CROSS-SECTIONAL STUDY ON DIFFERENT ENTRY POINTS FOR ANTEROGRADE FEMORAL INTRAMEDULLARY OSTEOSYNTHESIS

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ABSTRACT

Objective: To analyze the degree of knowledge among professionals who treat fractures using the recommended technique, with regard to correlating the nail with the entry point that is considered appropriate. Methods: A questionnaire that presented five types of nail and simulated a transverse diaphyseal fracture of the femur was developed. Results: Responses regarding the entry points corresponding to choosing the type of nail were obtained from 370 orthopedists who were participating in the 41st Brazilian Congress of Orthopedics and Traumatology. It was observed that only 20% correctly identified the entry point and that there was no difference between the professionals within the specialty of Traumatology and the others. Conclusion: It was concluded that the majority of the physicians attending the congress were unaware of the entry points.

Keywords – *Femur; Fracture Fixation, Intramedullary; Diaphyses*

INTRODUCTION

Osteosynthesis of the femur using an intramedullary nail is considered to be the gold standard for treating diaphyseal fractures of the femur, and this is considered to be superior to extramedullary fixation using plates and external fixators, from both the biomechanical and the clinical point of view[1].

Development of different intramedullary implants has given rise to changes in the traditional entry point for the intramedullary nail that was initially described by Küntscher[2].

Today, it is considered that choosing the correct entry point is one of the most important factors for ensuring success in treating diaphyseal fractures of the femur. Achievement of such success depends on precise knowledge of the anatomy of this region. For each nail model, there is a recommended entry point that should be respected[3].

The aim of this study was to analyze the degree of knowledge among professionals who treat diaphyseal fractures of the femur using recognized techniques, correlating the type of nail with the entry point that is considered appropriate.

MATERIALS AND METHODS

During the 41st Brazilian Congress of Orthopedics, 500 questionnaires (Annex 1) were randomly distributed in person to orthopedists and orthopedic residents. These questionnaires sought the following information: identification by means of initials,

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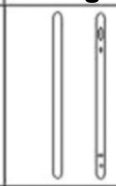
sex, age, year of graduation, resident or non-resident, whether the physician operated on the type of fracture in question (type A3 transverse diaphyseal fracture of the femur) and, if so, how many of these procedures he performed per year. These physicians were then asked to correlate the five types of nail presented with their entry points (Box 1).

The definitions for the correct entry points were based on the regions indicated for each type of nail in textbooks and articles published on this subject[3-5] (Figure 1).

STATISTICAL METHODS

Taking into account that 4,000 orthopedists and orthopedic residents would be participating in the congress, we calculated that 364 should be interviewed in order to obtain a representative sample of this population, with acceptance of a sampling error of 5%.

Box 1 – Choices of nail characteristic design that are available.

	Design	Coronal	Sagittal
Tipo 1		Straight	Straight
Tipo 2		Straight	Anterior curvature with radius of 1,500 mm
Tipo 3		Proximal inclination of 6°	Anterior curvature with radius of 1,500 mm
Tipo 4		Proximal inclination of 6° and cephalic blockage	Anterior curvature with radius of 1,500 mm
Tipo 5		Proximal inclination of 10°	Anterior curvature of 10°

Source: Department of Orthopedics and Traumatology, Unifesp-EPM

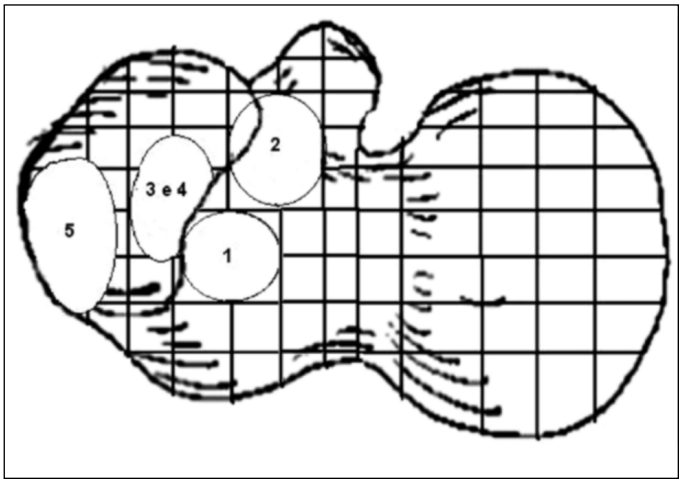


Figure 1 – View of femur from above, showing the entry points that are considered to be appropriate for each nail. Region 1: base of femoral neck. Region 2: trochanteric fossa. Regions 3 and 4: apex of greater trochanter. Region 5: lateral to greater trochanter ("bald point").

