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What is the ideal working length for bridge plating osteosynthesis of a femoral shaft fracture? A multinational online survey evaluation

Qual é a área de trabalho ideal na fixação de uma fratura da diáfise do fêmur com placa em ponte? Estudo multinacional transversal

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ABSTRACT

Objective: *to evaluate how orthopedic surgeons in Latin America define the working length for distinct patterns of femoral shaft fracture.* **Methods:** *a survey was developed presenting different options of working length in four femoral fracture patterns. The survey was submitted to the participants using Google Forms tool. The association between professional characteristics and medical management options according to each type of fracture was analyzed by Chi-square test, with 5% significance level.* **Results:** *seven hundred and seven professionals from all Latin America answered the survey. The majority prefered a smaller working length for all situations presented in the study. There was a significant association between the main interest area and the medical preference for the management in fracture types AO 32-B3 and 32-C2 (p<0.05). Other professional characteristics had no significant association at the level of 5%.* **Conclusion:** *most of the study participants preferred constructions with smaller working length, representing approximately one-third of the total length of the plate, regardless of fracture pattern. There was a significant association between the main interest area (orthopedic trauma) and medical management options for fracture type AO 32-B3 and 32-C2. This can be attributed in part to the fact that these two types of fractures are considered, in the view of the authors, intermediate patterns in terms of strain. This study reinforces the importance of understanding the concept of working length, showing that its calculation remains more based on the surgeons' experience than grounded by strong biomechanical concepts governing the fracture healing process.*

Keywords: *Surveys and questionnaires. Bone plates. Bone screws. Femoral fractures.*

INTRODUCTION

Fracture of femur shaft is relatively common, with a prevalence of approximately 3/10,000 people[1]. Due to its high morbidity and mortality, particularly associated to high direct and indirect costs, it is a severe health public issue. Its treatment is constantly evolving, based on the higher understanding of local anatomy and biomechanical forces involved in the fixation techniques[1,2]. Nowadays, osteosynthesis with an intramedullary tutor, in special in blocked intramedullary shaft, is standardized for this type of fracture, with low rates of infection and pseudoarthrosis[1].

However, some clinical situations, such as a very narrow medullary channel, previous vicious consolidation or the presence of implants that occupies partially the medullary channel (such as prosthesis, for example) make intramedullary osteoshyntesis unfeasible or difficult[1]. In these patients, the use of extra-medullary implants is a treatment option for fracture of femur shaft, and it is necessary to determine which method must be used[1]. The construction of a model with absolute stability, although allowing anatomical and direct reduction of the fracture, requires some devitalization of neighbor tissues around the bone, implying in healing problems of soft tissue and delayed consolidation[1,2]. For those reasons, in view of the current concepts, the use of an indirect reduction technique is advised for a more elastic stabilization of the fracture [1-5].

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However, very rigid constructions are responsible for the inadequate and usually asymmetric formation of bone callus, associated or not to implant fatigue. On the other hand, elasticity of the construction plate/screws is still undefined[5]. At present, the length of the implant and the location and number of screws are defined by the surgeons' experience instead of biomechanics evidence[5,6]. Recent guidelines using blocked implants suggest that the plate must be the longest possible and that at least three bi-cortical screws must be placed at each side of the fracture, but do not define which is the ideal working area for different patterns of femur shaft fracture[5-8].

In the authors experience, simple trace fractures, with high deformation percentage of the fracture site (strain) must have a working area bigger than that calculated for more complex fractures. Taking into account that hypothesis (H_0), the objective of the present work was to evaluate, by a question form, the medical choice of treatment of orthopedic surgeons from different countries of Latin America to define the working area in distinct patterns of femur shaft fractures.

METHODS

It was developed a question form, divided in two parts. The first part collected information about the participant, and the second presented fixation options for four different femur shaft fractures to be selected as best choice.

Question form was developed and submitted to participants using Google Forms tool. Invitation with the link to answer the questionnaire were sent by email by the Latin America Trauma Office (AOTLat - *Oficina da AO Trauma Latino-Americana)*. All affiliates of this medical association were invited to answer. The question form was in Spanish for all AOTLat members, except for Brazilians, who used a Portuguese version.

The first part of the question form was developed to identify professional experience grade, kind of practice and area with higher interest and action in the specialty. Since each participant was invited by email, his nationality could be identified, but this data was not used for statistical analysis.

