain scores. The rate of intraoperative complications was also higher in this patient group and THA was technically more demanding, as revealed by the prolonged operative time and increased amount of blood loss. There were more severe soft tissue contractures and damaged muscles in patients with previous Salter and Pemberton osteotomies.

Ethics Committee Approval: Ethics committee approval was received for this study from the Ethics Committee of Bakırköy Dr. Sadi Konuk Training and Research Hospital (13.04.2014 - 2014/157).

Informed Consent: Informed consent was not received due to the retrospective nature of the study.

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