TURKISH JOURNAL OF PLASTIC SURGERY

Case Report

DOI: 10.5152/TurkJPlastSurg.2016.1910

Reconstruction of the Tibia with a Bipedicle Fibular Flap

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Abstract

Tibial defects can be caused by trauma, congenital, osteomyelitis, or cancers. The tibia is the main bone for bearing the body. It is a big bone, and the difficulty of the reconstruction of tibia is importance to repair it. The fibular bone is a good provider for repairing the tibia defects. Generally, the repair was planned be a free vascularized flap. The most important disadvantage is the low calibration. In early age in particular, the original thickness of the tibia is reached after the surgery with a good follow-up process and rehabilitation. In this case; a 22-year-old female patient had a multi-part post-traumatic fracture of the left tibia and was administered to our plastic surgery inpatient clinic. The bone defect was reconstructed with a bipedicle fibular flap taken from the same leg. The fibula was embedded into the medulla with a screw plate, and fixation was applied with an external fixator. Wherefore the loss of skin, skin flap of fibula bottomed of perforators was not used. A vascularized anterolateral thigh flap, which was obtained from the other leg, was used to reconstruct the skin defect. One year after surgery, the bone viability was perfect. The integrity of the skeleton was created without shortening the leg. The rehabilitation of the patient was continued for repowering and resizing the fibula up to tibia. In this case report, we wanted to share our experience for repairing the tibia defect with using a bipedicle fibular flap.

Keywords: Tibia defect, fibula, flap

INTRODUCTION

The tibia is the second longest bone in the body after the femur and corresponds to 85% of the weight-bearing capacity of the leg. Tibia loss can occur for various reasons, including congenital anomalies, infections, tumoral masses, and trauma.[1] In case of trauma, Gustilo type III fractures exhibit tibial bone defect apart from soft tissue and vascular injuries.[2] Even if an adequate mass of muscular and soft tissue remains, extremity loss is inevitable if the loss of the tibia, which is a component of the main weight-bearing system, cannot be remedied. Loss of leg muscles, on the other hand, does not pose a major problem and is not a contraindication in operations aimed at saving the lower extremity. Securing an extremity length that evens the lower extremities is generally considered to be an adequate result in surgical procedures aimed at saving the extremity[1]. The presented case reports a tibia reconstruction with a double-pedicled fibula flap in a 22-year-old female patient with an extensive tibial defect.

CASE PRESENTATION

A 22-year-old female patient had a Gustilo type III injury on the anterior surface of the right leg, which was caused by a fall in which she had landed on a rocky surface from a considerable height. Multiple segmental tibial fractures were accompanied by a skin and muscle defect of 23×15 cm at the middle third of the tibia. The anterior tibial artery was severed at the proximal third of the tibia. The fibula was completely intact and had retained the overlying soft tissue. During emergency treatment, an external fixator had been positioned and fractured fragments were held together with absorbable sutures (Figure 1a). Wet dressings applied daily to the ex-

The case was presented on 5-8 September 2013 in 8th BAPRAS Congress Montenegro and was presented on 28-31 October 2013 in 35th TPRECD National Congress, as a poster in Istanbul.

Received: 17.10.2014
Accepted: 03.02.2015

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Figure 1. a, b. During the first surgical intervention process performed on the patient with a Gustilo type III fracture, tibia fragments were pieced together and stabilization was provided with an external fixator (a). View of the scar that was prepared for surgery by means of granulation after the necrotic tissue was cleared (b)

