

# **GEORGIAN MEDICAL NEWS**

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**ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ**

Медицинские новости Грузии  
საქართველოს სამედიცინო სიახლენი

## GEORGIAN MEDICAL NEWS

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**GMN: Georgian Medical News** is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.

GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

**GMN: Медицинские новости Грузии** - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

**GMN: Georgian Medical News** – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.

ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

### WEBSITE

[www.geomednews.com](http://www.geomednews.com)

## К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman (Кириллица)**, для текста на грузинском языке следует использовать **AcadNusx**. Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - <http://www.spinesurgery.ru/files/publish.pdf> и [http://www.nlm.nih.gov/bsd/uniform\\_requirements.html](http://www.nlm.nih.gov/bsd/uniform_requirements.html) В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректур авторам не высылаются, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

**При нарушении указанных правил статьи не рассматриваются.**

## REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or computer-printed on a single side of standard typing paper, with the left margin of 3 centimeters width, and 1.5 spacing between the lines, typeface - **Times New Roman (Cyrillic)**, print size - 12 (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: [http://www.nlm.nih.gov/bsd/uniform\\_requirements.html](http://www.nlm.nih.gov/bsd/uniform_requirements.html)  
[http://www.icmje.org/urm\\_full.pdf](http://www.icmje.org/urm_full.pdf)

In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

**Articles that Fail to Meet the Aforementioned  
Requirements are not Assigned to be Reviewed.**

## ავტორთა საქურაღებოლ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დაიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman (Кириллица)**, ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx**. შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ, რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემაჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შედეგის ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფხიხლებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

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## RETURN TO SPORT AFTER SURGICAL TREATED TIBIAL PLATEAU FRACTURES

Miloslav Doul<sup>1,2</sup>, Philipp Koehl<sup>2</sup>, Marcel Betsch<sup>3</sup>, Stefan Sesselmann<sup>4</sup>, Alexander Schuh<sup>5\*</sup>.

<sup>1</sup>Friedrich-Alexander-University Erlangen-Nuremberg, Erlangen, Germany.

<sup>2</sup>Hospital of trauma surgery, Marktredwitz Hospital, 95615 Marktredwitz, Deutschland.

<sup>3</sup>University Hospital Erlangen, Department of Orthopaedics and Trauma Surgery, Friedrich-Alexander-University Erlangen-Nuremberg, Erlangen, Germany.

<sup>4</sup>Institute for Medical Engineering, OTH Technical University of Applied Sciences Amberg-Weiden, 92637 Weiden, Germany.

<sup>5</sup>Hospital of trauma surgery, Department of musculoskeletal research, Marktredwitz Hospital, 95615 Marktredwitz, Deutschland.

### Abstract.

**Introduction:** Tibial plateau fractures (TPF) comprise 1% of all fractures, despite their limited frequency, due to their intraarticular nature they commonly result in significant functional morbidity. Generally, younger, and middle-aged men (64%) tend to have fractures as a result of high-energy trauma, such as high-speed motor vehicle accidents or falls from a considerable height, while older women have low-energy fractures (35%). While there is growing evidence on the clinical and radiological outcomes of surgical techniques, there remains limited evidence on return to sport following TPF.

Aim of this retrospective study is to determine the sporting abilities of patients after operative treatment of TPF.

**Material and Method:** 47 Patients (20 women, 27 men) who underwent surgical treatment for a TPF were surveyed by a questionnaire to determine their sporting activity were followed-up a mean of 47.6 months (Min: 12, Max: 115). All the patients fractures were systematically assessed using AO- Classification.

The Lysholm-Gillquist scores, IKDC Score, Injury - Psychological Readiness to Return to Sport (I-PRRS) scales and ACL-Return to Sport Injury Scale (ACL-RSI) were used to assess clinical outcomes.

**Results:** All fractures united, and no revision surgeries were required. There were no intraoperative complications. Mean postoperative IKDC score was 75 (Min:13, Max: 100), mean postoperative Lysholm score was 82 (Min: 5, Max: 100), mean ACL-Return to Sport Injury Scale (ACL-RSI) was 66 (Min: 0, Max: 100), Injury-Psychological Readiness to Return to Sport Scale (I-PRRS-Scale) was 39 (Min: 0, Max: 80). 31/47 patients were able to return to their former -sports- activity level, 8/47 did not achieve their former sports activity level before injury, 2/47 cases changed their kind of sport and 6/47 stopped sporting activities.

