ASSESSMENT OF THE FUNCTIONAL CAPACITY OF INDIVIDUALS SUBMITTED TO SURGICAL TREATMENT AFTER TIBIAL PLATEAU FRACTURE

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SUMMARY

Joint fractures are regarded as serious, causing disability, especially when involving a load joint, as the knee. Early treatment is required in order to get stabilization of fragments, preventing the occurrence of secondary complications. The present study was aimed at assessing functional capacity during daily life activities, on individuals who experienced tibial plateau fractures and submitted to surgical treatment between the years 2002 to 2005. Twenty patients were assessed by using the ADLS questionnaire (Activities of Daily Living Scale). We concluded that 85% of the individuals presented close-to-normal functional capacity, according to the scale's scoring system.

Keywords: *Tibial fractures; Assessment; Validation studies; Activities of daily living.*

Citation: *Camacho SP, Lopes RC, Carvalho MR, Carvalho ACF, Bueno RC, Regazzo PH. Assessment of the functional capacity of individuals submitted to surgical treatment after tibial plateau fracture. Acta Ortop Bras. [serial on the Internet]. 2008; 16(3): 168-172. Available from URL: http://www.scielo.br/aob.*

INTRODUCTION

The knee is an intermediate joint of the lower limb, lying between both the longer lever arms of the human body (femur and tibia)[1,2]. Despite of its complex mechanism and structures, it plays an important role for daily life activities. Under a functional point of view, it is essential for ambulation, keeping a bipodal stance, and for performing basic movements such as gait, run, sedestation and squatting. For being so required, this joint usually experiences function and stability changes[1,2].

Trauma injuries and its consequences account for 80% of the pathologies affecting the knee joint[3].

Tibial plateau fractures involve the proximal joint surface of the tibia that supports the femoral condyle on the same side. Lateral and/ or medial plateaus can be involved. Most of the injuries affect the lateral plateau alone (55-70%). Injuries of the medial plateau alone occur in 10-23% of the cases, while the involvement of both plateaus (bicondylar injuries) is found in 10-30% of the cases[4].

The most common mechanisms of trauma are divided into falls, traffic accidents and sports injuries. Studies reported that car accidents account for 40% - 60% of tibial plateau fractures[5-8]. Recently, the analysis of 1,426 tibial plateau fractures showed that 45% occur as a result of accidents with pedestrians, 13% car accidents, 17% high falls, 12% result from slips and sprains, while sports activities represented 3%, and motorcycle, bicycle and other accidents accounted for 10% [9].

Valgus or varus forces with axial load are responsible for most of the proximal tibial fractures[9,10]. A study assessing cadaver knees submitted to stress in valgus or varus, both alone and combined with axial compression, found some of the kinds of tibial plateau fractures frequently reported[11].

The distribution of the patients with this kind of injury for age and gender seems to show a bimodal pattern. The incidence peak in men occur during the 4th decade of life, caused by a high-energy trauma, while in women this occurs on the 7th decade of life, and are typically low-energy trauma on highly osteoporotic bones[4,12]. Low-energy trauma usually cause unilateral fractures with plateau depression, while high-energy traumas cause comminutive fractures with larger soft parts and neurovascular injuries[13].

Left knees are most frequently injured than the right ones (60% versus 40%), which may reflect the feet positioning of a car driver[4,14,15].

Several classifications have been developed for tibial plateau fractures (Hohl, Hohl e Luck, Moore and ASIF-AO), but, today, the most accepted and used classification worldwide is the one recommended by Schatzker[16]. This classification is based on the site and orientation of the fracture lines. Schatzker divided it into six types. Three fracture types involve the tibial lateral condyle: shearing (type I), shearing and depression (type II) and fracture with depression alone (type III). The medial condyle fracture is then subdivided into: type A, which is a high-energy fracture-dislocation, and; type B, with is a compression osteoporotic fracture. Bicondylar fractures are divided into: type V, in

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Received in: 04/12/07; approved in: 06/02/07

