COMPARISON OF VOLUMES OCCUPIED BY DIFFERENT INTERNAL FIXATION DEVICES FOR FEMORAL NECK FRACTURES

Daniel Lauxen Junior[1], Carlos Roberto Schwartsmann[2], Marcelo Faria Silva[3], Leandro de Freitas Spinelli[4], Telmo Roberto Strohaecker[5], Ralf Wellis de Souza[6], Cinthia Gabriely Zimmer[7], Leonardo Carbonera Boschin[8], Ramiro Zilles Gonçalves[8], Anthony Kerbes Yépez[8]

ABSTRACT

Objective: The objective of this paper is to measure the volume occupied by the most widely used internal fixation devices for treating femoral neck fractures, using the first 30, 40 and 50 mm of insertion of each screw as an approximation. The study aimed to observe which of these implants caused least bone aggression. Methods: Five types of cannulated screws and four types of dynamic hip screws (DHS) available on the Brazilian market were evaluated in terms of volume differences through water displacement. Results: Fixation with two cannulated screws presented significantly less volume than shown by DHS, for insertions of 30, 40 and 50 mm (p=0.01, 0.012 and 0.013, respectively), fixation with three screws did not show any statistically significant difference (p= 0.123, 0.08 and 0.381, respectively) and fixation with four cannulated screws presented larger volumes than shown by DHS (p=0.072, 0.161 and 0.033). Conclusions: Fixation of the femoral neck with two cannulated screws occupied less volume than DHS, with a statistically significant difference. The majority of screw combinations did not reach statistical significance, although fixation with four cannulated screws presented larger volumes on average than those occupied by DHS.

Keywords – Femoral Neck Fractures; Fractures Fixation, Internal; Hip/surgery

INTRODUCTION

Intracapsular fractures of the femoral neck correspond to approximately 50% of all hip fractures. Surgical treatment options for dislocated fractures include arthroplasty and internal fixation (the latter being the treatment of choice in younger patients). The majority of existing works do not demonstrate any great superiority between the more widely used internal fixation methods (dynamic hip screw, DHS; or multiple cannulated screws, MCS). Various meta-analyses and biomechanical works have failed to show any difference between the two methods[1-4]. It is known that one of the main complications of surgical treatment with these devices is avascular necrosis of the femoral head[5].

Studies on animal models demonstrate increased blood flow in the head of the femur with the use of internal fixation, and perhaps an additional increase in this flow when the fixation device applied compression on the fracture[6]. One possible means of reducing this complication is to reduce the volume occupied by the implants within the femoral head, facilitating vascularization and the process of bone consolidation. The aim of this study is to measure the volume occupied by different implants used for fixation of the fractured femoral head, using as approximation the first 30, 40 and 50 mm of each of these implants.

1 – Resident Physician, Irmandade da Santa Casa de Porto Alegre – ISCPA – Porto Alegre, RS, Brazil.
2 – Full Professor of Orthopedics and Traumatology, Universidade Federal de Ciências da Saúde de Porto Alegre (UFCSPA) and of the Orthopedics and Traumatology Clinic, Irmandade da Santa Casa de Porto Alegre – Porto Alegre, RS, Brazil.
3 – Professor, Universidade Federal de Ciências da Saúde de Porto Alegre – Porto Alegre, RS, Brazil.
4 – Assistant Physician, Hip Surgery Clinic, Irmandade da Santa Casa de Misericórdia de Porto Alegre – Porto Alegre, RS, Brazil.
5 – Coordinator, Physical Metallurgy Laboratory, Universidade Federal do Rio Grande do Sul – LAMEF/UFRGS – Porto Alegre, RS, Brazil.
6 – Physical Metallurgy Laboratory, Universidade Federal do Rio Grande do Sul – LAMEF/UFRGS; Master's Degree from the Universidade Federal do Rio Grande do Sul – Porto Alegre, RS, Brazil.
7 – Master's Degree Student in Material Sciences, Universidade Federal do Rio Grande do Sul – Porto Alegre, RS, Brazil.
8 – Assistant Physician, Hip Surgery Clinic, Irmandade da Santa Casa de Misericórdia de Porto Alegre – Porto Alegre, RS, Brazil.

Study conducted at the Physical Metallurgy Laboratory of the Universidade Federal do Rio Grande do Sul – LAMEF/UFRGS and Irmandade da Santa Casa de Misericórdia de Porto Alegre.

