

# VALGUSING INTERTROCHANTERIC OSTEOTOMY FOR THE TREATMENT OF FEMORAL NECK NON-UNIONS: REPORT OF 32 CASES

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## ABSTRACT

**Purpose:** The purpose of the present study was to review the results of femoral neck non-unions treatment with valgus-ing intertrochanteric osteotomy. **Methods:** Between 1988 and 2003 we treated thirty two femoral neck non-unions with valgus-ing osteotomy and fixation. The mean follow-up time was 9.8 years and the mean age was 41.7 years. **Results:** Twenty eight (87.4%) of the thirty two valgus-ing osteotomies evolved

to femoral neck union, while four cases (12.6%) evolved to total hip arthroplasty. Eight cases evolved to partial osteonecrosis. **Conclusions:** The valgus-ing intertrochanteric osteotomy for treating femoral neck non-unions achieved consolidation in 87.4% (28/32). However, only 56.2% (18/32) achieved full recovery of hip function.

**Keywords** – Femoral neck fractures; Osteotomies; Pseudoarthrosis.

## INTRODUCTION

Nonunion with avascular necrosis of the femoral head are the main complications of femoral neck fracture.

Without a doubt, consolidation of the nonunion with preservation of the femoral head is the biological alternative that offers the best long-term outcome if the patient is young. However, if the patient is elderly, above 65 years of age, based on consensus in the literature, total hip arthroplasty may offer a more promising result because it eliminates the two main complications of the biological alternative at the same time: recurrence of nonunion and aseptic necrosis of the femoral head.

The objective of this study is to evaluate the consolidation of valgus osteotomy for the nonunion of the femoral neck.

## METHODS

From January 1988 until October 2003, 32 cases of nonunion of the femoral neck were treated with valgus-ing osteotomy and fixation at the Orthopedics and

Traumatology Clinic, Santa Casa de Porto Alegre, RS, 20 of whom were male and 12 of whom were female. The youngest patient was 18 years old and the oldest was 66. The average age was 41.7 years. Follow-up was 9.8 years (1-15 years).

Fractures were initially classified as Garden I (zero), Garden II (zero), Garden III (14 cases), and Garden IV (18 cases).

In relation to the initial treatment, nine cases arrived at the hospital without any treatment. The other 23 cases were initially fixed with screws (13), DHS (7), one with three Steinmann wires, and two with an angled laminar plate (AO).

The average time from the fracture to the osteotomy, that is, the time of nonunion was 6.5 months (3.5-12 months).

The decision to perform the osteotomy was based only on radiological criterion (head sphericity). In only three cases was MRI performed. In all images there were signs of partial necrosis, which were not considered a contraindication for osteotomy.

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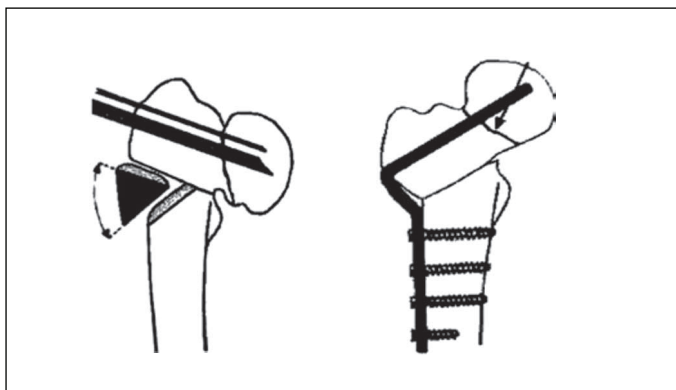
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We declare no conflict of interest in this article.

The technique used for osteotomy was described by Pauwels in 1935<sup>(1)</sup> with lateral wedge resection from 30° to 50° and fixation of the osteotomy (Figure 1). After osteotomy, when fixating it, we used the following materials: McLaughlin plate (1), AO plate (10), AO plate + anti-rotation screw (4), DCS (1), DHS 150° (2), and DHS 130° (14).

After osteotomy, support was only allowed after 90 days. From then, progressive partial support with crutches was allowed until consolidation.