RESULTS

Questionnaires filled out by congress attendees who were not physicians, were foreigners, had already answered the questionnaire previously or filled it out incompletely were discarded. The study included 370 participants, while another 38 questionnaires were filled out incorrectly and 92 interviewees said that they did not do the procedure in question.

The participants' mean age was 37.7 years, with a range from 27 to 85 years and standard deviation of 9.5 years.

Out of the 370 participants, 364 (98.4%) were male and only six (1.6%) were female.

In the sample selected, 92 individuals (24.8%) were residents within orthopedics and traumatology and 278 (75.2%) were orthopedists.

Around 237 individuals (64%) were specialists, of whom 104 (28.1%) were specialists in trauma and 133 (35.9%) were specialists in other fields.

Regarding the number of nail procedures performed per year, 87 (23.5%) said that they did less than five; 103 (27.8%) between five and ten; 84 (22.7%) between 10 and 20; 60 (16.2%) between 20 and 40; and 36 (9.8%) more than 40 nails per year (Figure 2).

When the participants were asked which type of nail they preferred, 40 (10.8%) chose nail type 1; 161 (43.5%) type 2; 74 (20%) type 3; 38 (10.2%) type 4; and 57 (15.5%) type 5 (Figure 3).

Annex 1 – Questionnaire applied to study participants.

Cross-sectional study on the different entry points used in anterograde femoral intramedullary osteosynthesis

Identification (just initials):	Age:
Sex: ☐ Male ☐ Female	
Year of obtaining "TEOT":	Resident: ☐ Yes ☐ No
Specialist: ☐ Yes ☐No	
☐ Trauma ☐ Others	

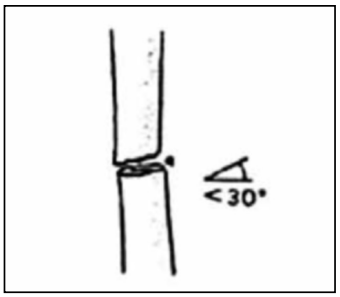
Do you perform osteosynthesis using intramedullary nails for diaphyseal fractures of the femur?

☐ Yes ☐ No

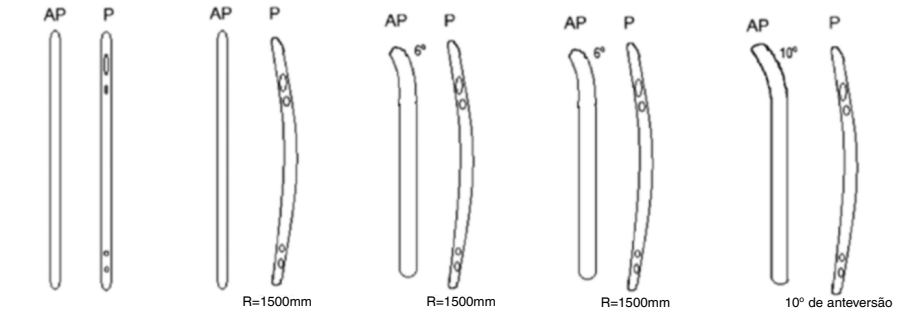
Approximately how many fractures per year do you treat using an intramedullary nail?

☐ Less than 5 ☐ Between 5 and 10 ☐ Between 10 and 20 ☐ Between 20 and 40 ☐ More than 40

The next questions should be answered in relation to this fracture:



Which nail design do you prefer?



Center of medulla; straight ☐

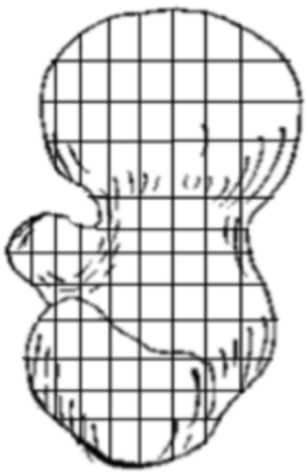
Anterior curvature with R = 1500 mm ☐

Lateral proximal inclination of 6° ☐

Cephalic blockage ☐

Lateral proximal inclination of 10° ☐

Locate the entry point for your preferred nail.



