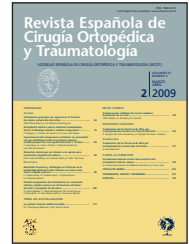


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## ORIGINAL PAPERS

### Open reduction by means of a medial approach: an alternative for congenital hip dislocation

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#### KEYWORDS

Open reduction;  
Medial approach;  
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dislocation

#### Abstract

**Introduction:** Open reduction by means of a medial approach (adductors) is used in non-ambulating patients under 13 months, diagnosed with hip dislocation and managed with early closed reduction in unstable non concentric hips.

**Material and method:** The present retrospective study includes a series of cases that illustrate the authors' experience. The results of 548 hips (367 patients) operated over a period of 12 years (1995-2007) are reported.

**Results:** Complications occurred in 62 hips. The most frequent were epiphysitis (2.9%), partial or total necrosis of the femoral head (6.3%) and redislocation (2%).

**Conclusions:** We describe a modification to the surgical technique originally reported by Ludloff, whereby the adductor brevis is not split; instead, the latter is detached and the pectineus muscle is pushed distally. In this way, the surgeon has a good view of the circumflex vessels, which protects them from injury. Also, the tension generated between the pectineus and the psoas by the abduction maneuvers is relaxed.

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**PALABRAS CLAVE**

Reducción abierta;  
Vía interna;  
Luxación congénita de  
cadera

**Reducción abierta por vía interna: una opción para la luxación congénita de cadera****Resumen**

**Introducción:** la reducción abierta por vía interna (aductores) se emplea, en pacientes no ambulantes con diagnóstico de luxación de cadera, menores de 13 meses, manejados con reducción cerrada temprana en caderas inestables, no concéntricas.

**Material y método:** el presente trabajo es una serie de casos, retrospectivo, donde se presenta la experiencia de los autores y se describen los resultados de 548 caderas (367 pacientes) durante un periodo de 12 años (1995–2007).

**Resultados:** se presentaron complicaciones en 62 caderas, las más frecuentes son: epifitosis (2,9%), necrosis parcial o total de la cabeza femoral (6,3%) y reluxación (2%).

**Conclusiones:** se describe una modificación del abordaje a la técnica quirúrgica descrita originalmente por Ludloff evitando separar el aductor brevis, en vez de ello, se desinserta y rechaza distalmente el músculo pectíneo, así se logra visualizar los vasos circunferenciales, se evita su lesión y disminuye la tensión generada entre el pectíneo y el psoas con las maniobras de abducción.

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**Introduction**

The incidence of congenital hip dislocation (CHD) in Colombia amounts to 1/1,000 infants of those born-alive.<sup>1,2</sup> The frequency of developmental hip dysplasia is 1.09% in Colombia and 2% in the world. There are two types of surgical treatment for CHD: simple and complex open reduction.<sup>3</sup> Simple reduction restores the dislocated joint back to normal and enables hip development, thus taking advantage of the growth potential of the child. According to which approach is used, simple reduction can be classified into two types: 1) the medial, or adductor, approach simple open reduction (MAOR), and 2) the anterior iliofemoral approach (AAOR).<sup>4,5</sup> We have obtained precise indications for these procedures from our experience at the Clínica del Niño and Clínica 104 of the *Saludcoop Corporation* of Bogotá, Republic of Colombia. Open complex reduction requires osteotomy at the level of the ilium or of the femur in order to correct dysplasias in those areas, and is performed anteriorly. An additional procedure is required, such as a simple osteotomy of the ilium (Salter, Pemberton, Pemberton or Chiari) or a combination with diaphysectomy and femoral varus derotation osteotomy, a procedure that is generally known as the Klisic method.

2.5 chronological years has been deemed to be the maximum age limit for obtaining the improvement of the dysplastic acetabulum by means of abduction and extension hip splints. Eighteen months, however, is the age limit between simple open reduction (MAOR or AAOR) and complex reduction, since the growth and re-modeling potential of the acetabular cup and femoral head is insufficient after this age.<sup>6-28</sup>

The aim of this work is to describe the experience we acquired in the treatment of hip dislocation during development in non-ambulating patients using the medial approach open reduction as an option for diminishing avascular necrosis. One part of the series was treated with the modified technique: the pectineus muscle is detached

and pushed distally to obtain a better view of the circumferential vessels and thus relax the tension exerted on them by the pectineus and the psoas.

