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Astur Neto, Nelson; Antunes Barreto Lins, Romero; Kojima, Kodi Edson; Leme da Cunha, Bruno; Hungria Neto, José Soares; Tomanik Mercadante, Marcelo; Walter Christian, Ralph; Soares Hungria, José Octávio

Resultados do tratamento das fraturas da diáfise do fêmur ipsilaterais às do colo ou transtrocantérica

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OUTCOMES IN TREATMENT OF DIAPHISEAL FEMUR FRACTURES IPSILATERAL TO THE NECK OR TRANSTROCANTERIC FRACTURE

NELSON ASTUR NETO, ROMERO ANTUNES BARRETO LINS, KODI EDSON KOJIMA, BRUNO LEME DA CUNHA, JOSÉ SOARES HUNGRIA NETO, MARCELO TOMANIK MERCADANTE, RALPH WALTER CHRISTIAN, JOSÉ OCTÁVIO SOARES HUNGRIA

ABSTRACT

Objective: To perform a radiographic and functional evaluation of the complications of diaphyseal fractures of the femur associated with ipsilateral fractures of the trochanter or the neck of the femur. Methods: From 2002 to 2007, seventeen patients were treated, of which 88% were men, with a mean age of thirty-one years and three months. Ten (59%) had associated fractures of the femoral neck and seven (41%) had associated trochanteric fractures. The final range of motion of the hip and knee, the radiographic fracture consolidation, and the type of implant, used were evaluated, both at the time and retrospectively, based on the patients' records. The mean follow-up time was 48 months. Results: All the trochanteric fractures consolidated without residual deformities. Of the femoral neck fractures, three (30%) presented delayed consolidation and two consolidated with in varus deformity. Two patients had delayed diaphyseal consolidation. All the associated diaphyseal/trochanteric fractures had good or excellent functional outcomes. Of the associated neck fractures, seven (70%) had excellent or good results, two had regular results, and one had a bad result. Conclusions: The association of diaphyseal with trochanteric femur fractures showed better radiographic and functional results, with less complications, than the association of diaphyseal and femoral neck fractures.

Keywords: Hip fractures. Femoral fractures. Intramedullary fracture fixation. Femoral neck. Femur.

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INTRODUCTION

Diaphyseal femur fractures affect young patients, victims of high-energy trauma,[1] giving rise to frequent association with injuries to the knee or in the proximal region.[2] The injuries are caused by the large quantity of kinetic energy, which generates compression force, affecting the flexed knee, with the hip also flexed and discreetly abducted. A considerable part of this kinetic energy is dissipated in the diaphyseal fracture. The residual energy continues in the direction of the hip, where it causes a peculiar kind of fracture, determined by the lower intensity of energy.[3] For this reason, it is important to perform a careful evaluation of the hip in search of fractures in this region. The transtrochanteric fracture, due to the more evident radiographic image, hardly ever goes undiagnosed, yet the fracture of the neck is frequently neglected.[3-6]

Individually, each one of these fractures already represents a challenge to treatment; when in association, therapy becomes more complex. The concomitance of diaphyseal fracture of the femur with the neck was described in literature for the first time in 1953 by Delaney and Street[5] and the association with transtrochanteric fracture, in 1961 by Kimbrough.[6]

In fractures of the proximal portion of the femur, when isolated, the fixation of the transtrochanteric fracture in general presents better clinical and radiographic evolution than that of the femoral neck. The aim of this study was to evaluate the clinical and radiographic evolution and the complications of the treatment of these fractures when associated with the ipsilateral diaphyseal fracture.

All the authors declare that there is no potential conflict of interest referring to this article.

Faculdade de Ciências Médicas da Santa Casa de São Paulo.

