

**A DISSERTATION ON**  
**STUDY OF**  
**RECONSTRUCTIVE STRATEGIES FOR LOWER ONE**  
**THIRD LEG SOFT TISSUE DEFECT**

In partial fulfillment of the  
regulations for the award of the degree of

**MASTER OF CHIRURGIE**

**(MCh.) Degree**

**BRANCH – III – PLASTIC SURGERY**



**THE TAMILNADU**  
**DR. M.G.R. MEDICAL UNIVERSITY**  
**CHENNAI, TAMIL NADU.**  
**AUGUST 2013**

## **DECLARATION**

I solemnly declare that this dissertation “**RECONSTRUCTIVE STRATEGIES FOR LOWER ONE THIRD LEG SOFT TISSUE DEFECT**” was prepared by me under the able guidance and supervision of our Professor & HOD, Department of Plastic & Reconstructive Surgery, Madurai Medical College and Government Rajaji Hospital, Madurai between August 2010 and January 2013.

This is submitted to The Tamil Nadu Dr. M.G.R. Medical University, Chennai, in partial fulfilment of the requirement for the award of **MASTER OF CHIRURGIE, M.Ch. PLASTIC SURGERY**, degree Examination to be held in **AUGUST 2013**.

**Date :**  
**Place : Madurai**

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## **CERTIFICATE**

This is to certify that this dissertation entitled  
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SOFT TISSUE DEFECT”** Submitted by **Dr. E.R.SRINIVAS** Post Graduate,  
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of the requirement in the award of degree of **MASTER OF CHIRURGIE IN  
PLASTIC SURGERY, Branch – III**, for the **AUGUST 2013** examination is  
a bonafide research work carried out by him under our direct supervision and  
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## ACKNOWLEDGEMENT

I thank our respected Dean of Madurai Medical College and Medical Superintendent of Government Rajaji Hospital, Madurai for permitting me to use the hospital facilities for this study.

I am very grateful to my humble, enthusiastic teacher, advisor **PROF. C. BALASUBRAMANIAN, M.S., M.Ch**, Head of the Department of Plastic & Reconstructive Surgery, for his constant guidance, encouragement and enthusiasm throughout the period of this study.

I am indebted to our beloved **PROF. R. RAJA MUTHAIAH**, Associate Professor, Department of Plastic & Reconstructive Surgery for his able guidance, thoughtfulness and tolerance during the entire course of my study.

I deeply express my respects and gratitude to our Associate Professors **DR. S. GNANASEKARAN, DR. P. PARTHASARATHY** and all the Assistant Professors in our department – **DR. V. RAVICHANDRAN , DR. P. SURESH KUMAR, DR. S. ARAM, DR. V. JEYAKODISH AND DR. K. RAJA** for their guidance, suggestions, critical comments, execution and assistance throughout the study course, helping me to sail steadily.

I also express my indebtedness to my seniors, **DR. S. LAKSHMI BAI, DR. R. GUNASEKARAN, DR. K.S.SEDHURAJA ,** my colleague **Dr Aruna**

**Devi**, my juniors, **DR. T. THIRUMALAISWAMY , DR. G. ARUN & DR SENTHIL KUMAR** for their comments, criticism and continued help during this study.

I sincerely thank my patients without whom this study would not be possible.

Above all, I thank my **PARENTS** and **THE ALMIGHTY** for the blessings they have showered upon me in all the deeds of my life.

Finally, I thank my wife, daughter, son and my near & dear ones for their utmost kind co-operation and understanding throughout the course of my study.

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## INTRODUCTION

Increasingly, urban trauma is becoming a major health care issue. Large emergency departments are inundated with patients with multiple injuries, requiring state-of-the-art care. Most of these complex injuries involve trauma to the extremities, often due to motor vehicle accidents. In a study by MacKenzie et al. It was shown that lower extremity injuries accounted for about 40% of the charges for motor vehicle trauma treatment in a given year. Hospital-based studies reveal that disabilities persist for a long time with mean time taken to return to work ranges from 42 months to 120 months.<sup>1</sup>

Coverage of soft tissue defect of the leg presents unique defects requiring the ingenuity of the surgeon in planning flaps for stable coverage.

Though well established norms are in place regarding the time and nature of cover, it requires a team effort, practicing it with involvement of the orthopaedic surgeon and allied specialities like vascular surgeons, general surgeons.

The relatively unprotected antero-medial portion of tibia results in exposed bone after trauma, which requires specialized soft tissue cover.<sup>2,3</sup>

Most muscles become tendons at this level hence flap cover becomes mandatory in case of soft tissue loss.<sup>4,5</sup>

Treatment of lower extremity trauma has evolved over the last two decades to the point that many that would require amputation are now routinely salvaged.<sup>6</sup>

Plastic surgeons role becomes not only important in covering a raw area, but also in providing a functional lower limb with an acceptable aesthetic result.

