



Reconstruction of lower extremity close-range shotgun injuries with gracilis free flap: a report of two cases

Alt ekstremite yakın mesafe pompalı tüfek yaralanmalarında grasilis serbest kas flebi ile onarım: İki olgu sunumu

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Close-range shotgun injury to the lower extremity is a devastating problem and is a challenge to the surgeon. Point-blank shotgun injuries to the extremities create a typical wound that is deep but not wide. These wounds almost always need to be treated with local or distant tissue transfer. We report two cases of shotgun injury to the lower extremity at point-blank range, which were treated using debridement, vacuum-assisted closure and free gracilis muscle flap transfer.

Key Words: Close range shotgun; gracilis free flap; lower extremity trauma.

Yakın mesafeden oluşan pompalı tüfek yaralanmaları uzuvlarda tedavisi zor yaralara neden olur. Bu yaralanmaların sıfır noktasından yapılması uzuvlarda tipik olarak derin fakat geniş olmayan kaviter yaralar oluşturur. Bunların tedavisinde çoğunlukla doku nakline ihtiyaç vardır. Bu şekilde yaralanmış iki olguda debridman, negatif basınçlı pansuman ve serbest grasilis kas flebinin kullanımı sunulmuştur.

Anahtar Sözcükler: Yakın mesafeden vurulma; grasilis kas flebi; ekstremite travması.

Close-range shotgun injury to the lower extremity is a devastating problem and is a challenge to the surgeon. Point-blank shotgun injuries to the extremities create a typical wound that is deep but not wide. These wounds almost always need to be treated with local or distant tissue transfer.

We report two cases of shotgun injury to the lower extremity at point-blank range who were treated using debridement, vacuum-assisted closure (VAC) and free gracilis muscle flap transfer.

CASE REPORTS

Case 1- An 18-year-old male patient sustained a shotgun injury from a distance of 5 cm to his medial distal tibia and malleolus while cleaning his rifle. His initial treatment and debridement were performed by an orthopedic surgeon and he was transferred to our service on day 10 of the injury after placement of an external fixator. On examination, he had a defect mea-

suring 11 x 7 cm wide and 7 cm deep extending from the junction of the middle and distal thirds of his tibia to his medial malleolus (Gustilo type IIIb) (Fig. 1a). The wound contained necrotic bone with visible pellets. After two days of dressing changes with Dakin's solution, he was taken for debridement, and most of the distal tibia, which was necrotic, was removed, with only a small segment of bone remaining on the lateral aspect. The medial part of his tibio-calcaneal joint was exposed after the debridement. Postoperative X-ray examination showed a small segment of lateral distal tibia remaining (Fig. 1b). On day 17 of the injury following VAC treatment (Fig. 1c), the patient underwent gracilis free flap reconstruction of the defect. The patient experienced no problems during the postoperative period and is awaiting definite reconstruction of the bony defect (Fig. 1d).

Case 2- A 17-year-old male patient sustained a shotgun injury from a distance of 10 cm to his right