In the second part, it was presented four fracture patterns, with illustration representing fractures classified by the AO Group as 32-A3, 32-B3, 32-C2 and 32-C3. The choice of the types of fractures was made considering those with higher trace (32-AA3 and 32-B30 and lower strain (32-C2 and32-C30), with different morphologies. In the four presented situations, the center of the fracture was always located at most central point of the femoral diaphysis. In 32-A3 fracture, it was created a fracture to simulate a 2mm diastase between proximal and distal fragments, allowing the contact of trans cortical during load. In the types 32-B3, 32-C2 and 32-C3, fracture zone was located precisely at the medium third of diaphysis. Patterns of fracture are illustrated in Figure 1, that shows the representation of fractures 32-A3, 32-B3, 32-C2 and 32-C3 of the AO classification, with one of the constructions of the answer options. In types 32-B3, 32-C2 and 32-C3 the fracture zone was located at the medium third of diaphysis.

In each of these fractures, it was presented to the participants four options of answers, and three of them contained different constructions of fixation with blocked plate, with varying distribution of screws. Most proximal and most distal screws were always present and the distribution of the remaining screws was based on clinical experience and on published studies[9,10]. The represented implant corresponded to a straight LCP® (Locking Compression Plate®, DPS, USA) with 16 holes and screws numbers in a crescent fashion, from 1 to16. Although not specifically pointed out to the participants, illustrations represented

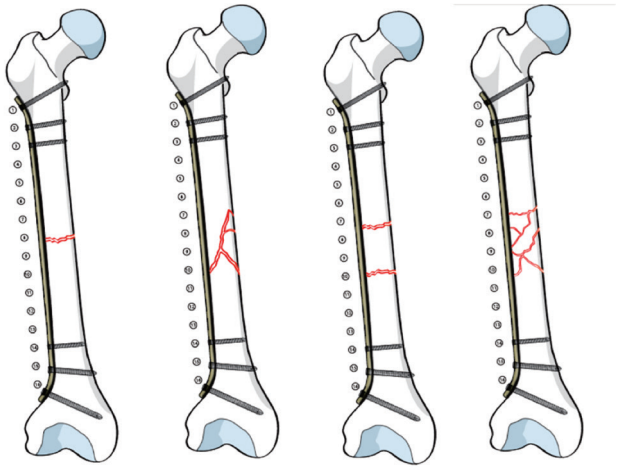

Figure 1. *Representation of the types of fractures.*

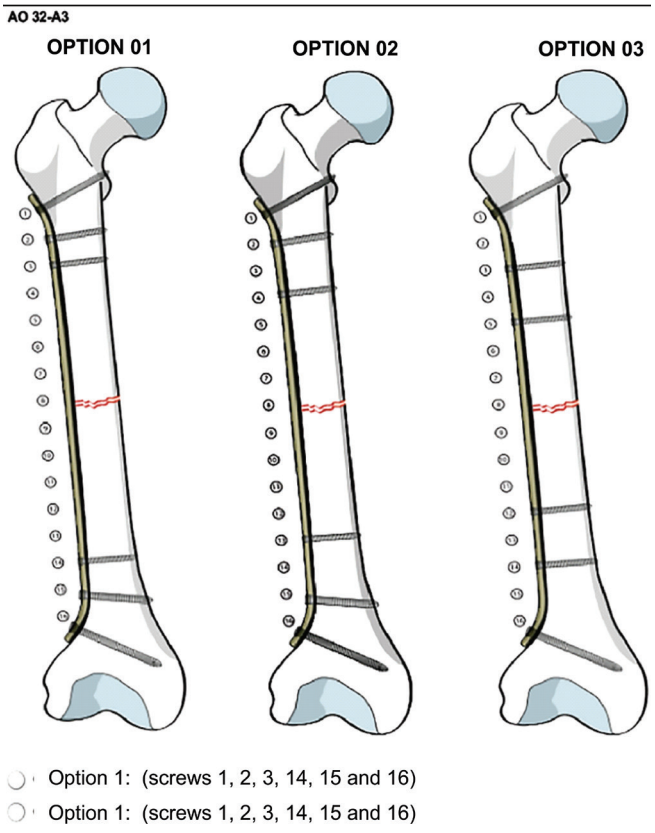

Figure 2. *Example of one of the presented situations, representing a fracture type AO 32-A3. It must be observed that the working area diminishes from option 1 to option 3. The last option allowed participants to choose none of the presented options (questionnaire in Spanish).*