The mechanical changes promoted by the osteotomy were evaluated and measured. The average abductor moment of the osteotomy side was 64.8 mm (54-75 mm). That of the contralateral side (normal) was 73.7 mm (63-92 mm).



**Figure 1** – Intertrochanteric osteotomy technique described by Pauwels<sup>(2)</sup>.

Therefore, on average, there was a decrease of 8.9 mm. There was a 12.1% decrease of the abductor moment.

The mean femoral offset after osteotomy was 24.9 mm (13-36 mm). The contralateral (normal) side was 45.5 mm (32-58 mm). Therefore, there was a 20.6 mm average decrease in femoral offset. The percentage decrease was 45.3%.

The average cervico-diaphyseal angle of the normal side was 131.5° (120°-145°). The average post-osteotomy angle was 144.4° (130°-152°). So there was a valgization average of 12.9 mm. The average valgization percentage compared with the normal side was 9.8%.

## RESULTS

Of the 32 cases, four nonunions progressed to total hip replacement. Twenty-eight osteotomies consolidated. In 27 cases, consolidation was achieved after one

osteotomy. One case developed into consolidation after a new osteotomy and exchange of new synthesis material.

The 28 consolidated osteotomies were evaluated for avascular necrosis according to the Inoue classification. Twenty cases were considered without necrosis. Five cases were found in stage two (abnormal or irregular density with slight flattening). Two cases were found in stage three (irregular density with segmental collapse). One case with 14 years of evolution was considered stage four (osteoarthritis with deformity of the head), but until this assessment total hip arthroplasty had not been required.

Patients were evaluated by the method of D'Aubigné et al.<sup>(2)</sup>. Of the 28 cases, 18 were considered to have 17 and 18 points. The remaining 10 cases had 15 or 16 points. None of the patients needed to use any support (cane or crutch), but eight exhibited mild claudication at the time of evaluation. No patient complained in relation to the ipsilateral knee.

## DISCUSSION

The fracture of the femoral neck has been described as the fracture without a solution<sup>(3)</sup>.

Despite advances in the surgical technique and the quality and design of the synthesis material employed, avascular necrosis of the femoral head and nonunion remain the major complications of the fracture.

Despite the goal of treatment of nonunion being to preserve the head through consolidation of the fracture, the choice of optimal treatment depends largely on the patient's age, the sphericity and congruency of the femoral head, the quality of the existing bone, and the experience of the orthopedist.

The problem besides being biological is fundamentally biomechanical as shown by Pauwels<sup>(1)</sup>. For the treatment of nonunion, he described a valgus intertrochanteric osteotomy that converts shear forces into forces of compression and attains consolidation.

Arthroplasty is generally indicated in patients over 60 years<sup>(4-6)</sup>, but the physiological age should be considered more than chronological age.

Marti et al.<sup>(7)</sup> indicate valgus osteotomy in patients up to 70 years of age.

The isolated presence of avascular necrosis without collapse of the head is not a contraindication to grafting or osteotomies. Several satisfactory results have been published in the literature<sup>(4,5,7-10)</sup>.

For this reason, simple radiographic evaluation (head sphericity) is the only test that is really necessary to evaluate the indication of osteotomy.

Femoral neck fracture is common in the elderly, but the higher incidence of nonunion is more commonly found in younger patients who have suffered fractures due to medium and high intensity trauma<sup>(11-13)</sup>.

The incidence of nonunion in femoral neck fractures occurs in 10% to 59% of cases<sup>(12-18)</sup>.

There are no definitive criteria to conclude whether the fracture progressed to nonunion, but a minimum period of six months should be considered. In a prospective multicenter study, Barnes et al.<sup>(14)</sup> found that only 14% of displaced intracapsular fractures consolidated in six months.

The clinical history is very important: persistent pain in the groin, buttock, anterior thigh, or knee that is exacerbated by rotational movements should be considered suspect and should be closely monitored.

Serial radiographs are often necessary to make the diagnosis. Alho et al.<sup>(18)</sup>, reviewing 203 cases, described predictors of nonunion: changes in the position of screws, changes in the trace of the fracture, and extrusion of the screws larger than 20 mm.

