ORIGINAL ARTICLE

ENTRY POINT FOR THE ANTEGRADE FEMORAL INTRAMEDULLARY NAIL: A CADAVER STUDY

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ABSTRACT

Objective: To analyze the natural exit of the wire guides in major trochanter through retrograde femoral approach, in cadaver specimens. Material and Method: 100 femurs had been perforated between the femoral condyles, at 1.2 cm of the intercondylar region. A 3-mm straight wire guide was introduced, through retrograde approach, until the proximal extremity of femur was reached. Femurs were assessed for posterosuperior and anterosuperior portions of major trochanter, pear-shaped cavity, and upper median line between the head-neck and the major trochanter. Results: in 62%, the straight wire guides exited at the anterior surface of major trochanter. In the pear-shaped cavity, the median distance found was 1.0 cm and the interquartile range was 0.5 cm, initially expressing, in relation to pear-shaped cavity, better accuracy. Conclusion: the central axis of the medullar canal, at coronal plane, projected better accuracy in the region of the pear-shaped cavity.

Keywords – *Femur; Fracture fixation; intramedullary; Cadaver*

INTRODUCTION

To be successful when using the antegrade intramedullary nail technique for the treatment of femur fractures, besides having a good understanding of the anatomy of the proximal femur, one must know how to choose the proper entry point to introduce the nail. The main objective of defining the entry point is to obtain anatomic alignment of the bone fragments.

There are different opinions in the literature about the best location for the point of entry into the proximal end of the femur. Some authors prefer the tip of the greater trochanter[1-3]. Others prefer the piriform fossa, as they believe that this location would be the axis between the trochanter and femoral diaphysis[4-7]. Regions of the anterior third and posterior two thirds of the tip of the greater trochanter have also been described[8,9].

The objective of this study was to analyze the natural outlet of the guide wire in the greater trochanter through the femoral retrograde approach in cadaver specimens.

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We declare no conflict of interest in this article.

METHODS

One hundred femurs from the Petrópolis School of Medicine, RJ, were used. Femurs with prior deformities, signs of wear or fracture of the greater trochanter and/or femoral condyle were excluded. Of the anatomical specimens, 47 were right and 48 left. All femoral specimens were drilled with a 6-mm drill between the femoral condyles, 1.2 cm from the intercondylar region[10,11]. A 3-mm straight guide wire was introduced retrograde until reaching the proximal end of the femur. Five femurs were excluded due to greater trochanter fractures during the passage of the guide wire, with a remaining total of 95 anatomical specimens. The location of the guide exit was measured relative to the posterosuperior (PST) and anterosuperior (AST) region of the greater trochanter, the piriform fossa (PF), and the superior median line between the head-neck and greater trochanter (Figures 1 and 2).

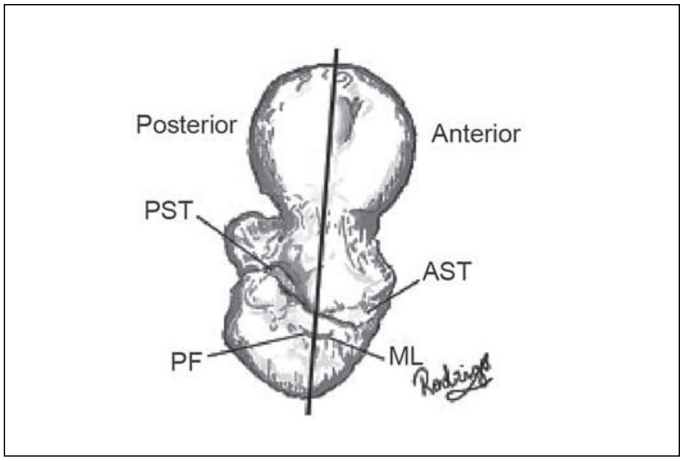


Figure 1 – Top view of the proximal femur. PST – posterosuperior region of the greater trochanter, AST – anterosuperior region of the trochanter, PF – piriform fossa, and ML-midline of the proximal femur.