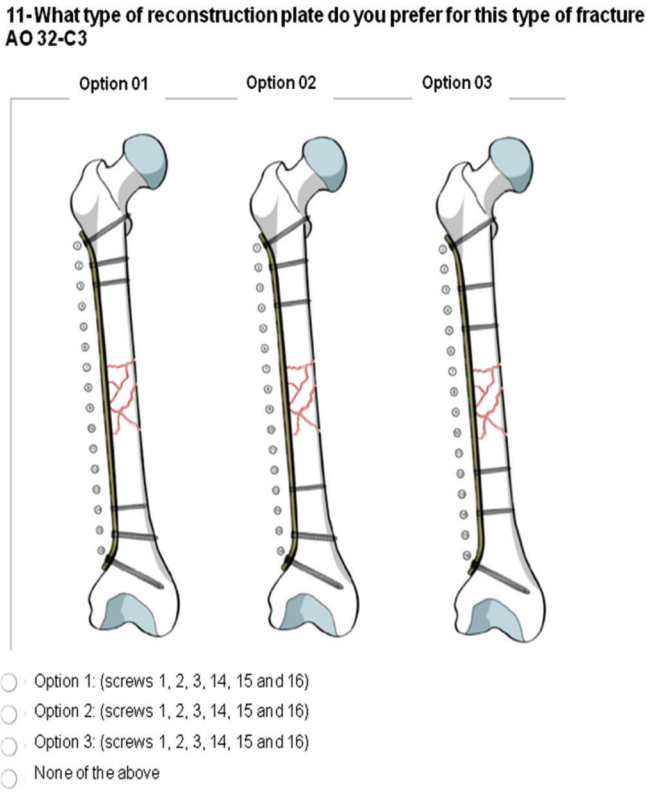

Figure 3. *Example of one of the situations presented to participants, representing a fracture type AO 32.C3. The working area is progressively smaller from option 1 to 3. The last option allowed the participants to choose none of the presented constructions (questionnaire in Portuguese).*

blocked screws. Regardless of the type of fracture, construction options were always the same. Figures 2 and 3 show examples of the second part of que questionnaire. In each of the four presented situations, it was asked to the participant the confidence level of his answer (Figure 4).

Data were gathered according to frequency and percentage, and presented in some graphics. Association between professional characteristics (experience, kind of practice and area with higher interest in the specialty) and medical treatment options according to each type of fracture were analyzed by Chi-square test (X^2). It was used a p=0.05 level of significance. Statistical analysis was processed by the statistical software SPSS version 20.0.

RESULTS

Seven hundred and seven professionals of Latin America from 15 different countries answered the questionnaire. Tables 1,2 and 3 show the frequency (n) and percentage (%) respectively, of professional characteristics and opinion regarding medical choice of treatment and respective confidence grade. In relation to professional experience, participants were divided in three categories: "less than 5 years", "5 to 10 years", and "10 or more years" and were grouped in "less than 5 years" and "5 or more years". In relation to type of professional practice, participants were

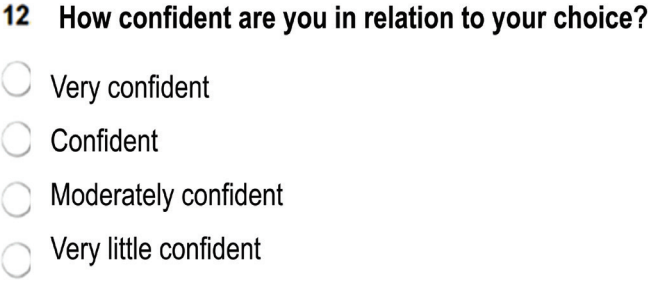

Figure 4. *Confidence level of the answer (questionnaire in Portuguese).*

divided in "academic", "non-academic", and "private practice", and posteriorly grouped as "academic" and "non-academic/private practice". In relation to area with higher interest and action in the specialty, participants were divided in "general", "orthopedics" and "trauma". Group "orthopedics" involved all participants that answered something different than General or Trauma.

Distribution of medical choice options for treatment according to type of fracture is shown in Figure 5.

Each type of fracture was individually evaluated and the results will be presented in the same manner.

- Type AO 32-A3 – there was no significant association at 5% of significance level between professional characteristics and choice of treatment for fracture AO 32-A3. Table 4 shows a descriptive analysis (frequency and percentage) of professional characteristics and treatment choice (option 1, option 2, option 3 and none) and the corresponding descriptive level (*p value*) of X^2 test. Some grouping of professional characteristics was made, to strengthen the tendency of observed results.