**Conclusion:** Tibial plateau fractures -a severe injury- have a great effect on patients in terms of quality and quantity of sporting activity. Nevertheless, most of our surgical treated patients were satisfied with the outcome with good values in the Lysholm- score, I-PRRS- Scale, IKDC score and ACL-Return to Sport Injury Scale.

**Key words.** Tibial plateau, Fracture, Surgery, Return to sports, Physical activity.

### Introduction.

Tibial plateau fractures (TPF) comprise 1% of all fractures, despite their limited frequency, due to their intraarticular nature

they commonly result in significant functional morbidity [1-7]. Elsoe et al. showed that TPF have an incidence of 10.3 per 100 000 people annually, with AO type 41-B3 being the most common type (35% of all TPF), followed by AO type 41-C3 representing 17% of all TPF [1,5,8]. The various fracture patterns range from undislocated split fractures and slightly or severely displaced depression fractures to complex comminuted fractures with severe destruction of the joint lines and cartilage lesions [1,7,9,10]. Generally, younger, and middle-aged men (64%) tend to have fractures as a result of high-energy trauma, such as high-speed motor vehicle accidents or falls from a considerable height, while older women have low-energy fractures (35%). In elderly patients, TPF may also occur due to a simple fall and low-energy trauma [1,11]. When treating fractures of the tibial plateau, an accurate anatomic reduction of the articular surface with rigid fixation is needed to allow for early rehabilitation and range of motion exercises for cartilage lubrication [12]. The goal of treating TPF is to obtain a stable joint, enabling early mobilization of the knee [1]. Treatment of such injuries is challenging. Previous studies showed that TPF frequently results in residual pain, functional limitations, and osteoarthritis (OA) [1,5]. Today, an increasing life expectancy rate also results in increasing patient expectations concerning the continued participation in sports and recreational activities [12].

Since the majority of patients sustaining TPF injuries are relatively young and active, this can have devastating consequences for their leisure or competitive involvement in sports. Adequate physical

activity is important among all ages, and its health benefits for both physical and emotional wellbeing have been well established [6,10].

While there is growing evidence on the clinical and radiological outcomes of surgical techniques, there remains limited evidence on return to sport following TPF [4,6,7,10,12-14].

Aim of this retrospective study is to determine the sporting abilities of patients after operative treatment of TPF and answer the question whether different fracture patterns lead to different times of return to sport.

### Materials and Methods.

Institutional review board approval was obtained before the initiation of this retrospective study. 47 Patients (20 women, 27 men) who underwent surgical treatment for a TPF were surveyed by a questionnaire to determine their sporting activity were followed-up a mean of 47.6 months (Min: 12, Max: 115).



Inclusion criteria were operatively treated TPF in patients with closed epiphyseal cartilage with a minimum follow-up of 12 months in a single trauma speciality center [10]. Exclusion criteria were non-articular fractures, bilateral fractures, patients with accompanying injuries in the same extremity, pathologic fractures, deceased patients, psychosis or addictive disorder, handicapped/walking disability before the tibial plateau fracture and patients missing CT scan preoperatively.

All the patients' fractures were systematically assessed using AO classification [15]. Analysis was based on standard antero-posterior and lateral radiographs of the knee and a CT scan with axial, sagittal, coronal and 3D reconstruction. Operation technique, implants and the use of bony transplants or bone substitution was documented. In all cases arthroscopic assisted osteosynthesis was performed.

The questionnaire also inquired about the patient's use of any pain medication during sports activity (regularly, occasionally, never), time to return to "normal activities" and return to sports and use of assistive equipment. We asked the patients for a subjective limited range of the motion of the affected knee prior accident, one year after surgery and latest follow-up.

Recorded complications were categorized as fracture-related infection, non-union and reintervention.

The Lysholm-Gillquist scores [16], IKDC Score [17], Injury - Psychological Readiness to Return to Sport (I-PRRS) scales [18] and ACL-Return to Sport Injury Scale (ACL-RSI) [19] were used to assess clinical outcomes.

The Lysholm Gillquist score is a patient-reported instrument that consists of subscales for pain, instability, locking, swelling, limp, stair climbing, squatting, and the need for support. Scores range from 0 (worse disability) to 100 (less disability) and is used for evaluating outcomes of knee ligament surgery, particularly for symptoms related to instability.

The IKDC score is a patient-completed tool, which contains sections on knee symptoms (7 items), function (2 items), and sports activities (2 items). Scores range from 0 points (lowest level of function or highest level of symptoms) to 100 points (highest level of function and lowest level of symptoms) and is used to assess patients with a variety of knee disorders including ligamentous and meniscal injuries as well as patellofemoral pain and osteoarthritis.

