

# TIMING OF MICROSURGICAL RECONSTRUCTION OF LOWER EXTREMITY: IS IT REALLY IMPORTANT IN FLAP FAILURE?

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## ABSTRACT

Landmine injuries of the lower extremity constitute a challenging problem to the reconstructive surgeon. These injuries create composite tissue defects which are always contaminated. The transfer of the patient to a well established center generally takes time. All these factors yield a delay at the definitive treatment of the patient. Here, we want to present 109 patients injured by landmine explosions and treated at different times and discuss the effect of timing of the microvascular tissue transfer on success of the procedure. All patients were injured due to landmine explosion and reconstructed with microvascular tissue transfer. The flap success rate and postoperative complications were evaluated.

The average follow-up period was 19 months. Of the 109 patients 12 were operated between 0-7 days (at the acute period). Forty-two of them were operated at the subacute period (between 7-14 days) and the remaining 55 were operated at the chronic period (more than 14 days). There was no flap loss at the patients whom were operated between 0-7 days. Flap failure rate was 16.7 % and 14.5 % for the subacute and chronic periods respectively and the difference was not significant. No postoperative infection was observed at the acute period. Postoperative infection rate was 16.7 % and 7.3 % at subacute and chronic period respectively, and the difference was statistically significant. When the surgery is performed according to microvascular principles subacute period does not differs from chronic period when the flap failure is concerned. Subacute period is associated with a higher infection rate.

**Keywords:** Lower extremity, Reconstruction, Microsurgery, Timing

## ALT EKSTREMİTE MİKROCERRAHI ONARIM ZAMANLAMASI: FLEP KAYBINDA GERÇEKTE ÖNEMLİ MİDİR?

### ÖZET

Alt ekstremitte mayın yaralanmaları rekonstrüktif cerrahlar için son derece sıkıntılı durumlardır. Bu yaralanmalar genellikle kontamine olmuş kompozit doku defektlerinden oluşurlar. Yaralanan hastanın donanımlı bir merkeze transferi zaman alabilmektedir. Tüm bu etmenler hastanın definitif tedavisinde bir gecikmeye yol açabilmektedir. Bu makalede mayın patlaması ile yaralanmış ve farklı zamanlarda tedavi uygulanmış 109 hasta sunulmakta ve zamanlamanın uygulanan mikrocerrahi prosedürlerin başarısı üzerine etkileri tartışılmaktadır. Hastaların tamamı mayın ile yaralanmış ve mikrovasküler doku transferi ile onarılmıştır. Fleplerin başarı oranları ve postoperatif komplikasyonlar değerlendirilmiştir. Ortalama takip süresi 19 aydır. 109 hastadan 12'si 0-7. günler içerisinde (akut dönem) onarılmıştır. 42'si 7-14. günler arasında (subakut period) ve geri kalan 55 hasta ise 15. günden sonra (kronik period) onarılmıştır. 0-7 günler arası opere edilen hastalarda flep kaybı görülmemiştir. Subakut ve kronik periodda opere edilen hastalarda flep kaybı oranı %16.7 ve %14.5 olarak görülmüş ve aynı gruplarda postoperatif enfeksiyon oranı %16.7 ve %7.3 olarak görülmüştür. Akut dönem hastalarında postoperatif enfeksiyon görülmemiştir. Aradaki fark istatistiksel olarak anlamlı bulunmuştur. Mikrovasküler prensipler doğrultusunda operasyonlar gerçekleştirildiğinde flep kaybı açısından subakut ve kronik gruplar arasında fark yoktur. Enfeksiyon açısından değerlendirildiğinde ise subakut grup daha riskli görülmektedir.