Though we live in an era of zero delay work, microvasuclar transfer and a single stage work up, due to circumstances beyond our control, it is still necessary to revisit the older methods which are reliable, comparable and easily reproduced.<sup>7, 8, 9</sup>

The study was done to reflect our work and thus to enhance our quality of work to produce good results with a few complications as possible.

There is need to challenge the concept, that distally based flaps are inferior to proximally based flaps just as the dogma that skin flap survival depends on rigid length to width ratios has been refuted. Adjusting all other factors, the true critical factor of flap viability is the nature of their intrinsic blood supply rather than any arbitrary orientation or configuration in either case.<sup>10</sup>

The patient expectations, an understanding of quality of existing source vessels in the given region and local anatomical constraints should be considered. One should go for other alternatives if any of the above prerequisites cannot be met.<sup>8</sup>



We must periodically reassess our own work, chart our future developments, and summarize them for the benefit of all involved in patient care. It was with these concepts in mind that this study was conceived and planned.

## **AIM**

1. To evaluate various reconstructive options for management of lower 1/3<sup>rd</sup> leg soft tissue defect and to highlight their merits and demerits
2. To establish a definitive time based protocol in managing these patients
3. To formulate an algorithm for treating patients requiring flap coverage for lower 1/3<sup>rd</sup> leg soft tissue defect at Government Rajaji Hospital, Madurai

## REVIEW OF LITERATURE

The first written report on injuries of the lower extremity is found in Roman war surgery books, in which amputation is suggested as the elective treatment for serious damage.

- Pierre-Joseph Desault (1744-1795), Paris, coined the term debridement<sup>7</sup>.
- Trueta - Infection could be avoided if all devitalized tissue was excised.<sup>7</sup>
- Trentz-O et al described priorities of treatment in open tibial fractures<sup>7</sup>
  1. Resuscitation
  2. Restoration of vascularity
  3. Debridement
  4. Skeletal stabilization
  5. Second look debridement
  6. Coverage with a local or free muscle flap within 96 hours.
  7. Reconstruction of bone defect by bone grafting, callus distraction or bone segment transport with fixator.
- McGregor and Morgan defined the distinction between axial and random pattern flaps.<sup>11</sup>
- In 1854, Hamilton described the cross-leg flap, introducing a new method to repair lower limb defects.<sup>12, 13</sup>

- Filatov, Gillies and Hugo Ganzer in 1920s described the tubed pedicled flaps.<sup>14, 15, 16</sup>
- Ger in 1968 described the first muscle flap and the concept of musculocutaneous flap revolutionizing lower extremity reconstruction.<sup>17</sup>
- Marko Godina in 1980 introduced and developed the concept of Emergency free tissue transfer.<sup>18</sup>
- Barclay in 1982 and Amarante in 1986 used distally based fasciocutaneous flaps based on lower perforators of the peroneal and posterior tibial arteries.<sup>4, 19</sup>
- Cormack and Lamberty described in detail the arterial anatomy of skin flaps in 1986 classifying Fasciocutaneous flaps.<sup>20</sup>
- The propeller flap concept described by Hyakusoku in 1991 for reconstruction of elbow defects in post burns contracture was extended by Teo to include flaps based on perforators which rotated 180 and could be used in lower extremities.<sup>21</sup>
- Masquelat in 1992 described neurofaciocutaneous flaps, these elegant flaps provided an alternative approach to defects which usually requires microsurgical reconstruction.<sup>22</sup>
- A further step in lower extremity reconstruction finally was achieved with introduction of free osteocutaneous flaps such as the fibula flap.<sup>8, 23</sup>

- Byrd et al. found that the overall complication rate for wounds closed within the first week of injury was 18% compared to 50% complication rates for wounds closed in the subacute phase of 1-6 weeks.<sup>9</sup>
- Godina et al found that the least complication rates were in wounds closed within 72 hours of injury.<sup>24</sup>
- Yaremchuk et al postulated that serial, complete debridement is more important than timing of soft tissue coverage.<sup>10</sup>
- Platelet counts increase four fold in the subacute phase after injury contributing to increased complication rate according to Choe IE et al.<sup>25</sup>
- Laughlin et al reviewed the functional outcome in eight patients with grade IIIB, and six with Grade IIIC injuries and found out that the recovery period was long.<sup>26</sup>
- The use of tissue expansion in the lower extremity has not been used frequently It is generally useful for healed, chronic defects as placement near open wounds results in more complications (Borgest et al).<sup>27</sup>
- Graf P et al found distally based fasciocutaneous flaps to be an alternative for free flaps.<sup>16</sup>
- Cross leg flaps were presented in a study from Central Hospital, China. 23 cases were successfully treated with no infection and flap loss.<sup>17, 28</sup>

- Tolhurst, Haesekar and Zeeman demonstrated 15% greater survival length in flaps that included fascia.<sup>29</sup>
- **"Vacuum Assisted Closure" (VAC)** is a non-invasive negative pressure healing process indicated in the treatment of chronic wounds associated with unfavourable local or systemic factors.