Correspondence: Rua Leopoldo Bier, 825/403 – Cep 90620-100, Porto Alegre, RS, Brazil – schwartsmann@santacasa.tche.br

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MATERIALS AND METHODS

Different brands of cannulated screw (MCS) and sliding screw (DHS), manufactured by three different national orthopedic materials manufacturers, were compared. The different brands were identified as A, B and C.

Given that there are different fracture lines (subcapital, mediocervical and basocervical) and that the femoral head can vary in size, the first 30, 40 and 50 mm of each screw were arbitrarily considered, to simulate different penetration lengths of the screws inside the femoral heads. The volume occupied by the DHS was compared with that occupied by the MCS, considering two, three and four cannulated screws.

The method used to determine the volumes of the screws was difference in volume. Three measurements were performed for each volume considered, using the mean value for the purpose of the calculations. The procedure was carried out according to the following sequence: marking of the screws, considering insertion of 30, 40 and 50 mm with a GECOR-Paq-01 digital caliper, addition of water to a graduated cylinder up to a determined volume, immersion of the irregular solid to the predefined height, then determining the new volume of water in the cylinder. The volume of the solid is the difference between the final and initial volumes. Figure 1A shows the system used for the volume measurements. In this system, the volume reading should be taken from the bottom of the meniscus, as shown in Figure 1B.

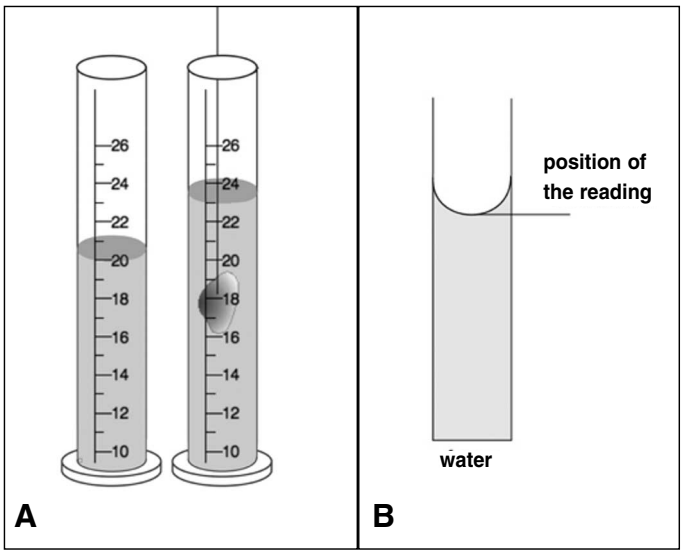

Figure 1 – (A) Representation of the system of graduated tube used to determine the volumes occupied; (B) reading position of the meniscus.

The premises of variance and distributions were evaluated for the application of the mean comparison tests. The Mann-Whitney non-parametric test was also applied, for comparison of the distributions. A level of significance of 5% was adopted for all the comparisons. The statistical calculations were carried out using the software SPSS 16.0.

RESULTS

Table 1 shows the different brands and screw sizes for the different insertion lengths (30, 40 and 50 mm) in relation to the volumes occupied. Table 2 shows the comparison between the DHS and the different screw configurations, considering the maximum and minimum volumes obtained for the screws of each manufacturer. Table 1 also shows the results of the statistical analysis of the data.

Figures 2, 3 and 4 show, in visual form, the mean values for the screw volumes, comparing DHS for two, three and four cannulated screws, respectively, observing the different insertion lengths (30, 40 and 50mm). In each case, a linear trend is observed.

In relation to the volume in cm^3, it is demonstrated that comparison of the DHS with the volume of three cannulated screws was the only configuration in which there are no statistically significant differences; two screws occupied a smaller volume, and four screws occupied a larger volume than the DHS.

Table 1 – Mean screw volume measurements.

Identification of the screws	Volume (cm^3)		
	30 mm	40 mm	50 mm
DHS			
Brand A thread 19	1.9	2.4	2.8
Brand A thread 28	1.9	2.4	3.0
Brand B thread 25	1.7	2.2	2.6
Brand C thread 20	1.5	2.0	2.4
Cannulated screws			
Brand A thread 19	0.5	0.7	0.9
Brand A thread 32	0.5	0.7	0.9
Brand B thread 32	0.5	0.7	0.9
Brand C thread 16	0.4	0.5	0.7
Brand C thread 32	0.5	0.6	0.8

DISCUSSION

In the treatment of fractures of the femoral neck, three surgical conducts are traditionally used: internal fixation, hemiarthroplasty, and total hip arthroplasty. Osteosynthesis has the potential to offer the patient a normal hip after consolidation of the fracture.