

## Avoiding complications in soft tissue coverage of lower extremity: an audit and review of literature

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### Abstract

**Objective:** The objectives of this audit were to determine the frequency of complications occurring following coverage of soft tissue defects of lower limb and to analyze their causes.

**Material and methods:** This was a prospective descriptive study of patients managed at Plastic and Hand Surgery Department of Liaquat National Hospital, Karachi from first November 2007 to 30th of October 2008 and included all patients requiring soft tissue coverage of lower extremity except those who required soft tissue coverage of amputation stumps.

**Results:** 107 patients were included in the study. Mean age was 31.6 years and there were 91 men (85%). Trauma was the most common cause (n=77) while leg was the most common site of defect. Most of the wounds were covered by skin grafts (65.4%) which all were split thickness. Fasciocutaneous local flaps were employed in 22.4 % of cases followed by free flaps (5.6%), perforator flaps (3.7%), muscle flaps (1.9%) and musculocutaneous flaps (0.9%). Complications were observed in 35 patients (32.7%). Most common were partial graft loss (n=11, 10.3%), followed by partial flap loss (n=8, 7.8%) and total flap loss (5,4.7%). Donor site complications were observed in 4 patients (3.7%), 3 were partial loss of graft and one was delayed healing of donor site of graft. Only one mortality was encountered.

**Conclusion:** Complications were higher for more complex procedure. Proper selection and good surgical technique yields good results in soft tissue reconstruction of lower limb. Suggestions were also given to avoid complications.

**Key words:** Soft tissue defects, lower limb, flaps, complications.

### Introduction:

A surgical complication is any undesirable, unintended, and direct result of surgery affecting the patient which would not have occurred had the surgery gone as well as could reasonably be hoped<sup>1</sup>. As modern surgery has become capable of addressing problems within human body that would have been unimaginable fifty to hundred years ago, range of potential surgical complications is greater than ever before.

However, modern surgeon is more capable to stabilize and overcome such complications because of vast armamentum of clinical techniques available today<sup>2</sup>. Soft tissue coverage and preservation of lower limb has persistently challenged Plastic surgeons.

Today, they have a variety of options to deal with this challenge ranging from non surgical like vacuum assisted closure to complex surgical ones like free tissue transfer.

The purpose of this audit was to determine the outcome (in term of complications) of soft tissue coverage to lower extremity, identify factors responsible for these complications and reviewing the literature.

Soft tissue coverage was defined as covering of the soft tissue defect with skin grafting, local flaps, distant flaps or free flaps.

Outcome was seen in terms of complications that will be defined as follows:

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### Complications of reconstruction

**Venous thrombosis of flap:** when flap has violaceous colour, brisk capillary refill, normal or increased temperature and dark blood after pinprick due to venous outflow obstruction

**Arterial thrombosis of flap:** when flap has pallor, decreased temperature, decreased capillary refill, absence of bleeding after capillary refill due to arterial insufficiency

- Hematoma
- Hemorrhage
- Excessive flap edema
- Partial flap necrosis: (<50% loss) any marginal necrosis or de epitheliasation
- Complete flap necrosis: total loss
- Skin graft loss on flap margins
- Sepsis
- Wound infection: early post operative recipient site infection, infection that required debridement.

The complications of donor site could be hematoma, seroma, cellulitis, partial wound dehiscence, skin graft failure that could be complete or partial, sensory nerve dysfunction, scar formation.

### Material and methods:

This descriptive case series study was conducted at Plastic and Hand Surgery Department of Liaquat National Hospital, Karachi from 23rd November 2007 to 26th of October 2008. A total of 107 patients with lower extremity defects requiring soft tissue coverage were studied through purposive sampling.

The patients who presented in Emergency/ Orthopaedics or Plastic surgery departments with lower extremity defect or wound with or without exposed bone and underwent reconstructive surgery or open fracture of lower extremity requiring soft tissue coverage were included in the study.