Continuous sub-atmospheric suction pressure (125 mmHg) was applied to the wound site. 125 mm hg appears to be the optimal, utilizing an alternating pressure cycle of five minutes suction followed by two minutes off suction. The cyclical application alters the cytoskeleton of the wound bed cells which trigger a cascade of intracellular signals that increase rate of cell division and subsequent formation of granulation tissue. The wounds were closed primarily, covered with split-thickness skin grafts, or a regional flap.<sup>30, 31, 32</sup>

According to retrospective study by Parrett et al., published in 2006 there is reduction from 42 % to 11% of free flap use with the advent of VAC

- **Hyperbaric Oxygen**

HBO<sub>2</sub> has several specific biological actions which enhance wound healing process. Hyper-oxygenation of tissue, vasoconstriction, down regulation of inflammatory cytokines, up-regulation of growth factors, antibacterial effects, potentiation of antibiotics, and leukocyte effects.<sup>33,</sup>

## **SURGICAL ANATOMY OF THE LEG**

The wound coverage of lower one third of leg is a challenging problem because of its anatomical features. The tibia and fibula are vulnerable to injury, open fractures being more common due to paucity of soft tissues around them. Most muscles become tendons at this level hence flap cover becomes mandatory in case of soft tissue loss. The peroneal, anterior and posterior tibial are the three major arteries of the leg and are in closed compartments without significant communication between them.

Detailed knowledge on blood supply of muscles and mapping of perforators has widened resources available for plastic surgeon in carrying out reconstructive surgeries in lower one third of leg.

The leg can be divided into four compartments

### **A. Anterior compartment**

This consists of the following muscles.

1. Tibialis Anterior
2. Extensor Hallucis Longus
3. Extensor Digitorum Longus
4. Peroneus Tertius.

The artery of the anterior compartment is the anterior tibial artery.

The nerve is the deep peroneal nerve.

## **B. Lateral compartment**

Muscles include

1. Peroneus Longus
2. Peroneus Brevis.

The artery(s) of this compartment are peroneal artery and anterior tibial artery.

The nerve is superficial peroneal nerve.

## **C. Superficial posterior compartment**

Muscles include

1. Gastrocnemius
2. Soleus
3. Plantaris
4. Popliteus

The arteries are sural, peroneal and posterior tibial and nerve is the tibial nerve.

## **D. Deep posterior compartment**

Muscles include

1. Flexor hallucis longus
2. Flexor digitorum longus
3. Tibialis posterior

The arteries are peroneal and posterior tibial and nerve is the tibial nerve.<sup>37, 38, 39</sup>



## **THE BLOOD SUPPLY OF THE LOWER LEG:**

In 90% of cases the popliteal artery runs obliquely inferolaterally to the lower edge of popliteus where it divides into anterior and posterior tibial arteries. This course can be marked on the surface by a line drawn from the junction of the middle and lower thirds of the thigh 2.5cm medial to the midline of the back of the limb, running downwards and slightly laterally to reach the midline between the femoral condyles. From here the course of the vessel continues inferolaterally along the same line to the level of the tibial tuberosity.

The anterior tibial artery passes between the tibial and fibular heads of tibialis posterior to pass over the upper edge of the interosseous membrane to reach the anterior compartment. It descends in front of the interosseous membrane and lies on the tibia in the lower third of the leg. The anterior tibial artery is initially medial to the deep peroneal nerve, but descends behind it, it is once more medial to it at the ankle. Near the ankle it gives origin to the medial and lateral malleolar arteries before passing midway between the malleoli onto the dorsum of the foot as the dorsalis pedis artery.

The posterior tibial artery is the larger and more direct terminal branch of the popliteal. It passes downwards in the posterior compartment separated from the interosseous membrane by tibialis posterior and lying beneath soleus though separated from it by a fascial layer. It gives a nutrient branch to the tibia and

continues downward behind flexor digitorum longus and becoming superficial, crosses the lower end of the tibia parallel to and 2.5cm in front of the medial border of the Achilles tendon. At the ankle joint it passes deep to the flexor retinaculum, midway between the medial malleolus and the medial tubercle of the calcaneus and divides, deep to abductor hallucis, into the medial and lateral plantar arteries.

The peroneal artery arises from the posterior tibial artery 2.5 cm below the lower edge of the popliteus muscle. It inclines laterally to descend along the medial crest of the fibula deep to or in the substance of flexor hallucis longus and ends behind the tibiofibular syndesmosis. It sends a nutrient artery to the fibula, and is linked to the posterior tibial artery by a communicating branch which lies on average 6.5 cm above the tip of the fibular malleolus. Nearer the ankle (approximately 5 cm above the fibular tip) it gives off a perforating branch which pierces the interosseous membrane and descends in front of the tibiofibular syndesmosis to the anastomose around the ankle.<sup>37, 38, 39, 40</sup>