Study conducted in the Department of Orthopedics and Traumatology of Santa Casa de São Paulo - Pavilhão Fernandinho Simonsen.
Mailing address: *Santa Casa de Misericórdia de São Paulo – Departamento de Ortopedia e Traumatologia (Pavilhão "Fernandinho Simonsen"), Grupo do Trauma. Rua Dr. Cesário Motta Jr., 112 .São Paulo, SP, Brazil, CEP: 01227-900. Email: nelsonan@yahoo.com / trauma@santacasasp.org.br*

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CASUISTRY AND METHODS

This retrospective observational study has as a population a sample group of patients with the injury under analysis that did not evolve to death and received surgical treatment between August 2002 and October 2007 in a large university hospital with public healthcare provision. During the period, 440 patients with femoral fractures were operated by the same orthopedic trauma team in the Orthopedics and Traumatology department of the hospital, among which 17 (3.8%) presented femoral diaphyseal fractures in association with ipsilateral fracture of the proximal portion of the same femur. Only patients with a minimum follow-up of 13 months were included in this study. There was no loss of follow-up of any patient in this period.

Fifteen (88%) patients were male and two (12%) female, and age ranged from 19 to 47 years with mean age of 31 years and 3 months. The right side was affected in 4 (23%) patients and the left in 13 (77%), with no bilateral case.

Association with fracture of the femoral neck occurred in 10 (59%) patients and association with transtrochanteric fracture in seven (41%).

The trauma mechanism was motorcycle accident in eight (47%) patients, followed by automobile accident in five (29%) and other causes such as run-over accidents and fall from height in the other four (24%) patients. The fracture was exposed in the femoral diaphysis in only one (6%) case.

Associated lesions occurred in 12 (70%) patients. (Table 1) In 9 (53%) patients the associated lesion occurred in the lower limbs. Two (12%) patients presented association with abdominal lesion and another two (12%) with thoracic lesion.

The postoperative follow-up ranged from 18 to 79 months with mean period of 48 months, and the hospitalization time of the patients was 12 days on average. The results were evaluated retrospectively through analysis of the medical records and of the photographs of the patients and radiographs from the group file besides the current functional and radiographic physical personal evaluation. As routine, all the patients in the postoperative period and their radiographs are photographed in the outpatient follow-up visits.

The classification adopted for femoral neck fractures was that proposed by Garden[7] and the transtrochanteric fractures were classified according to Tronzo.[8] Diaphyseal fractures were classified by the AO system.[9]

The surgical technique chosen for each patient was always decided in conjunction by the assistants of the orthopedic trauma group of the department and followed the osteosynethisis concepts of the AO group.[9]

The proximal and diaphyseal associated fractures treated with single implant were fixed with long cephalomedullary intramedullary PFN type nail (Synthes, Paoli, United States), which confers relative stability both in the proximal fracture and in the diaphysis. In those fixed with independent implants, the diaphysis was fixed with relative stability with DFN type retrograde intramedullary nail (Synthes, Paoli, United States), or with absolute stability with DCP autocompression plate (dynamic compression plate type). Proximal fractures were fixed targeting absolute stability, either with cannulated screws or with DHS type sliding screw plate (dynamic hip screw type).

Consolidation of fractures, presence of deviations and/or shortening, range of motion of knee and hip and residual pain were considered in the analysis of treatment results.

The results were classified according to Thoresen et al.[10] (Table 2) considering the criterion of lesser performance.

Complications considered were delayed consolidation; faulty consolidation; residual pain classified by the patient as absent, low, moderate and intense; and loss of knee movement, measured in degrees of flexion and extension.

RESULTS

All the results are described in Table 3.

Of the 10 patient with association of diaphyseal and the femoral neck fractures, five (50%) presented diaphyseal fracture classified as type A (simple) and five (50%) classified as type B (wedge). Fe-

Table 1 – *Associated lesions.*

Patient	Fractures	Other organs
2	L Collarbone + L Ankle	-
3	R Patella + R tibia and fibula exposed	-
4	L Patella + R and L Forefoot + L3	-
5	Opening of the Symphysis	Sigmoid lesion + Retroperitoneal hematoma
6	R Ankle + R Patella + R Tibial Pilon + R Talus dislocation	R pneumothorax + CET
7	R ankle exposed + R leg + L ankle	Sigmoid lesion
8	5 L costal arches + L patella	Pneumothorax
11	R Tibial Plateau	
12	R Acetabulum + L Ulna + R and L Ischiopubic rami	-
14	L Patella	-
15	Avulsion fracture of the tibial tuberosity	-
17	Transversal Processes L1 – L4	

