

HOW ARE CLOSED FEMORAL DIAPHYSEAL FRACTURES TREATED IN BRAZIL? A CROSS-SECTIONAL STUDY

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SUMMARY

A cross-sectional study was performed during the 36th Brazilian Congress of Orthopaedics and Traumatology, where the opinions of Brazilian orthopaedic surgeons addressing the treatment of femoral diaphyseal fractures in adults were surveyed. Five hundred and seven questionnaires were fully completed and the results show agreement in the following topics: fracture trace configuration and injuries of soft parts or neurovascular structures as key parameters for determining treatment; fractures classification, in which AO was most frequently adopted; milled blocked anterograde intramedullary nail for treating cross-sectioned and short oblique fractures at the isthmus; bridge plate for treating complex trace fractures; pre-operative skeletal traction; infection as the most frequent

complication, and; postoperative low molecular weight heparin. There were opinion conflicts for the following topics: use of traction table for performing intramedullary osteosynthesis, time interval between trauma and surgery; time of antibiotics use, and; mean hospitalization time.

Regarding literature, there was agreement concerning key parameters for determining treatment; fixation method for simple-traces fractures at the isthmus; adopted classification; antithrombotic prophylaxis. Issues such as fixation method for complex-traced fractures; time of antibiotics use; average interval between trauma and osteosynthesis, and; hospitalization time were different from literature.

Keywords: Femoral fractures; Cross-sectional studies; Fractures.

INTRODUCTION

Adult femoral diaphyseal fractures treatment is prominently surgical^(1,2,3,4,5). Different techniques and several kinds of implants exist that can be used for stabilizing those fractures. However, hospital resources such as image intensifiers, appropriate material availability for performing osteosynthesis and surgical staff training may influence the selection of the kind of osteosynthesis to be performed.

The objective of this study is to check how Brazilian orthopaedic doctors treat patients with femoral diaphyseal fractures regarding the following aspects: major parameters for deciding the kind of treatment; classification; stabilization options; use of traction table; kind of preoperative traction; average time interval between trauma and surgery; hospitalization time; use of antibiotic agents; most common complications, and; anti-thrombosis prophylaxis.

MATERIALS AND METHODS

Five hundred eighteen congress attendees, orthopaedic doc-

tors and resident doctors in orthopaedics and traumatology answered a questionnaire containing questions concerned to femoral diaphyseal fractures treatment during the 36th Brazilian Congress of Orthopaedics and Traumatology. Eleven questionnaires have been excluded: eight were incomplete, one was filled by a physical therapist, one by an European orthopaedic doctor, and one by a general practitioner.

The questionnaire contained 11 objective questions as a test, addressing the following aspects: identification (title); region of the country, major parameters in deciding about treatment; classification; treatment options for cross-sectioned simple-line and complex-line fractures; use of traction table; preoperative traction; time interval between trauma and surgery; hospitalization time; use of antibiotic agents; most common complications, and; anti-thrombosis prophylaxis. In some questions, more than one answer was allowed.

This study was approved by the Committee on Ethics in Research in our institution. Participants have freely engaged in the study, in a volunteer fashion. Answers were secret, and were analyzed with the aid of a software and computed according to statistical parameters.

Study conducted at the Department of Orthopaedics and Traumatology, Federal University of São Paulo (EPM).

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STATISTICAL METHOD

The presence of association between recommended treatment selection at different aspects of fractures treatment and some characteristics of interviewed individuals was assessed by Chi-square test or by Fisher's exact test (whenever applicable). A significance level of 0.05 (=5%) was adopted and descriptive levels (p) below this value were considered as statistically significant and represented by *.

It was determined that a percentage of answers above 50% and statistically superior to the other options, in each aspect, shall be considered as a consensus.

RESULTS

Participants' characteristics: 308 (61%) questionnaires were answered by orthopaedic doctors permanent members of the Brazilian Society of Orthopaedics and Traumatology (SBOT), 70(14%) by SBOT associate members, and 129 (25%) by resident doctors in orthopaedics and traumatology.