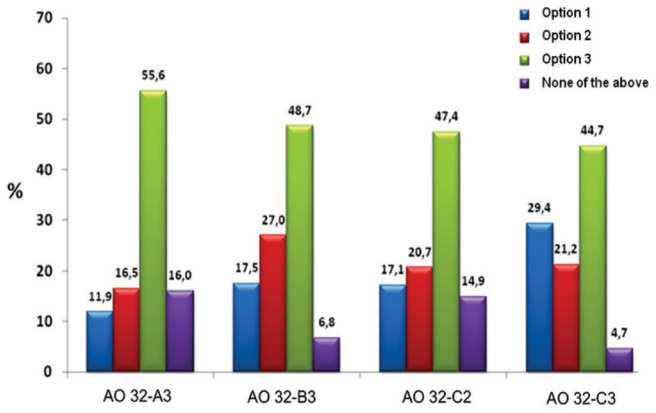

Figure 5. *Distribution option of medical choices of treatment according to the type of fracture (AO classification).*

- Type AO 32-B3 – there was a significant association between area with more interest in the specialty and medical treatment choice for fracture AO 32-B3 (p=0.029 with three categories and p=0.020 with two categories). Participants more interested in trauma tended to choose "options 1, 2 and 3", while generalists (General and Orthopedics) tended to choose "none". Other professional characteristics did not show any significant association at 5% of significance level, for medical choice of treatment of fracture type AO 32-B3. Table 5 shows the descriptive analysis (frequency and percentage) of

Table 1. *Distribution of professional characteristic of 707 participants.*

Question	Category	n	%
How long have you finished Medical Residence?	Less than 5 years	348	49.2
	5 – 10 years	117	16.5
	More than 10 years	242	34.2
How long have you finished Medical Residence? (*grouped*)	Less than 5 years	348	49.2
	5 or more years	359	50.8
How is your daily practice?	Academic	362	51.2
	Non-academic	195	27.6
	Private practice	150	21.2
How is your daily practice? *(grouped)*	Academic	362	51.2
	Non-academic/private practice	345	48.8
Which is your main interest in the specialty?	General	144	20.4
	Orthopedics	284	40.2
	Trauma	279	39.5

Source: SOT-HMMC. 2016.

Table 2. *Distribution of answers in relation to medical choice of treatment*

Type of fracture	Category	n	%
AO 32-A3	Option 1	84	11.9
	Option 2	117	16.5
	Option 3	393	55.6
	None of the above	113	16.0
AO 32-B3	Option 1	124	17.5
	Option 2	191	27.0
	Option 3	344	48.7
	None of the above	48	6.8
AO 32-C2	Option 1	121	17.1
	Option 2	146	20.7
	Option 3	335	47.4
	None of the above	105	14.9
AO 32-C3	Option 1	208	29.4
	Option 2	150	21.2
	Option 3	316	44.7
	None of the above	33	4.7

Source: SOT-HMMC. 2016.

professional characteristics according to medical choice (option1, option 2, option 3, and none) and the corresponding descriptive level (*p value*) of x^2 test. Grouping was made of professional categories to strengthen tendency of observed results.

- Type AO 32-C2 – there was a significant association between major interest area in the specialty and medical choice of treatment for fracture type AO 32-C2 (p=0.034 with two categories), meaning that participants with major interest in orthopedic trauma tend to choose "options 1,2 and 3", while generalists (general and orthopedics) tend to choose "none". There is a tendency of association between major area of interest in the specialty and medical choice of treatment for fracture type AO 32-C2 (p=0.11 with three categories). Other professional categories did not present any significant association at 5% of significance level with medical choice of treatment. Table 6 shows a descriptive analysis (frequency and percentage) of professional characteristics according to medical choice of treatment (option 1, option 2, option 3 and none) and the corresponding descriptive level (*p value*) of X^2 test. Grouping was made of professional characteristics to strength tendency of observed results.
- Type AO 32-C3 – there was a strong tendency of association between major area of interest in the specialty and medical choice of treatment for fracture type AO 32-C3 (p=0.062 with two categories). Participants with major interest in orthopedic trauma tended to choose "options 1,2 and 3), while generalists (General and Orthopedics) tend to choose "none". Probably this loss of significance, at 5% of significance level, is caused by the low number of "none" answers (n=33) for fracture type AO 32-C3. Other professional characteristics did not show any significant association at 5% of significance level, with medical choice of treatment for fracture type AO 32-C3. There was a slight tendency among specialists with more than 10 years of experience to choose the medical treatment "none", while those with less than 10 years of experience tended to

choose "options 1,2 and 3" (p=0.34). Table 7 shows a descriptive analysis (frequency and percentage) of professional characteristics according to medical choice of treatment (option 1, option 2, option 3 and none) and the corresponding descriptive level (*p value*) of X^2 test. Grouping was made of professional characteristics to strength observed results.

