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☏ +381 11 4092 776, Fax: +381 11 3348 653
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Paper Accepted*

ISSN Online 2406-0895

Original Article / Оригинални рад

Slavko Manojlović[1,2,♣], Rajko Dodik[1], Mirko Manojlović[1], Zeljko Jovičić[3], Dragana Dragičević-Cvjetković[4,5]

Total knee arthroplasty in patients with a proximal tibial stress fracture associated with bilateral severe knee osteoarthritis

Тотална артропластика колена код болесника са стрес преломом тибије удруженог са тешким обостраним остеоартритисом колена

[1]Gradiška General Hospital, Department of Surgery, Gradiška, Republic of Srpska, Bosnia and Herzegovina;
[2]University of Banja Luka, Faculty of Medicine, Department of Surgery, Banja Luka, Republic of Srpska, Bosnia and Herzegovina;
[3]Dr Miroslav Zotović Institute of Physical Medicine and Rehabilitation, Department of Orthopedic Surgery, Republic of Srpska, Bosnia and Herzegovina;
[4]Dr Miroslav Zotović Institute of Physical Medicine and Rehabilitation, Department of Rehabilitation and Balneology, Banja Luka, Republic of Srpska, Bosnia and Herzegovina;
[5]University of Banja Luka, Faculty of Medicine, Department of Physical Medicine and Rehabilitation, Banja Luka, Republic of Srpska, Bosnia and Herzegovina

Received: October 22, 2022
Revised: December 10, 2023
Accepted: December 18, 2023
Online First: December 26, 2023
DOI: https://doi.org/10.2298/SARH221022115M

♣Correspondence to:
Slavko MANOJLOVIĆ
University of Banja Luka, Faculty of Medicine, Department of Surgery, Save Mrkalja 14, Banja Luka 78 000, The Republic of Srpska, Bosnia and Herzegovina
E-mail: **slavko.manojlovic@gmail.com**

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SUMMARY

Introduction/Objective Proximal tibial stress fractures associated with bilateral severe knee osteoarthritis are rare but, due to possible consequences, are considered a treatment challenge. This paper aims to present the applied treatment method of these patients and its results.

Methods A prospective study followed 14 patients with an average age of 74.1 years and with unilateral proximal tibial stress fracture associated with bilateral severe knee osteoarthritis. Surgical treatment involved modular total knee arthroplasty (TKA) on the fracture side, in the first act, and contralateral standard TKA, in the second act, based on the severe osteoarthritis. Rehabilitation was performed after both operations for 21 days and included: kinesiotherapy, electrotherapy, magnetotherapy, hydrotherapy and thermotherapy. Monitoring parameters were: x-ray, range of motion, and WOMAC index. Monitoring periods were: preoperative and 3, 6 and 9 months after the first TKA surgery.

Results The radiological findings in all patients during these follow-up periods were normal. All tibial stress fractures healed within 6 months after surgery. Knee function was significantly improved 9 months after the first TKA surgery compared to the preoperative finding. A statistically significant improvement in the physical functioning was found in all postoperative periods, especially nine months after the first TKA surgery ($p<0.05$).

Conclusion Modular total knee arthroplasty on the tibial stress fracture side and delayed standard total knee arthroplasty of contralateral osteoarthritic knee combined by postoperative inpatient rehabilitation give optimal final functional outcome.

Keywords: tibia; fracture; stress; knee; osteoarthritis; arthroplasty

САЖЕТАК

Увод/Циљ Стрес преломи тибије повезани са билатералним остеоартритисом колена су ретки, али због својих последица представљају терапијски изазов. Овај рад има за циљ да прикаже примењени начин лечења ових болесника и његове резултате.

Методе Проспективна студија је пратила 14 болесника просечне старости од 74,1 година са једностраним стрес преломом тибије удруженим са билатералним тешким остеоартритисом колена. Хируршко лечење подразумева у првом чину уградњу модуларне тоталне протезе колена на страни прелома, а у другом чину имплантацију тоталне, контралатералне протезе колена на бази тешког остеоартритиса. Стационарна рехабилитација је обављена послије обе операције у трајању од 21 дан и обухватала је примену: кинезитерапије, радне терапије, електротерапије, магнетотерапије, хидротерапије и термотерапије. Параметри праћења били су: рендгенски снимак - преоперативно и постоперативно, обим покрета преоперативно и на крају лечења и индекс *WOMAC* преоперативно и постоперативно. Периоди праћења су били: преоперативно и 3, 6 и 9 месеци постоперативно.