In this series, nine patients arrived at the hospital without any prior treatment and, therefore, the diagnosis was evident, but the average time to diagnosis was 6.5 months.

In all cases, the radiological criterion was the only one used to indicate the osteotomy.

Although most authors use the laminar plate<sup>(4,5,7,19)</sup> for fixation of the osteotomy, a sliding screw was used in half of our cases (DHS 16/32) (Figure 2).

The sliding screw (DHS) is less aggressive, allowing for compression at the site of nonunion, and its implementation is technically easier.

In no case was bone graft placed in the focus of the nonunion.

Mathews et al.<sup>(5)</sup> were the first to measure the mechanical changes that occur after osteotomy.

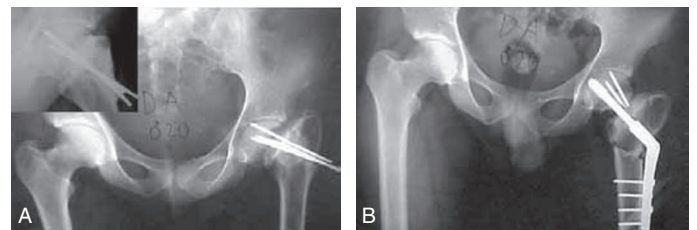
After reviewing 15 cases, they concluded that the abductor moment and femoral offset decreased 11 mm and 21 mm, respectively, when compared with the normal side. They also concluded that the cervico-diaphyseal angle increased from 123° to 149°.

The same mechanical changes were found in this series. On average, the abductor moment decreases

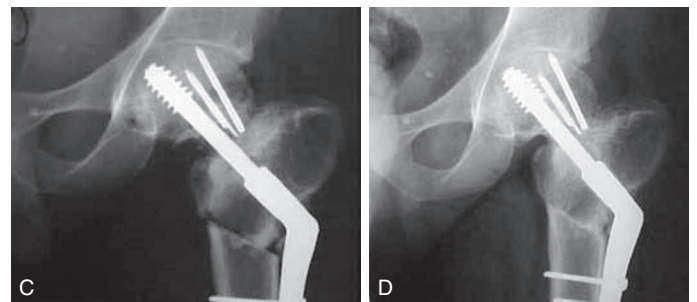
8.9 mm which theoretically represents a percentage decrease of 12.1% of the abduction force.

However, the difference in the femoral offset was much more significant. The decrease was 20.6 mm, on average. The percentage decrease in the offset was 45.3%. However, even with this important variation, one must consider that the change in the offset does not have the same impact as the abductor moment on the strength of the trochanteric pelvis.

Mathews et al.<sup>(5)</sup> found claudication in 13 (86.6%)



**Figure 2 A** – D.A., 20 years, male: Initial X-ray. Nonunion of the left femoral neck. Osteosynthesis with three Steinmann wires eight months prior. **B** – Panoramic X-ray of the hip after valgus osteotomy. It was not possible to remove two of the Steinmann wires. Osteosynthesis with DHS.



**Figure 2 C** – Left hip X-ray in detail in the immediate postoperative period. **D** – Consolidated nonunion and osteotomy. Observe that the superior Steinmann wire is subchondral.



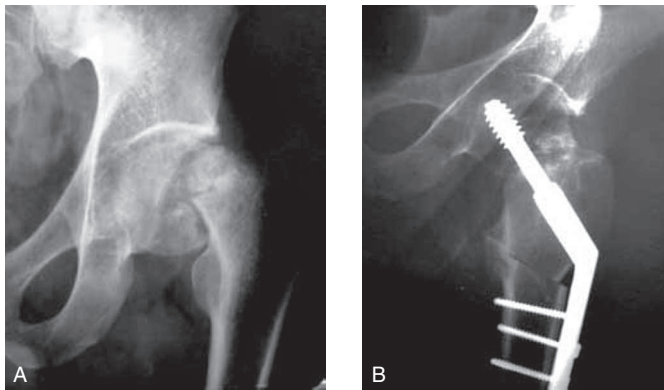
**Figure 2 E** – Top images: the patient after consolidation. Bottom images: the patient after seven years of follow-up.

of their series of 15 patients and justified it by these biomechanical changes. However, this finding was not constant in this series, since only eight of the 28 consolidated hips had some kind of claudication (28.0%). Reviewing clinical outcomes of 13 patients, Ballmer et al.<sup>(4)</sup> reported that only two limped (15.4%) (Figure 3).