DISCUSSION

Consolidation process of fractured bone depends directly of the biological and mechanical environment determined, respectively, by the kinetic energy that generated the lesion and by the type of stability provided by the surgeon[3-6,8]. In the treatment of the femur diaphysis fracture, bridge plate is indicated when the use of intramedullary tutor is contraindicated[1]. However, in the present, there is still doubt about which is the better construction for each pattern of fracture. According to the strain theory described by Perren[5], when stability principle is based on plate, osteosynthesis construction must present mechanical characteristics that turn it not too rigid or too flexible[2-5]. The understanding of the modulation of rigidity of the construction allows the surgeon to perform an osteosynthesis that is capable to balance biological and mechanical characteristics of each type of fracture.

Axial resistance grade and torsional stiffness of an extramedullary tutor may be modulated by the size of the working area, defined by the plate length under the fracture focus without fixation to the bone [4,7,9]. However, relationship of working area and interfragment mobility (strain) at the fracture focus is still undefined, making the screw positioning depended exclusively to the surgeon's experience.

In the present study, where simple trace patterns of fracture (higher strain) and complex trace (lower strain) were used, it was observed that most participants preferred a smaller working area,

Table 3. *Distribution of the confidence level in relation to corresponding medical treatment option.*

How confident are you in relation to your choice?	Category	n	%
Type AO 32-A3	Very confident	221	31.3
	Confident	359	50.8
	Moderately confident	73	10.3
	Very little confident	54	7.6
Type AO 32-B3	Very confident	202	28.6
	Confident	381	53.9
	Moderately confident	81	11.5
	Very little confident	43	6.1
Type AO32-C2	Very confident	151	21.4
	Confident	384	54.3
	Moderately confident	122	17.3
	Very little confident	50	7.1
Type AO 32-C3	Very confident	187	26.4
	Confident	376	53.2
	Moderately confident	105	14.9
	Very little confident	39	5.5

Source: SOT-HMMC. 2016.

Table 4. *Professional characteristic and medical choice of treatment for each fracture type.*

Question	Category	Option 1		Option 2		Option 3		none		*p value*
		n	%	n	%	n	%	n	%	
How long have you finished Medical Residency?	Less than 5 years	46	54.8	54	46.2	195	49.6	53	46.9	0.58
	5 - 10 years	8	9.5	23	19.7	68	17.3	18	15.9	
	More than 10 years	30	35.7	40	34.2	130	33.1	42	37.2	
How long have you finished Medical Residency?	Less than 5 years	46	54.8	54	46.2	195	49.6	53	46.9	0.63
	5 or more years	38	45.2	63	53.8	198	50.4	60	53.1	
How long have you finished Medical Residency?	10 or less years	54	64.3	77	65.8	263	66.9	71	62.8	0.86
	More than 10 years	30	35.7	40	34.2	130	33.1	42	37.2	
How do you categorize your daily practice?	Academic	36	42.9	61	52.1	204	51.9	61	54.0	0.68
	Non-academic	28	33.3	35	29.9	104	26.5	28	24.8	
	Private practice	20	23.8	21	17.9	85	21.6	24	21.2	
How do you categorize your daily practice?	Academic	36	42.9	61	52.1	204	51.9	61	54.0	0.42
	Non- academic / Private Practice	48	57.1	56	47.9	189	48.1	52	46.0	
Which is your main interest in the specialty?	General	10	11.9	21	17.9	84	21.4	29	25.7	0.26
	Orthopedics	34	40.5	50	42.7	154	39.2	46	40.7	
	Trauma	40	47.6	46	39.3	155	39.4	38	33.6	
Which is your main interest in the specialty?	General/Orthopedics	44	52.4	71	60.7	238	60.6	75	66.4	0.27
	Trauma	40	47.6	46	39.3	155	39.4	38	33.6	

x^2 test

Source: SOT-HMMC. 2016.

corresponding to one third of the plate length, regardless the pattern of the fracture. When asked about their confidence grade of the answers for the four situations, once again most participants answered that they were very confident or confident about the choice. Experience time and area with most interest of the specialty were important for the choice, in particular in some types of fractures (32-B3 e 32-C2).