Patients who had segmental bone defects and underwent reconstruction with vascularized bone grafts and patients who underwent reconstruction of amputation stumps were excluded.

All patients admitted in Plastic surgery department or referred from orthopedics or emergency with lower limb defect/wound and meeting the inclusion criteria were selected for the study after informed consent. Information prospectively collected was age, sex and etiology of defect, location and size of defect, presence of co existing medical illnesses like diabetes, hypertension and smoking history. In case of trauma, mechanism of trauma and associated bone fracture and its method of fixation was also recorded. Before embarking onto the procedure, patients were carefully examined. Before definitive coverage, number of debridements required was also recorded. The type of soft-tissue coverage performed by a Plastic Surgeon like skin grafting, local, distant flaps or free flaps, and date between injury and coverage was noted. The dimensions of flap was recorded for each case. Patients were followed up for 1 month and outcome was recorded. Outcome was assessed in terms of Complications like: wound infection including soft-tissue infections requiring debridement, Partial Graft loss, Partial flap Necrosis, need for secondary soft-tissue coverage, and future amputations. All this information was recorded on a proforma.

Data was analyzed by SPSS v 13.0. Mean and standard deviation was computed for quantitative variables like age, timing of soft tissue coverage, associated type of fracture, mechanism of trauma, size and site of defect. Any inferential test of significance will not be applicable for this descriptive study.

### Results:

One hundred and seven patients underwent soft tissue coverage of lower extremity from 23rd November 2007 to 26th of October 2008. Mean age was 31.9 years with range 3-70 years. There were 91 men (85%) and 16 women (15%). Mean hospital stay was 10 days ranging from 1-42 days. Follow up ranged from 1 month to 9 months.

Most of the defects were due to Trauma (72 %) followed by Diabetes (13.1%) and non diabetic skin infections (5.6 %). In case of trauma most common cause was motorbike accidents fol-

lowed by motorvehicle and pedestrian/motor-vehicle accidents. Most common causes of burn causing soft tissue were fire and electric burns followed by scald. Most of reconstructions were performed for Leg and ankle foot complex (each 36.4%) followed by thigh alone (16.8) and knee (6.5%) In case of knee, anterior knee was involved in 3 cases (2.8% of total) while popliteal fossa was involved in 4 cases (3.7% of total). In leg, most of the times, middle third (n=17, 15.9% of total) was involved followed by lower (n=10, 9.3%) and upper third (n=6, 5.3%). Dorsum of foot was mostly involved area in foot/ankle complex. (n=18, 16.8% of total) followed by plantar aspect of foot (n=6, 5.6%) and Achilles tendon area (n=5, 4.7%). No. of debridements required ranged from 1-3. Vacuum assisted closure therapy was used preoperatively in only 3 patients (2.8%). 9 patients had major vascular injury needing repair (8.4%). 19 patients (17.8%) (Figure 26) had associated fractures which were treated by external fixation in five patients followed by nailing (n=4).

Most of the wounds were covered by skin grafts (65.4%) which all were split thickness (figure 1). Fasciocutaneous local flaps were employed in 22.4 % of cases followed by free flaps (5.6%), perforator flaps (3.7%), muscle flaps (1.9%) and musculocutaneous flaps (0.9%). Most common fasciocutaneous flaps employed were proximally based of random pattern (13.1% of total) followed by distally based sural flap (4.7%) and bipediced flaps (2.8%). In two patients gastrocnemius muscle flap was used while the only one musculocutaneous flap used was flexor digitorum brevis musculofasciocutaneous flap. Among the free flaps latissimus dorsi and rectus abdominis muscle flaps (2 cases for each 1.9% of total) were most commonly employed followed by radial forearm and anterolateral thigh flaps (each used in one case only). Medially based perforator flap based on perforators from posterior tibial artery was employed in 1.9 % of total cases followed by distally based anterolateral thigh flap and perforator flap based laterally on peroneal artery perforators (each in 0.9 % of cases).