The Injury Psychological Readiness to Return to Sport (I-PRRS) scale is a 6-item scale that measures the psychological readiness of injured athletes to return to sport.

The ACL - Return to Sport after Injury (ACL-RSI) scale was developed in order to measure athletes' emotion, confidence, and risk appraisal when returning to sports after an ACL injury and/or reconstructive surgery. The survey consists of 12 items that are graded on a visual analogue scale from 0 points (extremely negative psychological responses) to 100 points (no negative psychological responses).

All above mentioned scales are used to assess return to sport following tibial head fractures in literature.

We asked for sports frequency (0-7 sessions per week), duration of sports activities (hours per week: <1h, 1-5h >5 h), and the patient's level of sports (recreational, competitive, elite) prior fracture and at latest follow-up.

Additional we asked for achievement of previous sports

activities, partial achievement of previous sports activities, abandonment of sports activities or change of sports activities.

Mann-Whitney U test was used for statistical analysis. All statistics were performed with SPSS (IBM SPSS Statistics for Windows, version 24.0), and alpha was set at  $P < 0.05$  to declare significance.

## Results.

The study cohort comprised 27 men and 20 women, with an unequal side distribution of involved knees (21 right and 26 left). Mean age at time of surgery was 52,5 years (Min: 21, Max:73).

The average postoperative follow-up was 47.6 months (Min: 12, Max: 115).

Of the 47 patients, 9 (20%) were injured after a fall from a standing height, 35 (74%) were injured after a fall of more substantial height and 3 (6%) were injured during sports participation.

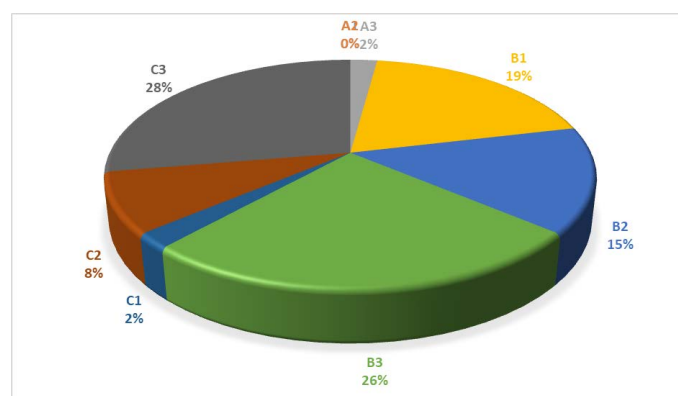
According to patients' information there were no limitations in range of motion (ROM) before the injury in 45 cases, slight limitation in ROM in one case and severe limitation in ROM in one case.

At latest follow-up 20 patients (43%) stated identical ROM in comparison to situation prior injury. 20 patients (43%) stated slight reduction of ROM and 7 patients (14%) suffered from severe limitation of ROM of the affected knee.

Sporting activities were possible 6 months after surgery with orthopedic devices like orthosis in 28 cases, 1 year after surgery orthosis were used in another 11 cases, at latest follow-up 2 patients used orthosis when performing sports.

All fractures united, and no revision surgeries were required. There were no intraoperative complications.

According to AO classification 1 fracture belonged to A3, 9 to B1, 7 to B2, 12 to B3, 1 to C1, 4 to C2 and 13 to C3 type (Figure 1).



**Figure 1.** Tibial plateau fracture type according to AO classification [29].

Bony defects were filled in 21/ 47 cases, calcium phosphate bone substitute was used to fill the defect in 17 cases, autologous spongiosa graft was used in 4 cases.

An angle-stable, anatomically shaped lateral tibial head plate was used in 42 cases, in 2 cases simple screws were used for osteosynthesis. Double plate osteosynthesis was used in 3 cases.

Mean postoperative IKDC score was 75 (Min:13, Max: 100),

mean postoperative Lysholm score was 82 (Min: 5, Max: 100), mean ACL-Return to Sport Injury Scale (ACL-RSI) was 66 (Min: 0, Max: 100), Injury-Psychological Readiness to Return to Sport Scale (I-PRRS-Scale) was 39 (Min: 0, Max: 80).

