

# Early experience about Antevera® plate for lateral femur fractures

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## Summary

**Introduction.** The hip fractures appear to be a real epidemic problem, especially in the western world, due primarily to higher average age. The social and economical impact is considerable with a continue social and health costs up-rising. The female-male ratio is approximately 8:1.

**Purpose.** The purpose of this report is to present a system of osteosynthesis for fractures of the lateral femoral neck. This system is a plate developed by INTRAUMA O'nil®, 3-hole plate with an 130° angle of valgus and 7° of anteversion.

**Materials and methods.** At the I Orthopedic Department at the University of Pisa from January 2009 to February 2012 were treated 52 fractures of the femur neck side with this system. All patients undergone to a clinical and X-ray evaluation according to the AO classification: 14 31-A1, 7 31-A2, 4 31-A3.

**Results.** The mean follow-up was 10 months, in all cases we did not have cut-outs with a TAD average of 23 mm.

**Conclusions.** This system offers the possibility to perform surgery quickly with low risk of cut-out thanks to 7° of anteversion. Ensures optimal fixation to the femoral shaft and an equitable distribution of forces, eliminating the risk of breakage of the implant and loosening of the screws.

**KEY WORDS:** hip fractures; plate synthesis; pertrochanteric fractures.

## Introduction

Femoral neck fractures are a widespread disease in the western world, with a real peak of the incidence over the past 50 years (1) and represents one of the most frequent causes of hospitalization. Many relevant factors are important: first of all, the rise of average life, as well as the possibilities of modern medicine to extend

the lifespan of people with diseases with osteopenic therapies (2-3), the lack of physical activity (4), bad dietary habits with a decreased consumption of milk and dairy products (5) and parallel abuse of alcohol and tobacco.

As regards the above mentioned issue, Italy holds an intermediate position in the western world, but nevertheless it has recorded a sharp increase in fractures and mortality in the last 20 years (6): we can even say that on the basis of some studies about 80,000 fractures of neck-femur occur in our country every year, with a doubling time of 5.5 years for annual incidence (7). The socio-economic impact of the above mentioned is devastating both for the dramatic impact on people's life quality and for the costs of the treatment: it has been estimated that hospital costs in Italy currently exceed 560 million Euros each year (8). We could say that we are faced with an epidemic: the average life expectancy is largely over 70 of age, and over one third of these elderly falls at least once a year (9), and in 20% of these home falls a neck femur fracture occurs (10).

This type of fracture primarily occurs in female gender with a ratio of approximately 8:1 more than male gender. It has been estimated that in white women aged between 65 and 84 years, 90% of proximal femur fractures is related to osteoporosis to the point of reaching more than 95% after 85 years old. Moreover, these fractures are associated with increased mortality and morbidity: in fact, within one year from the fracture event, about 20% of patients die, 40% is unable to walk independently and 25% require long-term home care. Because the majority of patients with pertrochanteric fractures are elderly, surgical treatment should be rapid, thus allowing immediate or very early load in the post-operative period (11).

Currently, the orthopedic surgeon may choose among several fixation devices for the surgical treatment of these fractures, but despite this, the means of synthesis is not often able to meet all the technical requirements of fixation. Moreover, the revision of the literature shows that there are still three major complications after osteo-synthesis: 1) varus collapse of the head/neck of the femur; 2) an excessive shortening of the femoral neck; 3) a fracture of the diaphysis distal of the means of synthesis, especially for the intramedullary nail (12). The reason for these complications seems to lie in the design of fixation devices and especially in the mistaken placement of the cephalic screw both in the coronal plane and in the axial one (13).

In order to try to help the correct positioning of the cephalic screw, a new angular stable plate which associates the possibility of a linear compression of the fracture with a rotational stability, guaranteed by an angle stability proximal nail, was introduced. Moreover, the fixed 7° anteversion allowed an easier positioning of the cephalic screw in the axial plane. The purpose of this paper is to describe this new form of synthesis and our initial experience taking into consideration that after an analysis of the literature, we have verified that there are no publications on this method of synthesis.