When they correlated the type of nail used with the entry point, 67 (18.1%) of the responses were correct and 303 (81.9%) were incorrect (Figure 4).

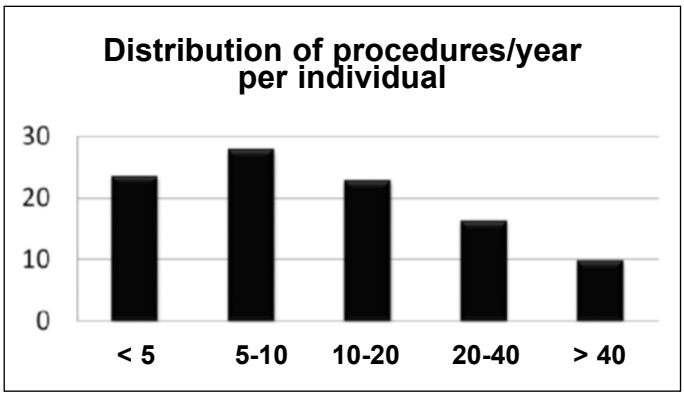


Figure 2 – Distribution of individuals according to the number of procedures per year.
Source: Brazilian Congress of Orthopedics and Traumatology, Rio de Janeiro, 2009.

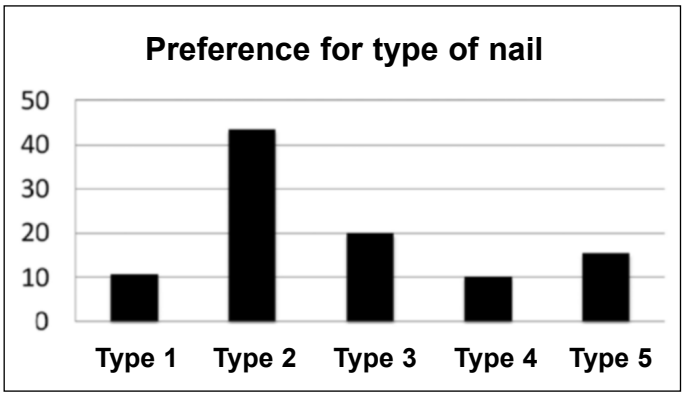


Figure 3 – Type of nail preferred, per individual.
Source: Department of Orthopedics and Traumatology, Unifesp-EPM.

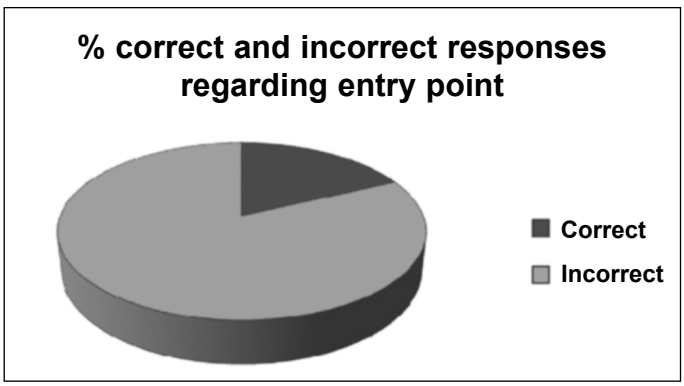


Figure 4 – Percentages of correct and incorrect responses relating to choosing the site for making the entry point for the nail.
Source: Department of Orthopedics and Traumatology, Unifesp-EPM.

Trauma specialists versus other participants

Comparison between the trauma specialists and the remainder of the participants (specialists in other fields and non-specialists), we found the following results:

In relation to the number of procedures performed per year, we observed that the trauma specialists performed more nail procedures than the other interviewees. Among these traumatologists, 14 (13.5%) performed less than five nail procedures per year; 27 (26.0%) between five and ten; 17 (16.3%) between 10 and 20; 32 (30.7%) between 20 and 40; and 14 (13.5%) more than 40. Among the remaining participants, 73 (27.5%) performed less than five nail procedures per year, 76 (28.6%) between five and ten; 67 (25.2%) between 10 and 20; 28 (10.5%) between 20 and 40; and 22 (8.2%) more than 40 (Figure 5).