Резултати Радиолошки налази код свих болесника током ових периода праћења били су нормални. Сви стрес преломи тибије су зарасли унутар 6 месеци од операције. Локални налаз на коленима код свих болесника 9 месеци постоперативно значајно се побољшао у поређењу са преоперативним налазом. Статистички значајно побољшање квалитета живота праћено индексом *WOMAC* утврђено је у свим постоперативним периодима праћења, посебно у 9. постоперативном месецу ($p < 0,05$).

Закључак Модуларна тотална протеза колена на страни стрес прелома тибије и одложена имплантација контралатералне протезе колена на колено захваћено остеоартритисом у комбинацији са постоперативном болничком рехабилитацијом дају оптималан функционални исход и побољшавају квалитет живота код ових болесника.

Кључне речи: тибија; преломи; стрес; колено; остеоартритис; артропластика

INTRODUCTION

Stress fractures of the proximal tibia often occur as a result of the gravity loads on the osteoporotic bone. They can be related to other conditions and diseases (inflammatory rheumatism, malignancies, metabolic bone diseases), but they are most common in bilateral

advanced knee osteoarthritis with marked varus deformity. In patients with such bilateral knee osteoarthritis, a stress fracture is caused by normal stresses placed on abnormal bone [1]. This poor biomechanical condition leads to a fracture in the proximal part of tibia at the site of the new resultant force [2, 3]. Such cases are rare, but possible consequences make its treatment a challenge [4, 5]. It is most often performed by bilateral total knee arthroplasty (TKA) on both sides, in two phases. The first phase involves the TKA with a modular tibial stem on the knee with the fracture, and the second phase is performed by a standard TKA on the contralateral knee (usually three months after the first TKA and after the rehabilitation is being finished) [6]. After both surgeries, additional inpatient physical therapy is being performed. The object of this paper is to present the algorithm and the results of the treatment on a series of patients with unilateral stress proximal tibial fracture and bilateral primary knee osteoarthritis in a manner as described above.

METHODS

In the period from 2005 to 2017, 14 patients with a unilateral proximal tibial stress fracture, associated with bilateral primary knee osteoarthritis grade 4 according to the Kellgren Lawrence classification, were surgically treated at General hospital Gradiska (Figure 1). These were also the inclusive criteria. Excluding criteria were: inflammatory and metabolic rheumatic disease, trauma, and previous surgery on the same leg. The treatment of choice was TKA with modular tibial stem on the fractured knee, in the first act, and standard TKA on the other knee, in the second act, for all patients. After standard preoperative preparation, the surgeries were performed under spinal anesthesia in all cases. A tourniquet was used each time. Standard mid-vast approach was applied. Thromboprophylaxis was performed in all patients one day preoperatively and during 21 days postoperatively. Walking with forearm crutches was allowed after the surgery with partial support up to the pain limit. All patients had postoperative rehabilitation of 21 days for two times – after the first and after the second surgery. Both inpatient rehabilitation treatments were performed one month after each TKA. The rehabilitation had included kinesitherapy, occupational therapy, electrotherapy 5 times a week, and daily hydrotherapy. Monitoring parameters were: x-rays, range of motion (knee flexion), and the Western Ontario and McMaster Universities Arthritis Index (WOMAC) index preoperatively, and 3, 6 and 9 months after the first surgery. Statistical analysis was performed by Student's t-test for $p<0.05$ level of significance, using the SPSS 19 software. Study was

approved by Ethics Committee of General hospital Gradiška (Reference Number: 01-1758-3/20).

RESULTS

The study sample included 14 women with an average age of 74.1 ± 2.07 years on the day of the first surgery. The rate of these patients in relation to all TKA surgeries for the observed period was 0.7% (14/1970). All patients denied any mechanism of trauma related to the pain. The limbs axis correction was confirmed after surgery and the fracture healing was clinically and radiologically confirmed in all cases 6 month after surgery (Figure 2), except for one case complicated by infection, being treated later throw another approach.

All patients preoperatively had a knee flexion contracture. Average extension deficit in the knee with tibial stress fracture was 15±3.1 degrees, while on the knee with osteoarthritis was 7 ± 2.5 degrees. At the same time, average knee flexion in knee with tibial stress fracture was 55 ± 2.7 degrees and on the knee with just osteoarthritis was 90±3.7 degrees. Nine months after the first surgery, when the rehabilitation following the second surgery was finished, full extension was observed in both knees of all patients. At the same time, average flexion was 100 ± 3.2 degrees in the arthritic knee without the fracture, and 85 ± 2.6 degrees in the knee with proximal tibial stress fracture, which was significantly improved compared to the preoperative condition ($p < 0.05$) (Figure 3).

