CLINICAL AND RADIOLOGICAL EVALUATION ON DEVELOPMENTAL HIP DYSPLASIA AFTER SALTER AND OMBRÉDANNE PROCEDURE

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ABSTRACT

Objective: To evaluate the clinical and radiological medium-term results from surgical treatment of developmental hip dysplasia through Salter innominate bone osteotomy and Ombrédanne femoral shortening. Methods: Fourteen patients were evaluated, with surgical treatment on 18 hips (seven right-side hips and eleven left-side hips) using the proposal technique, performed between 1998 and 2008. The Dutoit and Severin criteria were used respectively for clinical and radiographic evaluations. Results: The average preoperative index for the seven right-side hips was 43.3º (40º to 50º), and this was corrected through surgery to an average of 31.57º (24º to 42º). The average preoperative index for the eleven left-side hips was 42.1º (36º to 56º), and this was corrected through surgery to an average of 30.36º (20º to 44º). There was a statistically significant difference between the preoperative and postoperative acetabular indexes, with $P < 0.05$. The clinical evaluation showed that there were seven excellent hips (38.9%), eight good ones (44.4%), three fair hips (16.7%) and no poor ones (0%). By grouping the hips rated good and excellent as satisfactory and those rated poor and fair as unsatisfactory, 83.3% of the results were seen to be favorable. There were no statistically significant correlations between occurrences of complications and patient age at the time of surgery or between complications and the preoperative acetabular index ($p > 0.05$). The complications observed consisted of one case each of subluxation, osteonecrosis and osteonecrosis together with subluxation. Conclusion: The combined procedure of Salter and Ombrédanne is a viable option for treating developmental hip dysplasia after patients have started to walk.

Keywords - Hip Dislocation, Congenital/surgery; Surgical Procedures, Operative/methods; Bone Diseases, Developmental; Hip/growth & development

INTRODUCTION

Developmental hip dysplasia (DHD) involves several abnormalities, which range from hip ligament laxity, leading to instability, to dislocation with loss of the anatomical relationship between the femoral head and the acetabulum. The femoral head can remain spherical or appear posteromedially flattened, and the acetabulum progressively becomes thick, shallow and oblique. It can be classified as teratologic and typical, and the latter is subdivided into dislocatable, subluxated and dislocated hip.

The etiology of DHD remains unknown. Ethnic and genetic factors are important. The genetic factors can determine acetabular dysplasia, ligament laxity, or both, as reported by Wynne-Davies[1]. Mechanical factors, such as the intrauterine position and postnatal habits, are added to the preexisting factors. In several studies in scientific literature, the incidence of DHD has varied from 2 to 17 per 1,000[3]. In Brazil, Volpon and Carvalho Filho[2] demonstrated an incidence of 2.31 per 1,000.

The treatment depends on the patient's age, on the

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Study received for publication: 5/31/2010, accepted for publication: 6/22/2011.

The authors declare that there was no conflict of interest in conducting this work

This article is available online in Portuguese and English at the websites: *www.rbo.org.br and www.scielo.br/rbort*

degree of acetabular dysplasia and proximal femoral dysplasia. A surgical option for the treatment of DHD, after walking has started, is the association between Salter innominate bone osteotomy and Ombrédanne femoral shortening. This association is geared towards decreasing pressure in the femoral head that will be reduced surgically into the acetabulum, compensating the contracture of soft parts.

The aim of this study is to evaluate the clinical and radiological medium-term result of the surgical treatment of DHD through the Salter procedure and Ombrédanne femoral shortening osteotomy.

MATERIALS AND METHODS

Fourteen patients were evaluated, with surgical treatment on 18 hips between 1998 and 2008 by the Salter and Ombrédanne technique. None of the patients had received previous treatment for DHD, and they did not undergo postoperative physiotherapy or rehabilitation. The study was approved by the Research and Ethics Committee of the hospital where the trial was carried out.

The age of the patients, who were all female, ranged from two to eight years, and four presented bilateral DHD. Seven right-side hips and 11 left-side hips were affected. The ideal acetabular index has an acceptable maximum value of 30°[3]. The average postoperative immobilization time with pelvic-podalic plaster cast was 2.5 months. In the bilateral cases there was an average interval of six months between the two procedures. All the cases were operated by the same orthopedic surgeon (Figure 1). No preoperative traction was performed in any case.

The osteosynthesis material used in the procedures was removed, on average, after one year of postoperative follow-up. The clinical and radiological evaluation occurred with average outpatient follow-up of 56 months (26 to 132 months).