which medial and lateral condyles are similarly arranged, and; type VI, in which the metaphysis is separated from the shaft[16] .
Joint fractures are regarded as serious. Any fragment displacement determines joint incongruence with resultant localized overload. Often, other surrounding joints are affected due to the poor alignment of the load axis of the involved segment. The result is, then, progressive pain and functional disability. In order to avoid sequels, anatomical reduction and an stable fixation of the joint surface must be pursued, as well as allowing early movements in order to prevent adhesions and capsulo-ligamentar retractions[10,15,17]
Although many factors can influence treatment indication, such as clinical status of the patient, functional demand and kind of fracture, the key factor to be considered is the occurrence or not of fragments displacement or its potential instability. Fractures without displacement or as small as 4 mm are conservatively treated [3]. However, fractures with joint depression larger than 5 mm deserve surgical treatment[3,18,19].
As emphasized by Schatzker, the goal to accomplish when treating tibial plateau fractures is stability, alignment, mobility, relief of joint pain, as well as mitigation of the risks of evolving to osteoarthrosis. The access to fragments is critical for that. There are different treatment approaches: closed reduction with cast or traction; percutaneous fixation, with screws, wires or external fixator, under arthroscopic view or limited arthrotomy and open reduction by broad approach with plates and screws[20,21].
Additionally to the bone injury, soft parts such as blood vessels, nerves, joint capsule, menisci or ligaments are usually injured.
A recent study showed that meniscal injuries were present in 70% of the 112 studied cases[22]. Most of the injuries occur on the posterior half and always on the side of the fractured condyle[23]. However, no correlation was found between soft parts injuries and the kind of fracture[22,23]. Preserving the meniscus as much as possible is paramount to achieve a satisfactory outcome when treating tibial plateau fractures, because that structure is responsible for joint congruence, impact absorption, distribution of forces and joint stability[24].
Other studies assessed ligamentar damages associated to fractures, with the medial collateral ligament being more frequently injured. In a retrospective review of the knees, unrepaired collateral ligaments showed worse outcomes for late instability and knee total function when compared to repaired knees. All cruciate ligament ruptures occurred as combined injuries, with its worst result being the late arthrosis[25].
Because of the disability this kind of fracture can cause on knee joint, this study was aimed to analyze, from the answers obtained with the application of the ADLS questionnaire (Activities of Daily Living Scale)[26], functional capacity during daily life activities of patients experiencing tibial plateau fractures submitted to surgical treatment between 2002 and 2005 at the Hospital das Clínicas, Campinas State University (HC – UNICAMP).

MATERIALS AND METHODS

Patient data was withdrawn from the analysis of medical files stored at the HC – UNICAMP Medical Files Service (SAM). We requested from the operating theater of the hospital the codes corresponding to surgical procedures designed to treat tibial plateau fractures performed between January 2002 and December 2005.
A total of 36 medical files were assessed, studying the cases and assessing data (mechanism of injury, affected lower limb, fracture, surgery and hospital discharge dates, kind of fracture and surgical fixation, associated injuries, as well as personal data of each patient for a potential future contact) where only tibial plateau fractures had been diagnosed.
The exclusion criteria selected for the present study were: presence of associated fracture(s), failure to contact the patient, psychotic cases and death. Upon these criteria, 20 patients were subsequently selected and assessed, diagnosed with tibial plateau fracture.
For assessing the functional quality of the knee, the ADLS (Activities of Daily Living Scale)[26] questionnaire was applied. This questionnaire is composed of 17 questions, being seven (symptomatic) and ten (concerned to functional disability during daily life activities), each question has multiple alternatives with specific scores (Annex 1). Only one alternative should be checked for each question, and the scores are individually obtained for each subject by summing the scores on each question. The maximum score of the scale – concerned to the functional performance of the knee joint – is 80 and the minimum score is 0. The selection of the tool was based on its sensitivity when compared to other scales specifically designed to knee conditions (Cincinnati, Lysholm and Womac), which contributed to the article and to the new scale for functional evaluation of the knee joint[26,27].
This questionnaire was translated into Portuguese and applied to patients by telephone, without modifications to its overall characteristics.

RESULTS

From the selected patient sample, values for mean, standard deviation, maximum values and minimum value related to the scores of the ADLS questionnaire were obtained (Table 1).

Scale	Mean	SD	Max.	Min.
Functional capacity	51.75	20.22	79	11

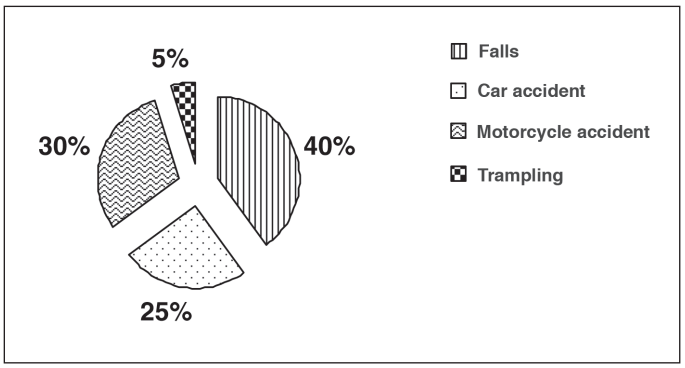
***Table 1** – Values corresponding to mean, standard deviation (SD), maximum (max.) and minimum (min.) scores for knee joint function during daily life activities, obtained by applying the ADLS questionnaire to individuals with tibial plateau fractures.*

Concerning gender, of the total of 20 patients (Table 2), 16 (80%) are males and four (20%) are females (a ratio of 4:1). Concerning the affected side, seven (35%) occurred on the right lower limb, and 13 (65%) on the left lower limb.

