DHS AND OPS: COMPARATIVE STUDY OF FAILED OSTEOSYNTHESIS

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ABSTRACT

Objective: This prospective study compared the occurrence of cut out in two types of osteosyntheses (Dynamic Hip Screw (DHS), Orlando Pinto Souza (OPS)), used for treating proximal femur fractures. Materials and Methods: From July to December of 2003, we operated 52 hip fractures, but only 38 cases were included in this study consistently with the inclusion criteria. The surgical technique was randomly determined at the moment of the procedure. Results: In the OPS group, we didn't observe the occurrence of cut out, and, in the DHS group, we found 10% of synthesis failure: one in a female with a Tronzo IV fracture and other in a male patient with a Tronzo III fracture, both regarded as unstable after reduction on orthopaedic table. The mean Tip Apex Distance to OPS pin was 56.63 mm, and to DHS, 31 mm. Conclusion: We concluded that when we compared both osteosynthesis the incidence of cut out and its correlation with TAD as recommended by Baumgartner, in OPS the cut out wasn't dependent of TAD and other factors like valgusing reduction were most important, in DHS the TAD recommended by Baumgartner must be followed.

Keywords: *Hip fractures, Fractures in elderly, Ostheossyntesys failure, Proximal fêmur fractures, Ostheossynthesys release.*

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INTRODUCTION

Transtrochanteric fractures are quite usual in our environment, especially among elderly patients, for being typically osteoporotic fractures associated to falls.

Frankel and Burstein[1] showed that the kinetic energy on the body side during a fall is ten times higher than necessary to produce a proximal femoral fracture.

Among the fractures that have been accounted for the increased risk of falls and fractures among the elderly population, the use of drugs causing somnolence, changing balance, muscular tonus and/ or causing hypotension are included.[2,3]

Hamra et al.[4] in a study addressing the prevalence of drugs use among individuals hospitalized for undergoing surgical treatment due to trauma with fractures, found that 72.2% were in use of some drug within the 24 hours preceding the accident.

Cordey et al.[5], reviewed 21,145 proximal femur fractures filed on the AO documentation center between 1980 and 1989, finding a gradual increase of proximal femur fractures with age, both for women and men. They also showed that there is an exponential increase of fractures on femoral proximal third (transtrochanteric and of the femoral neck) throughout life, reaching its peak around the age of 75 – 80 years. This datum is of great importance once population's aging is a present and marked fact in current Brazilian society.

According to a survey conducted by the Ministry of Health on SUS (Single Health System) patients, it was found that nine diseases spent 90% of the funds assigned to orthopaedic treatments; the transtrochanteric fracture is included among those diseases.[6]

In the USA, hip fractures account for 30% of all hospitalized patients[7] and, according to McLouglin et al.[8], the incidence of hip fractures in the USA was 238,000 in 1986, estimated to increase to 329,000 by 2040. In addition, the annual cost for treating this pathology is around US$ 16 billion.

According to Köberle[6], additionally of being a medical condition affecting a population with poor bone quality, challenging synthesis stability and predisposing to failure, transtrochanteric fractures become a social problem, once most of the cases is constituted of aged patients depending on family members, and the synthesis failure can corroborate with deadly success and/ or further disabling, turning life something hard and restricted.

According to Hamra et al.[4], 53.1% of fracture cases in hospitalized elderly individuals constituted of proximal femur fractures, consistently with data reported by Michelson et al.[3], who found a prevalence of 50% of transtrochanteric fractures in 169 studied patients. Treatment for this kind of fracture should be imminently surgical to allow patients' early ambulation, taking them away from bed, thus reducing the risks of clinical complications.

Although surgical treatment of proximal femoral fractures is widely known and accepted by the orthopaedic community, this is not a risk-free procedure, with the most feared complication being the "cut out" in most synthesis, which can be defined as the collapse of the cervical-diaphyseal angle, with the head turning to a varus position, leading to screw extrusion through femoral head and neck.[9] That complication is feared because it occurs in an osteoporotic

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bone in a previously impaired patient, who will be submitted to a new surgical procedure, thus increasing morbi-mortality rates.
In literature, a wide range of implants are available, developed for treating these fractures, including proximal intramedullary nails, Ender, DHS (Dynamic Hip Screw), OPS (Orlando Pinto de Souza), among others[10], with the latter two being the target of this study.
The present study aims to assess by comparison two kinds of synthesis performed in our service (OPS and DHS), for treating proximal femur fractures, for the occurrence of cut out, observing the predictive TAD value for the occurrence of this phenomenon.