posed tibia fragments were unable to secure their vitality. A tibial reconstruction was planned. The necrotic tissue in the injury site was cleared, and the injured areas were exposed. Occlusive dressings were applied daily, and the wound was cleared of infection after which it was left until coated with clean granulation tissue (Figure 1b). The patient later underwent a surgery for tibia repair, during which the granulation tissue and necrotic tibia fragments were cleared and distal and proximal segments of the tibia were prepared. There was a 15-cm bone defect between the two segments. The defect was prepared for reconstruction with the fibula taken from the same leg. The fibula was cut to spare approximately 6-cm long bone fragments that were incorporated into the joints at the distal and proximal ends. The 18-cm middle segment was relieved, taking care not to harm the peroneal artery at either the proximal or the distal end. After flexibility was ensured by loosening the external fixator, the double pedicled fibula flap thus obtained was positioned so that its distal and proximal ends were inserted into the medullae of tibial segments (Figure 2a). The axis of the leg was adjusted, and the external fixator was locked into place. After stabilization was achieved, sites at which connection was formed with mini-plates were fixed to prevent any dislocation (Figure 2b). For skin coverage, a 22×15 cm anterolateral thigh (ALT) free flap harvested from the contralateral thigh region was connected to the anterior tibial artery and vein stump at the recipient site by means of end-to-end anastomosis. The diameter of the recipient vessel was small, and the pulsation was weak. The fibula flap was covered completely with the ALT flap. The flap was unsuccessful and was lost at 72 h postoperatively. On the third day, the ALT flap was removed, and the fibula was dressed using vacuum-assisted wound closure. Approximately 7 days later, granulation was complete. A second surgery was performed in which the granulated fibula flap was closed with a partial thickness skin graft.

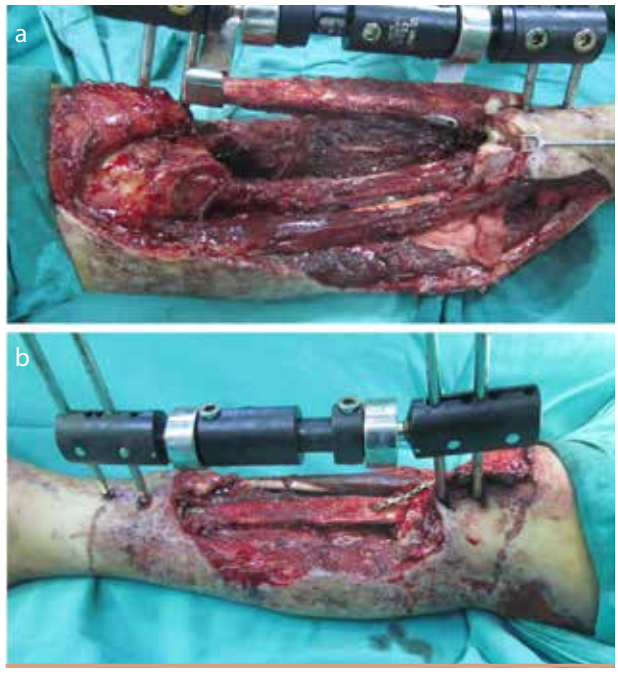

Figure 2. a, b. Removal of the bipedicled fibula flap (a) and insertion of the fibula flap to the medullae of proximal and distal segments of the tibia after which it was fixed in place with mini-plates (b)

Figure 3. a-c. Postoperative anterior–posterior X-ray image of the fibula after being adapted to the tibia (a). Lateral (b) and anterior–posterior (c) X-ray image of the fibula flap with enhanced calibration, having been adapted to the tibia after 12 months following surgery

Following proper recovery, the patient was discharged on postoperative day 10. She was regularly monitored for 12 months. Beginning from postoperative month 2, controlled load was applied to the fibula flap, accompanied by stepping and walking exercises. The X-ray evaluation in postoperative month 12 revealed that fibula calibration had increased to 3/4th of the normal tibia thickness (Figure 3a–c). In the last follow-up examination, it was observed that there was no difference in the length between the extremities and that the patient was able to stand and walk without support (Figure 4).