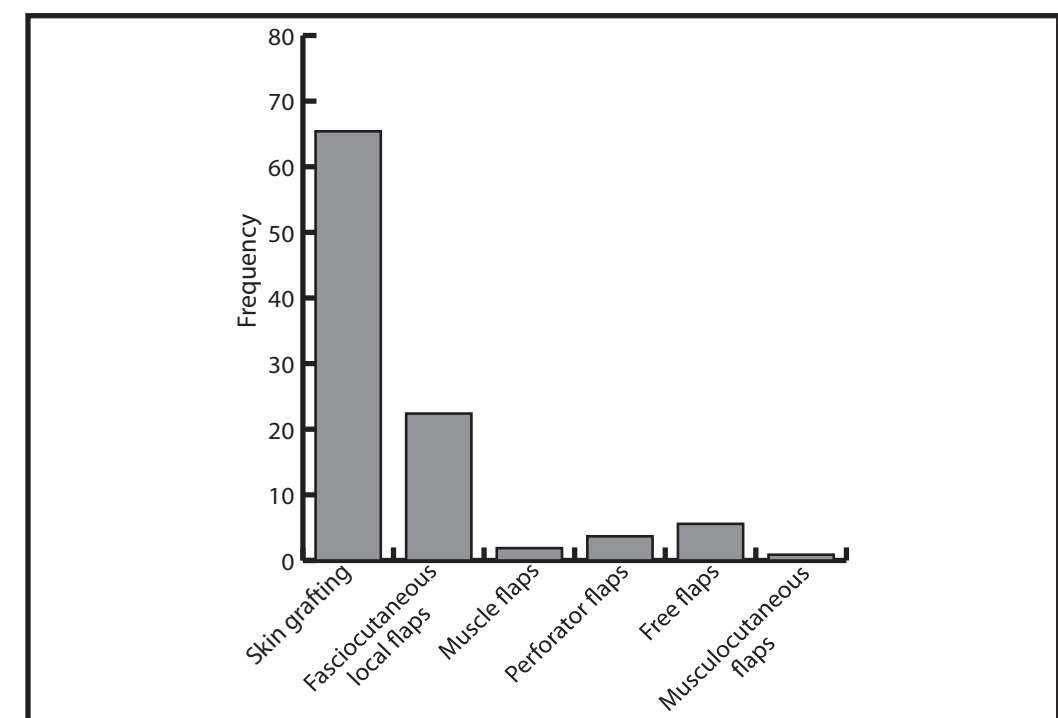


Figure 1: Type of Soft Tissue coverage

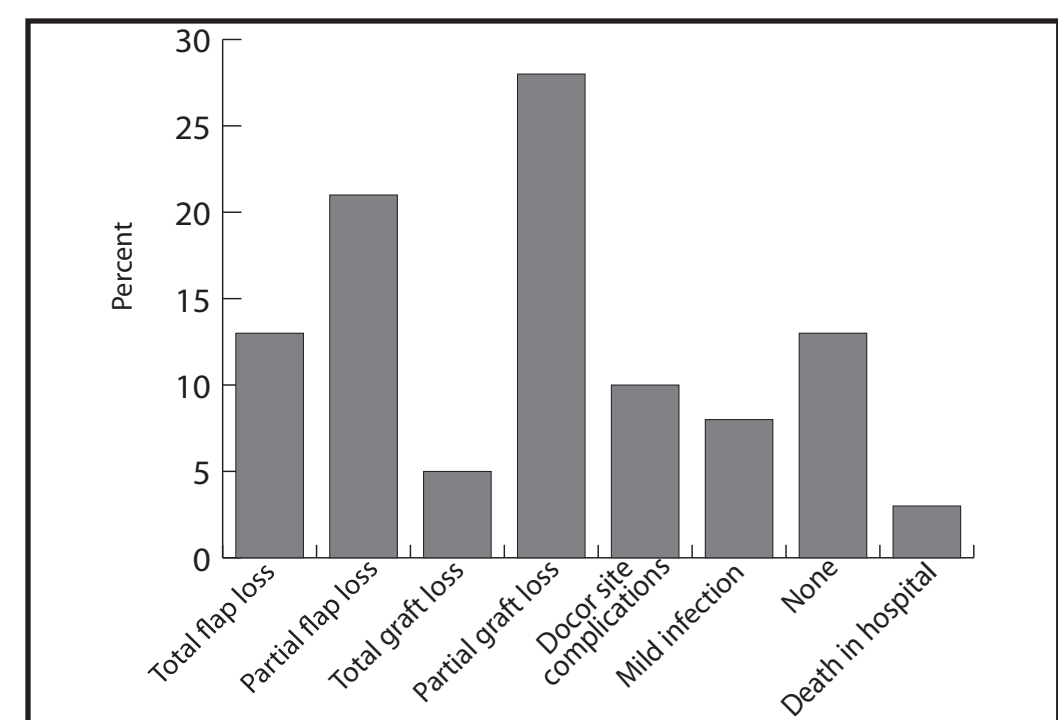


Figure 2: Complications observed

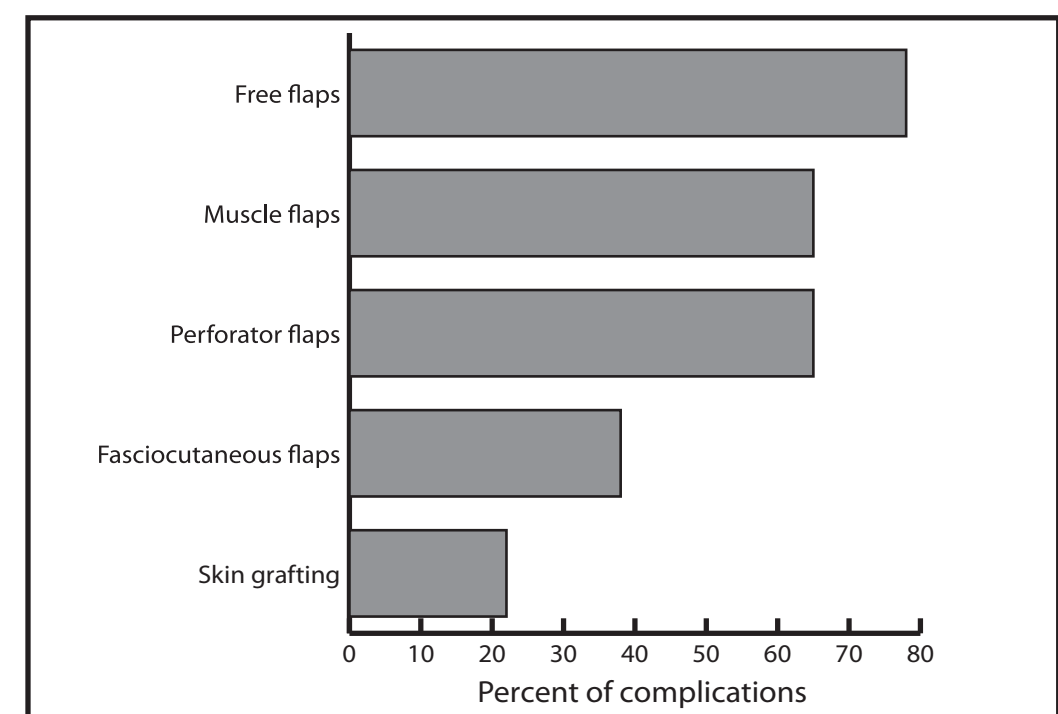


Figure 3: Relationship of complications with complexity of Coverage method

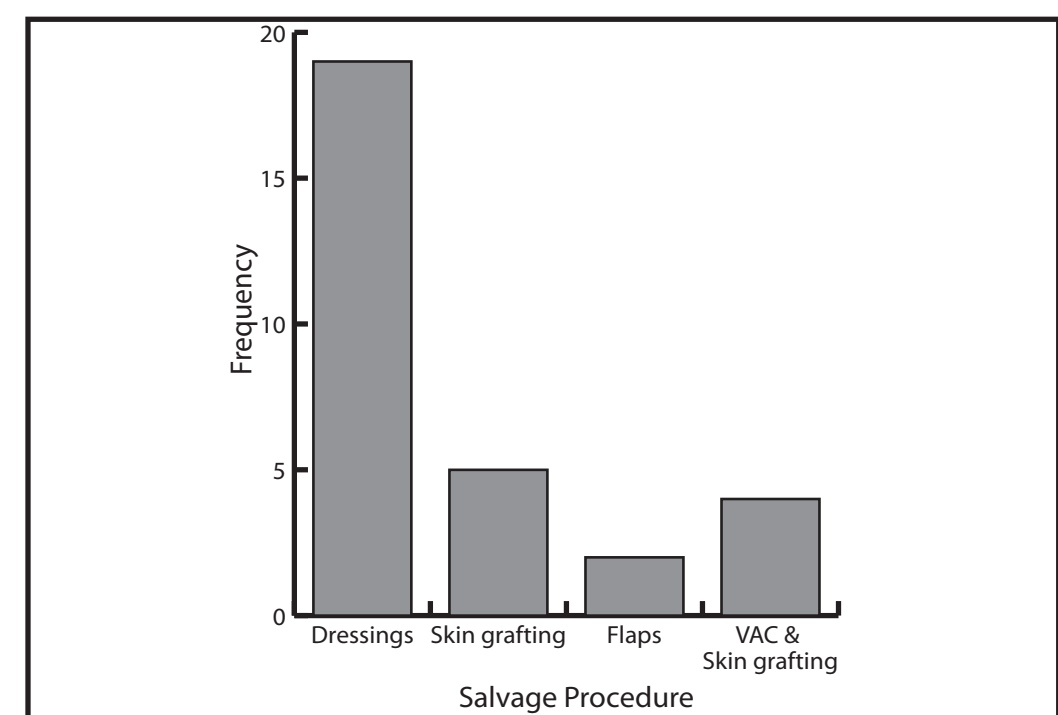


Figure 4: Salvage procedure once complication occurred

Complications were observed in 35 patients (32.7%) (Figure 2). Most common was partial graft loss (n=11, 10.3%), followed by partial flap loss (n=8, 7.8%) and total flap loss (5,4.7%). Donor site complications were observed in 4 patients (3.7%), 3 were partial loss of graft and one was delayed healing of donor site of graft. Only one mortality was encountered when one patient died on first post operative day (mortality =0.9%). Complications were higher for more complex procedure (figure 3). Majority of complications were dealt with dressings (19, 17.8%), skin grafting in five patients (4.7%), VAC and subsequent cover with skin grafting in four patients and flaps were used in only two patients (figure 4).

#### **Discussion:**

Soft tissue defects of the lower extremity especially of leg and foot used to be an enigma of reconstructive surgeons. Trauma due to road traffic accidents, diabetes mellitus and peripheralvascular disease account for most of the cases presenting with soft tissue losses in lower extremity. Reconstruction of lower extremity is different from upper limb because of its unique features. It is almost always in a dependent position and more susceptible for venous stasis. It has an increased incidence of peripheral vascular diseases. The subcutaneous location of the tibia, the main weight bearing bone of the leg, poses unique problems in the fracture healing.

In this study, skin grafts were the most commonly used reconstructive option (65.4%) with complications observed in 24.3% ; most common being partial graft loss (15.7%) needing further dressings. All of the thigh wounds were skin grafted showing that in thigh, flaps are rarely required. Similarly, 2nd most common site grafted was dorsum of foot.