MATERIALS AND METHODS

Between July and December 2003, 52 transtrochanteric fractures were studied, 38 of these were included in the present study.
The exclusion criteria were Tronzo V fractures with different synthesis indication than the one suggested by the study and lost follow-up for a six-month period. The technique to be used was selected by sorting during the surgical procedure.
All fractures were classified at baseline and intraoperatively, according to the classification described by Tronzo[11], and only patients with Tronzo I-IV fractures were included.
Twenty patients were operated using the DHS implant by a minimally-invasive technique, protecting fracture hematoma and fragments vascularization. Care was taken to obtain an anatomical reduction of the fracture, respecting the maximum distance of 100 mm of joint surface, positioned at the center of femoral head and neck.[7]
Eighteen patients were operated using OPS (Orlando Pinto de Souza) implant and technique (Figure 1), according to the technique described by Rudeli[12], this procedure being minimally invasive, totally performed under the use of intraoperative surgical arch.

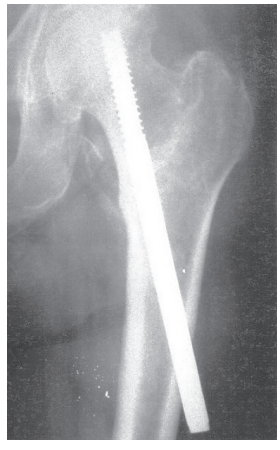


Figure 1 – *OPS on united Tronzo II fracture.*

The OPS implant is a cannulated screw-pin with 9mm in diameter implanted under the guide of a surgical arch in reduced fractures in valgus. Such screw should be supported essentially on three points: femoral lateral cortical, calcar and femoral head center, respecting the absence of arching on the guiding wire at the moment of implantation, since otherwise lateral femoral cortical fracture will occur during the pin implantation.
Even in fractures classified as Tronzo I and II, we turn them valgus so that the introduction of OPS pin could be made in valgus at a ratio of 1 : 2 concerning the proximal and distal portion to the fracture line, even if that measure provided fracture focus opening, thus obtaining a more appropriate stability pattern for that synthesis.
Throughout the study, no medialization procedure of the shaft was performed with the technique described by Dimon-Hughston.[13,14]
All patients were positioned on a fracture reduction table or on an orthopaedic table, with intraoperative surgical arch and X-ray images being used (whenever necessary). After reduction, fractures were classified according to the criteria developed by Evans[7], identifying them as stable or unstable, i.e., those in which the proximal fragment is directly opposed on medial cortical of the distal fragment, and; unstable for those in which the proximal fragment is not opposed to the distal one.
No data were collected for surgical time, blood volume, kind of anesthesia, and affected side because there were not correlated to the objective of the study.
All patients were operated by 2nd and 3rd grade resident doctors, under direct supervision of an assistant doctor.
Partial load was allowed with crutches and walker, usually at the end of the 1st week, or as soon as patient's clinical status allowed so.
For postoperative study, we took X-ray images at anteroposterior (AP) and lateral (L) planes at the early postoperative period and on the third and sixth month after the surgical procedure of each patient. We measured (in millimeters) the distance from screw tip to the apex of femoral head at AP and L planes, obtaining a value for each.
According to Baumgartner and Solberg[15], the sum of these two values provides Tip Apex Distance (TAD) (Figure 2), which, when exceeding 25 mm, an increased chance of cut out exists. Therefore, we obtained three TAD values for each patient: one at early postoperative period – TAD 1; on the third month – TAD 2, and; on the sixth postoperative month – TAD 3 (Figures 3 e 4). Pervez et al.[16] is even more strict concerning TAD, indicating that this should be 20 mm.