**Materials and methods**

We carried out a retrospective, descriptive, observational study, with a longitudinal analysis, of a series of non-concentric cases, between January 1995 and November 2007 (140 months), at the Clínica del Niño of the *Instituto de Seguros Sociales* and at the Clínica 104 Jorge Piñeros Corpas of the *Saludcoop Corporation* of Bogotá, Colombia. We included patients that had been treated by the Outpatient Services and that presented with developmental hip dislocation (Fig. 1).

In order to be included in the study group, the patients had to possess complete clinical documentation describing the limitation of abduction with signs of actual instability. The patients whose latest check-up had been performed



**Figure 1** A-P x-ray showing unilateral dislocation of the left hip, in a 12-month-old male patient.

**Table 1** Dislocation grade classification according to the Tonnis arthrogram

Grade 1. The cartilaginous femoral head is displaced laterally no more than 2/3 of its width; extended limbus
Grade 2. Femoral head is laterally displaced more than 2/3 of its width but not upwardly displaced more than 1/3 of its height; extended limbus and occasionally rolled up at the tip
Grade 3. Femoral head is displaced upwardly by more than 1/3 of its height from acetabular cartilage covering an extended, or occasionally clearly bent, limbus
Grade 4. Fully displaced femoral head, extended limbus with calcifications in the capsule that separates it from the acetabulum; there are adhesions in the superior and lateral capsule

more than 3 months before were contacted for clinical examination. We reviewed the clinical histories and radiographic studies of all the patients.

We took into account the following variables: gender, age, type of dislocation, laterality, and joint movement. We used a previously designed data base in which we included the following parameters: identification; diagnosis; clinical, radiographic and tomographic evaluation; stabilization time, and complications.

Only the patients that met the following criteria were included: non-ambulating, under 13-months-old and with previous unstable perinatal closed reduction, with slightly high non-concentric hips, i.e. grade 2-3 according to the Tonnis' arthrographic classification (table 1),<sup>1,29</sup> and having clear irreducibility factors.

The exclusion criteria were the following: ambulation, age over 13 months, previous surgical treatment, Tonnis grade 4 highly raised hips or hips with teratologic dislocation.

## Surgical Technique

Patient in the dorsal position, with hip at 90° flexion, and abduction enabling dislocation. The hip must be kept reduced during the procedure so as to allow the identification and adequate visibility of the surgical planes. Four centimeter long skin incision, parallel to the inguinal fold and sparing the prominent adductor longus. Hemostasis of skin and subcutaneous tissue. Longitudinal incision on adductor fascia. Adductor longus is detached and pushed distally exposing a plane formed by adductor brevis, medially, and pectineus, distally; vessels and anterior branch of obturator nerve are visible between the two.

At this moment the approach is usually continued outside of the pectineus (following Ludloff), or of the adductor (following Ferguson), separating these spaces until the joint capsule is visible.

A variant technique that was used in the management of some of our cases consisted in detaching the pectineus, once it had been localized, from the pubic bone. This muscle is adhered over a large surface and can be detached by means of blunt dissection so that it comes off easily from

the anterior surface of the capsule and from the circumflex vessels, which can then be clearly identified thus avoiding the risk of sectioning or compressing them. Another aim of this procedure is to do away with the compressive force on the circumflex vessels that is exerted at this point when, during abduction, the pectineus in front and the psoas tendon from behind come closer and cause a tension. It is thought that this pressure can be damaging to the perfusion of the femoral head, since these are retracted structures. The pressure increases when the hip is maintained in abduction with a cast, the circumflex vessels being pressed between the pectineus and the psoas. This has been considered a cause of avascular necrosis by different authors. The lesser trochanter and the psoas can be palpated distally from the vessels, and the tendinous portion of the psoas is resected. We thus find ample space between the adductor brevis and the iliopectineal ligament that separates this compartment from that of the femoral vessels.