	Gender		Side	
	M	F	R	L
	16	4	7	13
Total	20		20	

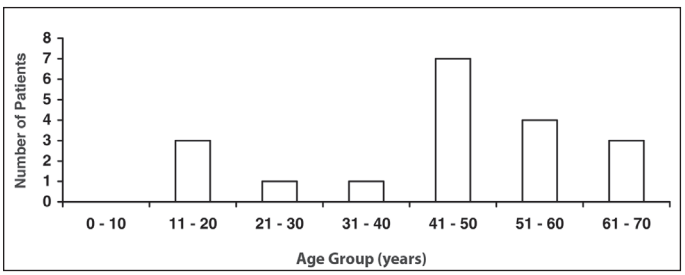
***Table 2** – Incidence distribution according to gender (M)- male and (F)-female and side: right (R) and left (L) of the affected individuals.*

Graph 1 describes the mechanisms of trauma found during the research. There were eight (40%) falls (low-energy trauma) and 12 (60%) traffic accidents (high-energy trauma), being 6 (30%) motorcycle accidents, five (25%) car accidents and one (5) trampling.



Graph 1 – *Incidence of mechanism of trauma, falls and traffic accidents (car and motorcycle accidents, and trampling) affecting the individuals.*

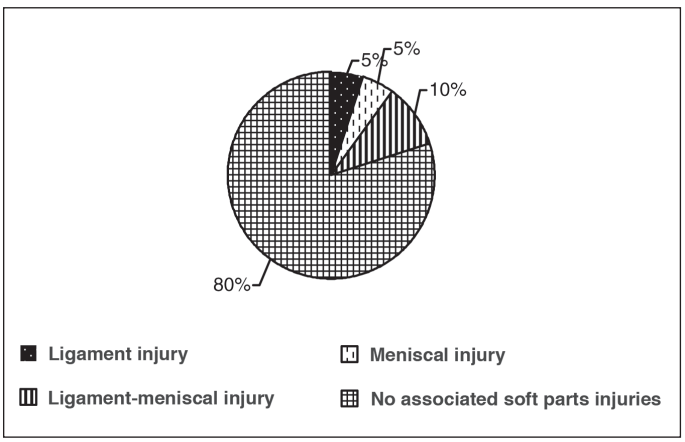
Graph 2 shows the distribution of patients for age, grouped according to the age group, in increments of 10 years.
Table 3 shows the mean, standard deviation, minimum and maximum values for the hospitalization time of patients submitted to tibial plateau surgery. Graph 3 shows that, among the 20 patients with tibial plateau fracture, four (20%) presented with associated soft parts injuries, two (10%) ligamentar, one (5%) meniscal, and one (5%) meniscal-ligamentar.



Graph 2 – *Patient sample distribution, in absolute numbers, according to the age group (years).*

	Mean	SD	Max.	Min.
Time of Hospitalization	21.25	13.06	53	7

Table 3 – *Values corresponding to mean, standard deviation (SD), maximum (max.) and minimum (min.) scores for time of hospitalization (days).*



Graph 3 – *Sample distribution, in absolute numbers, according to the presence or absence of associated soft parts (ligaments and menisci) injuries.*