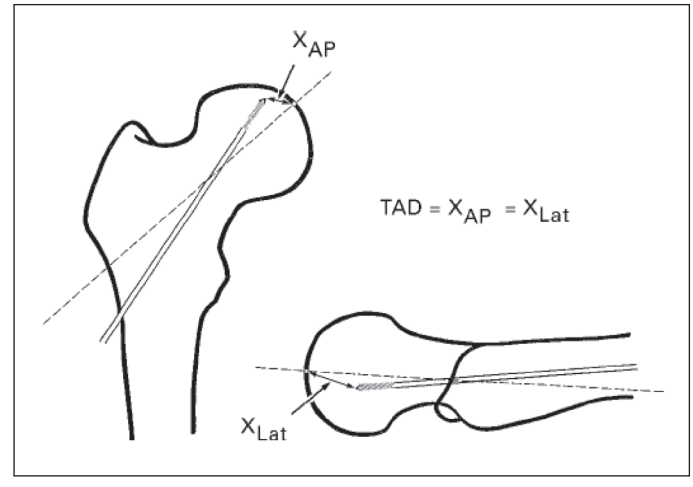


Figure 2 – *Method for TAD measurement, by summing the distance between the femoral head apex and the screw distal end on anteroposterior X-ray image (Xap) and the distance between head apex at lateral plane and the screw distal end (Xlat)15.*

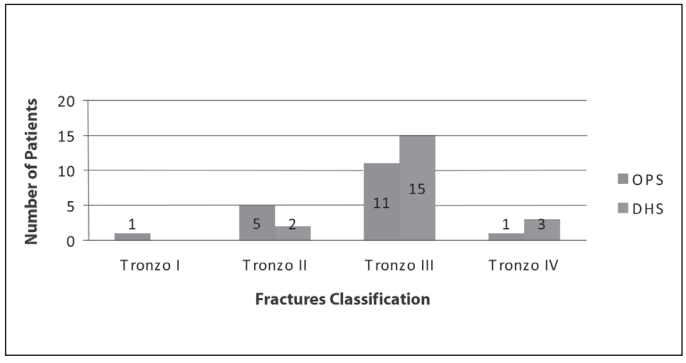
We used the ANOVA method to statistically analyze whether the variation of TAD measurements between one period to another were significant or not, with a significance level of $p>0.05$.
The Student's t-test with significance level of $p<0.05$, was applied based on an optimal TAD value of 25mm, comparing the measurements in a same time interval in order to check for statistical differences and variance patterns between both techniques measurements.

RESULTS

In the present study, the mean age was 71.6 years (44 – 95 years), with 22 females and 16 males.

Fractures were classified at baseline and intraoperatively, as: one Tronzo I (2.6%), seven Tronzo II (18.4%), 26 Tronzo III (68.4%) and four Tronzo IV (10.5%).

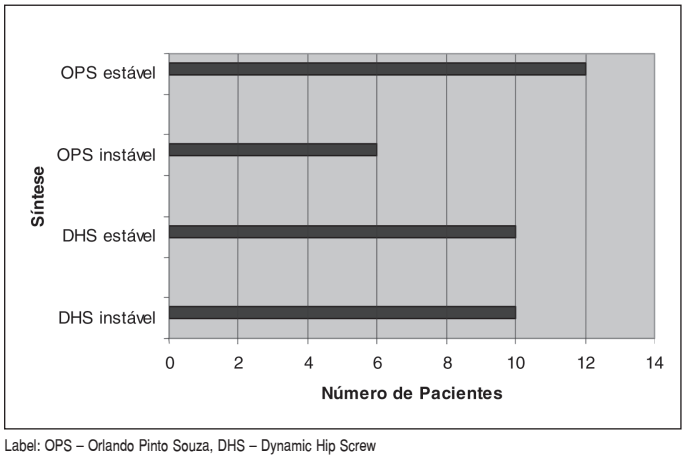
Implants employed: OPS in one Tronzo I fracture, five Tronzo II, eleven Tronzo III and one Tronzo IV; DHS was used in two Tronzo II, 15 Tronzo III and three Tronzo IV. (Figure 3)