### **The median superficial sural artery**

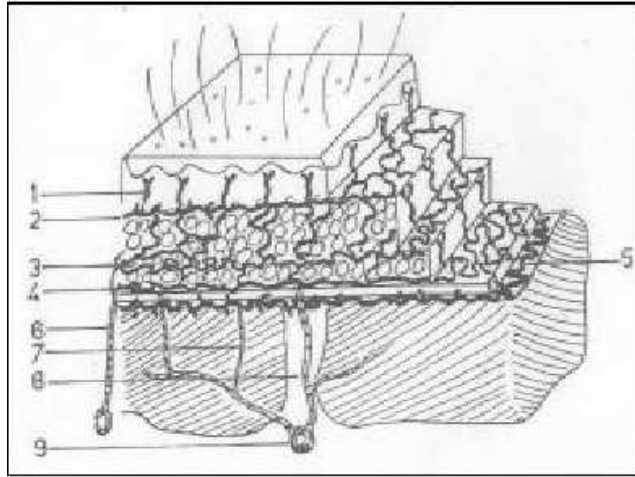
This vessel runs in the midline between the heads of gastrocnemius. It arises from the popliteal (48%), from the lateral sural (39%), from one of the inferior genicular arteries (13%) and pierces the popliteal fascia to accompany the medial sural cutaneous nerve and the short saphenous vein. The point at which the artery pierces the deep fascia bridging the groove between the two

heads of gastrocnemius is variable but is usually about half way down the lateral head of gastrocnemius. It follows the lateral edge of the Achilles tendon where it anastomoses with branches of the peroneal artery and posterior tibial artery.<sup>40, 41</sup>

**Variations:** The anterior tibial artery is often diminished in caliber but never entirely absent. The middle portion may be greatly reduced in which case the perforating branch of the peroneal artery joins the distal portion (5% of 2458 cases). When greatly increased in size the anterior tibial supplies the plantar surface of the foot.

The posterior tibial may reach only as far as the distal third of the leg where it is then reinforced by a large communicating branch from the peroneal. It may end as a nutrient vessel to the tibia or in supplying a muscle, or it may even be absent, in which case its territory is supplied by a particularly well-developed peroneal artery. Rarely may it be increased in caliber.

The peroneal artery is never absent but is occasionally much reduced in size. Anatomically its size is inversely proportionally to that of the other arteries in the leg, and as described above it may feed the distal parts of the anterior or posterior tibial arteries. Interestingly it is the vessel least affected by arteriosclerosis.<sup>37, 38, 39, 40, 41</sup>



**Figure 1: Vascular Basis of Fascia**  
 1. Subepidermal Plexus      2. Subdermal Plexus  
 3. Subcutaneous Plexus    4. Suprafascial Plexus  
 5. Subfascial Plexus        6. Direct Cutaneous Artery  
 7. Musculocutaneous Perforator    8. Septocutaneous Perforator  
 9. Main Vessel

**Location of septocutaneous perforators.** <sup>29</sup>

Vessels Location	PTA (Distance from Medial Malleolus)	PA (Distance from LM/FH)	ATA
N1	4.5cm	4-10cm (LM)	2-4cm from origin of Anterior Tibial artery
N2	6.0cm	10-13 cm (LM)	
N3	9-12cm	15-20 cm (LM)	
N4	17-19cm	5-6 cm (FH)	
N5	22-24cm		

**Code**

N - Number of Perforator

LM - Lateral Malleolus

FH - Fibular Head

PTA - Posterior Tibial Artery

PA - Peroneal Artery

ATA - Anterior Tibial Artery

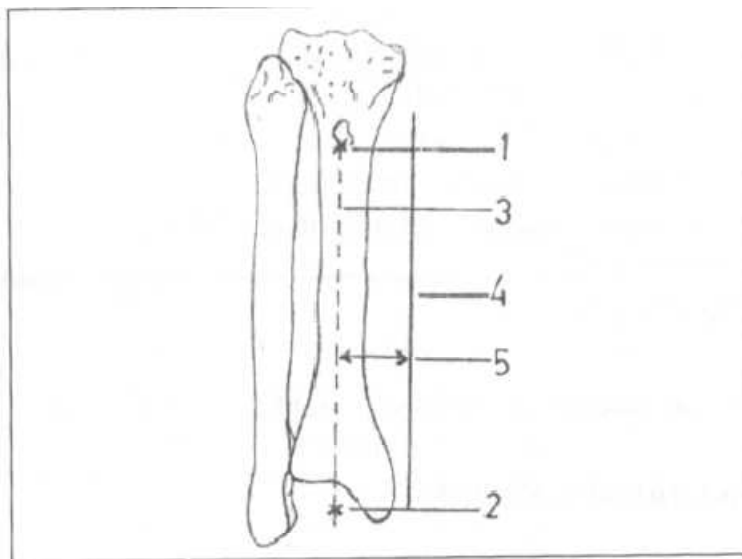
**Surface markings for the 3 main vessels are**

