

## PAPER DETAILS

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## Short-Mid Term Results of Open Reduction and Simultaneous Single Stage Pemberton Pericapsular Osteotomy in Patients with Bilateral Developmental Hip Dysplasia

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**Abstract:** In this study, we aimed to publish the data on the clinical-radiological outcomes and perioperative analysis of PPO applied simultaneously in patients with bilateral developmental hip dysplasia compared with the literature. In the study, which was retrospectively analyzed, 75 patients (150 hips) who were followed up for at least 1 year between 2010-2018 were included in the study. Preoperative radiological Asetabular Index (AI) measurement and the International Hip Dysplasia Institute (IHDI) classification, postoperative radiological AI measurement and Severin classification, clinically McKay criteria, for osteonecrosis Kalamchi-MacEwen classification were used. In the perioperative analysis, the duration of anesthesia exposure, hospital stay, and total cost were evaluated. Sixty-seven patients were girls and 8 patients were boys. The mean follow-up times were 31.65±16.2 (12-60) months and the age of surgery was 21.4 (18-36). There was no statistically significant difference between the mean follow-up times and surgical ages between both genders (p=0.681). A statistically significant difference between the mean corrected AI (p=0.509), intraoperative bleeding amount (p=0.431), hospital stay time (p=0.909), anesthesia exposure (p=0.368) and cost (p=0.531) between both sex no difference was found. It was statistically significant for the right and left hips in pre-postoperative AI (p<0.001). Clinical and radiological results were found in similar rates to the literature. Compared with the literature, clinical and radiological results were found in similar rates in patients who underwent simultaneous PPO. In addition, simultaneous PPO reduces anesthesia exposure time, hospital stay and total cost. Simultaneous procedure seems to be advantageous for surgeons who have sufficient experience in PPO or who have started using this technique routinely. © 2020 NTMS.

**Keywords:** Pemberton, Simultaneous Surgery, Developmental Hip Dysplasia.

## 1. Introduction

Developmental hip dysplasia (DDH) is a pathological condition that is common in children and infants. It is frequently seen unilaterally, and approximately 20% bilaterally (1, 2).

Early diagnosed DDH patients (less than 12 months) are mostly treated via conservative methods (bracing, casting) and particularly in walking age or not benefited from conservative therapy are treated surgically.

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Although there are many surgical methods for patients with DDH in walking age, pemberton pericapsular osteotomy (PPO) is one of the most common used surgical procedures (4). PPO is an incomplete osteotomy technique that reshapes the acetabulum and provides concentric reduction of the femoral head (5). And for this reason, forming a relatively stable pelvis has brought to mind the possibility of simultaneous bilateral technique.

Since PPO is an incomplete osteotomy technique, providing natural stability after the graft may allow surgery to be performed simultaneously bilaterally (6, 7). Although the literature is inadequate, whether concurrent or sequential surgery to the patients with bilateral DDH is often controversial.

In this study, we aimed to publish the data on clinical, radiological and perioperative analysis of the patients whom PPO applied simultaneously with bilateral DDH and compared with the literature.

## 2. Material and Methods

Patients with bilateral DDH who underwent PPO between 2010 and 2018 years were included to the study and they were retrospectively analyzed. Patient criteria; 18-36 months old, no neurological and congenital disease, no previous surgical treatment, no femoral osteotomy during surgery. 75 patients (150 hips) met these criteria and followed for at least 1 year were included in the study.

Anesthesia exposure time includes the time from the beginning of anesthesia to the end of it. Pelvipedal plastering is also within this period. The cost is the fee that the institution has incurred for any expenses (anesthesia premedication, blood tests, consultations, etc.) during discharge. The amount of intraoperative bleeding was recorded as a parameter obtained from the follow-up of the anesthesia team.

Patients who underwent PPO were used to measure the Acetabular Index (AI) preoperatively and the International Hip Dysplasia Institute (IHDI) classification (Figure 1). Tönnis classification is widely used in the literature. However, since the IHDI classification does not require the presence of ossific nucleus is a more reliable classification compared to the classification of Tönnis (8).

PPO patients were evaluated postoperatively with AI measurement and Severin classification (Table 1) for radiological assessment, McKay classification (Table 2) for clinical assessment, and Kalamchi-MacEwen classification (table 3) for osteonecrosis (9-11).