## Materials and Methods

At the Orthopedic Department of the University of Pisa from January 2009 to February 2012 a number of 52 lateral femur frac-

tures with a ANTEVERSA® plate (O'Neill Intrauma) were treated. All patients underwent clinical and X-ray evaluation through radiographs performed both in anteroposterior and in the groin, and then classified using the AO classification. The average age was 83.5 years (56-91) with a male/female ratio of about 1 to 9. The affected side was the right one for 54.6%. According to Zuckerman (14) the co-morbidity of these patients at the admission was assessed, such as diabetes mellitus, heart failure, cardiac arrhythmias, ischemic heart disease, cerebral vascular disease, renal failure, cancer underway, Parkinson's disease, arterial hypertension, COPD, anticoagulant therapies. The time span between the traumatic event and surgery was 47 hours on average. The average pre-operative ASA score (American Society of Anesthesiologists) was 2.9. As regards the breakdown of fractures it was 29 31-A1, 15 31-A2, 8 31-A3.

### The Antevera® plate

The Antevera® plate is a system consisting of a tube-plate with 3 holes of 9 mm in length and a valgus angle of 130°. The tubular portion has 7° degrees of anteversion, so there is a right and a left plate. The cephalic screw has a diameter of 8 mm and 11 mm in the threaded part with lengths ranging from 80 to 120 mm. The anti-rotational nail with angular stability, which is located proximal to the cephalic screw, has lengths from 65 to 100 mm. The diameter of the diaphyseal locking screw is 5 mm. All the material is made of steel AISI 316 LVM - ISO 5832-1 to allow the execution of any MRIs (Figure 1).

### The surgical technique

The patient is positioned lying supine on the operating table with branches as AO says. The fractured limb is pulled while the contralateral is abducted, flexed and extrarotated. Under amplioscopic control, both in the anteroposterior and in the groin area, the reductive fracture maneuvers are performed, which must be as much anatomical as possible together with broad contact of the surfaces of bone fracture. This is followed by standard preparation of the operative field. Through a sub-trochanteric incision of about 6-7 cm, the bone is reached. Then, by gently upper dislocating the vastus lateralis muscle, the 130° positioner is placed on the diaphyseal axis and the guide wire is sized up till the sub chondral tissue. The positioner has a fixed 7° anteversion, so as to fol-



Figure 1 - Antevera Intrauma Plate.

low the physiological anteversion of the femoral neck. Then the 130° positioner is removed leaving the wire still there. At this point, the length of the cephalic screw should be verified directly onto the guide wire through the meter. If the guide wire has been inserted up to the sub-chondral tissue, 10 mm must be subtracted from the measured length in order to obtain a TAD (Tip Apex Distance) optimal (<25 mm) (Figure 2). The area along the guide wire is reamed, the cephalic screw (8 mm diameter) is inserted and the plate is placed by sliding the tube cephalic screw and by controlling the orientation of the femoral shaft, which at this point is fixed with 3 angle stability screws. The depth of the cephalic screw is regulated with the screwdriver and if necessary, the compression is performed by using the cephalic screw compressor. Finally, the anti-rotation nail is positioned above the cephalic screw. The post-operative treatment consists of placing a suction drainage, which is left in place for up to 48h, and the transition to a sitting position, first, in the bed during the first post-operative day, and then on the chair during the second day. Flexion-extension movements of the knee and hip are possible. The load can be allowed very early (within 7 days), depending on the patient's performance status. The first clinical-radiographic control is after 35 days. New clinical and radiographic check-ups, are performed 2, 3, 6, 12 months after surgery, unless there are specific exceptions (heavy hip pain, lameness, dehiscence, etc.).

### Results

The standard follow-up turns out to be about after 14 months (25 max and min 4 months). One patient (91 years old) died 3 weeks after surgery due to respiratory failure, and one patient (94 years old) died 1 week after surgery due to kidney failure. Seven patients died one year after surgery. Thirty-nine patients had a complete consolidation of the fracture. In 4 cases, the follow-up is still short at the moment (<3 months) in order to affirm that the fracture has been consolidated. There were no cases of cut-outs, while the TAD remained unchanged compared to post-operative control and showed a mean of 23 mm (min. 11, max 35). The patients' performance status was similar to pre-operatively in 27 patients, while 12 cases of the walking ability has been reduced to the home setting and in 4 cases the patients are not longer able to ambulate autonomously.