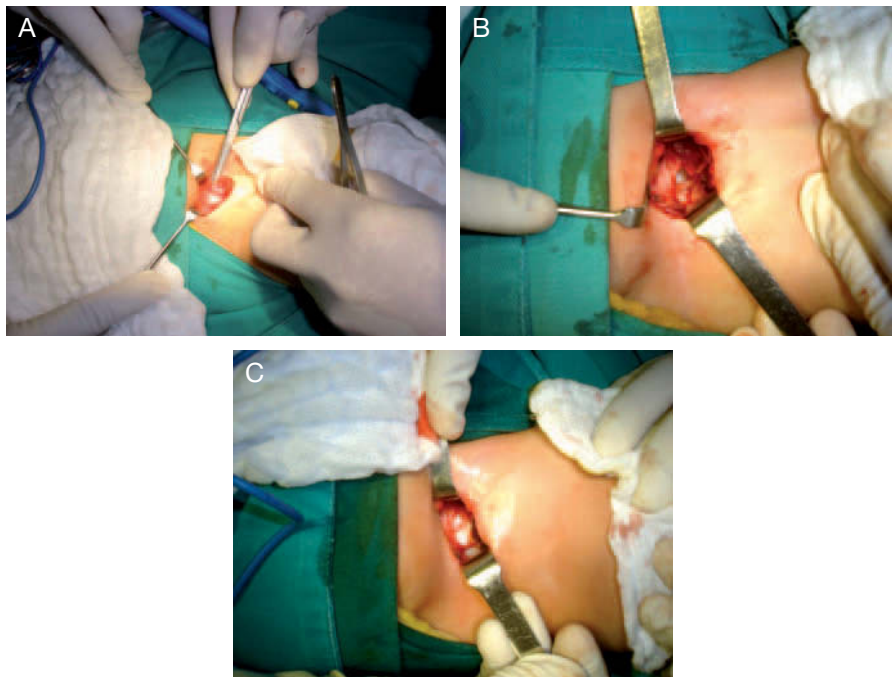
The anteroinferior capsule with the circumflex vessels is exposed completely with the use of separators (fig. 2). This dissection renders an ample view of the joint capsule. If the reduction attempted at this moment is not achieved or if its concentricity is doubtful, an arthrogram should be carried out with 1-2.5 ml of 30% iodinated contrast medium in order to establish the quality of the reduction obtained up to that moment.

If we try to manage the dislocated hip with reduction, we will observe the limitation of abduction and an increased inferior capsule retraction caused by the pressure exerted due to the retraction of the iliac psoas. This force will be more or less significant depending on age, dislocation height, degree of laxity or rigidity, and walking time, among other variables. We can also observe the capsular obstruction that is produced when remounting the posterior and superior acetabular rim in an upward movement.

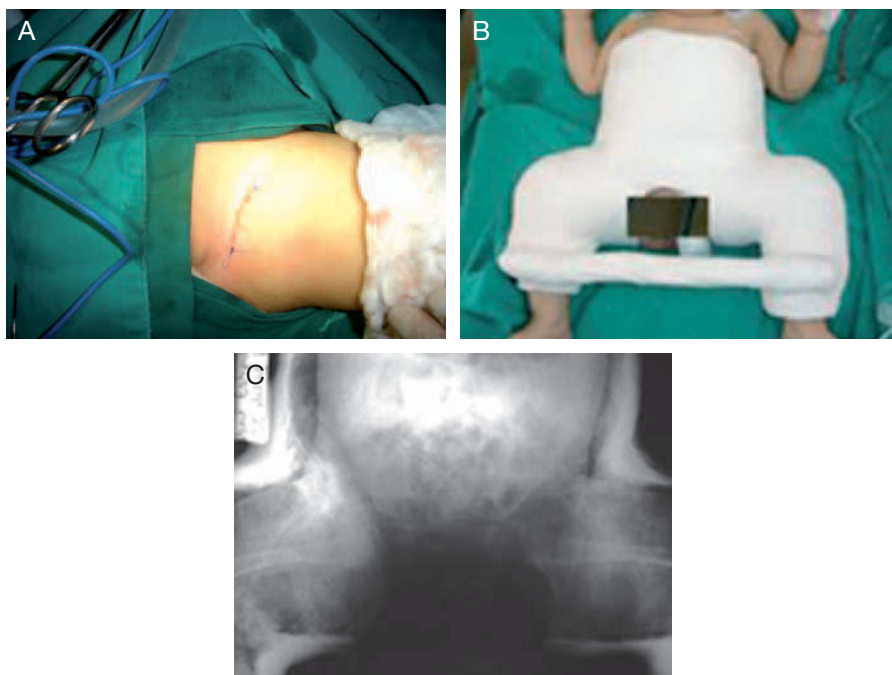
The capsular incision is T-shaped, with the release parallel to the acetabular rim in its anteroinferior part, and reaches the place of insertion of the capsule in the transverse ligament. Another incision should be made—perpendicular to the first one and parallel to the femoral neck—keeping the circumflex vessels in view and pushing them distally so as not to section them at the most inferior part of the incision.