Clinical and radiographic criteria were used to evaluate the results. The radiographs were evaluated by the Severin criteria[3], which take into account the acetabular (AC) and Wiberg's[4] CE angles, sphericity of the femoral head, dislocation or subluxation of the hip and the presence or absence of arthrosis. The clinical profile was analyzed by the criteria of Dutoit *et al*[5] based on hip stability and mobility, pain, lameness and the Trendelenburg test.

The statistical analysis was conducted in a descriptive and analytical manner, using the Student's t, paired Student's t, chi-square, ANOVA and Pearson methods, with the intention of establishing statistical significance between the clinical and radiological parameters.

RESULTS

The hips were grouped for analysis according to the affected side. In the seven right-side hips, the preoperative index ranged from 40° to 50° (average of 43.3°), and was corrected through surgery to an average of 31.57° (24° to 42°), while the 11 left-sided hips had preoperative mean of 42.1° (36° to 56°), evolving to 30.36° (20° to 44°). The paired Student›s t-test was used to analyze these data, obtaining a statistically significant result ($p < 0.001$) (Figure 2).

The clinical evaluation, according to Dutoit *et al*[5], showed seven excellent hips (38,9%), eight good hips (44.4%), three fair ones (16.7%) and no poor ones (0%). By grouping the hips rated good and excellent as satisfactory and those rated poor and fair as unsatisfactory, 83.3% of the results were seen to be favorable (Table 1).

The radiological evaluation showed six excellent hips (33.3%) (Figure 3), 10 good hips (55.6%), no fair ones (0%) and two poor ones (11.2%). By grouping the hips rated good and excellent as satisfactory and those rated poor and fair as unsatisfactory, 88.9% of the results were seen to be favorable (Table 2).

The complications observed consisted of one case each of subluxation, osteonecrosis and osteonecrosis together with subluxation, while the case of isolated subluxation was treated with another surgical procedure. There were no cases of infection, fracture, significant lower limb dysmetria or neurovascular lesion.

Both the clinical picture, based on the criteria of Dutoit *et al*[5], and the radiological picture, according to Severin[3], were associated with the preoperative acetabular index. However, statistical relevance was not achieved.

The clinical and radiological pictures were associated with one another by the chi-square test, yet no results with statistical value were obtained.

After the data analysis, it was observed that the evaluation of pre- and postoperative acetabular indices presented statistical significance with $p < 0.05$. In applying the Student's t-test, no statistical significance was obtained between the occurrence of complications and the patient's age at the time of surgery, and the preoperative acetabular index ($p > 0.05$).