31/47 (66%) patients were able to return to their former -sports- activity level, 8/47 (17%) did not achieve their former sports activity level before injury, 2/47 (4%) cases changed their form of sport and 6/47 (13%) stopped sporting activities. The patients who stopped performing sports belonged to B3 fracture type in 3 cases and C2 fracture type in 1 case and C3 fracture type in 2 cases.

A fracture type is extraarticular TPF. B and C fracture types are intraarticular TPF. We compared the group of B and C fracture types. The median time of return to sport was 12 months (min:6, max: 24) in group C fractures and 7.7 months (min: 6, max: 24) in group B fractures ( $p < 0.05$ ).

At latest follow-up 10 patients did not perform any sports. 15 performed sporting activities < 1 hour per week, 21 performed sporting activities 1 - 5 hours per week, 1 patient performed sports > 5 hours per week.

9 (19%) patients take regular pain killers to be able to perform sports, 15 (32%) patients take occasionally pain killers during sports activity, 23 (49%) patients don't take any pain killers during sports activity.

### Discussion.

Elseo et al. [8] showed that TPF have an incidence of 10.3 per 100 000 people annually, with AO type 41-B3 being the most common type (35% of all TPF), followed by AO type 41-C3 representing 17% of all TPF. In our study group 1 fracture belonged to AO type A3, 9 to B1, 7 to B2, 12 to B3, 1 to C1, 4 to C2 and 13 to C3 type which is a comparable fracture pattern distribution [7,8].

TPF may lead to disability and hinder patients' participation in recreational athletics [11].

The median time of return to sport in our study was 12 months (min:6, max: 24) in group C fractures and 7.7 months (min: 6, max: 24) in group B fractures ( $p < 0.05$ ).

At latest follow-up 31/47 (66%) patients were able to return to their former -sports- activity level, 8/47 (17%) did not achieve their former sports activity level before injury, 2/47 (4%) patients changed their form of sport and 6/47 (13%) stopped sporting activities.

Kampa et al. [4] could examine 20 patients following arthroscopic-assisted fixation of TPF (AAPF) after an average follow-up of 30 months (range, 12 -62). Mean postoperative IKDC score was 81 (range, 55-97), and mean postoperative Lysholm score was 87 (range, 54-100). 87 (range, 54-100). This result is comparable to our results after a mean follow-up of 47.6 months (Min: 12, Max: 115). Our mean postoperative IKDC score was 75 (Min: 13, Max: 100), mean postoperative Lysholm score was 82 (Min: 5, Max: 100). Median Lysholm knee scores ranged from 77 to 100 in the patient population, indicating fair to excellent results in several studies [20,21]. In comparison to other studies, we had more C3 fractures (28%),

which might be the reason why our clinical results were a little bit inferior in respect to Lysholm or IKDC score.

At the end of the follow-up of the study by Quintens et al. only 39% of the patients were engaged in sports, indicating that only two out of three patients playing sports before the injury are still able to do so after, illustrating a significant decrease. As much as 55% of all patients reduced their frequency of physical activity. The mean time needed to partially resume pre-injury activities was 6 - 9 months. Sixteen percent of the responding patients were not able to resume their activities being engaged in low-impact sports was associated with a sooner partial, as well as full resumption of preinjury sports, compared with high-impact sports [6]. Our return to sports rate was comparable higher even after the 4-year follow-up (At latest follow-up 31/47 (66%) of our patients were able to return to their former -sports- activity level, 8/47 (17%) did not achieve their former sports activity level before injury, 2/47 (4%) patients changed their form of sport and 6/47 (13%) stopped sporting activities).

The median time of return to sport in our study was 12 months (min:6, max: 24) in group C fractures and 7.7 months (min: 6, max: 24) in group B fractures.

Previously Kraus et al. and Loibl et al. [10,16] reported 82% and 88% return to sport rates in a general cohort of TPF. Quintens et al. observed a return rate of only 68% after a mean follow-up of 33 months [6]. Kugelmann et al. [11] reported even a lower return to sports rate of 52.4%. However, the mean follow-up in their study was only 15 months.

We follow Quintens et al. [6] that different results in several studies in respect to return to sports following TPF cannot be compared because return to sports rate differs from high impact and low impact sports and different follow-ups. One weakness of our study was that we missed to ask for the different kinds of sports!

Loibl et al. [12] as well as Kugelmann et al. [11] found that a higher age at the time of the injury was associated with a lower return to sports, arguing that an advancing age might be related to a reduced physiological reserve and healing potential. This is our impression, too. We did not evaluate this date as we had only a small cohort study. We focused on the severeness of the fracture type which is more important to the outcome in comparison to the age.