The patients absent in the Table did not suffer associated lesions

Table 2 – *Classification of results according to Thoresen et al.[10]*

	Results			
	Excellent	Good	Regular	Poor
Angular deviation				
Varus or valgus (degrees)	5	5	10	> 10
Antecurvatum or *recurvatum* (degrees)	5	10	15	> 15
Internal rotation (degrees)	5	10	15	> 15
External rotation (degrees)	10	15	20	> 20
Shortening (cm)	1	2	3	> 3
Range of motion of knee (degrees)				
Flexion (degrees)	> 120	120	90	< 90
Extension deficit (degrees)	5	10	15	> 15
Pain or edema	absence	sporadic, low	moderate	intense

Table 3 – *Synthesis of data of the patients studied.*

Patient	Gender	Age	Side	TM	FT	NF	TF	DF	Synthesis M	DC	DP	DD	Pain	Flex J	Res
1	M	41	L	Fh	71	IV	-	A2	Long PFN	prox	-	-	moderate	0-130	regular
2	M	46	L	Motorc.	17	-	II	B2	Long PFN	diaphysis	-	-	low	0-130	good
3	M	23	R	Motorc.	24	III	-	B3	DHS/DCP	-	5 varus	-	low	0-100	good
4	F	26	L	Fh	38	II	-	B2	2screw/DCP	prox/distal	12 varus	10 varus	moderate	0-90	poor
5	M	33	L	Automob	32	-	II	A3	Long PFN	-	-	-	absent	0-130	excellent
	M	19	L	Automob	18	II	-	B3	3screw/DFN	-	-	-	absent	0-140	excellent
7	M	33	R	Automob	78	-	I	C1	Long PFN	-	-	-	low	0-120	good
8	M	47	L	Motorc.	24	I	-	A3	3screw/DFN	-	-	-	absent	0-140	excellent
9	M	43	L	Automob.	78	-	II	A2	Long PFN	-	-	-	absent	0-130	excellent
10	M	23	L	Motorc.	79	II	-	A2	3screw/DCP	-	-	-	absent	0-140	excellent
11	M	43	R	automob.	75	II	-	B3	3screw/DCP bridge	-	-	5 recurv	absent	0-140	excellent
12	F	23	L	runover	34	III	-	A3	3screw/DCP	prox	10 varus	-	low	0-130	regular
13	M	29	R	Motorc.	71	-	II	A2	Long PFN	-	-	-	absent	0-130	excellent
14	M	25	L	Motorc.	18	II	-	A3	3screw/DCP	-	-	-	absent	0-130	excellent
15	M	37	L	Motorc.	49	-	II	B3	Long PFN	-	-	-	absent	0-130	excellent
16	M	26	L	Motorc.	41	-	I	A3	Long PFN	-	-	-	absent	0-130	excellent
17	M	40	L	Automob.	78	II	-	B3	2screw/DCP bridge	-	-	-	absent	0-140	good

TM: trauma mechanism (fh = fall from height above 3 meters); FT: follow-up time in months; NF: neck fracture classified according to Garden; TF: transtrochanteric fracture classified according to Boyd & Griffin modified by Tronzo; DF: classification of the diaphyseal fracture according to AO; Synthesis M: synthesis material used in the proximal focus/distal focus; DC: delayed consolidation; DP: angular deviation in degrees in the proximal fracture (vg = valgus; vr = varus); DD: angular deviation in degrees in the distal fracture; Shor: shortening in cm; Pain: spor = sporadic; Flex J: knee flexion in degrees; Res: classification of results according to Thoresen. PFN: Proximal Femoral Nail; DFN: Distal Femoral Nail; DHS: Dynamic Hip Screw; DCP: Dynamic Compression Plate; 3 screw: 3 Cannulated Screws.

moral neck fracture was classified as Garden I in only one (10%) patient, type II in six (60%), type III in two (20%) and type IV in one (10%) case. There was one case (10%) in which the diagnosis of neck fracture was not performed in the initial patient visit.

Of the seven diaphyseal fractures in association with transtrochanteric fracture, four (57%) were of type A, two (28%) of type B and one (15%) of type C (complex). The transtrochanteric fracture was Tronzo type in two (28%) patients and type II in the other five (72%) patients.