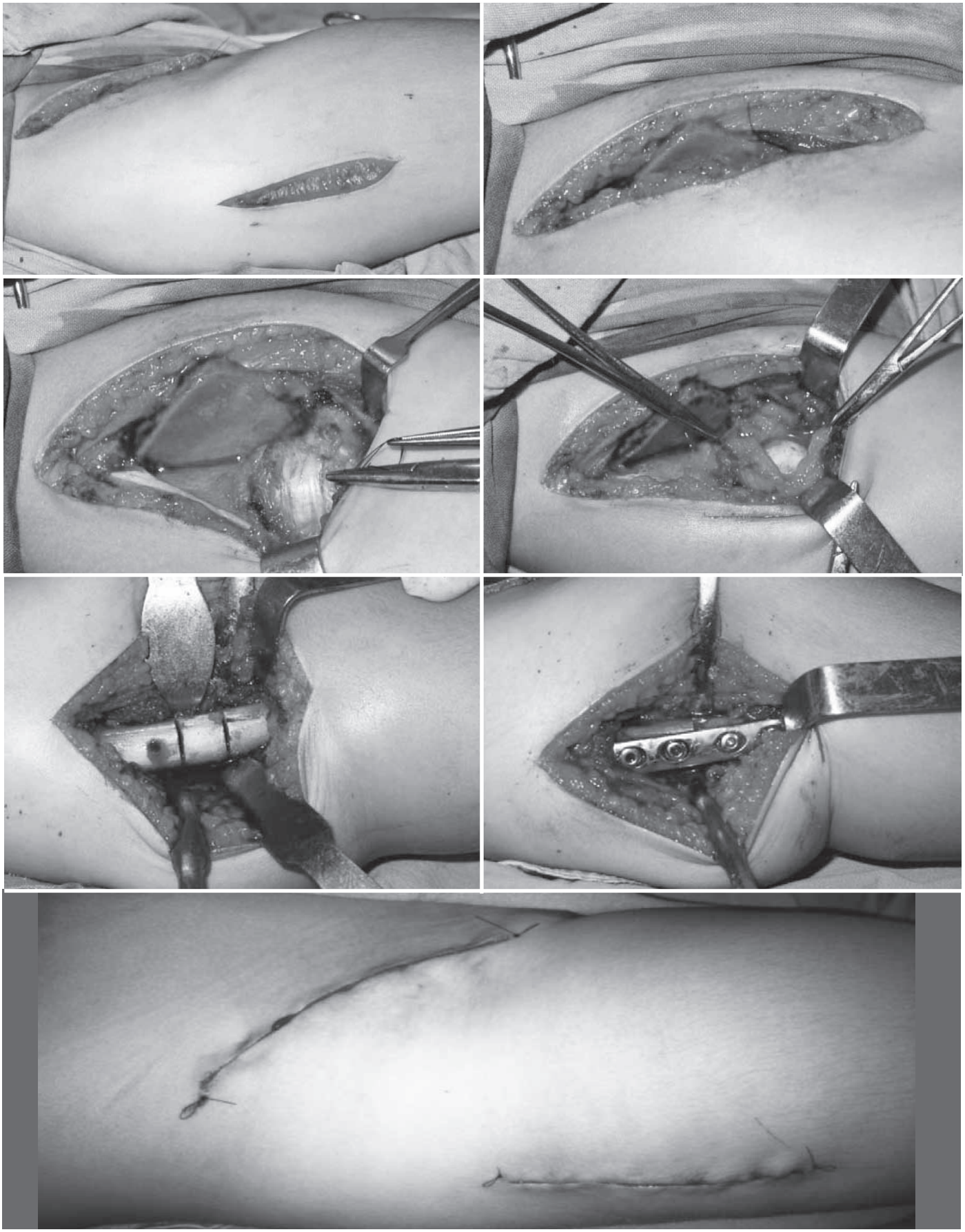

Figure 1 – Surgical technique: Salter innominate bone osteotomy and Ombrédanne femoral shortening.

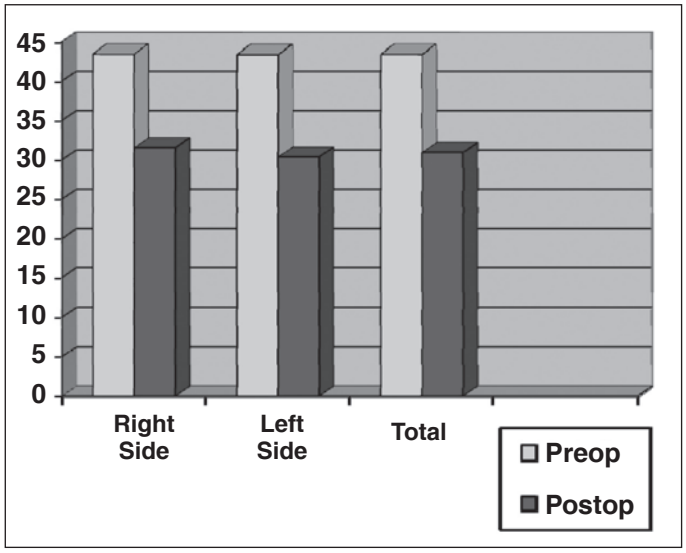

Figure 2 – Distribution of the pre- and postoperative acetabular index according to the affected side of the hip.

Table 1 – Result of the clinical evaluation according to Dutoit[5].

Dutoit		%	%
Excellent	7	38.90%	83.34 %
Good	8	44.44%	
Fair	3	16.66%	16.66 %
Poor	0	0.00	
Total	18	100%	100 %

Table 2 – Result of the radiological evaluation according to Severin[3].

Severin		%	%
1 – Excellent	6	33.34%	88.90 %
2 – Good	10	55.56%	
3 – Fair	0	0%	11.10 %
4 – Poor	1	5.55%	
5 – Poor	1	5.55%	
6 – Poor	0	0 %	
Total	18	100%	100 %

DISCUSSION

The physical examination to identify cases of DHD should be carried out on a routine basis on all newborns. The Ortolani maneuver, described in 1948 by Marino Ortolani, when positive, allows the diagnosis of DHD; however, a negative result does not rule out the diagnosis, since some hips are unstable, yet not dislocated. The Barlow provocative maneuver allows the diagnosis of hip instability. On the other hand, in children over three months of age, the Ortolani maneuver can be negative, since even if the hip remains dislocated, it is no longer possible to place the femoral head in the acetabulum. As regards the Barlow maneuver, it should be emphasized that many newborns