DISCUSSION

This study is primarily aimed to assess the functional capacity, after treatment, of individuals with tibial plateau fractures. In addition, several relevant data were analyzed in this research.
A recent study assessed the functional outcome of 35 patients with chronic debilitating knees after multiple ligament reconstruction. There were 27 men and eight women in the study, and the scores achieved on the ADLS questionnaire ranged from 25 to 98, with 72.7 as a mean value. According to the result of the research, 16 individuals were back to sports practice, and almost all of them, except for 3, returned to their professional occupations[28].
Another study assessed the changes on muscular activation patterns and lower limbs motion in individuals with knee osteoarthritis. After the application of the ADLS questionnaire, the 24 subjects belonging to the group with knee osteoarthritis achieved a score of 70.1 and the remaining 24 subjects included on the control group showed a mean score of 99.8. The mean age in both groups was 62 years[29].
This study assessed 20 individuals (16 men and 4 women). After the application of the ADLS questionnaire, we found the scores ranging from 11 to 79 (mean: 51.75). We could notice that three individuals scored 0-25%, none of them scored 26-50%, 10 were between 51 and 75%, and seven presented 76-100%, with the individuals presenting the best functional capacity being the ones closer to 100% (80 points) and the worst function closer o zero point. Therefore, most of the sample (17 individuals, 85%) showed a score for functional capacity of 51-100%. We could not qualitatively classify the patients, because the author of the scale did not determine parameters for this.
All the studies mentioned above used the ADLS scale to assess the functional capacity of individuals affected by different conditions compromising the knee joint. Thus, we found a variation on the scores and mean values of the scale that were achieved in each research. We could not make any comparison or discussion due to the different causes interfering on the joint function.
Currently, studies using the Activities of Daily Living Scale (ADLS) have been limited to apply the questionnaire to individuals with ligament and meniscal injuries, femoropatellar pain and osteoarthrosis.
According to the outcomes achieved in this study, left lower limbs were the most frequently affected structures compared to the right ones, with 13 (65%) involving the left side, and seven (35%) involving the right side, a finding that corroborates other studies(15,16) in which left knees were more often affected than the right ones (60% left vs. 40% right).
The most common mechanism was the low-energy trauma, accounting for eight (40%) of the cases, with motorcycle and car accidents accounting for six (30%) and five (25%) of the cases, respectively. These data conflict with other studies[5-8], in which car accidents are the most prevalent ones.
Regarding the involvement by age group we could notice that for men, the incidence peak was 41-50 years (seven individuals), five of them by high-energy trauma (car or motorcycle accident) and two by low-energy trauma (falls). Therefore, these data are consistent with recent studies[4].

Concerning gender, four women were enrolled in this study, two of them belonging to the age group of 17-20 years and the remaining individuals were 59 and 61 years old. We also noticed that the high-energy mechanism of trauma was more common in younger individuals, while the low-energy trauma was more common in both the older individuals. This result is similar to findings reported by literature[4,15], in which the low-energy mechanisms of trauma are more common in women on the seventh decade of life.

Concerning time of hospitalization and the presence/ absence of associated soft parts injuries, despite being relevant data for this research, they were not discussed here due to the scarcity of studies addressing this topic.

CONCLUSION

We conclude that the individuals submitted to surgical treatment for tibial plateau fractures showed functional capacity levels close to the maximum value established by the ADLS questionnaire, thus suggesting that the functional quality of the knee joint during daily life activities is close to normal.

Annex 1- Activities of Daily Living Scale

Instructions: The questionnaire below is designed to determine the symptoms and restraints you experience due to your knee condition while performing daily-life activities. Please, answer each question by checking the statement that best describes your experiences in the last two days. For each question there may be more than one statement describing your feelings, but, please, check only the one that best describes you when performing your usual daily activities.

Symptoms

1. To what extent the does the pain on your knee impact your daily life activities level?
5 – I never have knee pain.
4 – I do have knee pain, but this does not impact my daily activities.
3 – Pain causes a little impact to my activities.
2 – Pain causes a moderate impact to my activities.
1 – Pain causes a severe impact to my activities.
0 – My knee pain prevents me from performing all my daily life activities.

2. To what extent does the creak or scraping of your knee impact your daily life activities level?
5 – I never have knee creaks or scrapings.
4 – I do have knee creaks or scrapings, but these do not impact my daily activities.
3 – The creak or scraping causes a little impact to my activities.
2 – The creak or scraping causes a moderate impact to my activities.
1 – The creak or scraping causes a severe impact to my activities.
0 – The creak or scraping prevents me from performing my daily life activities.

3. To what extent does the stiffness of your knee impact your daily life activities level?
5 – I never have knee stiffness.
4 – I do have knee stiffness, but this does not impact my daily activities.
3 – Stiffness causes a little impact to my activities.
2 – Stiffness causes a moderate impact to my activities.
1 – Stiffness causes a severe impact to my activities.
0 – Stiffness prevents me from performing my daily activities.

4. To what extent does your knee swelling impact your daily life activities level?
5 – I never have swelling on my knee.
4 – I do have swelling on my knee, but this does not impact my daily activities.
3 – Swelling causes a little impact to my activities.
2 – Swelling causes a moderate impact to my activities.
1 – Swelling causes a severe impact to my activities.
0 – Swelling prevents me from performing my daily activities.