### Discussion

Pertrochanteric fractures (31-A) represent 50% of hip fractures and they can be achieved due to low energy trauma for the concomitant presence of osteoporosis. The mortality rate for hip fracture in the acute phase is 5% and 15-25% within a year span (15). Therefore, surgical techniques which are capable of minimizing the risk of both early and late complications and which allow early mobilization are needed (16).

So far, the intramedullary nail appears to be an excellent means of synthesis, especially for subtrochanteric fractures (31-B and 31-C). The surgery is fast-running, with a small dimension access, thus allowing to save the site of the fracture and soft periosteal tissue. In addition, the titanium intramedullary nail has a modulus of elasticity which is about half that of steel allowing for greater flexibility.

Nowadays, neither the intramedullary nail nor the plaque holds the balance of power, with the exception, as previously said, for subtrochanteric or pertrochanteric fractures (31-B 31-C) or for fractures with a great comminution where the medial wall would prefer a system that does not discharge the forces through the medial cortex (17). In these cases, the choice should be that of the intramedullary nail while for trochanteric fractures (31-A) the choice is oriented toward the plate with angle stability.

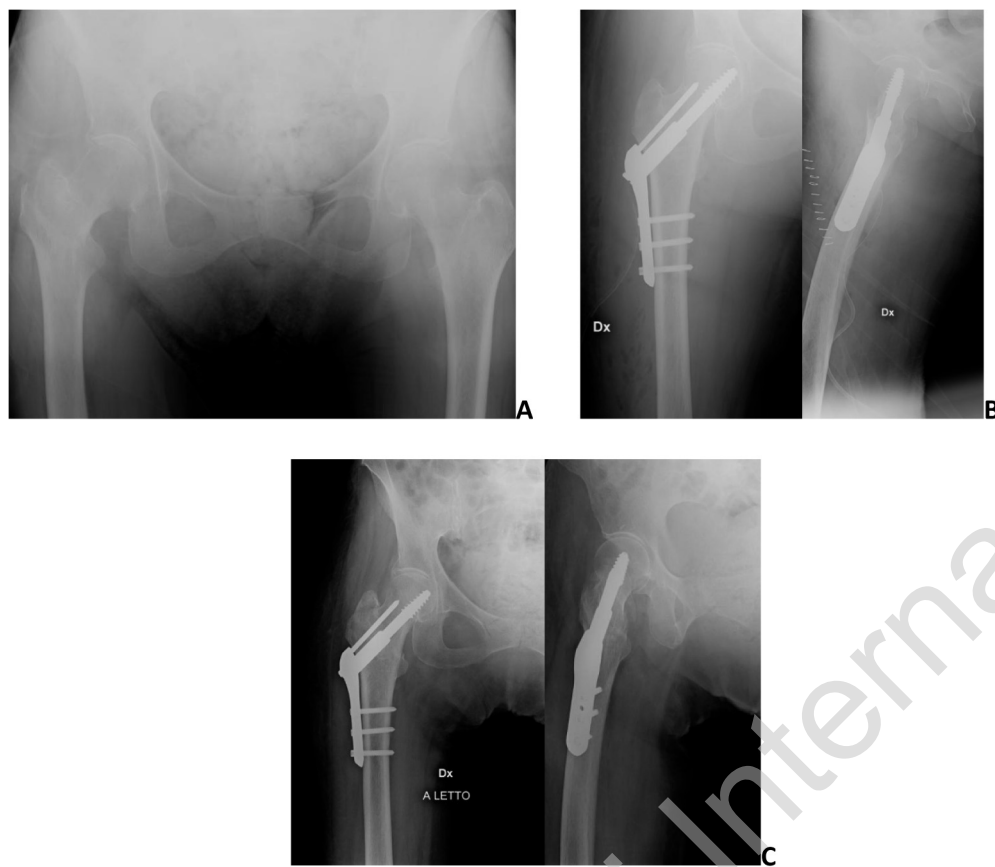


Figure 2 - A) Pertrochanteric fracture type 31 A-2; B) Immediate post-operative X-ray image control; C) 3 months post-operative X-ray image control.