Figure 2 – A) Location of entry of the guide wire in the intercondylar region; B) Anteroposterior view of the proximal end of the femur with the guide wire exit; C) Superior view of the proximal femur with the exit of the guide wire; D) Side view of the proximal femur with the exit of the guide wire.

RESULTS

This study aimed to trace the frequency profile of the guide wire in the trochanteric region after retrograde introduction into the intercondylar region of the femur in 100 anatomical specimens. Five femurs were discarded, since fracturing of the greater trochanter occurred when introducing the guide wire, which precluded taking measurements. This study protocol was analyzed and approved by the Ethics Committee of the Petrópolis School of Medicine.

Table 1 shows the measurements of the central tendency and dispersion of the distances from the retrograde entry point for 95 femurs with the mean, standard deviation (SD), mode, 1st quartile, 2nd quartile (median), 3rd quartile, 10th percentile, 90th percentile, minimum, and maximum.

Distance from the anterosuperior region of the trochanter

Of the 95 specimens studied, 100% of cases were between the minimum and maximum values, which were 0.5 to 2.8 cm, respectively; 90% did not exceed 2.3 cm (90th percentile). The median distance observed was 1.5 cm and the interquartile range (IQR = Q3-Q1) was 0.6 cm.

Distance from the posterosuperior region of the trochanter

Of the 95 specimens studied, 100% of cases were between the minimum and maximum values, which were 1.0 to 3.7 cm, respectively; 90% did not exceed 2.9 cm (90th percentile). The median distance observed was 2.3 cm and the interquartile range (IQR = Q3-Q1) was 0.6 cm.

Distance from the piriform fossa

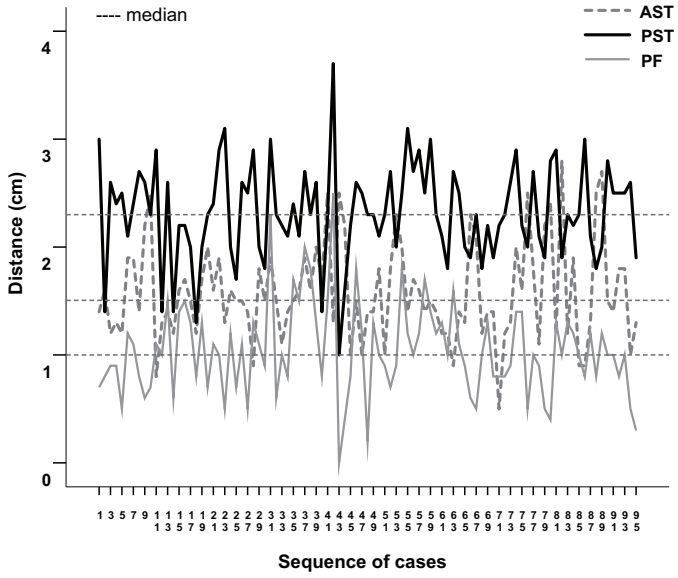
Of the 95 specimens studied, 100% of cases were between the minimum and maximum values, which were

Table 1 – Descriptive statistics of the distances (cm) from the retrograde entry point.

Distance (cm)	N	Mean	SD	Mode	1st quartile	2nd quartile (median)	3rd quartile	10th percentile	90th percentile	Minimum	Maximum
AST	95	1,58	0,46	1,4	1,3	**1,5**	1,9	1	2,3	0,5	2,8
PST	95	2,32	0,46	2,3	2	**2,3**	2,6	1,8	2,9	1	3,7
FP	95	1,04	0,43	1	0,8	**1**	1,3	0,5	1,54	0	2,5
Anterior ML	62	0,59	0,31	0,5	0,3	**0,5**	0,8	0,2	1,07	0,1	1,3
Posterior	15	0,37	0,17	0,2	0,2	**0,3**	0,5	0,2	0,62	0,2	0,8
Central	18	0		0	0	**0**	0				

SD: Standard deviation
Source: Petrópolis School of Medicine/RJ.