5. To what extent does the temporary displacement of your knee impact your daily life activities level?
5 – I never have temporary knee displacements.
4 – I do have some temporary knee displacements, but these do not impact my daily activities.
3 – Temporary displacements cause a little impact to my activities.
2 – Temporary displacements cause a moderate impact to my activities.
1 – Temporary displacements cause a severe impact to my activities.
0 – Temporary displacements prevent me from performing my daily activities.

6. To what extent does your knee blockage impact your daily life activities level?
5 – I never have knee blockage.
4 – I do have knee blockage, but this does not impact my daily activities.
3 – Blockage causes a little impact to my activities.
2 – Blockage causes a moderate impact to my activities.
1 – Blockage causes a severe impact to my activities.
0 – Blockage prevents me from performing my daily activities.

7. To what extent does your leg's weakness or lack of strength impact your daily life activities level?
5 – I never feel weakness on my legs.
4 – I do feel my legs are weak, but this does not impact my daily activities.
3 – Weakness causes a little impact to my activities.
2 – Weakness causes a moderate impact to my activities.
1 – Weakness causes a severe impact to my activities.
0 – My leg´s weakness prevents me from performing my daily activities.

Functional Disability in Daily Life Activities

8. How much does your knee impact your ability to walk?
5 – My knee does not impact my ability to walk.
4 – I do feel knee pain, but this does not impact my daily activities.
3 – My knee prevents me from walking more than 1600 meters.
2 – My knee prevents me from walking more than 800 meters.
1 – My knee prevents me from walking more than a block.
0 – My knee prevents me from walking.

9. Does your knee require you to walk with crutches or cane?
3 – I walk without crutches or cane.
2 – My knee requires me to walk with the aid of crutches or cane.
1 – My knee requires me to walk with the aid of two crutches.
0 – Because of my knee, I can´t walk, even with the aid of crutches.

10. Does your knee make you limp when walking?
2 – I can walk without limping.
1 – Sometimes my knee makes me limp when walking.
0 – Because of my knee I can´t walk without limping.

11. How much does your knee impact your ability to climb stairs?
5 – My knee does not impact my ability to climb stairs.
4 – I feel pain when I climb stairs, but this does not impact my ability to do so.
3 – I can usually climb stairs, but I need to rely on the handrail.
2 – I can climb stairs, one step at a time, relying on the handrail.
1 – I need crutches or a cane for climbing stairs.
0 – I can´t climb stairs.

12. How much does your knee impact your ability to climb down stairs?
5 – My knee does not impact my ability to climb down stairs.
4 – I feel pain when I climb down stairs, but this does not impact my ability to do so.
3 – I can usually climb down stairs, but I need to rely on the handrail.
2 – I can climb down stairs, one step at a time, relying on the handrail.
1 – I need crutches or a cane for climbing down stairs.
0 – I can´t climb down stairs.

13. How much does your knee impact your ability to remain on foot?
5 – My knee does not impact my ability to remain on foot. I can remain on foot for indefinite periods of time.
4 – I feel pain when I´m on foot, but this does not impact my ability to do so.
3 – Because of my knee, I can´t remain on foot for more than one hour.
2 – Because of my knee, I can´t remain on foot for more than half an hour.
1 – Because of my knee, I can´t remain on foot for more than ten minutes.
0 – I can´t remain on foot because of my knee.

14. How much does your knee impact your ability to kneel?
5 – My knee does not impact my ability to kneel. I can kneel for indefinite periods of time.
4 – I feel pain when I kneel, but this does not impact my ability to do so.
3 – I can´t kneel for more than one hour.
2 – I can´t kneel for more than half an hour.
1 – I can´t kneel for more than ten minutes.
0 – I can´t kneel.

15. How much does your knee impact your ability to squat?
5 – My knee does not impact my ability to squat. I can squat all the way down.
4 – I feel pain when I squat, but I can squat all the way down.
3 – I can squat almost all the way down.
2 – I can squat half the way down.
1 – I can squat quite poorly.
0 – I can´t squat.

16. How much does your knee impact your ability to sit with flexed knee?
5 – My knee does not impact my ability to sit with flexed knees. I can sit so for indefinite periods of time.
4 – I feel pain when I sit with my knees flexed, but this does not impact my ability to do so.
3 – I can´t sit with my knees flexed for more than one hour.
2 – I can´t sit with my knees flexed for more than half an hour.
1 – I can´t sit with my knees flexed for more than ten minutes.
0 – I can´t sit with my knees flexed.

17. How much does your knee impact your ability to stand up (from a chair)?
5 – My knee does not impact my ability to stand up (from a chair).
4 – I feel pain when I stand up, but this does not impact my ability to do so.
2 – Because of my knee, I can stand up only by relying on my hands or arms.
0 – I can´t stand up.

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