Furthermore, as shown by some studies, the percutaneous compression plate PCCP (eg, Orthofix) seems to be less invasive and comparable to intramedullary nails for the operative time (18). So, the careful planning together with meticulous preoperative radiographic assessments and subsequent classifications are the basic steps for the proper treatment of these fractures.

Although we have an acceptable rate of fracture healing using either the intramedullary nail or plate slippage, most studies report two complications associated with the use of a single cephalic screw (19). The first is the varus collapse of the head and the neck of the femur which is associated to the release of the screw from the top of the femoral head (cut-out). This seems to be caused by the incorrect positioning of the screw in the anterosuperior quadrant of the femoral head. Moreover, an excessive distance from the subchondral portion of the head (TAD > 30 mm) is an event which favors the cut-out. A system that allows the exact positioning of the cephalic screw of both planes is therefore necessary in order to avoid the malposition of the plant that leads to inevitable failure. The second problem is, encountered both for the intramedullary nail and plaques is the excessive shortening of the femoral neck. Although some degree of controlled collapse of the fracture is typical of compression systems, sometimes there is an unacceptable shortening of the neck which then affects the whole leg. Conversely, not creating a minimum compression can lead to delayed healing or even a pseudo-arthritis of the fracture. Thus, it is important to have a system that can guarantee, after the correct positioning of the cephalic screw, a gentle compression of the fracture on the outbreak avoiding rotational defects (20).

Once the compression is obtained, the system must also be able to sustain it over time. During analysis of our short series, we have never seen cephalic screw cut-out. The reason is likely to be found

in the correct positioning of the screw and the strict implementation of the TAD. Only in one case the TAD was not observed (35 mm), but nevertheless, the fracture healed without major complications. As for the shortening of the femoral neck, in our series we have not observed this complication. The average of shortening was always less than 5 mm and remained unchanged over time. This reassuring result is to be attributed not only to the means of synthesis, but probably to the fact that most of the fractures were all considered stable (31 A1/A2). Despite this, in literature there are some studies that show the average glide in stable fractures from 5.3 to 10.2 mm (21, 22).

The use also of a double point of fracture fixation reduces the possibility of a proximal fragment rotation during the early movements of the hip. This can result in a significant reduction in the number of nonunion or delayed union due to poor contact between the bony surfaces of the fracture fragments. Therefore, we believe that the system with Antevera® plate, located according to an appropriate surgical indication, offers the possibility to perform surgery quickly with excellent results in terms of reducing and maintaining low risk of the cephalic screw cut-out thanks to 7° of anteversion. Moreover, the presence of the tapered locking mechanism between the screw head and the support, ensures optimal fixation to the femoral shaft and an equitable distribution of forces, eliminating the risk of breakage of the implant and loosening of the screws. Thanks to the excellent stability offered by the entire system, large-size plates, which are still largely used nowadays, are no longer needed. The anti-rotation of the femoral head-neck fragment is ensured by the nail with angular stability, which is essential in order to reduce the risk of nonunion and varus angle in unstable fractures. Furthermore, the possibility of bringing forth a compression of the bone surfaces of the fracture due to the recall screw should not be underestimated.

## Conclusions

On the basis of the analysis of these short series, we can only make some considerations, but we cannot draw any real conclusions. Our overall perception is that there is a means of synthesis that has those requirements which are essential for the treatment of pertrochanteric fractures of the elderly. These requirements are represented by a screw plate that allows a rapid reduction of the fracture and guarantees a long-term stability due to the stability angle owned by the diaphyseal screws and anti-rotation nail. This way, the independence of the elderly, which was lost due to fracture, can be restored in a short time. The smallness of the instrument is another advantage of this mode of synthesis, and furthermore, it can be easily grasped and learned, thus even reducing the surgical times. All in all, more case studies and longer follow-up are needed in order to draw our final conclusions.

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