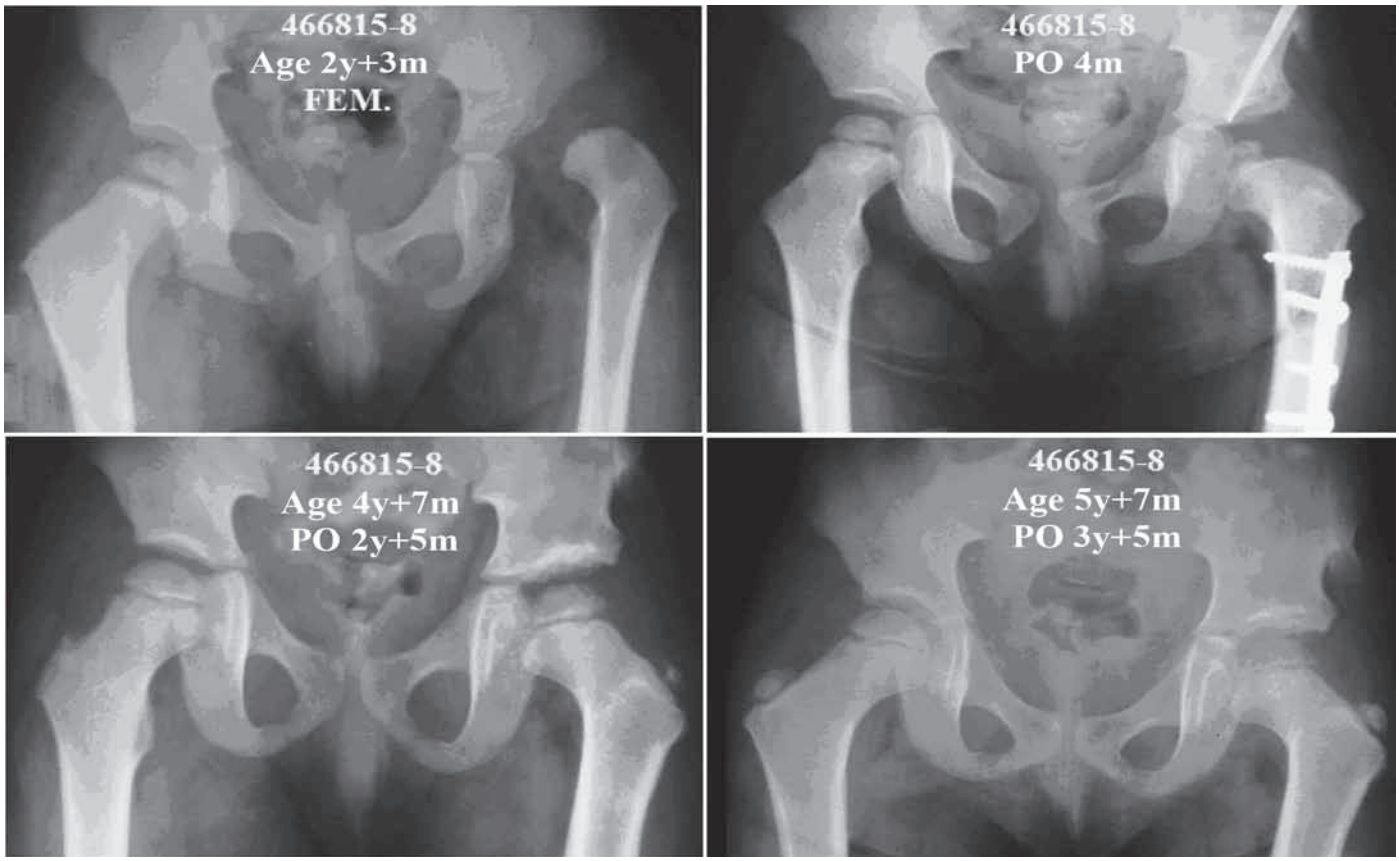

Figure 3 – Radiological evolution of a female patient with DHD submitted to Salter and Ombrédanne osteotomy. Note the excellent radiological result after 41 months of postoperative follow-up.

testing positive in the first examination become negative after two or three weeks.