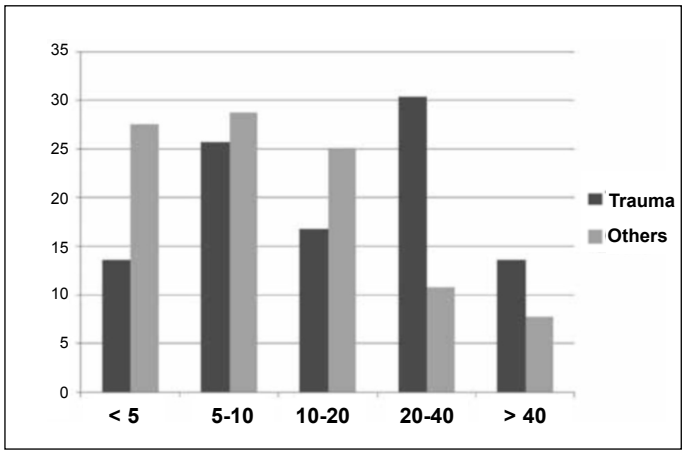


Figure 5 – Number of procedures done per year by traumatologists, in relation to the other interviewees.

Correlation of nail preferences between the traumatologists and the other interviewees, it was observed that both groups had a preference for nail type 2. However, the traumatologists used the other types of nail more than the other group did. Among the trauma specialists, 19 (18.3%) preferred nail type 1; 35 (33.6%) type 2; 20 (19.2%) type 3; 14 (13.5%) type 4; and 16 (15.1%) type 5. Among the remaining participants, 21 (7.8%) preferred nail type 1; 126 (47.3%) type 2; 54 (20.3%) type 3; 24 (9%) type 4; 41 (15.6%) type 5 (Figure 6).

Comparison of the numbers of correct responses regarding the entry point, between the trauma specialists and the other interviewees, showed that the two groups were similar (Figure 7).

Number of nails per year versus correct responses

Greater numbers of correct responses were found among individuals who performed greater numbers of procedures per year (Figure 8).

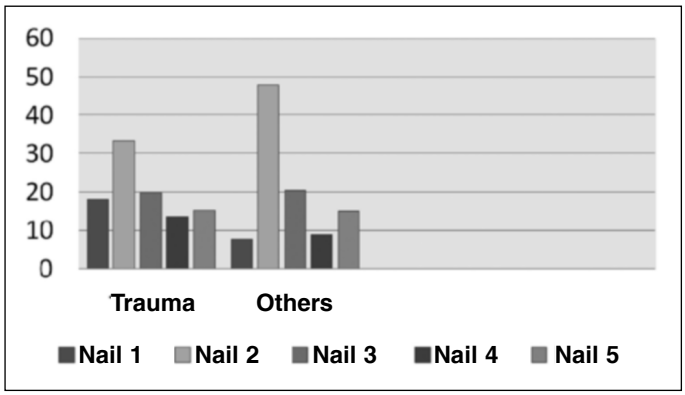


Figure 6 – Preference among traumatologists for type of nail, in relation to the other interviewees.
Source: Department of Orthopedics and Traumatology, Unifesp-EPM.

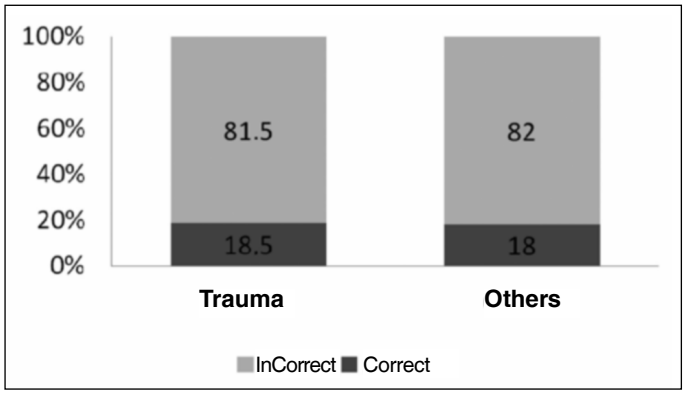


Figure 7 – Number of correct responses regarding entry point, among traumatologists in relation to the other interviewees.
Source: Department of Orthopedics and Traumatology, Unifesp-EPM.