Label: OPS – Orlando Pinto Souza, DHS – Dynamic Hip Screw

Figure 3 – *Correlation between the number of patients and fractures classification.*

Once positioning and reduction on orthopaedic table were performed, we found six unstable reductions and 12 stable reductions in the group treated with the OPS implant, while in the DHS group, we found 10 stable and 10 unstable. (Figure 4)



Label: OPS – Orlando Pinto Souza, DHS – Dynamic Hip Screw

Figure 4 – *Correlation of fractures stability after reduction.*

In the group where the OPS was implanted, we didn't notice the presence of cut out and, in the DHS group we found two synthesis failures ("cut out" - Figure 5) (10%), one on a female patient with a Tronzo IV fracture and another on a male patient with a Tronzo III fracture, both classified as unstable after reduction on orthopaedic table.

The female patient was subsequently submitted to cemented total hip arthroplasty (Figure 6), who passed away as a result of postoperative cardiovascular complications, and the male patient refused to undergo a new surgical intervention, ambulating with a subtle painless limping.

Figure 5 – *DHS cut out 20 weeks postoperatively in a Tronzo IV-type fracture.*

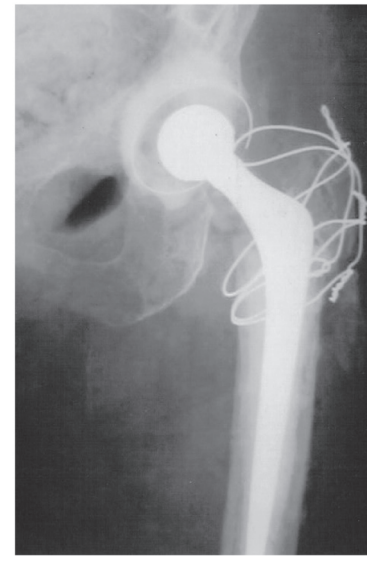


Figure 6 – *Total hip cemented prosthesis after DHS failure by cut out.*

Both failures occurred 20 weeks postoperatively, when ambulating with total load, with the pin fully migrated, which rendered the system stiff.[17-19] Furthermore, it is important to emphasize that in both synthesis failure cases, the pin was at an upper position, a finding that is consistent to the study by Pervez et al.[16]

None of the patients included in this study presented with superficial or deep surgical wound infection.

The mean TAD achieved was 31 mm for DHS group (Table 1) and 56.63mm for OPS. (Table 2)

By applying the ANOVA method on each individual group, we found a p value of 0.94 for DHS and 0.98 for OPS; therefore, no significant TAD variation was found for the three periods with the same technique, thus showing that no progressive change occurred on the position of implants at femoral head along the six postoperative and fracture union months, except for the two cases in which synthesis failed.

Using the *t* test, we found a p value at time zero (TAD 1 – EPO) of 0.00004; on the third month (TAD 2) $p = 0.0001$, and, on the sixth postoperative month (TAD 3) $p = 0.00005$, showing a significant difference for TAD measurements between both techniques when

compared together in a same period, and that DHS group showed less variation in its mean values when compared to OPS group, taking 25 mm as a reference value for TAD, as recommended by Baumgartner et al.[20]

Table 1 – *Mean TAD (in mm) for OPS*

TAD 1	TAD 2	TAD 3	Mean
56.5	56.1	57.3	56.63

Table 2 – *Mean TAD (in mm) for DHS*

TAD 1	TAD 2	TAD 3	Mean
31.65	31.30	30.05	31

DISCUSSION

Transtrochanteric fractures are injuries associated to weakness, usually found in elderly patients[3,5,6,11,14,21,22] Despite of that, in our case series, we could find a 44 year-old alcohol-dependent and undernourished patient, and these conditions compromise bone quality.

In our service, such fractures are imminently surgical. We always pursue a dynamic non-traumatic and stable treatment in order to provide a faster recovery for the patient and to reduce morbidity, allowing orthostatism and gait as soon as possible, avoiding clinical complications.