In the authors opinion, different from the participants, distinct fracture patterns, involving such an antagonistic interfragment mobility as observed in fractures type AO 32-A3 e AO 32-C3 should be treated with different working areas . Ideally, in the bridge plate, interfragment mobility should be balanced under the implant and at the opposite cortical (trans), respecting the concept of stress shielding[3,4,10]. This is clearly observed in fractures with simpler trace, such as AO 32-A3, in the presence of a correct alignment of proximal and distal fragments. Instead, in fractures with major contact defects or severe fragmentation, as in type AO 32-C3, stress concentration is supported singly by the implant, according to the concept of stress rising. Intermediate patterns depend of other factors, such as the local of the bone wedge (type AO 32-B3) and alignment of intermediate fragment (type AO 32-C2).

When planning the working area calculation for a diaphysis fracture with simple trace, to fixate it

Table 5. *Professional characteristic according to medical treatment choice for fracture type AO 32-B3*

Question	Category	Option 1		Option 2		Option 3		None		*p value*
		n	%	n	%	n	%	n	%	
How long have you finished Medical Residency?	Less than 5 years	67	54.0	90	47.1	170	49.4	21	43.8	0.79
	5 - 10 years	20	16.1	36	18.8	53	15.4	8	16.7	
	More than 10 years	37	29.8	65	34.0	121	35.2	19	39.6	
How long have you finished Medical Residency?	Less than 5 years	67	54.0	90	47.1	170	49.4	21	43.8	0.56
	5 or more years	57	46.0	101	52.9	174	50.6	27	56.3	
How long have you finished Medical Residency?	10 or less years	87	70.2	126	66.0	223	64.8	29	60.4	0.61
	More than 10 years	37	29.8	65	34.0	121	35.2	19	39.6	
How is your daily practice?	Academic	63	50.8	99	51.8	177	51.5	23	47.9	0.97
	Non-academic	37	29.8	54	28.3	90	26.2	14	29.2	
	Private practice	24	19.4	38	19.9	77	22.4	11	22.9	
How is your daily practice?	Academic	63	50.8	99	51.8	177	51.5	23	47.9	0.97
	Non-academic / Private practice	61	49.2	92	48.2	167	48.5	25	52.1	
Which is your main interest in the specialty?	General	22	17.7	38	19.9	67	19.5	17	35.4	0.029
	Orthopedics	56	45.2	67	35.1	140	40.7	21	43.8	
	Trauma	46	37.1	86	45.0	137	39.8	10	20.8	
Which is your main interest in the specialty?	General/Orthopedics	78	62.9	105	55.0	207	60.2	38	79.2	0.020
	Trauma	46	37.1	86	45.0	137	39.8	10	20.8	

x^2 test

Source: SOT-HMMC. 2016.

with a bridge plate, it seems logical that the working area must be longer, allowing more flexibility of the implant. The more rigid is the construction, the higher the concentration of stress in a smaller region of the implant, increasing the risk of fatigue during the consolidation process of the fracture[10,11]. When the construction area is increased, stress concentration over the implant, particularly during flexion, is smaller, since the deformation area is bigger; also, there is a limiting factor of the bending moment consequently protecting the plate, represented by the contact to the trans cortical[10]. This observation is corroborated by several authors observations[3,4,7,9,10]. By the use of an experimental model with sheep, it was demonstrated that an axial compression distance of 20% to 30% of the interval length in a 3-millimeter defect is capable to promote bone consolidation in approximately nine weeks[4,11]. In view of the known adaptive qualities of the bone, osteogenesis process is stimulated by elevated stress (or deformation), in the presence of enough stability between bone and plate[5].