Of the patients with neck-diaphysis fracture, the neck fracture was treated in one (10%) case with long PFN type cephalomedullary intramedullary nail, in one (10%) with sliding screw plate, in one (10%) with two cannulated screws and in the other seven (70%) patients with three 7.0 mm cannulated screws. In the case treated with the long cephalomedullary intramedullary nail, the diaphyseal fracture was treated with the same implant. Two (20%) patients had the diaphyseal fracture fixed with DFN type retrograde intramedullary nail, (Figure 1) and seven (70%) were fixed with 4.5mm autocompression (DCP) plate.

All seven (100%) cases of transdiaphyseal association were treated with PFN type long cephalomedullary intramedullary nail. (Figure 2)

The functional result was considered excellent and good in 14 (82%) patients, regular in two (12%) and poor in one (6%). The three cases with poor functional result were from the neck-diaphyseal group.

There was delayed consolidation in the proximal region in three (18%) patients and of the diaphysis in two (12%). All the cases of delayed proximal consolidation occurred in the neck-diaphysis group. Of the diaphyseal consolidation disorders, one occurred in the neck-diaphysis group and one in the transdiaphyseal group. One patient from the neck-diaphyseal group that evolved with postoperative infection presented delayed consolidation of the neck fracture and of the femoral diaphysis fracture simultaneously. Varus deformity of the proximal region of the femur was detected in three patients (18%). All these cases were from the neck-diaphysis group with consequent varus deformity of 5º, 10º and 12º. In the transdiaphyseal case there was no loss of proximal reduction, with deformity, in any case.

Faulty consolidation of the femoral diaphysis occurred in two (12%) patients. One in the neck-diaphysis group with varus deformity of 10 degrees and another in the transdiaphyseal group with recurvatum of 5 degrees were both treated with fixation of the diaphysis using a plate.

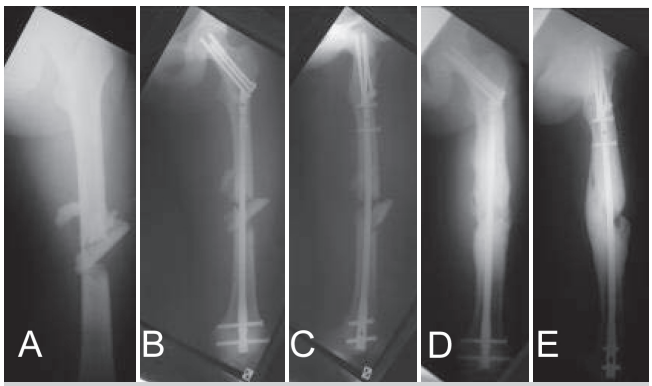

Figure 1 - *Patient with femoral neck and diaphysis fracture treated with DFN and cannulated screws. A) Preoperative radiography; B,C) AP and lateral radiographies in immediate postoperative period; D,E) 1 year and 2 months postoperative, AP and lateral radiographies.*

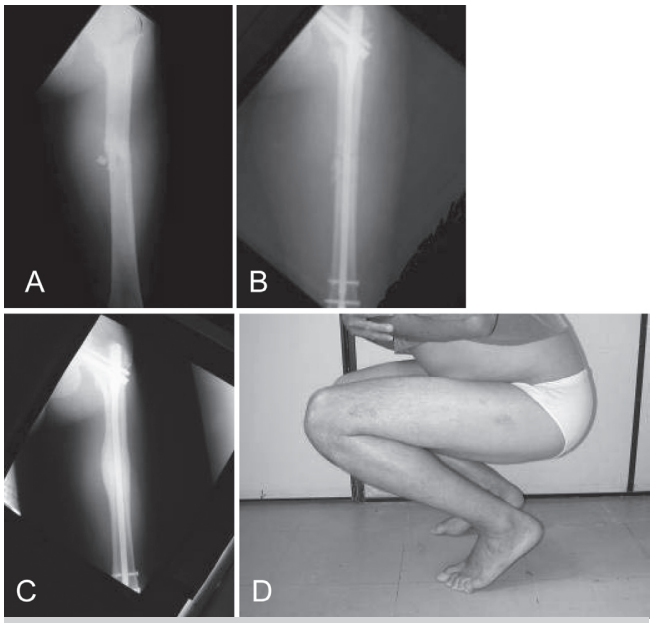

Figure 2 – *Patient with transtrochanteric and femoral diaphysis fracture treated with long PFN. A) Preoperative radiography; B) Radiography in immediate postoperative period; C) 4 years postoperative; D) Clinical result 2 years after operation.*