Kugelmann et al. [11] found that the number of patients who returned to participation in recreational athletics gradually increased over time after ORIF for a tibial plateau fracture. This is concordant to the result of our study. At the 6 months' time point after operative management, only one third of patients had returned to participation in recreational athletics. By final follow-up, over half of patients in this study had returned to participation in athletics [11].

In a study performed by Kraus et al, [10] nearly two-thirds of patients with operatively managed tibial plateau fractures returned to participation in recreational athletics at 1-year follow-up, while 88% of the patients participated in recreational athletics at a mean of 4.4 years of follow-up. This concordant to our results.

Previous studies have reported changes in patients' athletic participation, from high-impact sports, such as skiing and jogging, before their knee injury to lower impact sports, such as Nordic walking, aqua fitness, weight training, and cycling, after the injury [10,12]. Our results show that 31/47 patients were able to return to their former -sports- activity level, and only 2/47 cases changed their form of sport, 6/47 stopped sporting activities.

Our study has some limitations including the retrospective design and only midterm outcomes reported, which does not allow any conclusions regarding sporting activities at a later time point or the development of osteoarthritis of the knee. Nevertheless, our follow-up of 4 years is one of the longer follow-ups in comparison to other above-mentioned studies on return to sports following TPF. Additionally, we failed to document the different kinds of sports in respect to high impact sports or recreational athletics.

Robertson et al. [7] showed different rates of return to sports following different surgery techniques. Arthroscopic assisted techniques offered the best return rates at 83%, with a similar value for return to pre-injury level of sport. In comparison, the return rates for ORIF or using a frame were 60% and 52% respectively, and the return rate to preinjury level of sport were 34% and 31% [7,22-28]. We could not find any differences in return to sports in our study in respect of different surgical techniques using different implants. One reason might be that we performed arthroscopic assisted osteosynthesis in all cases. But we found different times in return to sports in respect to different fracture types.

Kraus et al. [10] support the hypothesis that TPF have a great effect on patients' sporting activity. Despite good clinical results, patients were likely to give up their ambitious sporting activity and switch to lower impact sports. Robertson et al. postulated that 70% percent of patients with a TPF returned to sport following injury, with only 60% were to return to their pre-injury level of sport [7].

Patients who were able to return to recreational athletics had associations with better functional outcomes, both physically and emotionally in comparison to high impact sports. This is one important information that should be communicated with the patient [11].

Gill et al. [2] reported an 84% rate of return to sports in 25 skiers with arthroscopically assisted reduction and internal fixation of tibial plateau fractures, with a mean follow-up of 2 years. However, precise information on sports participation is missing. Kraus et al. [10] in a detailed analysis of return to sports after tibial plateau fractures reported good clinical results and a rate of return to sports of 73%, with a mean follow-up of 4.4 years. In a small cohort study Chiu et al. 22/25 patients could return to their previous activity level, including sports such as basketball, tennis, and football [29].

In the series of Morin et al. [14] 87% of patients were able to return to sport activities. Of course, all these studies including ours, did not consider psychological influence on return to sports activities which could skew the final outcome which is a topic for future studies.

We follow Kugelmann et al. [11] that patients who sustain a TPF and are undergoing operative interventions should

be counselled, that they have a 50% chance of returning to participation in recreational athletics by 1 year after the injury. We could find a 65% chance of returning to sports on a former level in recreational athletics after 4 years, which is nearly identical to the results published by Scheerlinck et al. [30].

Our study has some limitations including a retrospective design without clinical or radiologic examination and a small cohort group. Sports activity level was assessed by the use of specially designed questionnaires and several activity scores. We believe that our study design is perfect to answer the question of return to sport following TPF. We could show different times to return to sports following PTF in respect to AO fracture types. C fractures took a significant longer time in comparison to B fractures.

### **Conclusion.**

Tibial plateau fractures -a severe injury- have a great effect on patients in terms of quality and quantity of sporting activity. Nevertheless, most of our patients were satisfied with the outcome with good values in the Lysholm- score, I-PRRS-Scale, IKDC score and ACL-Return to Sport Injury Scale. Patients have a 50% - 65% chance of returning to participation in recreational athletics, but patients with C fracture types need a longer time in comparison to B fracture types.

**The present work was performed in fulfillment of the requirement for obtaining the degree "Dr. med".**

### **Compliance with ethical standards.**

#### **Conflict of interest.**

The authors declare that they have no conflict of interest.

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#### **Ethical approval.**

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Yes

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