This approach provides a more direct view of the joint cavity than the classical approach: the real acetabulum and the femoral head are visible. An excision of the round ligament is performed, when this ligament is present. The ligament may have undergone hypertrophy, a defensive reaction against dislocation, or it may be elongated and thinner due to overloading or degeneration. In both cases, since the hip is reduced before the capsule is opened, the ligament is situated in the bottom of the acetabulum thus interposing itself between the acetabulum and the femoral head and interfering with concentric reduction. This can be improved with the modified approach. Furthermore, if a limbus is inverted and impedes concentric reduction in the bottom of the acetabulum, radial incisions of the fibrocartilaginous ring should be made with the aim of everting it and improving the contact quality of the joint.

The resection of the transverse ligament is usually performed, since this allows the femoral head to move into



**Figure 2** A: adductor muscles. B: hip with traction; joint background with its space. C: reduced hip.



**Figure 3** Application of spica cast in 1st (human) position in immediate post-op. (A) (B) (C).

the bottom of the acetabular cavity. If the section is not performed, the femoral head is situated in front but is not deeply seated in the acetabulum. It is essential to protect the circumflex vessels using the blunt separator so as to avoid sectioning them. When these incisions have been made, the cleaning of the acetabulum is completed with

gauze swabs. We then perform a blunt excision of the pulvinar tissue in the acetabular cavity; this tissue, which may be present in big or small quantities, occupies a space and this can cause lateralization.

The form of the anteversion and elongated acetabular cavity is also visible, as well as the femoral anteversion



when the internal rotation that is needed for a congruent reduction is completed. In this way, the femoral head is reduced into the cavity, and it can be clearly noted that the maneuver is smooth, easy, non-traumatic and stable ( g. 2).

When reduction management with previous therapy has failed, posterior capsular redundancy is great. If, in addition to this, joint stability is still not satisfactory, it can be improved by attaching the femoral head to the anterior acetabular rim with the round ligament, which must not have been previously resected from the femoral head. This treatment prevents the use of trans xation nails from trochanter to pelvis, which could bring about severe complications.

The joint capsule is left open. There is no need to reinsert the resected adductors and the fascia of adductors and skin is closed. Immobilization with a spica cast keeps reduction at 45° abduction, a 90° exion, and a neutral or internal rotation between 15° and 20°. Initial immobilization is applied for 3 months ( g. 3), and then either Batchelor casts or adductors are applied for 3 more months. An adduction splint can also be used. It is worth recalling that no preliminary traction is used.

An essential step in this technique is the inferior releasing of the capsule, which lies retracted in the form of an hourglass and has a signi cant role in the limitation of abduction and in the obstruction of reduction and stabilization. This approach also enables the release of the transverse ligament, the round ligament and the inverted

hypertrophied limb. Any open or closed maneuver that does not consider the importance of eliminating these damaging forces will produce an injury of the femoral head, whether it is by pressure or by the obstruction of nutritious vessels that leads to the development of avascular necrosis.

## Results

We found 548 hips in 367 children, 273 females and 94 males, with different grades of developmental congenital hip dislocation. The mean annual number of patients treated in this institution is 36.74 (9.4 males and 27.3 females) ( g. 4), the con dence range being 90% (z=1.65), and the percentage point 0.05. The mean age of the patients we studied was 11.8 (9.7-13.6) months in the female group and 12.1 (11.2-13.7) in the male group.

In order to analyze them statistically, we divided the patients into two groups, according to age at the moment of treatment. The rst group comprised 81 patients with 119 hips and an age range of 8-10 months; the second group was made up by 286 patients with 429 hips in an 11-13 months range. The numbers of hips analyzed were: left, 322; right, 105; and bilateral, 121. The evolution of the acetabular index (table 2), with 9 post-op months as the mean time for achieving normality, was between excellent and good. The criteria used were: joint mobility, post-op limping 6 months after end of treatment, concentricity, coverage and the stabilization of reduction achieved in 486 hips.