Most commonly employed flaps were fasciocutaneous flaps of lower limb. Complications were observed in 37.5 % of cases. Proximally based fasciocutaneous flap was the most commonly employed (58.3% of fasciocutaneous flaps) with complications observed in 35.7% of cases. Partial flap loss was observed in 3 while donor site

graft loss in 2 patients. Hallock found an 18.5% complication rate in 67 patients treated by fasciocutaneous flaps. Distally based flaps had a higher rate of 37.5%, however wound closure was ultimately achieved in 97% of patients<sup>3</sup>.

Distally based Sural flap was used to cover defects of ankle and foot in five cases and a total complication rate of 60% was observed. There was one (20%) total flap loss and two partial flap necrosis (40%). Complication rate is similar to Baumeister, SP et al<sup>4</sup> who critically examined complications of sural flap in 70 consecutive cases and found 59% complication rate with 19 % rate of total flap necrosis and 17% partial flap necrosis. They found that age older than 40 years was found to be a significant risk factor for complications, both in all patients and in those without comorbidities. Patients without medical problems showed a necrosis rate of 11 percent. Patients with systemic diseases other than diabetes mellitus, venous insufficiency, and peripheral arterial disease showed a necrosis rate of 33 percent. Patients with one or more of those three diseases showed a necrosis rate of 60 percent. The only failure we encountered was in a diabetic patient with age 52 years and dilated cardiomyopathy. In case of Partial flap loss in two patients, no obvious cause was found. One study from Rawalpindi, Pakistan has compared medial plantar artery flap to sural flap for coverage of heel defects and found former to be better in terms of weight bearing, early mobilization and less complications<sup>5</sup>.

Perforator flaps were used in four cases with limited success. Only one of the flaps totally survived. Out of these four, one was distally based anterolateral thigh flap which failed due to venous congestion on third day. It was used in 65 years old man with degloving injury to his knee and flap was used to resurface anterior knee. There are small case series on the use of distally based anterolateral thigh flap with high success rates. However they concluded one disadvantage of this flap that is the variability of the vascular pedicle and pivot point. It is difficult to dissect, as the distal portion of the descending branch runs into muscle, and taking a piece of

muscle with the pedicle to prevent vasospasm is recommended<sup>6</sup>.

Distally based island fasciocutaneous flap, based on a single perforator (propeller flap) was used in three patients: two based on posterior tibial and one on peroneal perforators. These flaps were completely successful in one, partially in one and completely failed in one patient. Flaps were delayed in two out of three patients. The single important determinant for occurrence of complication was the vertical dimension of flap. Both flaps which failed either partially and completely, had vertical dimension of 35 cm and 30 cm respectively. Proximal limit of flap falls within 8 cm from the knee joint line according to one study<sup>7</sup>. They also concluded limitations of these flaps. In patients where the defects were followed by severe trauma of the distal leg, it is not advisable unless the patency of the perforators has been proved by Doppler. The reach of the flap is not adequate to resurface the total sole or total dorsal defects of the foot.

Muscle/ musculocutaneous flaps were used in three patients. Two were gastrocnemius and one was flexor digitorum brevis musculocutaneous flap whose skin portion underwent necrosis. This musculocutaneous flap has been described in few case reports<sup>8,9</sup>, but flexor digitorum muscle flap is a useful flap in reconstruction of heel defects with good reliability<sup>10</sup>. Gastrocnemius flap (medial heads) was used in two patients for upper 1/3rd of leg defects with one complete success and one with partial necrosis due to infection.

Free flaps transferred to the lower extremity have been associated with a significant incidence of vascular complications and flap necrosis varying from 15 to 20%<sup>11,12</sup>. This is because recipient vessels are often very difficult to prepare, with wide zones of trauma<sup>13</sup>. Free flaps were used in six of our patients (5.6% of total) and all had traumatic wounds. Total flap loss occurred in 2 of our patients (33.3% failure rate). This is quite high when compared to other studies. So we tried to analyze the causes of high failure rate.

Diminished functional capacities of all vital organs in elderly patients and the presence of associated medical problems may increase perioperative and postoperative morbidity and mortality<sup>14</sup>. All of our patients undergoing free tissue transfer had mean age of 31 years with range 15-45 years. So age should not have been the problem. Age is not considered to be a risk factor now and successful transfers have been performed in patients upto 70 years of age<sup>15</sup>.