In the dislocated hip, the treatment consists of concentric and atraumatic reduction of the femoral head inside the acetabulum. Before the walking phase, this treatment can be conservative; however, as the infant starts to walk, there is a tendency for interposition of soft tissues (round ligament, labrum and capsule) in this joint and open reduction is necessary. Once reduction is obtained, this can be maintained through procedures in the acetabulum, in the femur, in the soft parts or in both. Lindstrom *et al*[6] demonstrated that, if concentric reduction is obtained and maintained, there will be remodeling of the acetabulum, which is more accentuated up to the age of four years and can occur up to the age of eight years.

Severin[3] developed a system for radiological classification of the results of surgical procedures for the treatment of developmental hip dysplasia, evaluating deformities both of the head and of the neck and acetabulum, using Wiberg's CE angle and the presence of subluxation/dislocation in the postoperative period as a reference.

Dutoit *et al*[5] developed a postsurgical clinical rating system based on joint mobility and stability and the presence of pain and/or lameness.

Salter[7] described innominate bone osteotomy for the treatment of congenital dislocation and subluxation of the hip, promoting acetabular repositioning with the formation of a roof to support the femoral head after the reduction.

Salter *et al*[8] reported that a reduction in which it is necessary to adopt an extreme position, with hyperflexion/abduction of the hip, tended to provoke avascular necrosis of the femoral head due to hyperpressure between the femoral head and acetabulum resulting from the action of the strong abductor muscles of the hip, promoting interruption of the blood supply to the proximal portion of the femur. They also concluded that this alteration evolved with severe complications for the patients affected, with significant worsening of their prognosis. Based on this finding, Klisic proposed the association of innominate bone osteotomy with femoral shortening.

Klisic and Jankovic[9] analyzed, over a minimum period of five years, 60 hips of children aged between five and 15 years, submitted to the Salter procedure associated with femoral shortening, obtaining 3% of excellent results (clinical and radiological) and 60% of good results.

Klisic *et al*[10] monitored 225 hips submitted to innominate bone osteotomy (procedures of Salter, Pemberton or Chiari) associated with femoral shortening in children between seven and 15 years of age, with long follow-up, obtaining satisfactory general results, with good function and absence of pain.

Santili[11], in a study of 42 hips, treated between two years and one month and 10 years and three months of age, with open reduction and Salter's osteotomy associated with femoral shortening, referred to 47.6% of excellent results and 40.5% of good results. In this study, the satisfactory results (good and excellent) achieved clinically and radiologically were, respectively, 83.33% and 88.88%.

Of the 18 hips included in this study, satisfactory clinical and radiological results were obtained in 83.33% and 88.9%, respectively; therefore there is concordance with the results of the other series.

Taking into account the frequency, the degree of disability, the duration of the symptoms and morbidity, osteonecrosis is the most formidable complication of the treatment of DHD. Osteonecrosis occurs only in patients who have received some form of closed or open treatment. The positioning of the hip in abduction of more than 70° or forced medial rotation is a frequent cause of osteonecrosis. This can occur even in the normal hip, opposite to the one that is being treated. Therefore, hip immobilizations in an appropriate position and a careful open or closed reduction technique, observing the basic principles, can reduce the risk of this serious complication.

Based on scientific literature[12], it is known that the Salter osteotomy is not exempt from complications, such as: superficial and deep infection, osteochondritis, subluxation, re-dislocation, chondrolysis, sciatic nerve praxis and avascular necrosis. With the intention of reducing the isolated complications related to acetabular osteotomy, mentioned above, the preferred procedure has been to associate the Salter osteotomy with femoral shortening. In this study, the complications were one case each of subluxation, osteonecrosis and osteonecrosis together with subluxation, where the isolated subluxation case was treated with another surgical procedure. There were no cases of infection, fracture, significant lower limb dysmetria or neurovascular lesion.

Some authors such as Galpin *et al*[13], Browne[14] and Gibson and Benson[15] prefer femoral osteotomy as a complement of open reduction. Other authors such as Karakas *et al*[16] and Williamson *et al*[17] associate femoral osteotomy with the Salter osteotomy after open reduction.

Saleh *et al*[18] demonstrated that pelvic remodeling after innominate bone osteotomy was not observed in patients with skeletal maturity. In this study, the osteotomy was performed on patients between 2.23 and 7.78 years of age (post-walking age); nevertheless, there was no influence on the clinical and radiographic results in the medium term, according to the description provided by Volpon and Carvalho Filho[2].

CONCLUSION

It is concluded that the Salter procedure in association with the femoral shortening osteotomy is a viable option for DHD treatment after the patient has started to walk, with satisfactory results both clinically and radiologically, presenting a low rate of complications.

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