Out of the total number of patients in our study, 66 (18%) patients (99 hips) required additional surgical treatment after MAOR consisting in simple pelvic osteotomies of the Pemberton Salter type, in different acts and at older ages.

## Complications

There were complications in 62 (11.2%) hips (p<0.02; range 0.01-0.04). Subsequent to the medial approach open reduction we diagnosed avascular necrosis following the criteria of Salter-Gage-Winter. They classify lesions into partial avascular necrosis and total femoral head necrosis. We found 34 hips with partial necrosis (p<0.49; range 0.24-

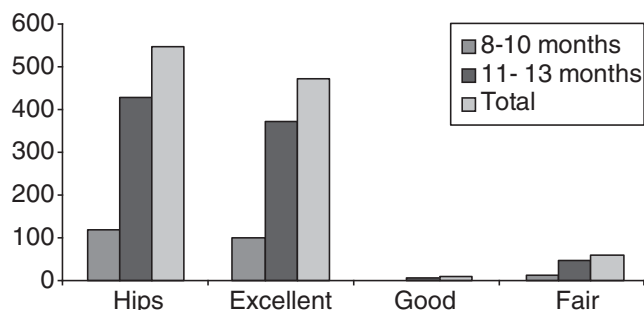


Figure 4 Results.

**Table 2** Assessment of mean acetabular index (AI) with the Mann-Whitney test, and univariate and multivariate analysis of variables

Age	Initial Mean AI	9-month PO (95%CI)	18-month PO (95%CI)	24-month PO (95%CI)
8-10 months	<35°	25° AI, p<0.01 (0.004-0.06)	22° AI, p<0.045 (0.018-0.14)	18° AI p<0.051 (0.022-0.19)
	38°	26° AI, p<0.032 (0.03-0.26)	24° AI, p<0.044 (0.04-0.72)	22° AI, p<0.03 (0.01-0.08)
	>43°	28° AI, p<0.035 (0.031-0.8)	25° AI, p<0.041 (0.033-0.53)	24° AI, p<0.049 (0.02-0.17)
11-13 months	<36°	25° AI, p<0.045 (0.018-0.14)	21° AI, p<0.042 (0.016-0.07)	23° AI, p<0.049 (0.04-0.46)
	40°	27° AI, p<0.049 (0.017-0.87)	25° AI, p<0.041 (0.034-0.92)	25° AI, p<0.049 (0.016-0.47)
	>45°	27° AI, p<0.05 (0.02-0.73)	26° AI, p<0.049 (0.022-0.19)	26° AI, p<0.045 (0.018-0.14)

PO: postoperative period.

**Table 3** Complications

Age	Redislocation	Kalamchi grade I epiphysitis	Avascular necrosis	
			Partial	Total
8-10 months	3	3	0	0
11-13 months	8	13	34	1
Total	11	16	34	1
Percentage	2	2.9	6.1	0.18

1.43) and one hip with total femoral head necrosis according to Kalamchi and Mac Ewen's system. It was a grade II-III, in an 11-month girl, with an acetabular index of 48°, who had a previous epiphysitis rated at grade I according to Kalamchi and had been treated with adductor tenotomy and closed reduction for 6 months. At 9 months post-op the AI improved to 35° and she was treated with femoral osteotomy, which improved the quality of the femoral head. In all, there were 16 (2.9%) cases of grade I non-severe necrosis that cured spontaneously without leaving a deformity, similarly to temporal ossification retardation. Excluding these 16 cases of epiphysitis, there is a 6.3% avascular necrosis corresponding to 35 hips. There was redislocation in 11(2%) hips (table 3).

## Discussion

At present it is generally agreed that hip dislocation with a delayed diagnosis does not necessarily imply a failure in early detection, rather, it is considered to be a dislocation with a delayed appearance.

Regarding the most common complications in the management of hip dislocation with any kind of treatment and not only with the technique we describe here, epiphysitis grade I according to Kalamchi, was recorded in 16 (2.9%) hips ( $p < 0.027$ ) in this study, all of which were spontaneously cured leaving no deformities in the femoral head nor any sequels of avascular necrosis (AVN). We also found an AVN incidence of 6.3% ( $p < 0.02$ ), a low rate compared with those recorded in other reports in the world.