According to the same concept, when planning the construction of the bridge plate for a multifragment fracture of femur diaphysis, working area should be the closest possible to the zone fracture[10]. Since stress concentration is observed at the fracture level, the smaller the working area is, the lower the stress over the implant (4,5,10). This

Table 6. *Professional characteristic according to medical choice of treatment for fracture type AO 32-C2*

Question	Category	Option 1		Option 2		Option 3		None		*p value*
		n	%	n	%	n	%	n	%	
How long have you finished Medical Residency?	Less than 5 years	61	50.4	68	46.6	165	49.3	54	51.4	0.90
	5 - 10 years	16	13.2	24	16.4	59	17.6	18	17.1	
	More than 10 years	44	36.4	54	37.0	111	33.1	33	31.4	
How long have you finished Medical Residency?	Less than 5 years	61	50.4	68	46.6	165	49.3	54	51.4	0.88
	5 or more years	60	49.6	78	53.4	170	50.7	51	48.6	
How long have you finished Medical Residency?	10 or less years	77	63.6	92	63.0	224	66.9	72	68.6	0.73
	More than 10 years	44	36.4	54	37.0	111	33.1	33	31.4	
How is your daily practice?	Academic	53	43.8	78	53.4	176	52.5	55	52.4	0.24
	Non-academic	45	37.2	33	22.6	89	26.6	28	26.7	
	Private practice	23	19.0	35	24.0	70	20.9	22	21.0	
How is your daily practice?	Academic	53	43.8	78	53.4	176	52.5	55	52.4	0.35
	Non-academic / Private practice	68	56.2	68	46.6	159	47.5	50	47.6	
Which is your main interest in the specialty?	General	22	18.2	27	18.5	69	20.6	26	24.8	0.11
	Orthopedics	54	44.6	59	40.4	121	36.1	50	47.6	
	Trauma	45	37.2	60	41.1	145	43.3	29	27.6	
Which is your main interest in the specialty?	General/Orthopedics	76	62.8	86	58.9	190	56.7	76	72.4	0.034
	Trauma	45	37.2	60	41.1	145	43.3	29	27.6	

x^2 test

Source: SOT-HMMC. 2016.

fact leads to higher axial rigidity under the plate, with reduced interfragment mobility and implant deformation[10]. It has been shown that, in highly fragmented fractures, more flexible constructions predispose to inadequate formation of bone callus, potentially causing hypertrophic pseudoarthrosis or plastic deformation and mechanical failure of the implant[5,10,12].

As mentioned before, intermediate patterns of fracture must be individually addressed according to the fracture concept. It must be kept in mind the need to maintain the balance between biology and mechanics, controlling variables such as reduction quality, choice of implant and rigidity grade of construction. Specifically, implant choice is important for stress modulation in the fracture focus[3,4,10,12]. Blocked plates support higher flexion loads and torsions than conventional plates, resulting in higher stress over the implant. Due to this fact, several authors propose the use of conventional cortical screws close the fracture focus, in particular when working area is smaller, what seems to be ideal for fractures with multifragment pattern[10,12,13]. This technical detail reduces rigidity of the construction compared to the use of blocked screws[13].

In the present study, although it was not the choice of most participants, the authors options for the different presented situation would be the use of

Table 7. *Professional characteristic according to medical choice of treatment for fracture type AO 32-C3*

Question	Category	Option 1		Option 2		Option 3		None		*p value*
		n	%	n	%	n	%	n	%	
How long have you finished Medical Residency?	Less than 5 years	106	51.0	75	50.0	152	48.1	15	45.5	0.50
	5 - 10 years	35	16.8	23	15.3	57	18.0	2	6.1	
	More than 10 years	67	32.2	52	34.7	107	33.9	16	48.5	
How long have you finished Medical Residency?	Less than 5 years	106	51.0	75	50.0	152	48.1	15	45.5	0.89
	5 or more years	102	49.0	75	50.0	164	51.9	18	54.5	
How long have you finished Medical Residency?	10 or less than 10 years	141	67.8	98	65.3	209	66.1	17	51.5	0.34
	More than 10 years	67	32.2	52	34.7	107	33.9	16	48.5	
How is your daily practice?	Academic	101	48.6	77	51.3	165	52.2	19	57.6	0.58
	Non-academic	66	31.7	44	29.3	77	24.4	8	24.2	
	Private Practice	41	19.7	29	19.3	74	23.4	6	18.2	
How is your daily practice?	Academic	101	48.6	77	51.3	165	52.2	19	57.6	0.74
	Non-academic / Private practice	107	51.4	73	48.7	151	47.8	14	42.4	
Which is your main interest in the specialty?	General	38	18.3	35	23.3	61	19.3	10	30.3	0.18
	Orthopedics	87	41.8	58	38.7	122	38.6	17	51.5	
	Trauma	83	39.9	57	38.0	133	42.1	6	18.2	
Which is your main interest in the specialty?	General/Orthopedics	125	60.1	93	62.0	183	57.9	27	81.8	0.062
	Trauma	83	39.9	57	38.0	133	42.1	6	18.2	

x^2 test

Source: SOT-HMMC. 2016.