**A. Posterior tibial artery**

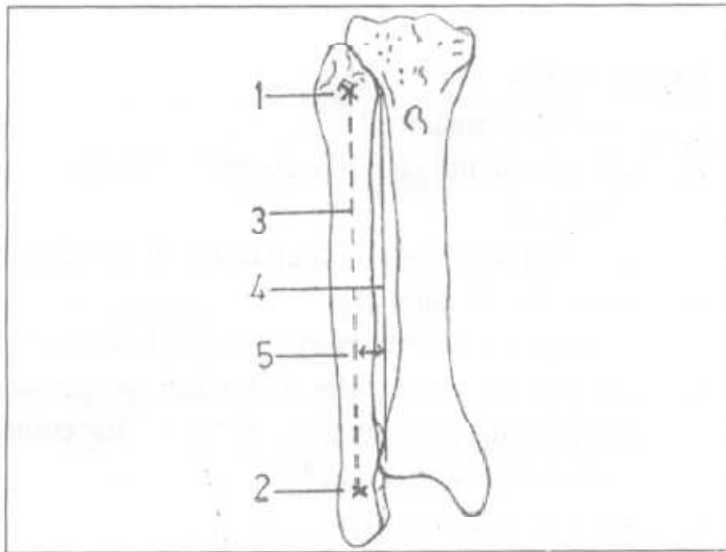
A line from tibial tuberosity to the mid malleolar point. The vascular axis lies 4.5 cm medial and parallel to this line or 1.5 cm from medial border of tibia.

**B. Anterior Tibial artery and Peroneal artery**

Reference line is drawn by joining the head of the fibula and tip of the lateral malleolus. Anterior tibial artery axis lies 2.5 cm anterior and parallel to this line, peroneal artery axis lies 2.5 cm posterior and parallel to this line.

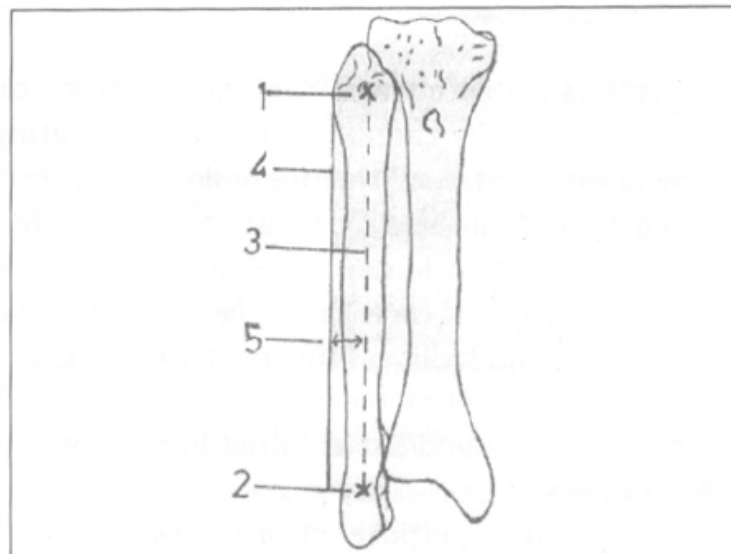


**Figure 2: Vascular Axis of Posterior Tibial Artery**  
1. Tibial Tuberosity  
2. Mid Malleolar Point  
3. Reference Line  
4. Vascular Axis  
5. 4.5 Cm Medial and Parallel



**Figure 3: Vascular Axis of Anterior Tibial Artery**

- |                             |                                 |
|-----------------------------|---------------------------------|
| 1. Head of Fibula           | 4. Vascular Axis                |
| 2. Tip of Lateral Malleolus | 5. 2.5 Cm Anterior and Parallel |
| 3. Reference Line           |                                 |



**Figure 4: Vascular Axis of Peroneal Artery**

- |                             |                                  |
|-----------------------------|----------------------------------|
| 1. Head of Fibula           | 4. Vascular Axis                 |
| 2. Tip of Lateral Malleolus | 5. 2.5 Cm Posterior and Parallel |
| 3. Reference Line           |                                  |

The perforators of the posterior tibial artery and peroneal artery are located at every 4-5 cm from tip of the malleoli. In distally based flaps, the lower limit of the dissection decides the reach of the flap which is based on the lower

perforators of the leg as depicted by Bhattacharya is taken as the safe limit of dissection inferiorly. <sup>29</sup>

**Cormack and Lamberty classification: The types include** <sup>29</sup>

A - Has a fascial plexus

B - Has a single perforator

C - Has multiple perforators and segmental source artery

**Mathes and Nahai's Classification of fasciocutaneous flaps based on its blood supply** <sup>29</sup>

A - Direct cutaneous pedicle to the fascia

B - Septocutaneous perforator

C - Musculocutaneous perforator

**Variants of Fasciocutaneous flaps** <sup>29</sup>

1. Antegrade (superiorly based)
2. Retrograde (inferiorly based)
3. Deepithelized turn over flaps
4. Islanded perforator based flaps
5. Fasciocutaneous with adipofascial extension

## **MATERIALS AND METHODS**

This study was conducted in the Department of Plastic Surgery, Government Rajaji Hospital, Madurai over a period of 30 months from Aug 2010 to Jan 2013.