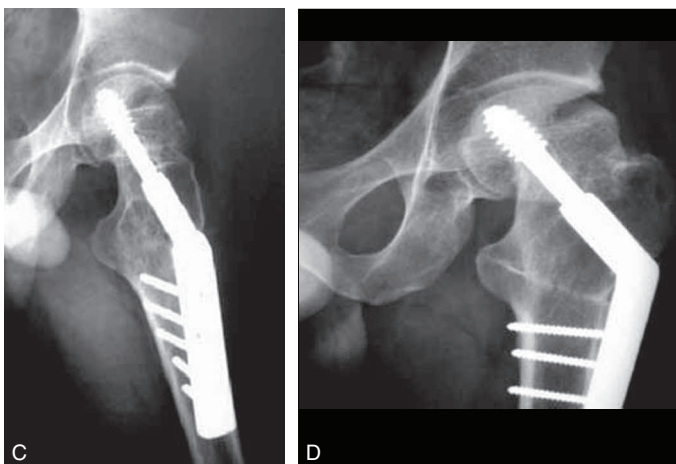
Evidently, cervico-diaphyseal angle changes were also observed. The average of the cases changed from 131.5° to 144.4°.

Up to the time of the last assessment, four cases evolved to hip arthroplasty, but consolidation was achieved in the remaining 28 cases (87.4%).

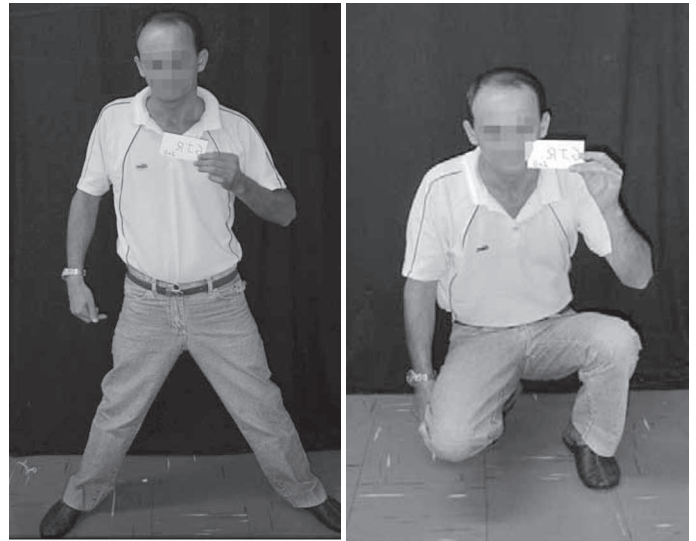
Pidhorz et al.<sup>(20)</sup> obtained consolidation in 74% of cases, Marti et al.<sup>(7)</sup> in 86%, Wentzensen et al.<sup>(21)</sup> in 100%, Mathews et al.<sup>(5)</sup> in 80%, Ballmer et al.<sup>(4)</sup> in 88%, and Wu et al.<sup>(22)</sup> in 94%.



**Figure 3 A** – N.F., 35 years, male: Initial X-ray showing nonunion of the femoral neck. **B** – Consolidated osteotomy and nonunion after one year. Osteosynthesis with DHS.



**Figure 3 C** – N.F. X-ray after four years and three months. Note that the DHS screw reaches the subchondral bone. **D** – Panoramic X-ray of the hip after 12 years of follow-up.



**Figure 3 E** – Functional appearance of the patient after 12 years.

Despite the high level of consolidation that this osteotomy achieves, it is known that in many cases there may be necrosis, necrosis with reossification, and partial or total collapse of the femoral head. These degenerative changes tend to evolve, but satisfactory clinical results can be seen for many years<sup>(7)</sup>. Clearly, if the degenerative changes become progressive, total hip replacement will be required at some point in the follow-up. With follow-up of 7.1 years, Marti et al.<sup>(7)</sup> reported that 14% progressed to arthroplasty; after four years, Mathews et al.<sup>(5)</sup> reported 15.3%, and Ballmer et al.<sup>(4)</sup> cite two cases, 11.7%.