a bigger working area for type AO 32-A3 ("option 1") and a smaller working area for type AO 32-C3 ("option 3"). For the other types (AO 32-B3 and 32-C2), presented at the question form, with correct axial alignment at coronal plane, we would choose an intermediate working area ("option 2"), due to the existence of some sharing grade of stress between bone and implant. It has been observed lower von Mises tension over the construction when there is bone in contact and increased working area, reducing the risk of plate failure[4,10].

Our study has some limitations. One is the three distinct options of working areas, although other possibilities may exist. For this reason, each participant had the opportunity to answer that none presented option would be chosen. The choice of the assemblies used in the study tried to reproduce a model where the working area was long ("option 1"), short ("option 3"), and intermediate ("option 2"). Mardian et al (9) used similar methodology for investigation. These authors used four working areas for a quantitative analysis with finite elements using computed tomography. The definition of the position of the screws was based in their personal experience and in published recommendations[9,10].

Another limitation of the study is that the models were based in the skeleton of a young adult with excellent bone mass. The answers could have

been different for older patients, and particularly with reduced bone mass. However, in these situations, other technical details of osteosynthesis seem to be more important than the definition of the working area itself[14,15]. For example, if we increase the plate length, distribution of stress will occur throughout the implant, preventing concentration at the fracture level and improving the resistance of the construction[15]. In our study, the length of the implant was the longest possible among straight and non-anatomic blocked plates, according to current recommendations.

Finally, the absence of a significant association among most professional categories and the medical choice of treatment may be regarded as a study limitation. However, only in fracture type AO 32-A3 it was observed a complete association. In types AO 32-B3 and 32-C2 it was observed statistical significance at 5% with participants with higher interest in orthopedic trauma, that tended to choose more the options "1, 2, and 3". However, in type AO 32-C3, there was no statistical significance. Probably this loss of significance at a 5% level was caused by the small number of answers "none" (n=33) for this type of fracture.

We can conclude in our study that most participants (49.1%) preferred constructions with smaller working areas, representing approximately one third of total length of the plate, regardless the fracture pattern. There was a significant association between the area with more interest in the specialty (orthopedic trauma) and medical choice of treatment for fractures type AO 32-B3 and 32-C2, probably because these fractures present intermediate strain. Our study reinforces the importance of understanding the working area, but questions its concept, since its calculus is still more based on the surgeon experience than on biomechanical principles that dictate the consolidation process of the fractures.

RESUMO

Objetivo: avaliar a conduta de cirurgiões ortopédicos da América Latina na definição da área de trabalho em distintos padrões de fratura da diáfise do fêmur. **Métodos**: foi desenvolvido um questionário em que foram apresentadas opções de fixação extra-medular em quatro padrões de fratura da diáfise do fêmur com três diferentes áreas de trabalho. O questionário foi submetido aos participantes utilizando-se a ferramenta *Googleforms*. A associação entre as características profissionais e as opções de conduta médica de acordo com cada tipo de fratura foi analisada pelo teste de qui-quadrado, com nível de significância de 5%. **Resultados**: setecentos e sete profissionais da América Latina responderam o questionário. A maioria dos participantes optou por uma menor área de trabalho na osteossíntese em todas as situações do estudo. Observou-se associação significativa entre a especialidade e a conduta médica nas fraturas do tipo AO 32-B3 e 32-C2 ($p < 0,05$). As demais características profissionais não mostraram associação significativa. **Conclusão**: a maioria dos participantes deste estudo prefere construções com menor área de trabalho, representando aproximadamente um terço do comprimento total da placa, independentemente do padrão de fratura. Houve associação significativa entre o tipo de especialidade (trauma ortopédico) e as opções de conduta para as fraturas do tipo AO 32-B3 e 32-C. O presente estudo reforça a importância da compreensão do conceito de área de trabalho, mostrando que sua estimativa continua sendo baseada mais na experiência do cirurgião do que em conceitos biomecânicos que regem o processo de consolidação de fraturas.

Descritores: Inquéritos e questionários. Placas ósseas. Parafusos ósseos. Fraturas do fêmur.

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