In the late postoperative period, pain was absent in 11 (65%) patients, low in four (23%) and moderate in two (12%) cases. There was no pain of high intensity in any patient. We observed that the two cases of moderate pain occurred in the neck-diaphysis group.

Knee mobility was reestablished in all the patients except one from the neck-diaphysis group who presented range of motion from 0 to 90 degrees.

DISCUSSION

The epidemiology of this study corresponds to that of literature in relation to the gender affected, with greater incidence of cases in male patients.[4] However, what draws attention is the mean age of our patients, 31 years and three months, which was higher than most studies that evaluate patients with fracture of the femoral diaphysis alone. In these studies, the mean age bracket is in the second decade.[11,12] Another epidemiologic fact that differs from literature was the high incidence of cases provoked by motorcycle accidents (47%). This must be a consequence of the current traffic conditions in our country, with heavier traffic and a greater number of motorcyclists. In the city of São Paulo there is an average of 25 serious motorcycle accidents per day, which result in death or hospitalization for more than 24 hours according to the Associação Brasileira de Medicina de Tráfego (ABRAMET – Brazilian Traffic Medicine Association).[13,14] Due to the trauma mechanism of motorcycle accidents, the lower limb is more exposed, hence the high association that occurred with other fractures of the lower limbs in our patients (53%). (Table 1) The higher number of fractures caused by motorcycle accidents may explain the involvement of patients with a higher mean age, as the drivers that are accident victims are usually express delivery workers, and generally adults of a more advanced age.

The association with abdominal and thoracic lesions occurred in 24% of the patients (Table 1), a higher value than studies that analyze the patient with isolated diaphyseal or proximal fracture of the femur.[7,10-12,15] This high number must be related to the higher level of energy required to cause the ipsilateral fracture of the diaphysis and proximal fracture of the femur, resulting in a patient with more associated lesions, and therefore of more difficult and costly treatment for the public health system, as before the treatment of fractures systemic lesions often need to be treated and the need to admit patients to the intensive care unit is not uncommon.

International literature shows that proximal fractures of the femur, especially those of the neck, are often neglected in the first consultation, attaining 60% of diagnostic failure in some studies.[4,16-18] In our study we had only one case (6%) of neck fracture that was not detected at the time of initial diagnosis. The verification of neck fracture was performed during the fixation of the diaphyseal fracture, thus not giving rise to a delay in treatment of the fracture. Accordingly, it is always worthwhile emphasizing the importance of the careful evaluation of the proximal region in diaphyseal fractures of the femur, in search of associated fractures, with a special focus on neck fracture. Radiographies of this region are usually hard to perform due to the pain of the patient and the position in flexion and lateral rotation of the proximal fragment. If the patient had a computed tomography due to abdominal trauma, it is often possible to search for the femoral neck fracture in the more caudal cuts. In the operation it is advisable to evaluate the proximal region of the femur after anesthesia and positioning of the patient with the radioscopy.[4]

In our cases, association with neck fracture was the most frequent (59%), yet in a lower proportion than that described by Shuler et al.,[19] who had 90% of the cases with neck fracture. In the casuistry of these authors, automobile accidents were the most frequent cause, and certainly the trauma mechanism that causes femoral fracture is different from that provoked by motorcycle accidents. In automobile accidents, the trauma of the knee on the dashboard, leading to axial force on the femur, also exerts axial pressure in the proximal region, favoring the femoral neck fracture. In motorcycle accidents there is axial force on the femoral diaphysis, but there are also associated flexion and shear forces, which may explain the greater frequency of associated transtrochanteric fractures in our patients. Unlike transtrochanteric fractures, which were stable in all the cases, femoral neck fractures were stable in 70%, and unstable in 30% of the cases. This data is important, as stable fractures tend to have a better evolution than unstable ones, especially in the region of the femoral neck.[15,20-22]

