

PREDICTIVE FACTORS FOR GAIT IN FEMORAL TRANSTROCHANTERIC FRACTURES

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ABSTRACT

Objective: The objective of this study was to identify variables that could predict the quality of gait in patients with transtrochanteric femoral fractures after treatment. **Materials and Methods:** Hospitalized patients diagnosed with transtrochanteric femoral fractures were selected between September/2005 and August/2006 and followed-up for 6 months after the trauma date. An observational prospective study was conducted to assess the quality of gait 3 and 6 months after fracture in 31 patients (13 males and 18 females). The mean age was

76±2,7. **Results:** Seven patients (22,6%) passed away during the follow-up period. The patients with associated fractures or with four or more co-morbidities showed a worse quality of gait after 6 months. Patients without orthopaedic complications or who got partial weight load prior to 30 days showed a better performance. **Conclusion:** The quantification of predictive gait indexes allows us to propose new treatment approaches consistently to the different realities showed by each group of patients.

Keywords: Hip fractures. Gait. Postoperative complications.

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INTRODUCTION

Transtrochanteric region, located between major and minor trochanter, is the interface between femoral neck and shaft, characterized by a dense bone trabeculate, responsible for transferring load to the lower limb. Transtrochanteric fractures account for most proximal femur fractures, and they occur predominantly in aged people, presenting an important incidence increase in the last few decades.^{1,2}

The most prevalent mechanism of trauma is falls during gait.^{3,4} In aged people, systemic comorbidities are frequent and should be considered when selecting a therapeutic approach.⁵

The treatment of choice is surgery, aimed to provide a stable internal fixation and an early return to ambulation. The most frequently employed materials are plates with pressure screws and proximal femoral intramedullary nails.^{6,7}

The immobilization caused by fracture may lead to or worsen several clinical and orthopaedic pathologies, such as osteoporosis, with a mortality rate after one year that can reach to 33% of the cases.^{8,9}

Studies show that a patient with clinical intercurrents during hospitalization, such as delirium, usually present a worse gait quality after fracture¹⁰ and that the pre-fracture level of functional activity is strictly related to gait ability after treatment.¹¹

However, there is no standardization in literature for postoperative gait predictive factors on femoral transtrochanteric fractures.

The purpose of the present study is to identify variables able to

predict gait quality of patients with transtrochanteric fractures after treatment.

MATERIALS AND METHODS

Patients hospitalized with the diagnosis of transtrochanteric fracture have been selected from September 2005 to August 2006, who have been followed up for a period of six months after trauma.

Patients skeletally immature and with pathological fractures were excluded, totaling 31 patients included in the study.

After signing a previous consent form, each patient was assessed through a structured questionnaire and by physical examination on the first hospitalization week, and then three and six months after trauma.

Epidemiological data, fracture classification, associated comorbidities, presence of delirium, gait quality and patient's pre-fracture independence were collected at the moment of hospital admission.

Many studies documented the low reproducibility of systems used for classifying transtrochanteric fractures.¹² Therefore, the classification as stable and unstable fractures was shown to be more interesting. Unstable fractures are those with comminution of the posteromedial cortex, with subtrochanteric extension or reverse obliquity.

The presence of delirium was diagnosed by DSM-IV criteria.¹³

In order to quantify gait quality and patient's independence prior and after fracture, we used the maximum distance achieved by

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walking, the ability to climb stairs and the ability to ambulate with and without support, providing a score for these items according to Table 1. Gait functional rate is provided by summing all items.

Table 1 – Gait functional index

Gait functional table	
distance walked	Score
unable to walk	0
up to three blocks	1
More than three blocks	2
stairs	
unable	0
difficult	1
normal	2
Support	
unable to walk	0
with support	1
without support	2

The patients were submitted to surgical treatment by the Trauma group in this institution, and data concerning surgical procedure, hospitalization time until surgery, surgical time, and total hospitalization time were recorded.

At the outpatient follow-up, the following were assessed: gait restart with or without support, gait quality, degree of mobility, and clinical and orthopaedic complications.

Statistical analysis of the results:

The analysis of results was performed by using the Fischer's test for all clinical and surgical parameters included in the protocol with a significance level of $p \leq 0.05$.

RESULTS

Eighteen female and 13 male patients were assessed (ratio: 1.4:1).