Godina noted a failure rate of 0.75% for flaps covering wounds that were 0 to 3 days in duration, 12% failure for wounds remaining for 3 days to 3 months after injury, and 9.5% failure for flaps covering wounds remaining for longer than 3 months after injury in his study of 532 flaps<sup>16</sup>. Gonzalez et al. noted a 19% (eight out of 42) rate of flap failure in chronic leg wounds of greater than one month duration<sup>17</sup>. Byrd et al. noted a 33% (seven out of 21) rate of flap failure when covering wounds of the tibia in the subacute period (1 to 6 weeks) and the chronic period (>6 weeks)<sup>18</sup>. It is clear that in the delayed coverage group the rate of complications is increased markedly. Mean time between injury and wound coverage in our study was 6 days ranging from 2-14 days.

The microvascular surgeon's choice of flap donor site has a significant effect on the probability of flap survival, and not all free flaps are equal. Krott et al<sup>19</sup> noted that rectus abdominis free flap, the free latissimus dorsi flap, the radial forearm free flap, and the free jejunal flap had the lowest failure rates and the fewest complications in their hands. Conversely, the free fibula flap, the DCIA (iliac crest) flap, the scapular (osteocutaneous) flap, the lateral arm flap, and the lateral thigh flap had higher failure rates and more risk of complications. They concluded that during selection of a free flap to use for a given defect, the reconstructive surgeon should consider the ease of flap execution as one factor determining flap choice, especially if he or she is relatively inexperienced. If all other factors are equal, the flap with the lowest failure rate will ordinarily be the best selection. Rectus abdominis and radial forearm yielded good results in our hands while

anterolateral thigh flap failed probably because we are gaining experience in this flap. Similarly the only latissimus dorsi that failed was elevated by a registrar. However in a small series of five patients it is difficult to draw conclusion.

The choice of microvascular anastomotic technique, end-to-end versus end-to-side, is still an item of debate. We used end to end anastomosis for artery in 3 while end to side for 2 patients and in case of venous anastomosis end to side for 4 while end to end for one patient. We found no significant difference in success rate but conclusion cannot be drawn from such a small sample. A review of the literature reveals no difference in patency rates in animal models<sup>20,21</sup> where there is no size discrepancy. The available clinical evidence stems from Godina's early experience<sup>22</sup>, who reported 41 consecutive free flaps using end-to side anastomoses without failure after having considerably less success using arterial end-to-end anastomosis. The choice of technique therefore should be secondary to factors influencing the choice of recipient vessel, such as the condition of the vessel, its accessibility, and the preservation or augmentation of maximal distal flow to an extremity.

### Conclusion:

In conclusion, soft tissue coverage of lower limb is demanding and challenging and at the same time rewarding because most of the patients are young and victims of trauma. Earlier coverage not only results in fewer complications but also earlier mobilization and return to work. Following this study we recommend the use of earlier coverage whenever possible, frequent use of Vacuum assisted therapy and muscle flaps where indicated, use of Sural flap in selected patients and restricting the use of Propeller flaps for the leg defects only and not for the foot defects. Similarly it is recommended to use those free flaps which are frequently performed in the unit to ensure success.