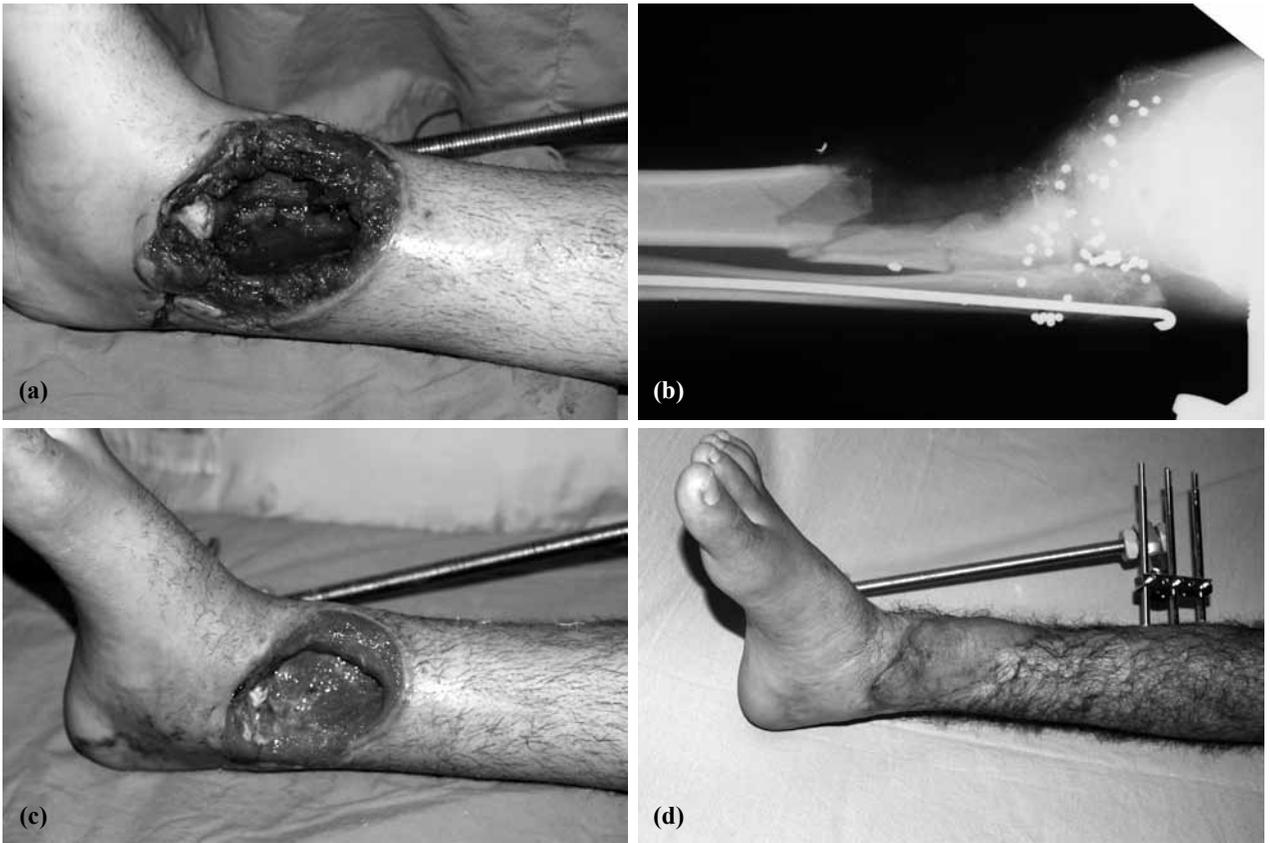


Fig. 1. (a) Patient with a shotgun injury to the distal tibia. (b) X-ray showing the debrided distal tibia and pellets around the ankle joint. (c) Condition of the wound after vacuum-assisted closure treatment. (d) Postoperative period after the free gracilis muscle transfer.

lateral calcaneal area while cleaning his rifle. His initial treatment and debridement were performed by an orthopedic surgeon and he was transferred to our service on day 7 of the injury. On examination, he had a defect measuring 7 x 6 cm wide and 5 cm deep (Fig. 2a). The wound was relatively clean with no gross necrotic material. At the base of the wound, the calcaneal bone was exposed in addition to pellets from the gunshot. On the sole of the foot, although there were no open wounds, pellets were visible under the skin. On

X-ray examination, a small lateral part of the calcaneal bone was missing. The patient did not experience any complications in the postoperative period and was ambulatory at two months after the surgery (Fig. 2b).

Treatment Protocol and Technique of Free Flap Harvest and Insetting

After the patients were admitted to our service, wound cultures were taken and patients were placed on Dakin's solution dressing changes for two days.

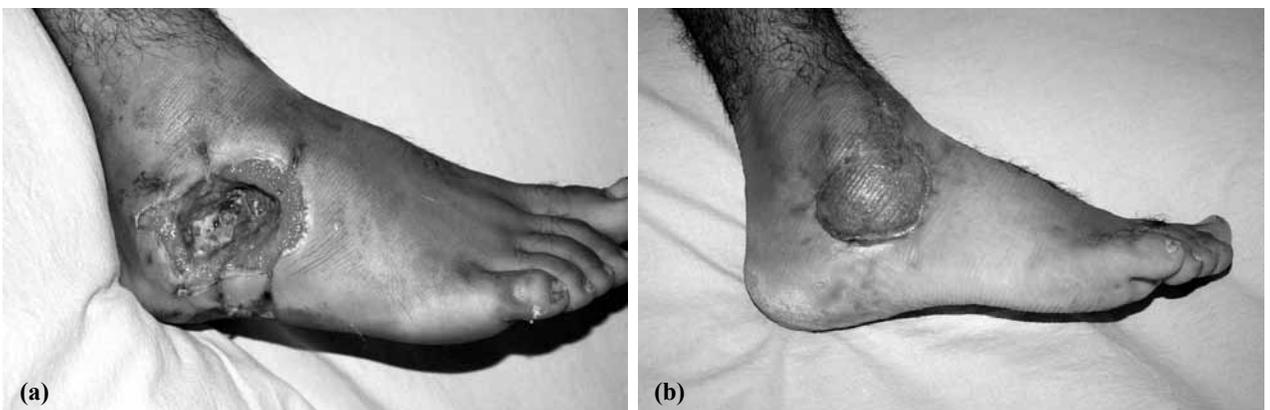


Fig. 2. (a) Patient with a gunshot wound to the lateral calcaneal area. (b) Postoperative period after the free gracilis muscle transfer.