Figure 4. At the end of 12 months, the two extremities were equal in length and the patient could stand without support

DISCUSSION

Bone and soft tissue loss is present in Gustilo type III injuries caused by trauma.[2] In these injuries, it is mostly impossible to identify a bone that can replace the tibia in terms of size and strength. Three basic methods can be applied to overcome bone defects and to achieve both functional and anatomical healing. These include autogenous bone grafts, distraction osteogenesis, and vascularized bone grafts. It is theoretically possible to close extensive defects with distraction osteogenesis; however, in practice, the best results are obtained in closing 4–8-cm defects. Complications that may arise include mismatch in leg length, axial deformities, refracturing, pin tract infections, bad scarring, and bone healing problems.[1]

Iliac and calcaneus bone grafts may be used for bone graft applications. In this procedure, the bone should be closed using infection-free soft tissues with adequate blood supply. In extensive tibial defects, bone graft applications are not sufficient because infections and problems with blood supply also occur. The ischium can provide for this requirement for up to 10 cm, whereas the vascularized fibula is generally the only solution in rescuing the extremity in cases where a longer bone is needed. Under these circumstances, a free vascularized fibula flap seems to be a reasonable option. However, the morbidity of the donor site and length of the surgery limit the use of this technique. Another method in overcoming large tibial defects is the tibialization procedure. In this method first described by Huntington in 1905, the fibula of the same leg is prepared and transferred to the tibial defect, while preserving the pedicle. In a two-stage repairing process, Huntington had first cut the fibula proximally and positioned it in the medulla of the proximal tibial segment and also cut the fibula from its distal end and fitted the bone into the distal segment medulla of the tibia in the 10th month following bone union.[3] The fibula, which is proximally incorporated into the knee joint and distal to the ankle joint, thus functions as a stabilizer. Therefore, the whole fibula can be used as a graft, provided that at least 6 cm of bone is preserved at both the distal and proximal ends. The independent blood supply it receives from the peroneal artery renders the fibula a reliable flap. Vascularized fibular grafts can close up to 24-cm long bone defects.[1] The fibula, being thinner than the tibia, is more susceptible to fractures caused by pressure. Thus, stress fractures may occur in the fibula following surgery. Stress fractures are described to be between 7% and 35% in the medical literature.[4-6] Controlled load application following bone union serves to enlarge the bone and increases bone strength to a level comparable with that of the tibia. On an average, this process requires 16 months.[7] Yajama has shown that by using the fibula in two segments, it is possible to shorten the period to achieve optimal load-bearing capacity by 6 months.[8] The pedicled fibula flap is a more reliable and an easier surgical procedure than a procedure with the fibula free flap. Because bone damage is accompanied by vascular damage in Gustilo type III injuries, preserving the vascular structures with utmost care is of vital importance in terms of circulation within the extremity. In free tissue transfer, the use of an artery that supplies the leg endangers circulation in the foot. In our case, because soft tissue, the muscle, and the anterior tibial artery located at the anterior region of tibia were severed at the proximal third of the bone, preserving the peroneal artery was particularly important in ensuring circulation at the extremity. On the other hand, short duration of surgery and reduced donor site morbidity may encourage preference for the technique. Tibial reconstruction performed with the tibia has been shown to produce better results in younger age groups.[9] Therefore, it is thought that the intact ipsilateral fibula should be used for reconstruction before deciding on amputation. Calibration and decreased bone strength are the greatest disadvantages of the technique. We therefore believe that controlled and efficient weight-bearing exercises performed after surgery is one of the most important factors in determining the success of the technique.

Informed Consent: Written informed consent was obtained from patient who participated in this case.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - A.K.; Design - A.K.; Supervision - A.K., S.Y.; Resources - Y.S.; Materials - H.T., Y.C.; Data Collection and/or Processing - Y.C.; Analysis and/or Interpretation - A.K., S.Y.; Literature Search - A.K.; Writing Manuscript - A.K.; Critical Review - S.Y.; Other - S.Y., H.T., Y.C., Y.S.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study has received no financial support.

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