### References

1. Sokol D, Wilson J. What is a surgical complication? *World J Surg.* 2008 32:942-944.

2. Chapman A. A History of Surgical Complications. In: Hakim NS, Papalouis VE, editors. *Surgical complications: Diagnosis and treatment.* London: Imperial College Press; 2007:37.
3. Hallock GC. Complications of 100 consecutive local fasciocutaneous flaps. *Plast Reconstr Surg.* 1991;88:264.
4. Baumeister SP, Spierer R, Erdmann D, Sweis R, Levin LS, Germann GK. A realistic complication analysis of 70 sural artery flaps in a multimorbid patient group. *Plast Reconstr Surg.* 2003 Jul;112(1):129-40; discussion 41-2.
5. Rashid M, Hussain SS, Aslam R, Illahi I. A comparison of two fasciocutaneous flaps in the reconstruction of defects of the weight-bearing heel. *J Coll Physicians Surg Pak.* 2003 Apr;13(4):216-8.
6. Pan SC, Yu JC, Shieh SJ, Lee JW, Huang BM, Chiu HY. Distally based anterolateral thigh flap: an anatomic and clinical study. *Plast Reconstr Surg.* 2004 Dec;114(7):1768-75.
7. Bhattacharya V, Reddy GR, Goyal S, Kumar U. Skeletonised retrograde distal perforator island fasciocutaneous flaps for leg and foot defects. *J Plast Reconstr Aesthet Surg.* 2007;60(8):892-7.
8. Ikuta Y, Murakami T, Yoshioka K, Tsuge K. Reconstruction of the heel pad by flexor digitorum brevis musculocutaneous flap transfer. *Plast Reconstr Surg.* 1984 Jul;74(1):86-96.
9. Stevenson TR, Kling TF, Jr., Friedman RJ. Heel reconstruction with flexor digitorum brevis musculocutaneous flap. *J Pediatr Orthop.* 1985 Nov-Dec;5(6):713-6.
10. Hartrampf CR, Jr., Schefflan M, Bostwick J, 3rd. The flexor digitorum brevis muscle island pedicle flap: a new dimension in heel reconstruction. *Plast Reconstr Surg.* 1980 Aug;66(2):264-70.
11. Gorman PW, Barnes CL, Fischer TJ, McAndrew MP, Moore MM. Soft-tissue reconstruction in severe lower extremity trauma. A review. *Clin Orthop Relat Res.* 1989 Jun(243):57-64.
12. Melissinos EG, Parks DH. Post-trauma reconstruction with free tissue transfer--analysis of 442 consecutive cases. *J Trauma.* 1989 Aug;29(8):1095-102; discussion 102-3.
13. Chen HC, Chuang CC, Chen S, Hsu WM, Wei FC. Selection of recipient vessels for free flaps to the distal leg and foot following trauma. *Microsurgery.* 1994;15(5):358-63.
14. Williams ME. Clinical implications of aging physiology. *Am J Med.* 1984 Jun;76(6):1049-54.
15. Coskunfirat OK, Chen HC, Spanio S, Tang YB. The safety of microvascular free tissue transfer in the elderly population. *Plast Reconstr Surg.* 2005 Mar;115(3):771-5.
16. Godina M. Early microsurgical reconstruction of complex trauma of the extremities. *Plast Reconstr Surg.* 1986 Sep;78(3):285-92.
17. Gonzalez MH, Tarandy DI, Troy D, Phillips D, Weinzwieg N. Free tissue coverage of chronic traumatic wounds of the lower leg. *Plast Reconstr Surg.* 2002 Feb;109(2):592-600.
18. Byrd HS, Spicer TE, Cierney G, 3rd. Management of open tibial fractures. *Plast Reconstr Surg.* 1985 Nov;76(5):719-30.
19. Kroll SS, Schusterman MA, Reece GP, Miller MJ, Evans GR, Robb GL, et al. Choice of flap and incidence of free flap success. *Plast Reconstr Surg.* 1996 Sep;98(3):459-63.
20. Albertengo JB, Rodriguez A, Buncke HJ, Hall EJ. A comparative study of flap survival rates in end-to-end and end-to-side microvascular anastomosis. *Plast Reconstr Surg.* 1981 Feb;67(2):194-9.
21. Rao VK, Morrison WA, Angus JA, O'Brien BM. Comparison of vascular hemodynamics in experimental models of microvascular anastomoses. *Plast Reconstr Surg.* 1983 Feb;71(2):241-7.
22. Godina M. Preferential use of end-to-side arterial anastomoses in free flap transfers. *Plast Reconstr Surg.* 1979 Nov;64(5):673-82.