0 to 2.5 cm, respectively; 90% did not exceed 1.54 cm (90th percentile). The median distance observed was 1.0 cm and the interquartile range (IQR = Q3-Q1) was 0.5 cm, which was the shortest distance between the anatomical regions considered, initially expressing better precision in relation to the piriform fossa (Figure 3).



Sequence of cases Source: Petrópolis School of Medicine/RJ.

Figure 3 – Illustrates the sequence of the distance points according to anatomical regions. (AST – distance from the anterosuperior region of the trochanter; PST – distance from the posterosuperior region of the trochanter; PF – distance from the piriform fossa).

DISCUSSION

The antegrade intramedullary nail is a standard procedure for diaphyseal fractures of the femur in both exposed and closed fractures[12,13]. Although there are anatomical reference points in the proximal femur, the surgeon may encounter some difficulty in locating the ideal entry point when opting for treatment with the intramedullary nail. Many authors point out the great importance of a proper entry point with the antegrade intramedullary nail[1,14,15]; the wrong location can cause several intraoperative complications such as angular deformities postoperatively[5,14-19]. Information on the correct location of the entry point are rarely found in the literature, and are controversial and confusing[2,9,20,21].

In the original description by Küntscher cited by Gausepohl et al.[2], he only mentions that the retractor is placed over the tip of the greater trochanter under fluoroscopic control. Christensen[21] simply mentioned that the tip of the trochanter, and not the trochanteric fossa, should be used for the insertion of the nail. Other authors have recommended that the point of entry be placed on the medial aspect of the greater trochanter[22,23]. Hansen and Winquist[24] recommended a point between the femoral neck junction and the trochanter. They did not, however, show the exact anatomical location of the entry point and emphasized the position in the sagittal plane. Kempf et al.[1] believed that the ideal entry point is the tip of the trochanter; however, they suggested a point that is more medial to the trochanteric wall in proximal femoral fractures. More recently, several authors have recommended an entry point medial and posterior to the greater trochanter in fractures of the proximal femur[5,25,26]. Georgiadis et al.[9] using only the upper part of the femur to its isthmus, defined the greater trochanter as the ideal entry point, in a more dorsal position compared to the tendinous insertion of the piriformis muscle. Gausepohl et al.[2] included the distal femur in their research, considering the natural curvature of the femur. Results showed that the ideal entry point was significantly more ventral over the insertion of the piriformis muscle.

Harper et al.[27] introduced 3mm diameter intramedullary guides in a retrograde manner in the intercondylar region of the femur. They concluded that the tip of the trochanter was not the most natural exit for the guide and that the junction between the femoral neck and trochanter is a better location. Our results, also using a 3mm diameter guide introduced in a retrograde manner to 1.2 cm in the intercondylar region of the femur, a region considered to be the center of the femur, showed relatively uniform results. The natural exit of the guide was in the piriform fossa, which showed a smaller range (median distance of 1.0 cm and interquartile range of 0.5 cm). This means better precision and probably is reproduced with better reliability.

The curve radius of the femur should be considered when opting for treating femoral fractures with the intramedullary nail. The neutral point of entry can be obtained by starting its placement in the trochanteric fossa or at the tip of the trochanter, no more than 2 cm from the posterior region of the trochanter[9]. We observed that in positioning the guide wire in relation to the anteroposterior proximal femur, 62% exited prior to the medial line of the femur. This may have been due to the use of a straight guide wire, not following the curve radius of the femur, which can be a critical factor. Harper et al.[27] introduced implants with a curve radius (203 cm and 137 cm) and found an entry point located dorsal to the trochanter, a result different from that found when they used a straight guide wire, which was more anterior.

CONCLUSION

The central axis of the medullary canal, in the coronal view, showed better precision in the region of the piriform fossa. For straight nails, the best location of the entry point is the piriform fossa.

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