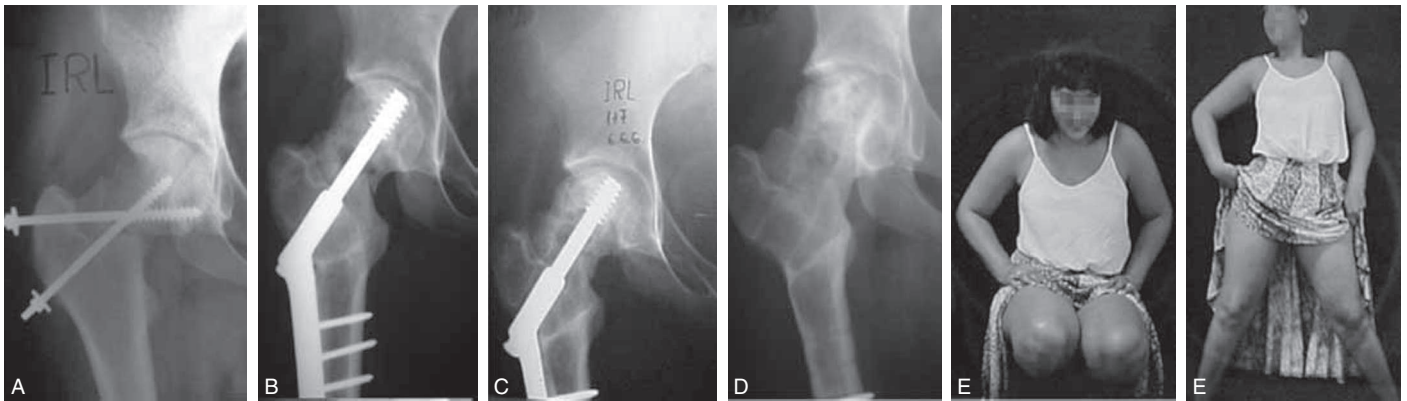
In this series, eight cases evolved with necrosis. Only one case with 14 years of evolution was considered Inoue stage four<sup>(6)</sup>, but still had good mobility, tolerable pain, and there is no prediction of total hip arthroplasty (Figure 4).

In the evaluation by D'Aubigné et al.<sup>(2)</sup>, 18 patients were considered normal with 17 and 18 points. Ten had 14 to 16 points due to sporadic pain, claudication, or restriction of movement.

Reviewing this series with a mean follow-up of 9.8 years, we conclude that valgus osteotomy for the treatment of nonunion of the femoral neck in young patients (41.7 years) was responsible for consolidation in 87.4% (28 cases) and for the full recovery of hip function in 56.2% (18 cases) (Figures 2, 3, and 4).

Without a doubt, total hip arthroplasty is the other major alternative treatment for nonunion.

It fosters fast pain relief and early mobilization.



**Figure 4** – G.J.R., 37 years, female, nonunion of the femoral neck. Fracture neglected for five months. Note the resorption of the edges of the fracture. B – X-ray in detail after osteosynthesis with DHS and valgus osteotomy. C and D – AP and profile radiographs in detail after consolidation of the osteotomy and nonunion. E – Clinical appearance of the patient after five years.

However, long-term results are not always satisfactory and high rates of failure and poor results have been found in young patients<sup>(23-27)</sup>. In these patients, total hip arthroplasty may be the easiest, but not the best, solution. To treat a nonunion of the femoral neck in these patients, a more conservative attitude is worthy of consideration: Pauwels valgus osteotomy<sup>(1)</sup>.

## CONCLUSIONS

Reviewing 32 cases of nonunion of the femoral neck in young patients (41.7 years) we conclude that the biological alternative (valgus osteotomy) was responsible for a high rate of consolidation of 32 cases (87.4%). With a mean follow-up of 9.8 years, only four cases (12.6%) progressed to total hip arthroplasty.

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