Mean age of the sample was 76 years \pm 2.74, ranging from 35 to 98 years. Twenty-six patients (83.9%) were older than 70 years.

The most frequent mechanism of trauma was simple fall, affecting 23 patients (74.2%). The others had high-energy trauma. Four reported high falls, three were hit by cars, and one fell from a motorcycle. Among the patients younger than 70 years, all had high-energy trauma.

Twenty-four patients (77%) had isolated transtrochanteric fractures, and seven associated fractures. One case of thoracic spine fracture, one pelvic fracture, 2 upper limb fractures, and three lower limb fractures. Sixteen were stable and 15 were unstable fractures.

Only six (19.3%) patients presented one or no clinical comorbidity, 12 had 2 to 4 comorbidities, and 13 (41.9%) had more

than four. Table 2 shows the distribution of the most frequent comorbidities.

Eleven patients had no previous history of falls, 11 have had previous falls but no fractures, while 9 reported histories of falls with fractures.

Eleven patients developed delirium during hospitalization, while 20 did not, according to DSM-IV criteria.

Seven patients passed away during the study. Three before surgical procedure, 2 during hospitalization and after surgical procedure, and 2 after hospital discharge.

Excluding the seven deaths, nine patients showed a gait functional index of 0 – 3 points, according to Table 2, and 15 patients scored 4-6 points. (Figure 1)

Table 2 – Distribution of patients' comorbidities

Comorbidity	Number of patients
High blood pressure	19
Heart diseases	13
Diabetes	11
Visual deficit	12
Hearing deficit	9
Cognitive deficit	8
Balance deficit	5

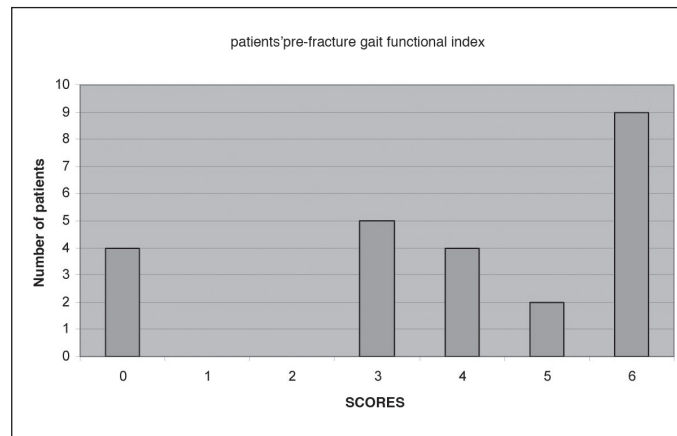


Figure 1 - Distribution of patients according to gait functional index scores before fracture

Of the 28 patients submitted to surgical treatment, 16 received plates with dynamic compression screws – angle: 135 degrees, 2 with PCCP-type plates, 5 with intramedullary nail for proximal femur, and, in 5 patients, plates with dynamic compression screw have been used – angle: 95 degrees.

The time interval between accident and surgery was 6.75 \pm 0.84 days, with 7 patients being operated within up to the third hospitalization day, 14 within 3 to 7 days, and seven patients were operated after 7 days.

Hospitalization time was 15.83 \pm 3.35 days, with 5 patients remaining in hospital for up to one week, 9 during over two weeks, and the remaining ones between one and two weeks.

Ten patients had postoperative clinical complications, and these are listed on Table 3.

Table 3 - Distribution of postoperative clinical complications

Clinical complications	Number of patients
Urinary infection	3
Pneumonia	3
Acute myocardial infarct	1
Arrhythmias	2
Pulmonary embolism	1
Acute pulmonary edema	1

Seven patients had postoperative orthopaedic complications during the 6 months of follow-up: 2 infections, 2 synthesis material failure, and 3 union delays.

Excluding the 7 deaths, we found 4 patients (16,6%) unable to walk prior to the fracture, and the patients included in this group remained so 3 and 6 months after fracture. Of the 20 patients able to walk (Table 4), only 11 (55%) with 6 months of follow-up could recover pre-fracture levels. In the group of patients who could walk at most for 3 blocks, 4 patients (57.1%), 6 months after fracture, remained unable to walk, and, in the group of subjects able to walk more than 3 blocks, only one (7.6%) remained disable, but this subject had suffered a high-energy trauma with multiple fractures. ($p < 0.05$).