Only cases with soft tissue defect of lower 1/3<sup>rd</sup> leg requiring flap cover i.e defects with tendon, bone or implant exposed or in patients undergoing staged procedures were included in this study. A total of 73 patients were included in the study.

Timing of coverage was classified into<sup>18</sup>

**Acute** - within 72 hours

**Subacute** - 3 days to 6 weeks

**Chronic** - Greater than 6 weeks

Defects were classified according to their site as per the usual norms of upper third, mid third and lower third.

### **Inclusion criteria**

All patients with post traumatic soft tissue defects of the lower 1/3<sup>rd</sup> leg who required a soft tissue cover were included in the study

### **Exclusion criteria**

Patients with degloving injuries, arterial injury, head injury, abdominal injury, thoracic injury, bony injuries elsewhere, brachial plexus injuries and patients



who were not willing to participate in the study and for whom skin graft was planned were excluded from the study.

**Methodology:** All the patients included in the study were admitted to the trauma ward under the care of the attending orthopedician and received first aid. They were then resuscitated to minimize bleeding, restore airway and correct shock. <sup>5,8</sup>

Detailed history was taken on the mechanism of injury; the time since injury and history of neurological deficits. Then all the patients were subjected to a full general and local clinical examination to rule out other coexisting injuries and to assess the site and size of the defect, the presence or absence of exposed bone, tendons or neurovascular structures, the degree of wound contamination and the condition of surrounding skin. A complete vascular and neurological examination with comparison to the other healthy limb was performed. Laboratory investigations necessary for surgical fitness were done. X-rays and hand held Doppler studies were done to identify and classify the fracture and assess vascular status. <sup>5,8,12</sup>

All patients were taken up for wound toilet and debridement on the day of admission. Skeletal stability was achieved if necessary with external fixators, illizarov ring fixators, plates or K-wires as deemed appropriate by the orthopedic surgeon. To control the infection the wound pus culture and sensitivity done and the systemic antibiotics used accordingly. Wounds were

dressed daily with a saline dressing. Once the wounds were free of infection the soft tissue cover was planned. The appropriate reconstructive technique was selected for every patient according to the reconstructive ladder putting into consideration the site, size and type of the defect, the condition of local tissues, previous surgical procedures in the injured limb, future planned surgical procedures and the patient's general condition.<sup>12, 42, 43</sup>

All the patients received postoperative care including proper antibiotic therapy, analgesics in the post-operative period, elevation of the limb to prevent oedema and monitoring of the flap- colour, temperature and capillary refill. First look dressing of the skin graft was done on the 5<sup>th</sup> postoperative day. Assisted ambulation was allowed for the patients whenever possible at the end of the 5<sup>th</sup> postoperative day. Dependable weight bearing was allowed at the end of the 7<sup>th</sup> postoperative day depending on the presence of bone fractures and the method of bone fixation. Sutures were removed on the 10<sup>th</sup> post operative day and the patients were transferred back to the orthopedic surgeon for further treatment.<sup>43, 44</sup>

Patients were evaluated on their 1<sup>st</sup>, 5<sup>th</sup>, 10<sup>th</sup>, 15<sup>th</sup>, 30<sup>th</sup> and 60<sup>th</sup> post operative day. Evaluation parameters included viability and stability of the flap, take of the skin graft for secondary defect, presence of pain, ulceration, functional deficit, hospital stay and patient satisfaction with the reconstruction. On the 30<sup>th</sup> day patients were asked to subjectively grade the reconstruction in terms of

functionality, return to work and aesthetic appeal. Follow up periods varied from 6 months to two years depending on the patient's compliance.<sup>44, 45</sup>

Functionality – 2points

Return to work – 2 points

Esthetic appeal – 1 point

Scores of 4 & 5 indicates good satisfaction.

2 & 3 indicate fair satisfaction.

1 indicate poor satisfaction

Data was collected in the form of a proforma which included epidemiological data, clinical data, wound area measurements and operative surgical information. The data so obtained was subjected to simple statistical analysis to determine and analyze the various reconstructive options used.

## **SURGICAL PRINCIPLES**

The initial assessment and treatment of patients with lower extremity trauma should be in accordance with the Advanced Trauma Life Support (ATLS) guidelines.

The second phase of management begins when the patient arrives in the operating room. Debridement is initiated with the pneumatic tourniquet.

Large bone fragments with significant soft tissue attachment are maintained and small, free fragments are removed. A second debridement is performed with the tourniquet deflated, and the wound is irrigated.<sup>44, 45</sup>

### **GUSTILO ANDERSON CLASSIFICATION of open fractures (1976) .<sup>46</sup>**

**Type I** - Open fracture with a clean wound, < 1cm in length.

**Type II** - Open fracture with a laceration >1cm long and without extensive soft tissue damage or avulsion.

**Type III** - Subtype (1984)

A - Adequate periosteal cover of a fractured bone despite extensive soft tissue laceration or damage; high energy trauma irrespective of size of wound.