### 2.1. Surgical Technique and Patient Follow Up

The classical Smith-Peterson anterior iliofemoral surgical approach was used and if necessary, iliopsoas tenotomy was performed over the pelvic rim. Ligamentum teres were cleared and the transverse acetabular ligament was loosened. Fibrous adipose tissues in the acetabular fossa were cleared, but limbus was preserved. Pemberton type iliac osteotomy was

performed in all cases. Pelvipedal plaster was generally applied in a safe position with 35-40° abduction, 30-45° flexion, 0-10° internal rotation, and 35-45° knee flexion.

After applying pelvipedal plaster for 2 months, abduction orthosis was applied for another month. Plaster cover was opened in the incision area for wound care on the first postoperative day. Patients were called for 2-month follow-up in the first 1-year period, and an anterior posterior (AP) radiograph was requested at each control (Figure 2). Encouraging advice was given to walking. Preoperative traction was not used in any patient.

### 2.2. Statistical Analyses

Statistical Analysis Data was analyzed using the Statistical Package for Social Sciences (SPSS) version 20 statistical analysis program (IBM Corp; Armonk, NY, USA). Data were presented as mean, standard deviation, minimum, maximum and percentage. The significance of AI change was analyzed with the Wilcoxon test, using mean gender follow-up time and surgical age, corrected AI amount, intraoperative bleeding amount, hospital discharge time, anesthesia exposure and cost difference with Mann-Whitney U test. If  $p < 0.05$ , the differences were considered significant.

## 3. Results

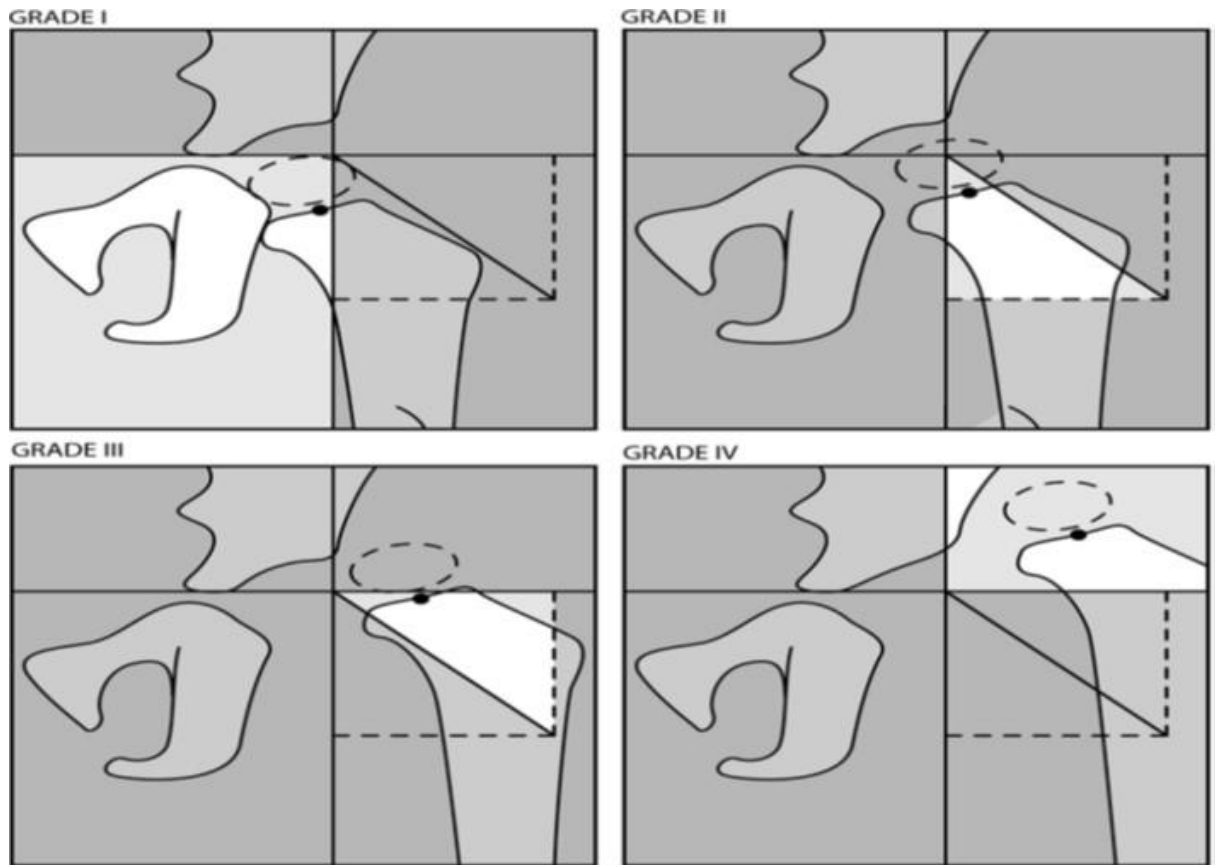
67 of the patients were female and 8 were male. The mean follow-up times were  $31.65 \pm 16.2$  (12-60) months and the age of surgery was 21.4 (18-36). There was no statistically significant difference between the mean follow-up times and surgical ages between both genders ( $p = 0.681$ ).