Concerning the ability to climb stairs (Table 5), only 55% of the patients were able to reach pre-fracture levels after 6 months of follow-up.

Of the 14 patients who could walk without support before fracture (Table 6), three (21.4%) were unable to walk after 6 months. Of the 6 patients that walked with support, 2 were unable to walk after 6 months (33.3%), an insignificant difference.

With 3 months of fracture, we found the worst gait functional indexes, with 17 patients with scores ranging from 0 to 2 points, and 7 patients with 3-4 points, and none with 5-6 points (Figure 2).

But, after 6 months, excluding the seven deaths and the 4 patients with pre-fracture scores equal to 0, 13 of the 20 patients had fully recovered pre-fracture gait pattern or lost only one point on the gait functional index.

We found that gender, age, mechanism of trauma, fracture classification, delirium during hospitalization, previous history of falls, hospitalization time, and postoperative clinical complications did not influence gait functional index recovery.

Of this group of 20 patients, 6 had associated fractures, with only one patient losing 0 or 1 point of gait functional index after 6 months of trauma. But, in the group with isolated transtrochanteric fracture, 12 of 14 patients were fully recovered or lost only 1 point, a statistically significant difference ($p = 0.007$).

Of the 7 patients with 4 or more comorbidities, six lost more than one point 6 months after fracture compared to pre-fracture levels.

Table 4 - Maximum walked distance before fracture, and after 3 and 6 months

Pre-fracture		3 months after fracture		6 months after fracture	
Distance	Patients (N)	Distance	Patients (N)	Distance	Patients (N)
Unable	4	Unable	4	Unable	4
up to 3 blocks	7	unable	6	unable	4
		up to 3 blocks	1	up to 3 blocks	3
more than 3 blocks	13	unable	7	unable	1
		up to 3 blocks	6	up to 3 blocks	4
				more than 3 blocks	8

Table 5 - Ability to climb stairs, previously to fracture, and 3 and 6 months after fracture

Pre-fracture		3 months after fracture		6 months after fracture	
Stairs	Patients (N)	Stairs	Patients (N)	Stairs	Patients (N)
Unable	4	Unable	4	Unable	4
Difficult	11	Unable	9	Unable	4
		Difficult	2	Difficult	7
normally	9	Unable	4	Unable	1
		Difficult	5	Difficult	4
				normally	4

Table 6 – Ability to walk with and without support previously to fracture, and 3 and 6 months after fracture.

Pre-fracture		3 months after fracture		6 months after fracture	
Support	Patients (N)	Support	Patients (N)	Support	Patients (N)
Unable to walk	4	Unable to walk	4	Unable to walk	4
With support	6	Unable to walk	5	Unable to walk	2
		With support	1	With support	4
Without support	14	Unable to walk	8	Unable to walk	3
		With support	5	With support	1
		Without support	1	Without support	10

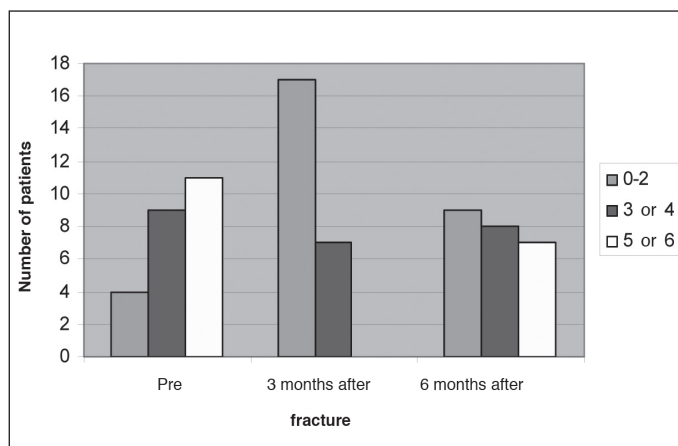


Figure 2 – Distribution of patients according to gait functional index scores before, and 3 and 6 months after fracture.

On the other hand, patients with less than 4 comorbidities (total: 13 patients), only 2 showed the same results, a statistically significant difference ($p=0.004$).

Patients with postoperative orthopaedic complications had worse results in terms of gait pattern recovery after 6 months of fracture ($p=0.007$).