**Anahtar kelimeler:** Alt ekstremitte rekonstrüksiyon, mikro cerrahi, zamanlama

## INTRODUCTION

Treatment of complicated fractures and soft tissue defects of the lower extremity depends on many factors such as the energy of the trauma, the anatomic location and the morphology of the wound, concomitant injuries and diseases and the age of the patient. With rapid advances and increased success rates, microvascular surgery became a preferred method in clinical practice. As there is a wide variety of cosmetic and functional

alternatives, the traditional treatment strategies changed especially in lower extremity reconstruction.<sup>1,2</sup> The major advantages of microvascular surgery are single stage operation, minor donor site morbidity, numerous donor flap alternatives, early mobilization and reconstruction with tissue with well circulation.<sup>1</sup> Besides the advances in microvascular technique and operation instruments, there are still flap failures and there has not been accepted procedures to prevent flap failure.<sup>1,2</sup>

In this study, we retrospectively analysed 109 microvascular lower extremity reconstructions due to gunshot wounds, performed in Gulhane Military Medical Academy Plastic and Reconstructive Surgery Clinic and evaluated the timing of the free tissue transfers. We aimed to find the relationship between the timing of the operation and flap success and other complications.

### MATERIAL AND METHOD

One hundred and nine microvascular lower extremity reconstructions, performed in Gulhane Military Medical Academy Plastic and Reconstructive Surgery Clinic were retrospectively evaluated. Epidemiologic features, medical histories, operative details and complications were evaluated.

The mean age of the patients was 23 (range, 19-44 years). All of our cases were male. Of the 109 cases, 60 were smokers and none had problems with alcohol. The etiologies of wounds were gunshot in 16 cases and mine explosion in 93 cases. Only gunshot and missile wounds were included to the study, traffic accidents, crush syndromes, replantations and fractures with soft tissue damage were excluded. Immediate reconstruction of the defect was preferred but this was not possible for every case.

The treatment procedure started with radical soft tissue debridement and revision the bony structure. After cleaning and irrigating the wounds bony fragments and foreign bodies were cleaned. The resulting defect, therefore, was always much larger than the preoperative one. For all of our cases X-rays were taken, and in order to evaluate vascular status angiographies and ultrasonic Doppler angiographies were performed if needed. Fixation with K-wires or external fixators was done for fractures and joint injuries. Dextran was used as an antitrombotic agent after anastomosis at 35 cc/h. Flap monitoring was performed with clinical observation (color, temperature and capillary refilling), laser Doppler flowmeter and ultrasonic Doppler.

The patients were categorized into acute, subacute and chronic period patients according to the time of the free tissue transfer. The acute period was the first 7 days following the trauma. Subacute period was between 7-14 days. Microsurgical operations were at the chronic period if they were performed 14 days or more than later.

### RESULTS

The foot defects were classified according to Shaw and Hidalgo and all were type III wounds. The other lower extremity wounds were Gustillo type III or IIIa wounds<sup>3</sup>. When epidemiologic features are considered, there were no difference between the groups.

Of the 109 patients, 12 were operated between 0-7 days (at the acute period). Forty-two of them were operated at the subacute period (7-14 days) and the remaining 55 were operated at the chronic period (later than 14 days). There was no flap loss at the patients whom were operated between 0-7 days. Flap failure rates were 16.7% (n=7) and 14.5% (n=8) for the subacute and chronic periods respectively, and the difference was not statistically significant ( $p>0.05$ ). No postoperative infection was observed at the acute period. Postoperative infection rates were 16.7% (n=7) and 7.3% (n=4) at

the subacute and chronic periods respectively and the difference was statistically significant ( $p<0.05$ ).

### DISCUSSION

After the first clinical microsurgical experiences of McLean and Buncke rapid advances in both technique and instruments in microvascular tissue transfers encountered.<sup>4,5,6</sup> Currently, microvascular free tissue transfers are the treatment of choice in lower extremity reconstruction, especially in cases with large tissue defects, open bone fractures and osteomyelitis. But there is still a controversy about the timing of the free tissue transfer to the lower extremity.<sup>7</sup> In the present study, we want to discuss the effects of timing of the microsurgical tissue transfer on success of the procedure.