From orthopaedic doctors responding to the question about subspecialty, 22% were hip experts, 11% trauma experts, 11% hand experts, 11% sports traumatology experts, 10% knee experts, 7% spine experts, 7% foot and ankle experts, 7% musculoskeletal experts, 5% pediatric orthopaedic doctors, 5% shoulder and elbow experts, and 4% external fixators experts.

Concerning the geographic region, 67% live in the Southeast region, 11% in the South, 11% in Northeast, 8% in Mid-West, and 3% in the North.

Parameters used when deciding the kind of treatment:

Fracture line configuration was the major parameter used by orthopaedic doctors, totaling 60% of answers. Soft parts or neovascular structures injuries were mentioned by 58%; injuries associated to other fractures or vital organs injuries, by 34%, and age was mentioned by 11%.

Classification employed: The vast majority of Brazilian orthopaedic doctors (91%) use some classification for femoral diaphyseal fractures. From those following some classification, the AO-ASIF group classification was most commonly selected, accounting for 84% of answers. The Winquist classification was mentioned by 16%.

Treatment options for cross-sectioned and short oblique fractures at femoral isthmus (Figure 1): The milled blocked intramedullary nail is the method adopted for treating those frac-

tures, being preferred by 54% of orthopaedic doctors, followed by the non-milled blocked intramedullary nail, chosen by 25%; plate and screws in open technique (25%); unblocked intramedullary nail (18%); bridge plate (12%); retrograde intramedullary nail (6%); traction or cast (4%); single-planar external fixator (4%); Ilizarov (2%) and wave plate (1%).

Treatment options for long and comminuted oblique fractures (Figure 2): The bridge plate was the method of choice for 53% of the orthopaedic doctors, followed by the milled blocked intramedullary nail (37%); non-milled blocked intramedullary nail (33%); plate and screws in open technique (15%); single-planar external fixator (5%); Ilizarov (5%); retrograde intramedullary nail (4%); unblocked intramedullary nail (3%); wave plate (3%) and traction or cast (0%).

Use of traction table: Concerning the use of orthopaedic traction table for intramedullary osteosynthesis performance, 50% of the orthopaedic doctors use it.

Time interval between trauma and surgery: In this item, 18% of the orthopaedic doctors fix fractures within 24 hours or less; 37% wait 24-48 hours to perform surgery; 23% wait 48-72 hours; 16% wait 72 hours to 7 days to operate them, and; 7% wait more than one week to fix those fractures.

Preoperative traction: Skeletal preoperative traction is performed by 72% of the orthopaedic doctors. Skin traction is preferred by 18%, and 10% do not use traction at all.

Average hospitalization time: Between 4 and 5 days was the average of time chosen by 46% of the orthopaedic doctors; 20% chose between 6 and 7; 15% between 7 and 10 days; 15% up to three days, and; 4% chose more than 10 days.

Use of antibiotic agents in closed femoral diaphyseal fractures:

Regarding the use of antibiotic agents, 29% of the orthopaedic doctors use them during the first 24 postoperative hours; 27% during the first 48 hours; 13% during the first 72 hours; 18% use them for one week; 2% for more than 7 days; 7% use them only at anesthetic induction, and 4% do not perform antibiotics prophylaxis.

Most common complications:

(Figure 3) Soft parts infection was chosen by 50% of the orthopaedic doctors as the most common complication, followed by pseudoarthrosis, accounting for 38%; deep venous thrombosis, 30%; pulmonary thromboembolism with 14%, and; osteomyelitis for 11%.