Concerning the period of time between accident and surgery, we noticed that patients operated within 7 days at most showed a trend to have a better gait prognosis compared to those operated after 7 days. ($p=0.07$).

The patients in which partial load was released on the operated limb within up to 30 days had a better recovery of the gait quality after 6 months of fracture compared to patients in which load was released after 30 days ($p=0.05$).

DISCUSSION

In our sample, there was a prevalence of transtrochanteric fractures on aged people, 83.9% of the patients were older than 70 years, and the most frequent mechanism of trauma was simple fall, which is consistent with literature reports.^{2,3}

Over half (57%) of the fractures were treated with DHS (dynamic screws), reflecting the low complexity of fracture trace and low-energy mechanism of trauma as simple falls, as described by literature. Proximal femur nails (PFN) and DCS were preferably used on more complex fractures because they provide better stability. These two syntheses accounted for 36% of the surgical

procedures. There was no significant difference between assessed groups concerning gait quality. Baumgaertner et al.⁶ studied 135 transtrochanteric fractures and did not evidence differences after 6 months on groups treated with dynamic screws and proximal femur nails concerning functional recovery. Harrington et al.¹⁴ reported similar results after 12 months of follow-up.

The number of deaths during six months of follow-up was 23%, which is consistent with literature, reporting 30% within one year.^{8,9,15} This data is interesting for comparing statistics of large international trauma centers to the reality faced in our institution, indicating expertise, theoretical knowledge, and tradition in the treatment of trauma patients.

In the present study, we found that patients with associated fractures had a worse gait quality after 6 months as compared to the group with isolated transtrochanteric fracture. The association of transtrochanteric fracture and other fractures delays gait start: fractures on upper limbs do not enable the use of supportive orthoses; contralateral fractures on lower limbs do not enable gait training; axial skeleton fractures conservatively treated require up to three months in bed.

These patients, with mean age of 76 years, usually develop mental confusion associated to hospitalization; we had 35% incidence of delirium during hospitalization. Marcantonio et al.¹⁰ found that patients presenting delirium had worse gait prognosis after one month of transtrochanteric fracture. Our study did not evidence differences on gait functional level after 6 months of fracture. It is likely that the early return to family environment can enable patients to spatially locate themselves, retake normal awake-sleep cycle and reintegrate to daily live activities and, consequently, recover the ability to walk.

It was evidenced that a number of more than four comorbidities is associated to a worse gait quality after 6 months of trauma. One must keep in mind that in the age group of most patients with transtrochanteric fractures, four associated comorbidities is very usual. Therefore, some expertise should be used to explain rehabilitation challenges to patients and their families in order to balance expectations regarding a less favorable evolution. The higher number of comorbidities was correlated to a poorer recovery of the gait pattern in other studies.^{16,17}

Patients with a shorter time interval between accident and surgical treatment showed a trend to a better final functional gait recovery. Other studies show that a longer hospitalization time was a determinant factor for a worse gait prognosis.^{16,18}

Postoperative rehabilitation period was shown to be important for gait prediction. The emphasis on physical therapy and early gait training, as released by the orthopaedic doctor, must be considered, since the first month of recovery was the dividing factor for a better and worse gait prognosis. It was found that the release of partial load on the operated limb before the thirtieth postoperative day presented a better gait prognosis after 6 months of fracture. Therefore, the partial return to ambulation in the first months is relevant for planning transtrochanteric fracture patients' rehabilitation.

For being established in a university hospital, our service has longer-lasting surgical procedures compared to those found in conventional surgical centers due to the learning curve of the resident doctors. A better optimization of the available resources in the institution is suggested both for reducing total hospitalization

time and the surgical procedure time, aiming, at the end of the process, an early return of the patient to family environment and gait functional recovery.

CONCLUSION

This study identified four new data that can be used as predictive factors for better gait recovery on patients submitted to transtrochanteric fractures treatment, namely: a number of comorbidities smaller than four; inexistence of concomitant fractures; gait starting before thirty days; absence of postoperative orthopaedic complications.

The evaluation of transtrochanteric fracture condition regarding its various peculiarities allows for a more accurate decision concerning its behavior for gait prognosis, allowing for suggesting different treatment approaches for each individual patient.

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