Pain and stiffness reduction as well as improvement of physical function (decrease of physical function difficulty), valued by WOMAC index at 3 and 6 months after the first TKA surgery, and they were improved in relation to preoperative values. This improvement was particularly significant 9 months after the first TKA surgery, when the rehabilitation following the second surgery was also finished (Figure 4).

DISCUSSION

Tibial stress fractures in patients with bilateral primary knee osteoarthritis associated with severe flexion varus deformity are rare and complex clinical condition, making its treatment a challenge [4, 6]. This type of fracture is caused by the action of repetitive gravity loads on the proximal tibial metaphysis due to the change of the axes in the knee, both in coronal and sagittal planes. The goal of the treatment in these patients is to achieve the fracture healing, satisfactory joint stability, a normal relation between the limb axes, painless joint

mobility, and independent walking. Improving these factors improves the patient's quality of life. Anamnestic data about sudden worsening of the primary knee osteoarthritis symptoms can indicate the proximal tibial stress fracture. The diagnosis of these fractures is performed by radiography. The treatment of these patients is mainly surgical [7, 8] When we had such a first patient, there were very few published papers on this topic in the literature, with a very small number of cases [9, 10]. Later, we found in the literature different ways of the surgical treatment: corrective osteotomies with plate fixation, intramedullary fixation, standard arthroplasty, and the modular TKA [1, 11–18]. Our choice from the beginning was the use of modular TKA in all patients with a proximal tibial stress fracture associated with bilateral primary knee osteoarthritis. Rehabilitation goals were to reduce pain and swelling, improve the range of knee motion increase the muscular strength of thigh muscles, and achieve the independent gait. We found a radiographically correct finding in most of the patients. The average range of motion in the knees postoperatively was significantly better at 6 and 9 months after the first TKA surgery than preoperatively. Improvement of knee extension was better and faster than knee flexion. However, knee flexion was significantly improved at 6 and 9 months after the first TKA surgery. A small decline or stagnation in the knee flexion recovery at third month after the first TKA surgery indicates that these limitations were caused by impaired function of the contralateral osteoarthritic knee.

Our sample consisted of elderly women. There is a study that does not confirm these results [3]. As a possible reason for the proximal tibia stress fracture occurence in this population, associated with the physiological loss of mineral bone density, but due to difficulty in movement, we should also consider the correlation between inactivity and osteoporosis [19].

Our research indicates a significant improvement in general physical functioning at already 3 months after the first TKA. Given that modular TKA provides the primary goals to be achieved in the surgical treatment of an osteoarthritic knee proximal tibial stress fracture (fracture healing, osteoarthritic surfaces plasty, and local biomechanical correction), and that a postoperative rehabilitation contributes to better functional results throw the pain, and swelling reduction, it is clear why the physical functioning was significantly better at already 3 months after the first surgery. After the first TKA, the symptoms dominantly influencing the WOMAC index were related to primary osteoarthritis of the other knee.

Only after the definitive treatment is complete in these patients, i.e. after the rehabilitation following the second TKA is complete, the definitive outcome can be fully assessed. Measured by WOMAC index 6 months after the first TKA, i.e. after the both knees TKA surgeries,

patients had a good physical functioning, significantly better compared to the preoperative level, but also at 3 months after the modular TKA surgery. Since stress fractures of the proximal tibia associated with bilateral primary knee osteoarthritis are rare, just few studies with small sample sizes have been published [20, 21]. Soundarrajan et al. performed the study on 20 patients and concluded that long-term plaster immobilization slows down the fracture healing process and even can lead to nonunion thus as the treatment method of choice was suggested modular TKA as soon as possible [22]. The same was confirmed by Sawant et al. throw the series cases of 4 patients [23]. Wui et al. confirmed on series cases study good short-term results of the treatment with a modular prosthesis on the stress fracture side and standard TKA on the OA side [24]. Shah et al. published the results of a study on 62 patients and confirmed that modular stem implantation is a good solution for patients with tibial stress fracture associated with knee OA [25]. Studies by Indian researchers from 2019 and 2022 performed on small samples confirm are in correlation with our results [26, 27].

We did not find a study with the results opposed to our own.

CONCLUSION

Modular total knee arthroplasty followed by postponed standard knee arthroplasty at contralateral side is a suggested choice in the treatment of unilateral proximal tibial metaphysis stress fracture because its application provides a good fracture healing, osteoarthritis treatment, deformity correction, and restoring knees axes to a normal. The quality of life is expected to be significantly improved 9 months after the modular TKA surgery, followed by standard contralateral TKA performed about 6 months after the first TKA. This treatment should include inpatient physical procedures after each surgery, because of its significant contributing to the final outcome improvement.