Later, the patients were taken for a debridement to remove any remaining necrotic material or foreign body. At the end of the procedure, VAC system was applied to the wound for 5 to 6 days (Fig. 1c). Vascular examinations done with a handheld Doppler device showed intact anterior tibial, dorsalis pedis and posterior tibial arteries, and an Allen's test confirmed the integrity of the arch. The ipsilateral gracilis free flap was harvested via an 6 cm incision described by Jeng et al. and Hasen et al.^[1,2] The flap was inset into the defect using deep sutures to assure all the dead space was filled with muscle tissue. A suction drain was placed between the flap and the wound. Arterial anastomosis was made to the anterior tibial artery in an end-to-side fashion. The two venae comites of the gracilis muscle were anastomosed to corresponding veins of the anterior tibial system in an end-to-end fashion. Part of the muscle was laid on the area where the anastomosis was made rather than primarily closing the skin. A split thickness skin graft was applied over the flap. An epidural catheter, which was placed before the surgery, was kept for three days in the postoperative period. The patients were prescribed a daily aspirin (100 mg) for four weeks. The suction drain under the flap was removed on day 5. On day 10, the patients started using compression bandages over the flaps, which were continued for four months. Patients were followed for one year. The bulk of the flap gradually decreased, taking the contour of the recipient anatomic area. The wounds were completely healed without any evidence of recipient or donor site complications.

DISCUSSION

Soft tissue shotgun injuries are classified from type 0 (benign) to type III (most severe).^[3,4] Type 0 injuries, which involve only skin penetration, are from a distance of 50 meters. Type I injury, which involves penetration of the subcutaneous tissues and deep fascia, are from a distance of 7 to 20 meters. Type II injuries are from a distance of 3 to 7 meters. Type III wounds are from shots within 3 meters and cause extensive damage to everything in their path. In this case, the pellets remain tightly clustered and the entire load functions as a unit. Wound diameters less than 15 cm usually indicate injury to deeper structures. They are associated with a high rate of major fracture (48%), soft tissue disruption (59%), vascular injury (35%) and nerve damage (58%).^[5] Furthermore, fragmented bone can become secondary bullets, increasing tissue damage.^[6]

Contrary to popular belief, bullets or pellets are not sterilized on discharge.^[5] In addition, shotgun wadding may result in a high degree of wound contamination,^[7] which may prolong the hospital stay. Debridement should be done as early as possible to remove necrotic tissue and shotgun fragments. However, an

extensive debridement initially is not indicated to prevent iatrogenic injury by removing possibly viable tissue. Rather, multiple small debridements can be done until the wound appears stable for coverage. We used Dakin's solution and applied a VAC system between debridements. One additional problem may be the potential lead intoxication (plumbism) due to retained shotgun pellets.^[8] This is especially true if the pellets are lodged in joint spaces and bone, and less so in soft tissue. The effects can be seen days to years after the injury. Although as many fragments as possible should be removed from the wound, this may not always be possible without causing further iatrogenic damage to surrounding tissues and vital structures. In these cases, a decision can be made to leave these pellets in place. In our experience, remaining pellets did not cause any problems for the patients.

Redett et al.^[9] used the gracilis muscle on 50 consecutive patients with acute Gustilo type IIIB fractures in both the acute setting and in chronic osteomyelitis. They achieved a limb salvage rate up to 96% with minimal donor area morbidity. They advocate that the gracilis muscle is ideal in lower extremity defects up to 100 cm² and has great versatility. Celikoz et al.,^[10] in a group of patients who underwent free flap coverage for gunshot and mine injuries to the lower extremity, found that the most significant factor determining the anastomotic failure was the severity of the wound damage. With regards to close-range shotgun injuries, although the local destruction in depth is extreme, the width is limited, sparing the vascular structures within close proximity of the wound. Thus, a gracilis free flap with a pedicle length of 6-8 cm would reach one or the other vessels outside the area of injury, making a safe anastomosis possible. Conversely, point-blank shotgun injuries have a significant depth of penetration and often lead to bone destruction. Using the VAC on such deep wounds is an integral part of our protocol. This would remove the secretions, enhance vascular tissue ingrowth and possibly decrease the size of the wound until definite reconstructive treatment is undertaken. The size and shape of the gracilis muscle is ideal for wounds that are not wide on the surface but have significant level of depth. Thus, a small part of the gracilis muscle is sufficient to effectively fill these defects. In our series, via a small 6 cm incision, only the proximal half of the muscle was harvested in less than 30 minutes. Pu et al.^[11] treated through-and-through gunshot wounds of the feet using free gracilis muscle flaps. In their small series, both the entry wound and the exit wound were covered with the same gracilis muscle flap. This is similar to our cases, with the small widths but significant depths of the wounds.

In conclusion, the gracilis muscle free flap is ideal in the reconstruction of point-blank shotgun injuries

involving bone exposure. It adequately fills the typically deep but narrow wound with no donor site morbidity.

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