Three cross leg flaps for lower leg reconstruction of Gustilo type III C open fracture

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ABSTRACT
A 60 year old male had Gustilo type III C open fracture of the right lower leg. After radical debridement, the large open defect including certain loss of the bone tissue was successfully augmented and covered, by consecutive three cross-leg flaps, which consisted of the free rectus abdominis musculocutaneous flap, the fibula osteocutaneous flap and the conventional sural flap. Although indication for amputation or preservation is decided with multiple factors in each case, a strategic combination of cross-leg flap, free flap, external fixation and vascular delay could increase the potential of preservation of the lower leg with even disastrous Gustilo type III C.

Key words: Cross leg, external fixator, lower leg reconstruction, open fracture
MeSH terms: Fracture fixation, compound fractures, orthopedic fixator devices, fractures, open

INTRODUCTION
For treatment of disastrous injury of lower leg accompanied with bone defect, one dramatic reconstructive surgery like free flap is not always enough and reconstructive surgeons must form a strategic scenario consisting of making healthy bed for subsequent bone graft, grafting vascularized and/or nonvascularized bone and if possible, preparing backup options for major or minor revisions. In this case, consecutive three cross leg flaps, consisted of free rectus abdominis, distally pedicled fibula osteocutaneous and conventional medial sural flap, effectively played a main role in that scenario for reconstruction of devastating Gustilo type III C open fracture. This report shows that in spite of the limbs being in an awkward position for a long time when consecutive cross leg flaps are done, the results are good, if done with proper technique including rehabilitation in the intervals. Although indication for amputation or preservation is decided with multiple factors in each case, to the best of our knowledge, this is the report of the most challenging case for preservation of the lower leg.

CASE REPORT
A 60 year old male, who had had an open fracture of the right lower leg accompanied with the vascular injuries of the anterior tibial, posterior tibial, and peroneal artery by a traffic accident. Mangled Extremity Severity Score at the time of presentation was eight points. Although the posterior tibial artery that was repaired primarily resulted in the obstruction with thrombus, the tissue distal to the injury survived by the collateral vasculature [Figure 1a and b]. After radical debridement of the necrosed tissue, there was a large open defect with a certain loss of bone, including the plafond in lower third of the lower leg [Figure 1c]. Continuity of the tibial nerve was identified with severe attenuation, and both the superficial and deep peroneal nerves were lost. Since there was severe soft tissue injury proximal to the popliteal fossa for exploration of the proximal parts of the major arteries, secondary reconstruction of major arteries using arteriovenous loop3 was impossible and avoided. After explanation to the patient regarding the respective results and complications that could be expected with below knee amputation (BKA), and with difficult reconstruction for preservation respectively, he desired to retain the injured lower leg.

As the first step for reconstruction, the defect was augmented by a cross leg free rectus abdominis musculocutaneous flap as to achieve healthy recipient site for subsequent bone graft. The deep inferior epigastric artery and its vena...
Sano, et al.: Three cross leg flaps for lower leg reconstruction

Figure 1: Clinical photograph of Gustilo type III C open fracture of the right lower leg. (a and b) Tissue distal to the ankle survived with collateral vasculature after unsuccessful repair of the posterior tibial artery (c) After radical debridement, there was a large open defect

Figure 2: Clinical photograph, a postoperative view of rectus abdominis musculocutaneous cross leg free flap (the 1st cross leg flap)

Discussion

The great part of the indication of cross-leg flap introduced by Hamilton (1854) has been converted to that of free flap. However due to its versatility like combination with free flap (cross-leg free flap) and/or its definitive secondary role as a fail safe method, cross-leg flap has been still useful option for reconstruction of devastating lower leg injury. Many reconstructive surgeons empirically think that cross leg flap is the last option and once is enough in each case. Major reasons of hesitation to use cross leg flap are forcing uncomfortable immobilization to a patient and troublesome management during immobilization periods. Skillful technique of external fixation apparatus that has a wide range of application, e.g. Ilizarov (Smith and Nephew Inc., TN, USA) and Hoffmann II (Stryker Inc., MI, USA), is mandatory for mitigation of these disadvantages. Complications like joint contracture of the donor’s leg due to long lasting immobilization can be prevented with adequate ROM exercise in the intervals of each immobilization periods.

Over 3 years after injury, including almost a year of the total period of substantive treatment, the patient can walk on crutches with patella tendon weight bearing orthosis. No limitation of ROM was identified on both limbs except the fused ankle of the affected side. Deep sensation of the foot were preserved. Bone and functional results using Association for the Study and Application of the Method of Ilizarov scoring system were both good.

comitantes were anastomosed to the posterior tibial artery and its venae comitantes of the normal opposite limb. The legs were immobilized by external fixator [Figure 2]. Three weeks later, the pedicle was severed and then external fixator for immobilization of the both legs was removed.

After 8 weeks for rehabilitation to the both legs, the distally pedicled fibula osteocutaneous cross leg flap was planned. Prior to flap harvest, vascular delay to the peroneal artery at the bifurcation from the posterior tibial artery was administered [Figure 3a]. Two weeks later, contralateral distally pedicled fibula osteocutaneous flap was elevated. The fibula was divided into two parts, and then the double-barreled fibula 12 cm in length each inserted into the bone defect between the proximal remnant of the tibia and the talus [Figure 3b and c]. The both legs were immobilized by external fixator again. Three weeks later, the vascular pedicle was divided and then the external fixator was removed. Because the cutaneous flap put between both legs during the immobilization period resulted in necrosis due to excessive pressure, flap coverage of the grafted fibula with 3rd cross leg flap was mandatory.

Four weeks after previous operation, the exposed bone was covered with the proximal based medial sural cross leg flap [Figure 4a and b]. The both legs had been immobilized by external fixator for 3 weeks, and then the pedicle was divided and the external fixator was removed [Figure 5a]. After a course of consecutive three cross leg flaps, neither contralateral knee nor ankle contracture remained due to an adequate range of motion (ROM) training in the intervals of each immobilization periods [Figure 5b and c].

There have been only three reports of cross leg fibula graft. The reason is that its short vascular pedicle (peroneal vessels) is unsuitable for cross-leg transfer.
Practical fibula cross leg transfer to the contralateral lower leg is to make it free flap of which the vascular pedicle is reattached to the dorsals pedis or posterior tibial vessels around the ankle on the same side, otherwise distally pedicled flap. Vascular delay limits preliminarily the tissue perfusion only from the intended vascular pedicle of the flap, and enhances blood perfusion from the vascular pedicle, resulting in increasing viability of the flap. This technique is well recognized and has been exploited over the past some decades to allow satisfactory breast reconstruction using superior pedicled transverse rectus abdominis flap. Vascular delay added to the predominant proximal peroneal artery must guarantee the primary vascular reliability in case of harvesting long distally pedicled fibula flap.

Most surgeons in this field would rightfully encourage a patient like this case to undergo BKA based on thought of easier and earlier achievement of activity of daily living and lower economical cost. Although one of the most popular hobbies of retired and semi-retired elderly people in our country including this patient is to go to the public spa in which visitor has to soak nakedly, postoperative people, who have any remarkable handicap in their appearance, hesitates to go there against eyes of others with curiosity. Furthermore, since most traditional spas have not been “barrier-free” prepared yet, it is difficult for BKA patient without artificial leg to use spa. We believe that higher quality of postoperative life cannot be always guaranteed along with BKA.
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