**Introduction**

Bone defects may have negative consequences on the quality of life of the patient such as destitution, disability, divorce or depression and they present complex treatment challenges [1, 2]. They can result from an acute trauma with bone loss, tumor excision, chronic infections requiring bone resection or chronic non-unions with segmental bone defects [3]. In case of septic non-unions, most authors recommend aggressive resection of contaminated devitalized bone and surrounding scar tissue [3, 4]. Because of difficulty in managing bone defects and their poor outcomes, amputation used to be the preferred treatment [1]. Nowadays, the alternative methods of limb salvage and restoration of its functions include limb shortening, autologous nonvascularized cancellous bone grafts, free vascularized bone transfer, interpositional bone allografts, bone transport distraction osteogenesis or an intramedullary rod, segmental metallic prostheses and intercalary scaffolds augmented with growth factors [3–13]. We report the surgical treatment of a patient with distal femoral non-union and a co-existing failure of the knee extensor mechanism using a specific intramedullary segmental defect bridging knee arthrodesis system (Osteobridge). At the final check-up twenty four months later, he had excellent clinical, functional and radiological results.

**Conclusion.** Osteobridge is an excellent knee arthrodesis system, which is preferable to other methods in case of resection of the distal femur along with the failure of the knee extensor mechanism.

**Key words:** Limb Salvage; Femoral Fractures; Knee Prosthesis; Arthrodesis; Arthroplasty, Replacement, Knee; Quality of Life; Treatment Outcome; Patient Outcome Assessment

**Case report**

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**Prikaz slučaja.** Prikazan je slučaj 50 godina starog muškarca sa lažnim zglobom donjeg okrajka butne kosti i koegzistirajućim oštećenjem ekstenzornog mehanizma kolena, koji je bolje uspe rekultivacije unutarokostačnog sistema za premošćavanje defekta i ukočenje zgloba kolena (Osteobridge). Na poslednjem kontrolnom pregledu posle 24 meseci imao je odlične kliničke, funkcionalne i radiografske rezultate. Osteobridge je odličan sistem artrodeze kolena koji je bolje uspe rekultivacije unutarokostačnog sistema za premošćavanje defekta i ukočenje zgloba kolena.

**Ključne reči:** Spasavanje ekstremiteta; Fraktura femura; Proteza kolena; Arthrodeza; Artroplastika, zamena kolena; Kvalitet života; Ishod lečenja; Procesa pacijenta
Case Report

A fifty-year-old man, who had had a car accident five years before resulting in an open complete articular, bicondylar fracture with supracondylar comminution of his left femur (AO Müller Classification: 33-C2), had eight separate surgical operations performed by three different surgeons in hospitals in Greek province. Initially, he was treated with an external fixator, which was replaced with a condylar buttress plate and screws three weeks later. A complete rupture of the quadriceps tendon was also diagnosed and repaired at the same time. Four months later, the plate was broken and replaced by a new larger buttress plate and autologous grafts from the iliac crest. However, the plate was removed after two months because of an infection and Staphylococcus Aureus was cultured. Intravenous antibiotics were administered according to the antibiogram for six weeks. A splint extending from the hip and down to the ankle was placed to stay for the same time. After nine months, the patient had normal values of sedimentation rate and C-reactive protein and normal findings in the three-phase bone scintigraphy. Thus, a wide soft tissue debridement and dead bone resection along with a new open reduction and internal fixation with a buttress plate and bone autografts was attempted. A rupture of the patellar tendon occurred when the surgeon tried to mobilize the knee joint, which had been immobilized in the full knee extension for all these months. The tendon was repaired with suturing through bone tunnels within the tibial tubercle. Unfortunately, the plate was removed ten months later due to the hypertrophic non-union. The surgeon removed the devitalized bone and soft tissues and tried to cover the bone defect using the bone transport distraction osteogenesis method. Twelve months later the majority of the defect was successfully covered but non-union was confirmed at the fracture site. Moreover, after all these operations and the long-lasting immobilization of the knee, there was a complete failure of the extensor mechanism and the joint was ankylosed in the extended position. Finally, the surgeon suggested the transfemoral amputation of the left lower limb as the definite solution.