Several treatment techniques have been advocated for these associated lesions, with no consensus regarding the ideal method.[17,23] Wellin et al.[24] warn that fracture of the intermediate bone segment may occur during the use of two plates for the fixation of both fractures. Swiontkowski[17] considered the treatment of neck fractures with screws and that of the diaphysis with the adequate intramedullary nail. In 1985, Barquet et al.[16] describe preference in the treatment with AO-ASIF plates that allow consolidation in a good position with early and painless mobilization. In a meta-analysis published in 1996, Alho[4] reports the treatment of diaphysis with intramedullary nails as the most effective and with the lowest incidence of complications.

In 9 of the 10 cases of neck-diaphysis association in this study there was fixation using independent implants, that is, one method for fixation of the neck and another of the diaphysis. This choice was made because we believe that the use of the single implant, of the long cephalomedullary intramedullary nail type, is not indicated in these cases for the following reasons: 1) intramedullary nails are not suitable in femoral neck fractures,[22,25] 2) the entrance point of the intramedullary nail is very close to the neck fracture, 3) there may be deviation of the fracture upon introduction of the nail and 4) the adequate positioning of the screws for fixation of the neck through the intramedullary nail is not always easy.

From the clinical point of view, according to the classification of Thoresen et al,[10] (Table 1) who evaluates angular and rotational deformities, shortening, arc of flexion of the knee and presence of pain, all the cases of transdiaphyseal association showed an excellent or good result. Of the 10 cases of neck-diaphysis association one presented a poor result, with faulty proximal and diaphyseal consolidation, pain and limitation of knee movement. And two cases were classified as regular, as they presented evolution problems of the proximal region and pain. (Table 4) Due to the small number of patients in this casuistry, the statistical study does not bring significant differences.

In the cases of neck-diaphysis association, the only patient fixed with long cephalomedullary intramedullary nail exhibited unfavorable evolution, with delayed consolidation of the neck fracture and functional result considered regular. It is difficult to correlate the poor result with use of the single implant, as more important still, we observed that the neck fracture was Garden 4, and thus with deviation and unstable. But after the appearance of the complication its treatment is much more difficult, as the same implant fixes the two fractures, hindering the correction of the proximal deformation or complication without the removal of the implant, which would interfere in the fixation of the diaphysis.[26]

Of the nine cases of neck-diaphysis treated with independent syntheses, only one case was treated with sliding screw plate and the other eight, with cannulated screws. Of this group, two patients presented delayed consolidation of the femoral neck fracture. One of them presented Garden III neck fracture treated with three cannulated screws and consolidated with 10 degrees of varus and the other presented Garden II neck fracture fixed only with two cannulated screws consolidated with 12 degress of varus. The probable cause of the failure of the first patient must have been the poor reduction of the neck fracture, which despite fixation with three screws, led to loss of reduction in varus. The second patient presented a Garden II type neck fracture, thus without deviation, and was fixed with two screws, which placed very close to one another, must have conferred insufficient fixation.

We observed that as is the case in the isolated fracture of the femoral neck, fixation with plate and screws or with cannulated screws offers good results, whereas the complications are related to inadequate reduction, insufficient fixation or instable fractures with deviation.[15,20-22,25]

In our patients of the neck-diaphysis association, only 30% were fixed with intramedullary synthesis, which today is considered standard for fixation of the diaphysis.[9,12,27] All these patients presented good evolution with consolidation of the diaphyseal fracture, without deformities. Of the patients fixed with plate, one presented consolidation in recurvatum, which did not interfere in the final result and did not require re-intervention. Another patient (patient 4, Table 3, Figure 3) presented unfavorable evolution both of the neck fracture and of the diaphyseal fracture, with consolidation in varus of the femoral neck and development of inflection in the femoral diaphysis fracture. The infection was treated conventionally, yet there was also consolidation in varus of the diaphysis that brought about a poor functional result. The plate, as a synthesis that causes greater aggression to the soft tissues,[9,27-30] might have been a factor for the development of the infection.