Thrombosis at the anastomosis site, hypercoagulation, stasis and smoking are known to the major causes of flap failure. But when posttraumatic cases are considered, especially at the lower extremity, post-traumatic vessel disease can also cause flap failure. Post-traumatic vessel disease is known to be the pathologic changes of perivascular and vascular structures of major vessels in the lower extremity. The reason of these changes is not well understood but these changes appear at 1 week following the injury and it can be seen proximal to the injury zone. So immediate reconstruction is advocated and especially in late reconstruction the anastomosis is suggested to be done more proximal and end-to-end.<sup>8</sup> It is reported that failure rate increases two fold when anastomosis is done at the injury zone.<sup>9</sup> Zone of injury refers to the inflammatory response of the soft tissues of the traumatized lower limb which extend beyond the gross wound and result in perivascular changes.<sup>10,11</sup> These changes, reported to include increased friability of these vessels and increased perivascular scar tissue, contribute to a higher failure rate in microvascular surgery of lower limb, presumably from a greater rate of microvascular thrombosis.<sup>12</sup> To minimize the presumed adverse effects of zone of injury upon microvascular anastomosis, extensive proximal dissection of recipient vessels and, as needed, interpositional vein grafts were recommended<sup>13</sup> Vessel pliability and the quality of blood flow from the transected end of the vessel were important in determining a recipient vessel's acceptability than the distance from the wound. Rating for recipient vessels for friability, perivascular scarring, transmural thickening and the presence of perivascular hemorrhage must be performed by the surgeon<sup>14</sup> In our cases, we performed the microvascular anastomosis out of the zone of injury and for 16 we used interpositional vein grafts. The intraoperative evaluation of the recipient vessels for post-traumatic vessel disease was performed by the surgeon and the blood flow quality from the vessels was encountered. After this evaluation the microvascular anastomosis was performed in end-to end fashion. The timing of definitive treatment of the lower extremity wounds depend on the factors such as the general conditions of the patient and the condition of the wound. The bacterial status of the wound, type of fracture, different types of tissues involved in the injury and the exposed structures are factors that influence the timing of wound closure. Godina<sup>15</sup> emphasized the pathophysiology of high energy trauma and the

emergency or the importance of the radical debridement and early tissue coverage within the first 72 hours. Lister and Scheker<sup>16</sup> reported the first case of an emergency free flap transfer to the upper extremity in 1988 and they defined the emergency flap as a "flap transfer performed either at the end of the primary debridement or within 24 hours after the injury".<sup>16</sup> Yaremchuck et al recommended that flaps be transferred between 7 to 14 days after injury and after several debridements.<sup>17</sup> The argument in favor of this approach is that the zone of injury, which may often not be apparent at presentation, can be determined by serial debridement performed in the operating room over several days. Acute coverage by day 5 to 7 is generally accepted as having a good prognosis in terms of decreased risks of infection, flap survival and fracture healing<sup>18</sup> There is several studies advocating that early aggressive wound debridement and soft-tissue coverage with a free flap within 5 days reduced postoperative infection and decreased flap failure, nonunion and chronic osteomyelitis.<sup>7,19</sup> In our series, only gunshot and missile wounds were included to the study. Traffic accidents, crush syndromes, replantations and fractures with soft tissue damage were excluded. So our series were composed of more severe and contaminated wounds. Despite the adverse wound conditions, flap success was not effected in subacute and chronic periods. This was probably due to strictly adherence to microsurgical rules, as all anastomosis were performed out of the zone of injury and vein grafts were used where needed.

The exact classification of timing of the microsurgical lower extremity reconstruction is a matter of debate. Byrd, Yaremchuck and Godina advocated different classifications.<sup>7,15,17,19</sup> We think that the classification must reflect the pathophysiologic findings. As histologic changes of post-traumatic vessel disease occurs at the first 7 day, this period is thought to be acute period. The following 7 days were characterized by inflammation at the perivascular space and this period is thought to be subacute period. The period following 14 days of injury, the perivascular inflammation reaches to a plateau and begins to decrease. This period is thought to be chronic

period. Our classification resembles to Byrd et al<sup>7,19</sup> Acute reconstruction of the lower extremity is advised as all authors. But this is not possible in all cases. According to our findings, in delayed cases timing of the operation has no effect on flap success but free tissue transfers performed at the subacute periode has more infections.

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