B - Extensive soft tissue loss with periosteal stripping and bone exposure, usually associated with massive contamination.

C - Associated arterial injury requiring repair, irrespective of degree of soft tissue injury

Byrd, Spicer and Cline enlarged the classification of open tibial fractures into four types in order in increasing energy of injury<sup>9</sup>

Type I fractures represent low energy forces causing an oblique fracture of the tibia with a relatively clean cutaneous wound less than 2 cm length.

Type II fracture indicates moderate energy forces causing either a displaced fracture or a comminuted tibia fracture with a skin wound greater than 2 cm in length.

Type III fracture results from high energy forces causing a significantly displaced or severely comminuted fracture or segmental fractures with extensive associated skin loss and devitalized muscle.

Type IV fracture pattern indicates extreme energy forces, a history of crush or degloving injury or vascular injury requiring repair.

As surgeons gained more experience in treating these complex injured wounds, the need to objectively assess and predict the functional outcome was felt and that led to the development of a wide variety of scoring systems, the notable of which are

- Mangled extremity severity score (MESS)
- Ganga Hospital Open Injury Severity Score (GHOISS)

- Limb salvage Index (LSI)

Johansen reported the Mangled extremity severity score (MESS) in 1990. The MESS evaluates 4 important variables<sup>47</sup>

#### **Skeletal / soft-tissue injury**

Low energy (stab; simple fracture; pistol gunshot wound): 1

Medium energy (open or multiple fractures, dislocation): 2

High energy (high speed MVA or rifle GSW): 3

Very high energy (high speed trauma + gross contamination): 4

#### **Limb ischemia**

Pulse reduced or absent but perfusion normal: 1\*

Pulseless; paresthesias, diminished capillary refill: 2

Cool, paralyzed, insensate, numb: 3\*

#### **Shock**

Systolic BP always > 90 mm Hg: 0

Hypotensive transiently: 1

Persistent hypotension: 2

#### **Age (years)**

< 30: 0

30-50: 1

> 50: 2

\* Score doubled for ischemia > 6 hours

MESS score of greater than or equal to 7 had a 100% predictable value for amputation.

The GHOISS assessed the severity of the injury to the limb separately to each of the three components of the limb: the 'covering tissues' i.e., skin and fascia, the 'skeleton' i.e., bones and joints, and the 'functional tissues' i.e., muscles, tendons and nerve units. Treatment may be influenced by several systemic factors and outcomes were given two points each, and the final score is arrived by adding all the individual scores together. Salvage should be attempted if score is less than or equal to 14, primary amputation considered in those with score of 17 or above and those in between should be assessed by an experienced team on case-to-case basis.<sup>48</sup>

LEAP study concludes that although the published scores were successful in predicting amputations, scoring systems are not predictive of functional recovery among patients who have undergone successful limb reconstruction. Practitioners should exercise caution when interpreting scores in the context of potential recovery from high-energy trauma.<sup>49</sup>

After the debridement has been accomplished, bone fixation can be provided. The final step is the provision of soft tissue coverage. Definitive closure within 72 hours is advantageous in terms of bone healing. If immediate coverage is planned, it necessitates removal of all free fragments, including the

large fragments, however the large fragments with soft tissue attachments can be salvaged eliminating the need for a second bone grafting procedure.

Various options available for reconstruction of the lower extremity are:

- A. Skin Graft
- B. Skin Flap
- C. Fasciocutaneous flaps
- D. Adipofascial flap
- E. Muscle flap with SSG
- F. Propellar flaps
- G. Free flaps
- I. Cross leg flaps

### **Technique of Flap rising**

All flaps were done under spinal anaesthesia, with pneumatic tourniquet control. Perforators were marked pre-operatively with hand held Doppler. Flaps were marked preoperatively after planning in reverse. Dissection was begun distally taking care to suture the fascia to the dermis to prevent shear. After raising the appropriate length of the flap, it was transferred to the defect and inset given in a single layer with 3 '0' Ethilon after placing a drain. Flap donor area is covered with skin graft. Immobilisation was done with a plaster of Paris slab if the external fixator was not sufficient.



## **A. Skin grafts**

Skin grafts are applicable only if there is a healthy vascular recipient bed or if the periosteum over the bone is intact.