A statistically significant difference between the mean corrected AI ( $p = 0.509$ ), intraoperative bleeding amount ( $p = 0.431$ ), hospital discharge time ( $p = 0.909$ ), anesthesia exposure ( $p = 0.368$ ) and cost ( $p = 0.531$ ) between both sexes. No difference was found.

Right-left preoperative AI and postoperative AI of the patients were given in table 4. It was found statistically significant for the right and left hips in pre-postoperative AI ( $p < 0.001$ ). In the same table, intraoperative bleeding amount, hospital discharge time, anesthesia exposure and cost were given together with mean and standard deviation values.

Number (rate) according to the preoperative IHDI and postoperative Kalamchi-MacEwen, Severin and McKay classification were given in table 5.

Deep infection was not detected in any patient. Superficial infection was detected in four patients. All patients showed improvement with antibiotherapy. There was no need for additional surgery.



**Figure 1:** The standard Perkins (P) line is drawn perpendicular to the superolateral edge of the acetabulum. An additional 45 degrees cross line (D-line) is then drawn from the combination of Hilgenreiner's line (H-line) and P-line. The H-line is a single line drawn bilaterally from the top of the triradiate cartilage. The relationship of the H-point with these 3 lines determines the IHDH rating. The IHDH grade I is at the hip, H point at the P line or medial. In the IHDH grade II hip, the H-point is lateral to the P line or medial of the D-line. In the IHDH grade III hip, the H-point is lateral to the D-line and below the H-line. Finally, the H-point on the IHDH grade IV hip is above the H-line.



**Figure 2:** Respectively; Pelvis radiographs of the patient before the operation, immediately after the operation and 4<sup>th</sup> year.

**Table 1:** Severin's Radiological Classification.

Degree	Description
<b>I</b> (excellent)	Normal view
<b>II</b> (good)	Mild deformity in the acetabulum or femoral head and neck
<b>III</b> (moderate)	Dysplasia or mid degree deformity in acetabulum-femoral head and neck or both
<b>IV</b> (worse)	Subluxation of the femoral head
<b>V</b> (worse)	Joint of the femoral head with the wrong acetabulum
<b>VI</b> (worse)	Redislocation

**Table 2:** McKay Clinical Classification.

Degree	Description
<b>I</b> (excellent)	Pain-free, stable hip, no limping, full range of motion, negative Trendelenburg sign
<b>II II</b> (good)	Pain-free, stable hip, normal or slightly limp, slightly reduced range of motion
<b>III</b> (moderate)	Slight or painless claudication, stable hip, moderate stiffness, positive Trendelenburg sign
<b>IV</b> (worse)	Pain and instability in both hips, positive Trendelenburg sign

**Table 3:** Kalamchi-MacEwen Osteonecrosis Classification.

Degree	Description
<b>I</b>	Changes affecting the ossific nucleus
<b>II</b>	Lateral physical damage
<b>III</b>	Central physical damage
<b>IV</b>	Total damage to fizis and femoral head
<b>V</b>	Unclassifiable

**Table 4:** Preoperative AI, Postoperative AI, Intraoperative Bleeding Amount, Hospital Discharge Time, Anesthesia Exposure and Cost Means and Standard Deviations.

	Mean±Standard Deviation	
Preoperatif AI	39,92±5,22 (right)	40,75±5,37 (left)
Postoperatif AI	12,68±4,58 (right)	13,37±5,10 (left)
Intraoperative Bleeding Amount/cc	80,07±17,13	
Hospital Discharge Time/Day	4,96±1,25	
Anesthesia Exposure/Min	200,13±50,5	
Cost /TL	2642,60±407,39	

**Table 5:** Preoperative IHDI and postoperative Kalamchi-MacEwen number according to Severin and McKay classification (rate).