In January 2013, the patient came to the orthopedic department of our hospital asking if there was an alternative solution to prevent the amputation of his limb. He was screened preoperatively for the presence of infection by clinical signs and laboratory evaluation that consisted of complete blood cell count, erythrocyte sedimentation rate and C-reactive protein levels. Furthermore, he underwent the three-phase bone scintigraphy and magnetic resonance imaging (MRI). All these tests were found to be negative for the presence of infection. Moreover, MRI helped us to determine the amount of dead bone that was present, as well as the level where the dead bone had to be removed. Over the level of the non-union, the area of less than two centimeters of the proximal femoral fragment was found to be non-vital in contrast with the distal femoral fragment, which was found to be more than 80% dead. Additionally, new imaging tests (computed tomography and x-rays) of his left femur and knee were done (Figures 1 and 2). Resection of the distal third of the left femur, distal to the level of the
non-union, was performed via the anteromedial approach. Two centimeters of the proximal femoral fragment, the patella and the proximal five millimeters of the upper tibia were also removed. This resulted in a twelve centimeter bone defect, which was reconstructed using an Osteobridge Extended System PLUS Knee Arthrodesis. All implant components of this system are made of titanium alloy (TiAl6V4), which ensures biological integration of the prosthesis into the bone structure [4]. Bridging of the defect and knee joint was achieved using two metallic spacers of five centimeters (angled at ten degrees of flexion and five degrees of valgus) and seven centimeters in length, which were connected with a spacer connector. Two intramedullary nails were used in order to anchor the implant to both the femur and tibia. These nails were statically locked into the bone using two interlocking screws at each of them. The spacers were assembled with their interconnectors in situ with the nails and each one of them was secured to the adjacent one with eight screws according to the manufacturer’s instructions (Figure 3). The surgical time was two hours and fifteen minutes and the patient lost about four hundred milliliters of blood. Neither limb length discrepancy nor intra-operative complications were recorded. The intensive rehabilitation program began three days after the operation. Passive and active exercises of both hip and ankle joints and muscular strengthening were performed for six weeks. Partial weight bearing was instructed after the fifth postoperative day, which was switched to full weight bearing in eight weeks. The follow-up protocol, which was based on clinical, functional (Knee Society Score) [14] and radiological findings, included interval assessments after one, three, six, 12 and 24 months postoperatively. The patient’s Knee Society Score was 70 and the Knee Function Score was 90 24 months after the operation. He was able to walk for a long distance and get up from sitting position without pain or support, with no evidence of periprosthetic infection and without radiological findings of implant loosening or breakage (Figures 4 and 5). Generally, he was completely satisfied with the results of the operation and returned to work and his daily activities.

Discussion

Osteobridge is a knee arthrodesis system which serves as an implant for bridging large bone defects, after resection of the distal femur and proximal tibia. It provides intra-operative modularity, limb length restoration, simple handling, short-time surgery, analgesia, low complication rate, stability, immediate mobilization, rapid rehabilitation and early weight-bearing [15, 16]. Extra stability is provided by the roughened titanium surface of the prosthesis stem, which stimulates osseointegration [4]. The position of the knee joint

![Figure 3. Intra-operative application of intramedullary segmental defect bridging knee arthrodesis system](image3)

![Figure 4. Antero-posterior radiograph of both femurs and knees 24 months postoperatively](image4)
(extension/flexion, varus/valgus) can be adjusted by rotation of the angled spacer [4]. Hollow spacer shells can be used as the carriers of antibiotics and bone grafts for the active stimulation of bone growth [4].

Compared with other techniques, such as the use of free vascularized fibular graft alone or in combination with allograft and with bone transport distraction osteogenesis, the application of Osteobridge seems to be an easier technique, which enables shorter treatment duration, better functional results, earlier weight-bearing and lower complication rate [10, 12, 17–19]. In the reported case, the Osteobridge Knee Arthrodesis System was preferred to a custom-made mega-prosthesis or an Ilizarov frame with the technique of bi/unipolar segment transport. A custom-made mega-prosthesis requires good functioning of the extensor mechanism of the knee [20]. Since there was a complete failure of the knee extensor mechanism in this patient, the use of a custom-made mega-prosthesis was excluded. On the other hand, the authors believed that the application of an Ilizarov frame and the bone transport distraction osteogenesis technique would not be reliable because the distal femoral bony fragment was found to be non-vital more than 80% according to the MRI findings. In this case, the modularity of the Osteobridge provided the straightforward and simple reconstruction system of a twelve centimeter bone defect and at the same time a stable knee arthrodesis system. The leg length was easily restored without the need for extensive pre-operative planning or the need of expensive custom-made mega-prostheses.

The advantages and the effectiveness of the Osteobridge system are mentioned in other studies in the literature as well. Mavrogenis AF et al. reported excellent oncological and functional results and no complications using Osteobridge in the treatment of a patient with adamantinoma of the tibia [4]. The results of two studies conducted by Sakellariou et al. supported the use of the Osteobridge technique [21, 22]. These studies suggest a promising future for the Osteobridge system. However, studies examining the long-term postoperative results of its use are scarce. Severe mechanical complications, such as loosening or breakage, have been reported in long-term follow-up studies with the use of other intercalary endoprosthesis [16]. In case of Osteobridge, we cannot be sure of possible disadvantages or future complications of this system without long-term follow-up and studies with larger patient populations.

**Conclusion**

No intra-operative or post-operative complications were recorded after the application of the Osteobridge Knee Arthrodesis System in this patient. No limb length discrepancy was observed. Full weight-bearing without pain or support were achieved eight weeks after the operation and the patient returned to his normal daily activities. He had good clinical (Knee Society Score 70), and extremely good functional (Knee Function Score 90) and radiological results 24 months after surgery at the last check-up.

Consequently, we believe that the Osteobridge Knee Arthrodesis System is an excellent lower limb salvage technique, which is preferable to other methods in case of the distal femur resection, along with the failure of the knee extensor mechanism.

**References**

6. Chen TH, Chen WM, Huang CK. Reconstruction after intercalary resection of malignant bone tumours: comparison