Methods for preventing thromboembolic phenomena in adult femoral diaphyseal fractures:

Concerning this item, 77% of the orthopaedic doctors

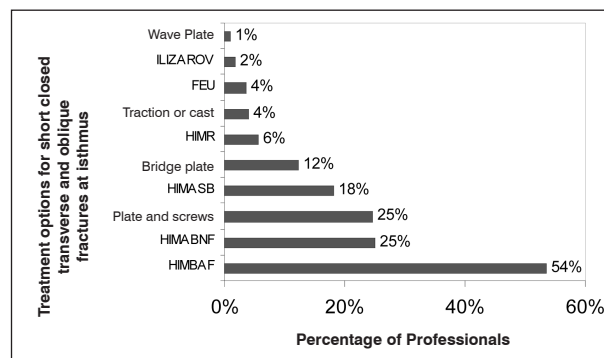


Figure 1 – Treatment options for short transverse and oblique fractures at femoral isthmus.

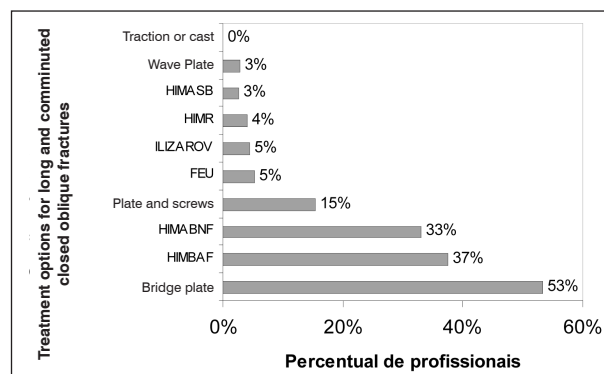


Figure 2 – Treatment options for long and comminuted oblique fractures.

use low molecular weight heparin; 14% use elastic socks; 7% warfarin; 5% acetylsalicylic acid, and; 3% use foot pump.

DISCUSSION

Femoral diaphyseal fractures usually occur as a result of high-energy trauma and affect mostly male (55%) young adults, with a subtle prevalence of the right side (52%).

Femoral diaphyseal fractures treatment is prominently surgical, because it allows for an early rehabilitation of the patient and reduced the risk of systemic complications. Some parameters are secondary, but must be analyzed for indicating the kind of treatment of adult femoral diaphyseal fractures: fracture line configuration; soft parts and neurovascular structures injuries; combined fractures and age. Brazilian orthopaedic doctors credited more importance (60%) to fracture line configuration. Regarding classifications, the most used ones are AO-ASIF group's and Winqvist's.

The AO classification is constituted of a codification system based on location (proximal, medial, or distal), on fracture line, and on the degree of comminution. At total, twenty seven kinds are described.

The Winqvist classification considers the comminution degree and indicates the kind of treatment. Type I (simple-line fracture, or with minimal comminution); Type II (comminution of up to 50% of diaphysis circumference); Type III (50%- 100% diaphysis comminution); Type IV (circumferential comminution of the diaphysis, without contact between the largest two fragments after reduction). In our field, 91% of orthopaedic doctors use some kind of classification, with that of the AO group being preferred by 84%, which characterizes the widely divulged knowledge of the AO philosophy in Brazil.

Among treatment methods for femoral diaphyseal fractures are the milled/ non-milled blocked/ unblocked intramedullary nails; compression plates in open or bridge technique; single or multiple planar external fixators, and; alternative methods such as skeletal traction and immobilization with casts.

Currently, biological fixation (at closed focus) with intramedullary nails is preferred in cases of femoral diaphyseal fractures. The use of static or dynamic blockage in the nail is a controversial subject. In simple line fractures located at the isthmus, some authors do not recommend blockage. However, some clinical trials reported that the static blockage did not influence union in those fractures⁽¹⁾. We use nail blockage, regardless of fracture line or location⁽⁴⁾.

In cases of open reduction and osteosynthesis with static-blockage intramedullary nail, some authors recommend the dynamization within eight to twelve weeks postoperatively⁽⁵⁾. Intramedullary fixation represents one of the major innovations of last century for fractures treatment.