The transdiaphyseal association proved to have a better prognosis, with consolidation of all the fractures and good functional result in all the patients. This occurred because the trochanteric region presents in itself a better biological condition for consolidation and, as described previously, the fractures did not present deviation, which makes the surgery easier and the good result more predictable.

Table 4 – *Range of motion of the hips of patients with limitation.*

Patient	1	2	4	13	14
M.R.	30	20	30	30	30
L.R.	20	40	20	30	20
Flexion	110	90	100	110	110
Extension	0	10	10	30	20
Aduction	15	20	20	20	20
Abduction	30	30	30	50	40

M.R. = Medial rotation; E.R. = Lateral rotation. Values in degrees

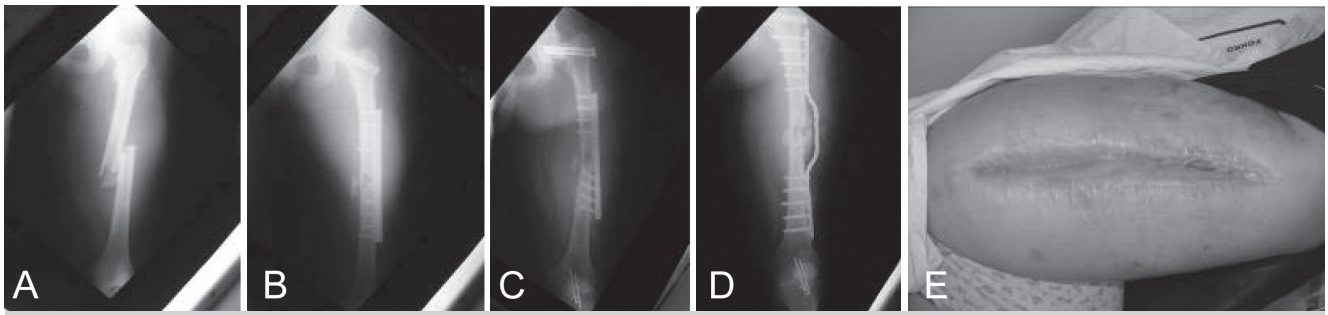

Figure 3 – *Patient with femoral neck and diaphyseal fracture treated with plate and screws. A) Preoperative radiography; B) Radiography in the immediate postoperative period; C) 1 year postoperative showing implant failure; D) Immediate postoperative period after change of plate; E) Patient persists with active fistula.*

When the diaphyseal fracture is associated with the transtrochanteric fracture without deviation, the fixation is technically easier, as it is sufficient to initiate the procedure with the temporary fixation of the transtrochanteric fracture then to perform the introduction of the nail, followed by cephalic and distal fixation. In cases with deviation, it is essential to perform previous reduction of the transtrochanteric fracture, which is not easy with manual distal manipulation, with the distractor or on the traction table, due to the presence of the diaphyseal fracture. In most cases it is necessary to perform reduction with direct manipulation of the fragments, executed preferentially in a percutaneous manner, but that can be open if minimally invasive reduction is not performed.

Transtrochanteric fractures tend to present good evolution because, besides being of the stable pattern, without fragmentation, they present a large contact area and good vascularization. Once again attention should be drawn to the need for good reduction prior to the insertion of the intramedullary nail.

In spite of the small casuistry, which rules out statistically significant analysis, evaluating our results, we see that the neck-diaphysis and transdiaphyseal association have very different behaviors. The transdiaphyses have a more favorable evolution, with better radiographic and functional evolution and the treatment can be performed with single cephalomedullary implant. However, the neck-diapysis association has a more reserved prognosis, with a greater number of complications and unfavorable results both in the neck and in the diaphysis, meaning that the best option is the treatment of this lesion with independent implants for neck and diaphyseal fractures, which would favor better treatment of each one of the fractures and ease in the treatment of any complications.

CONCLUSION

We concluded that in our cases, femoral diaphysis fractures in association with ipsilateral transtrochanteric fracture appear to have a better clinical and radiographic evolution than when the diaphyseal fracture is associated with the femoral neck fracture, with the latter having presenting a higher incidence of complications both of the neck fracture and of the diaphyseal fracture.

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