	IHDI		Kalamchi-MacEwen		Severin		McKay	
	Right	Left	Right	Left	Right	Left	Right	Left
			49 (65.3)-no AVN	52 (69.3)-no AVN				
<b>I</b>	2 (2.7)	2 (2.7)	20 (26.7)	18 (24.0)	47 (62.7)	49 (65.3)	56 (74.7)	56 (74.7)
<b>II</b>	41 (54.7)	41 (54.7)	3 (4.0)	-	26 (34.7)	23 (32.0)	13 (17.3)	15 (20.0)
<b>III</b>	20 (26.7)	20 (26.7)	3 (4.0)	5 (6.7)	2 (2.7)	2 (2.7)	6 (8.0)	4 (5.3)
<b>IV</b>	12 (16.0)	12 (16.0)						

#### 4. Discussion

PPO is a surgical technique described by Pemberton in 1965, which he first described with his name (5). PPO provides anterior (anterolateral) covering especially in the acetabulum and reduces concentrate femoral head reduction by reducing the acetabulum volume. It is an incomplete osteotomy technique since it uses triradiate cartilage as a hinge. PPO has become popular over time because it does not create pelvic instability, does not cause leg length difference and does not require fixation after osteotomy (4).

In the literature, many positive results have been reported in patients with unilateral DDH related to PPO. However, there are different opinions in bilateral cases. There is a lot of literature information about the positive results of PPO (4, 12, 13).

It has been reported in the literature that PPO significantly improves on acetabular index (AI). Alsiddiky et al. (14) 22.36 degrees in the right hip, 22.64 degrees in the left hip, Subaşı et al. (15).

On the other hand, they achieved an average correction of 16.7 degrees in patients who underwent sequential surgery. Agus et al. (1) average 10.2 degrees, Baki et al. (16) achieved an average of 31.2 degrees of improvement. In our study, an average of 27.3 degrees in the right hip and 27.4 degrees in the left hip were obtained. An AI value was obtained among the correction amounts specified in the literature.

Since PPO does not create pelvic instability, especially in patients with bilateral DDH, it allows simultaneous bilateral operation. Zorer et al. (7) reported significant data in favor of simultaneous acetabular index, cost effectiveness, duration of anesthesia, and length of hospital stay among patients with bilateral and unilateral DDH to whom they applied PPO. In this study, the average length of hospital stay was determined as 4.1 days. Agus et al. found this time to be an average of 5 days (1). The mean discharge times of the patients who underwent simultaneous PPO in our case series were 4.9 days. The reasonable discharge times we have obtained show us that the simultaneous operation of patients with bilateral DDH does not prolong hospital stay.

Agus et al. (1) compared bilateral simultaneous open reduction and unilateral pelvic osteotomy for DDH treatment in patients over the walking age after approximately 55 months of follow-up. They could not find a significant difference between the two groups in terms of results in clinical, radiology and corrected AI between the two groups. In the studies of Alsiddiky (14), Baki (16) and Subaşı (15), the results of open reduction and pelvic osteotomy in which they performed sequential single-session and bilateral single-session were excellent (14-16). In our study, where we presented our concurrent PPO results, we used the results of the 4 studies mentioned above as a control group.

One of the worst complications associated with DDH treatment is osteonecrosis or avascular necrosis (AVN). Multiple theories about the cause of AVN are explained. The general common idea is that with increasing age, the risk of developing postoperative AVN is increased. The average incidence of AVN after open reduction and pelvic osteotomy ranges from 7 to 22% (1, 19, 21).

In our study, AVN developed in 11 (7.3%) of 150 hips. Since type 1 is accepted as the variant of the normal in the literature, the sum of type 2 type 3 and type 4 has been evaluated as avascular necrosis.

The relatively low AVN rates we achieved; we believe that our patient age range in our case series is related to our age range (18-36 months).

## 5. Conclusions

Our study revealed that simultaneous bilateral open reduction and pelvic osteotomy demonstrated very limited and treatable complications for children with 18-36 months of bilateral DDH. In addition, the need for equipment and hospitalization costs decreased when a single operation was performed. We believe that this

procedure will cause less problems for families in terms of psycho-social aspects.

## Conflict of interest statement

None

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