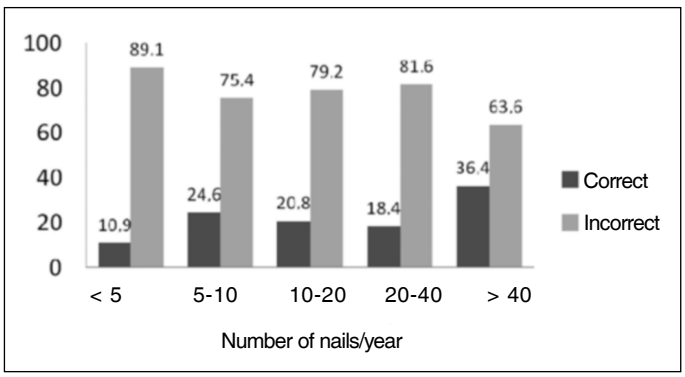


Figure 8 – Correlation between number of correct responses regarding the entry point and the number of procedures performed per year.
Source: Department of Orthopedics and Traumatology, Unifesp-EPM.

DISCUSSION

Achieving the correct entry point is one of the most important factors in the surgical technique for anterograde intramedullary osteosynthesis of the femur.

Using an incorrect entry point may lead to non-union or pseudarthrosis, or even to new iatrogenic fractures[6-8].

Straight nails in the coronal plane (front) should enter at a point presenting continuity with the center of the medullary canal, i.e. medially to the greater trochanter and at the center. On the other hand, nails that present some proximal curvature in this plane have an entry point that is more lateral.

In the sagittal plane (profile), straight nails should be inserted at the transition between the femoral neck and the trochanteric region, and at the center. Those that present curvature should be inserted in the posterior third, since they attempt to follow the antecurvatum of the femur.

In relation to the center of the medullary canal, one of the sites that we took as a reference point was the trochanteric fossa, which is an extra-articular depression on the surface posteromedial to the greater trochanter. This is the site of insertion of the external obturator muscle and is also called the digital fossa. The trochanteric fossa is often confounded with the piriform fossa: this latter is located approximately 2 cm anteriorly to the posterior edge of the greater trochanter and is the insertion site for the piriform tendon[9].

In a cross-sectional study conducted by Kale, only 4% of the interviewees were able to identify the piriform and trochanteric fossae on a drawing and name them correctly.

Labronici et al[10] conducted a study in which the center of the medullary canal was projected into the region of the piriform fossa by means of retrograde insertion of a guidewire.

With the aim of adapting the implant shape to the anatomy of the femur, nails with anterior curvature in the sagittal plane have been developed, and their entry point should be in the trochanteric fossa.

In 1977, in the same factory in Kiel where Küntscher nails were produced, Groose and Kempf apud Bong *et al*.[11] went back to producing straight nails, since these made it easier to perform distal blockage, thus diminishing the need to use radioscopy. This became known as the Strasbourg nail. We believe that, because of its characteristics, its ideal entry point is the piriform fossa.

The tip of the greater trochanter is not collinear with the axis of the medullary canal. Nails inserted in this area should have an angle of approximately 6° in relation to the medullary canal. This entry point was described by Küntscher, who used a hollow nail that

was thus more malleable and could undergo some degree of deformation and go into the medullary canal through this entry point, even though it was a straight nail[12].

Recently, the concept of a "bald" point located on the lateral facet of the greater trochanter arose. This is an elliptical area in which there are no tendon insertions. It is located 10° laterally to the medullary center and its geometrical center is 11 mm distally to the tip of the greater trochanter and 5 mm anteriorly to it[13].

CONCLUSION

Approximately 80% of the interviewees incorrectly identified the entry point that should be used with the nail that they had previously chosen. This suggests that the majority of orthopedists are not using the correct technique for performing this procedure.

The nail preferred by the majority of the interviewees (43.5%) was type 2: a straight nail in the coronal plane with a radius of anteversion of 1,500 mm.

Trauma specialists performed more nail procedures per year than the remainder of the interviewees did. However, there was no statistical difference in the percentage of correct responses between these two groups.

There was not always direct proportionality between the number of nail procedures performed per year and the percentage of correct responses regarding the entry point.

Osteosynthesis using an anterograde intramedullary nail is considered to be the gold standard for treating diaphyseal fractures of the femur, and when this procedure is performed, attention is required such that the correct technique is used.

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