Conflict of interest: None declared.

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Figure 1. X-rays of both knees in a patient with a proximal metaphysis stress fracture of the right tibia, associated with severe bilateral knee osteoarthritis

Figure 2. X-rays of both knees in a patient with a proximal metaphysis stress fracture of the right tibia, associated with severe bilateral knee osteoarthritis, treated with bilateral total knee arthroplasty in two acts, nine months after the first, modular total knee arthroplasty

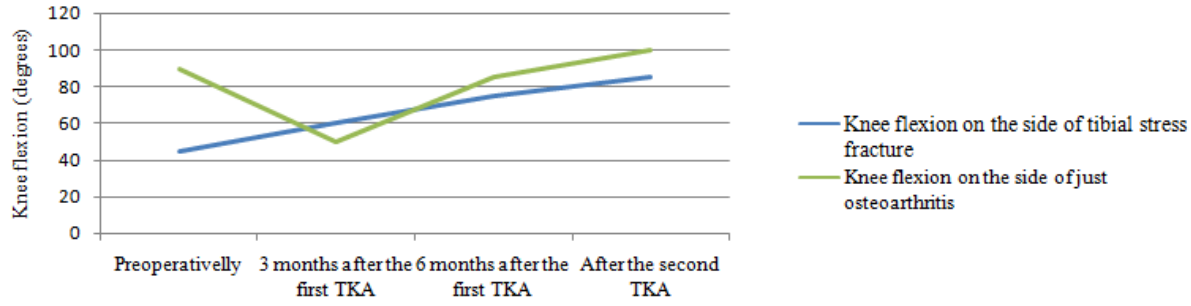

Figure 3. Improvements of average knee flexion in both knees;

TKA – total knee arthroplasty

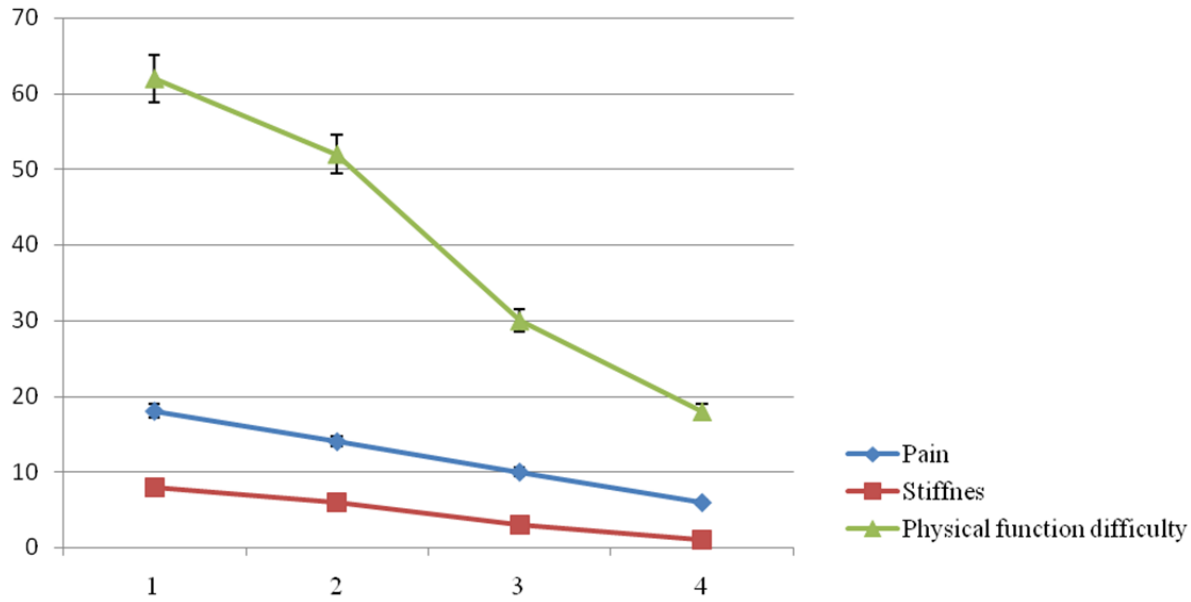

Figure 4. Subscales of the WOMAC index; X-axis: (1) three months after the first total knee arthroplasty (TKA), time of the second TKA; (2) six months after the first TKA, three months after the second TKA; (3) six months after the first TKA, three months after the second TKA; (4) nine months after the first TKA, six months after the second TKA