Therefore, we choose synthesis enabling dynamic compression, because these make fragments impaction, and union, as a result, easier. Thus, we can avoid complications ranging from a simple union delay to the most serious one, which is pin extrusion through femoral head (cut out), usually associated to stiff fixations.[10]

However, dynamic syntheses are not exempted from complications, usually associated to a poor implantation technique.[14,17]

This study intended to provide an evaluation by the method described by Baumgartner et al.[20] and Baumgartner and Solberg[15], named Tip Apex Distance, which acts as a predictive value for implanted synthesis failure risk.

Our case series was composed by 38 patients with transtrochanteric fractures, predominantly in female elderly patients (1,3 F: 1 M) consistently with literature reports.[1,5]

In our patients, we found a prevalence of stable fractures in 50% of the patients submitted to DHS and 66% of the patients submitted to OPS. In none of the cases we selected the Dimon-Hughston[23] technique for treating this kind of fracture, once we have found in literature some studies proving good union when treated with DHS.[13,14,22,24-26]

We found a failure rate of 10% in patients treated with the DHS, which is inferior to the complication risk rate reported by Baumgartner et al.[19] ranging from 16 to 23%, Gundle et al.[27] report failure in 10% of the cases, which can be as high as 16%; however, McLoughlin et al.[8] report a failure rate of 3 - 16%. Such failures are due to fracture instability and poor technique and poor positioning of the implant, which was not inserted at the central region of femoral head, but at an anterosuperior region, causing the cut out. In addition, TAD measurement was not respected, being this larger than 2.5 mm.[15,20] Although there is no consensus in literature, we consider that the pin should be positioned at the level of femoral head and neck center, as recommended by Baumgartner et al.[20] and Baumgartner and Solberg.[15]

A factor to be observed is that the synthesis failure occurred when the course for system telescoping was completed, thus rendering the system stiff[11]. Because of fracture instability, an increased varusing moment occurred on pin apex, extruding it through femoral head.

According to Parker[28], the most common cause for failure on extracapsular fractures fixation by DHS is the cut out effect.

In our study, we found no variation of the TAD throughout the six postoperative months in a same group, showing that the synthesis and bone fragments formed a single system, moving conjunctively in fracture impaction, with femoral head being the axis of mechanical stability, as shown by Hartog et al.[25]

Interestingly, we didn't find any intraoperative synthesis failure with OPS; however, we did find a mean TAD of 56.6 mm in this group. Such fact is probably due to a stronger valgusing effect at fracture reduction as compared to DHS, additionally to the fact that there is no limit for pin telescoping. According to Parker[28] this stronger valgus reduction could contribute to a better stability of the system despite TAD was not respected, according to Pervez et al.[16] the right angle for fracture reduction is 165 - 170^0.

During OPS-type synthesis, we maintained the guiding wire at strong valgus position, supported by calcar and at the center of femoral head, and we also did not allow any arching in it so that during pin's milling or implantation, no stress was applied to the lateral cortical to cause fractures.

It is important to highlight that in stable fractures treated with DHS, even when TAD was not respected, there was uncomplicated fracture union. This is because these fractures have the proximal fragment supported on calcar, reducing the mechanical stress to femoral head and synthesis during the union process, as well as for the lack of restraints for pin telescoping. Thus, at no moment, this synthesis became stiff favoring cut out occurrence.

We emphasize that both techniques had a dynamic impaction of the fracture in common, but they distinguish from each other by the fact that fracture valgusing is extremely important for OPS, with appropriate pin support on calcar, lateral cortical and femoral head, while, for DHS, respecting TAD and centralizing the pin at femoral head and neck are important factors, since when these are summed up, they favor synthesis failure.

CONCLUSION

We conclude that, when both osteosyntheses are compared for the incidence of cut out and its correlation with the TAD rate recommended by Baumgratner, we find that, in OPS, cut out was not dependent on this measurement, and that other factors such as valgusing and reduction were priorities, while, in DHS, the TAD rate recommended by Baumgartner should be pursued.

Joint rupture by cut out was found only with the DHS osteosynthesis, on unstable fractures with increased TAD and when maximum telescoping occurred.

When OPS was used, there was no limit for telescoping.

Failures occurred when a set of predisposing factors were present: poor positioning, high TAD and fracture instability.

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