The authors of thirteen international studies advocate this procedure as safe and reliable, and show AVN indexes that oscillate between 0 and 30%. Only two authors advise against it indicating its high incidence in AVN (43 and 66%).<sup>29-46</sup>

If a stable and concentric reduction is impossible to achieve with the closed technique, then a MAOR is needed. This surgical technique was first described by Ludloff in 1908 and propagated in the 70's by Mau et al, as well as by Ferguson at present.<sup>42</sup> The technique explores the acetabular cavity of children and releases capsular and transverse ligament retractions in their anterior and inferior aspects. These are considered to hamper hip abduction at these ages and are therefore deemed to be the major cause of irreducibility in a child who cannot walk. This technique, then, allows free access to the acetabular cavity at the level of the adductor brevis and pectineus.

Areinsertion or pexia of the round ligament is performed, as described by Ludloff, since this is one more technique that ensures stability in the reduction of highly unstable hips; furthermore, the use of pelvirochanteric nails is avoided and the psoas tendon is sectioned.

Cutaneous traction prior to reduction was not used in the technique described here. This technique differs from Ludloff's original technique in that he approached the hip from between the pectineus and the psoas, and it also differs from Ferguson's technique, since he approached it from between the adductor magnus, behind, and the brevis and longus, in front. In some of the cases in our study, 32% (117 hips) ( $p < 0.0004$ ) of the series, the approach was made without separating the masses of muscle, rather, the capsule was accessed by detaching the pectineus from its pelvic insertion until the circumflex vessels were exposed. This had the double aim of preventing any damage to the vessels and reducing the pressure exerted on them by the "sandwich" effect generated by the pectineus and the iliac psoas when, upon reduction, the hip is abducted.

This procedure is simple and can be performed in 45 minutes. Hospitalization, if needed, will be only for one night and two days. It requires no blood transfusion since dissection is minimal and the scarring in the inguinal fold is cosmetically acceptable.

Indications for open reduction with a medial approach differ from those with an anterolateral approach, due to the fact that the latter is carried out in older children who can walk and who have irreducible dislocations requiring extreme positions for reduction, or in children over 18 months who generally need complementary pelvic osteotomy. It is also believed that this technique is unadvisable for teratologic dislocation, for previously operated patients and for hips that require osteotomy.

According to what we have observed in this study, we can infer that it is essential to release completely the retractions of the anteroinferior fascia of the capsule and to section the transverse ligament in the Haversian canal of the acetabular bottom, since these are the obstacles that interfere with the abduction maneuver and, consequently, with reduction. The approach described here allows direct access to the psoas tendon; an elongating or complete fractioned tenotomy may be performed, since the tendon is considered to be, due to its retraction, a factor that will interfere with a smooth reduction and its subsequent stabilization. This procedure results in a hip reduction without any kind of pressure and with no damage to the nutrition of the femoral head.

Early diagnosis of this condition is fundamental in order to improve the results of treatment, to diminish the risk of complications and to modify its natural history favorably. One way of assessing functional hip recovery consists in observing acetabular index improvement. A precise clinical history and physical examination by means of contemporary imaging studies, such as ultrasound and CT-scan, have increased our ability to diagnose and treat developmental hip dislocation. The use of the Pavlik harness has become the essential procedure in the treatment of children of less than 6 months. If a stable reduction is not obtained after a two-week treatment with the Pavlik splint, we would indicate hip exploration with general anesthesia with the aim of attempting closed reduction. If concentric hip reduction in children over 7 months of age proves unsuccessful, we would recommend surgical reduction of the dislocated hip.

Just before reaching his first year of age, the child's capacity to stand up and load his weight onto his lower limbs, together with the progressive contracture of the soft tissues resulting from a dislocated hip, renders closed procedures ineffective and increases the risk of vascular necrosis.

In conclusion, the results we obtained lead us to advocate the use of the medial approach in the management of dislocation as a successful procedure having a low rate of complications. We cannot conclude that the use of a medial approach with distal displacement of the pectineus had an incidence on the low rates we obtained for AVN, due to the fact that we did not use it on all our patients; however, we will base future comparative studies on this hypothesis and include patients treated with the classical approach as a control group. To conclude, we can state that, in the search for a more satisfactory prognosis for hip dislocation, we recommend the use of the medial approach open reduction in patients with precise indications, preferably non-ambulating and under 13 months of age.

## Conflict of interests

The authors have declared that they have no conflict of interests.

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