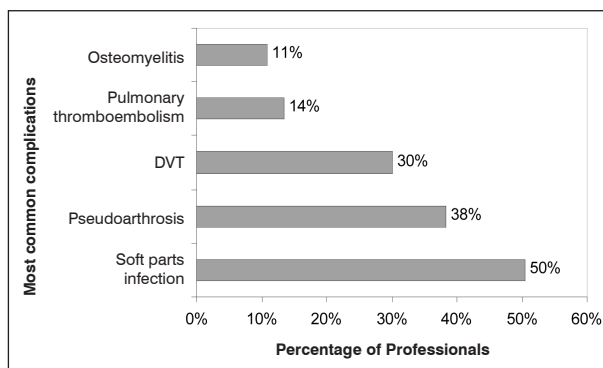


Figure 3 – Most common complications.

The first mention of intramedullary fixation is credited to conquerors of the 16th Century. They noticed that Incas and Aztecs used resinous wood pins at medullary channel of long bones intending to treat pseudoarthrosis. That report was found in a small paragraph in Spanish files, but it does not provide technical details, of the number of pins employed, or of outcomes.

Ivory pins were mentioned by

König⁽⁶⁾, in Germany, in 1913.

Silver pins were used by Schöne, from Kiel clinic, in Germany, in 1913. It seems that silver tended to control bacterial contamination⁽⁷⁾.

Hey Groves, in England, used the intramedullary fixation technique in femoral fractures caused by gun bullets during the First World War. In three patients, the pins employed closely resembled current devices. There were three nail standards: a perforated tube, a nail with an X-shaped section and a solid round nail, which was preferred, because of the absence of crevices that might give shelter to infections⁽⁸⁾. All pins failed, and the author gave up the method, not performing any additional experiments.

A well succeeded intramedullary osteosynthesis, as we know it, emerged during the Second World War, with a study by Küntscher in 1940⁽⁹⁾.

Grosse & Kempf proposed a method that consisted in a resistant nail introduced into the milled medullary channel and fixed to the bone by means of a proximal screw and two distal screws to fracture core. They emphasized recommendations on the use of orthopaedic table, image intensifier and surgeon's hands protection against radiation⁽¹⁰⁾.

Paschoal introduced the FMRP nail (from the Medical College of Ribeirão Preto). As advantages against nails available in Brazil at that time, that nail did not require the use of image intensifiers and had a lower cost. The blockage was done by means of two screws at the trochanter region and two other screws at the distal portion of the femur⁽¹¹⁾. Biomechanical studies prove that the FMRP nail is more rigid to flexion and to torsion than the AO-ASIF nails (universal nail). Its mechanical behavior was superior when implanted in *in vitro* human femurs compared to the AO-ASIF nail⁽¹²⁾. The high union rate was seen with the clinical application of this nail (94.4%) and few complications were reported⁽¹³⁾.

Osteosynthesis with retrograde intramedullary nail presents some advantages compared to the anterograde nails in the following situations: obese patients; multiple-trauma patients; those with ipsilateral fractures of the pelvis, acetabulum, proximal femur and tibia. Apparently, there is no difference regarding union time, pseudoarthrosis rate, and postoperative knee pain².

There are evidences in literature that medullary channel milling

reduced pseudoarthrosis rates in lower limb's long bones fractures 3. In Brazil, we see that short transverse and oblique fractures at the isthmus are not preferably (54%) treated with milled blocked intramedullary nails, agreeing with current evidences in literature.

External fixators find application particularly in multiple-trauma patients and at the early stabilization of complex and floating-knees fractures. In this study, a low applicability rate is seen for external fixators in femoral diaphyseal fractures (6% in simple line fractures, and 10% in complex line fractures).

Osteosynthesis with compression plates, allowing for an active mobilization of the limb and primary union by rigid fixation was introduced by Danis, (apud Colton, 1996). That study directly influenced the creation of the Swiss AO group (Arbeitsgemeinschaft für Osteosynthesefragen)⁽¹⁴⁾. Several authors published their results with the use of plates in femoral diaphyseal fractures treatment, emphasizing that complications are greater when cortical contact is not achievable. The osteosynthesis based on the absolute stability principle through compression plates is still a reality in Brazil, corresponding to the method of choice of 25% of surgeons in simple line fractures and of 15% in complex line fractures. This is probably due to the fact that, in many regions in the country, radiology is not available for intramedullary osteosynthesis, or, they do not count on staff members familiar to it. It's a method fostering tissues devitalization and, as a result, higher infection rates, union delay and pseudoarthrosis.

The concept of biological fixation of fractures was introduced by Krettek, when the term "MIPPO" (minimally invasive percutaneous plate osteosynthesis) became popular, which consisted of inserting plates by means of proximal and distal incisions to fracture core, as well as an indirect manipulation of fractured fragments⁽¹⁵⁾.

For femoral multiple-fragmentary diaphyseal fractures treatment, both blocked intramedullary nails and bridge plates enable good clinical outcomes, with high union rate and few complications⁽⁴⁾.

We noticed that 54% of Brazilian orthopaedic doctors choose osteosynthesis with bridge plate for treating complex line fractures. Current literature considers this method as a reliable alternative for femoral diaphyseal fractures fixation⁽⁵⁾, especially in places where intramedullary implants are not available.

Another controversial issue is regarding the use of traction table or not to perform intramedullary osteosynthesis. Stephen et al⁽¹⁶⁾ reported that there was no statistically significant difference regarding surgery time and quality of reduction in a total of 87 patients randomized to use traction table or not.

During a long period, traction constituted a definitive treatment form for femoral diaphyseal fractures. Today, due to the early stabilization concept for those fractures, both skin traction (modified by Buck 1861) and the skeletal traction, of which the mostly recognized one is the Thomas-Pearson balanced traction, became temporary methods, until a definitive fracture fixation is achieved.

The vast majority of Brazilian orthopaedic doctors (72%)

prefer preoperative skeletal traction. Maybe because 63% of them do not perform osteosynthesis within the first 24 hours of fracture; whether due to operational reasons or due to a belief that the initial muscular spasm could make fracture reduction difficult.

People carrying femoral diaphyseal fractures are, most of times, multiple-trauma patients, and remain in hospital for a long period (average: 26 days), which results in a high costly treatment. In this study, we noticed that 61% of the orthopaedic doctors reported an average hospitalization time of up to five days. This could be explained because, at the questionnaire, an isolated femoral diaphyseal fracture approach was emphasized.

It's a consensus that femoral diaphyseal fractures should be early operated (within the first 24 hours)⁽¹⁷⁾, especially due to potential pulmonary complications inherent of long bones fractures. Some authors, however, reported that there was no influence on union time and knee range of motion in patients lately operated (9.1 days)⁽⁴⁾. We can notice, in this study, that the majority of surgeons (63%) do not operate patients within the first 24 hours after trauma, maybe because a large portion of orthopaedic doctors work in public services where operational difficulties are bigger.

The antibiotic prophylaxis is recommended even in closed fractures osteosyntheses. It may be used in a single preoperative dose if the antibiotic agent reaches the minimal inhibitory strength for a period of 12 hours. Antibiotic agents with a shorter half-life may also be used, but in multiple doses allowing a minimal inhibitory strength for a period of 12 hours. Cephalosporin is the mostly used antibiotic agent⁽¹⁸⁾. In this item, we notice that the vast majority of orthopaedic doctors does not perform antibiotic prophylaxis according to current recommendations provided by literature, which could justify the high infection rates reported by them (50% report soft parts infection, and 11% osteomyelitis, while, in the second group, 41% of the orthopaedic doctors ($p=0.658$) report soft parts infection as a common complication, and 10% ($p=0.0438^*$) reported osteomyelitis.

Regarding the use of suction drains postoperatively, there is no evidence based in randomized studies supporting or refusing its use in orthopaedic surgeries for closed fractures⁽¹⁹⁾.

Thromboembolic phenomena are common complications in femoral fractures. The use of non-fractionated heparins, or, preferably, low molecular weight heparins reduced the incidence of deep venous thrombosis, as well as foot pumps⁽²⁰⁾.

Nevertheless, there is no evidence showing the existence of protection against pulmonary thromboembolism or reduced mortality rate with its use⁽²⁰⁾. Most of Brazilian orthopaedic doctors (77%) perform antithrombotic prophylaxis with low molecular weight heparin, which is in accordance to current evidences in literature. It is important to mention that 7% of the interviewed individuals perform antithrombotic prophylaxis with warfarin. Not only this method is not the first choice for these situations, but the use of such drug also requires periodical control with RNI.

Regarding sample size, we conclude that this is representative

(507 fully answered questionnaires, in a total of 518), once the Brazilian Society of Orthopaedics and Traumatology (SBOT) is composed of 7260 people, being 6581 permanent members and 679 associate members. Resident doctors belonging to services certified by SBOT comprehend a total of 1311 individuals.

By comparing the sample size in this study to that reported in international literature, a significantly superior number was achieved by Khalily et al⁽²¹⁾, who achieved 178 and Bhandari et al⁽²²⁾, with 444 questionnaires answered in cross-sectional studies about closed fractures and other fractures in general (closed and open) of tibial diaphysis, respectively.

Regarding the distribution of members in their correspondent states, SBOT concentrates 61.39% of orthopaedic doctors in Southeastern region, 16.76% in Southern region, 7.10% in the Mid-West, 12.03% in Northeastern region, and 2.69 in the North, which demonstrates that this sample is representative, with similar distribution of interviewed individuals.

In this study, 67% of questionnaires were filled by orthopaedic doctors from Southeastern region; 11% from the South; 11% from Northeast; 8% from Mid-West, and 3% from North.

It is important to observe responses related to the various regions of the Country, so that we can check if the economical power in some centers matters when compared to other less favored centers in treating patients with femoral diaphyseal fractures, or if there is any difference on technical knowledge about the matter in different regions of the Country.

In this study, no statistically significant difference was seen regarding methods for fixing these fractures.

The identification of the individuals who answered the questionnaire concerning their titles is also important for checking if there is any difference of statistically significant answer among permanent members, associate members and resi-

dent doctors in orthopaedics. The issue recertification was not addressed as well, since only the individuals with more than five years of expert title can be recertified, which could create a false idea of SBOT's members outdated.

There was a statistically significant difference between individuals' answers (regarding their titles) about the treatment method for simple and complex line fractures. Among resident doctors in Orthopaedics, 45% ($p=0.000^*$) perform osteosynthesis with milled blocked intramedullary nail, which is considered as the method of choice for femoral diaphyseal fractures. The same method is used by 34% of permanent members and by 24% of SBOT's associate members. In complex line fractures, 30% ($p=0.000^*$) of resident doctors use this method, compared to 24% of permanent members and 11% of associate members.

We chose not to identify the authors on questionnaire head, because, according to a report by Bhandari⁽²³⁾ in 2003, in the United States, exhibiting names of surgeons belonging to a known institution may negatively influence the individuals' response rate on questionnaires.

CONCLUSIONS

We conclude that, concerning adult femoral closed diaphyseal fractures treatment, most of Brazilian orthopaedic doctors: considers fracture line as the major parameter for treatment decision; use the AO-ASIF classification; perform osteosynthesis with milled blocked intramedullary nail for short transverse and oblique fractures at the isthmus and with bridge plate in complex line fractures; use preoperative skeletal traction; see infection as the most common complication, and; perform antithrombotic prophylaxis with low molecular weight heparin.

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