## **B. Skin flaps**

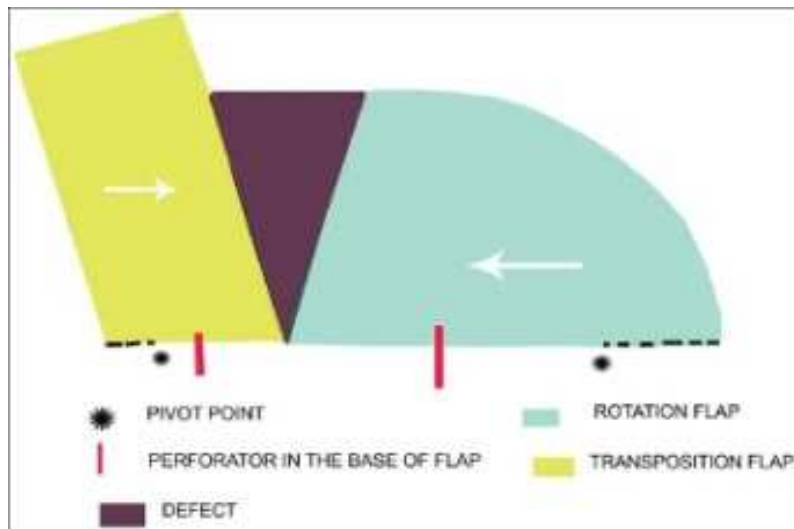
Local skin flaps like transposition flaps are suitable only for small to medium defects. With understanding of the anatomy better Fasciocutaneous flaps came into vogue and are more reliable and a larger flap can be harvested.

## **C. Fasciocutaneous flaps**

Fasciocutaneous (FC) flaps have been well investigated and tried out in leg defect. FC flap can be used in the ipsilateral limb locally as well as distally in the form of cross leg flap.<sup>50, 51</sup>

**'The perforator plus' technique** combines the advantages of providing additional blood supply and safeguarding the venous return.

The 'perforator plus' peninsular flap has prior identified perforator at the base and, therefore, gives freedom to make a back cut without any fear of compromising blood supply. A back cut moves the pivot point closer to the defect thereby facilitating better movement of flap and thus easing the tension on the distal edge. This principle is applicable to rotation, transposition, interpolation or any other peninsular design flap.<sup>52</sup>



Selection of fasciocutaneous flaps for lower leg defects

- Distally based fasciocutaneous flaps based on lower perforators of the peroneal and posterior tibial arteries.
- lateral supramalleolar flap
- Reverse sural artery flap.

#### **D. Adipofascial flaps**

Adipofascial flaps have become extremely popular in the last decade in the reconstruction of lower leg defects. Adipofascial flaps are like fasciocutaneous flaps, as the vascular basis is same in both flaps. The basic advantage of adipofascial flaps over fasciocutaneous flaps is that it carries least donor site morbidity as the donor site can be closed primarily.<sup>6</sup>

## **E. Muscle flaps**

They are compound flaps which constitute muscle, fascia, subcutaneous fat and skin combined as a single unit of tissue based on one or more vascular pedicles. Blood supply to these flaps comes primarily from the muscle and reaches the skin by vessels which pierce the muscle pass through the fascia to ramify in the subcutaneous tissues.<sup>17, 53, 54, 55</sup>

Mathes and Nahai classified Muscles into five types based on the number of vascular pedicles entering the muscle.<sup>54</sup>

Muscle flap for distal third leg defects include

- Peroneus brevis
- Tibialis anterior
- Extensor hallucis longus
- Distally based Soleus

### **Peroneus brevis Muscle Flap**

The blood supply is provided by segmental branches, usually three or four in number, arising from peroneal artery.

The distal portion of the muscle belly can be felt immediately behind the lower third of the fibula in front of the Achilles tendon. Access to the muscle is by a longitudinal incision along the posterior border of the lateral malleolus.

The distal 10 to 12 cm of the muscular attachment of the fibula can be released without compromising the blood supply to the muscle flap. The muscle flap, nearly 10cm long by 3cm wide, can be swung forward to cover the upper half of the lateral malleolus and the adjoining part of the fibula. A split-thickness skin graft is used for epithelial cover. There will be no functional loss by using this muscle flap if the peroneus longus is preserved.<sup>56</sup>

#### **F. Neurofasciocutaneous flaps**

Small arteries and veins usually accompany the cutaneous nerves and they send perforators to overlying skin was Masquelat concept

The reverse flow sural fasciocutaneous flap is based on median superficial sural artery. Good circulation is ensured by the constant anastomoses with 3 to 5 septocutaneous perforators from peroneal artery.

If the accompanying arteries of lesser saphenous vein are included, the success rate of the flap increases as these give off cutaneous perforators along its suprafascial course. The components of the pedicle include superficial and deep fascia, median superficial sural artery, sural nerve, lesser saphenous vein and accompanying vessels. The skin island, subcutaneous tissue and the fascia make the flap proper. The limb draped with tourniquet after placing the patient in prone position. Midpoint of lateral malleolus to tendoachilles to mid Popliteal fossa is the flap axis. To outline the pedicle a mark is made 5 to 7 cm proximal

to tip of lateral malleoli, to locate the arc of rotation, avoiding injury to the more distal septocutaneous perforators. After measuring the size of the defect, the cutaneous island to be transferred is marked out on middle or distal third of leg, depending on the length of pedicle necessary to reach the wound. Keeping the pedicle centralized with regard to flap, skin incision made from proximal to distal. Proximally the sural nerve and accompanying short saphenous vein identified, ligated, cut and included in the flap. The fascia must be included in both the skin island and the pedicle dissection. Later via a skin tunnel or the skin bridge the flap is transferred. Primary closure of donor site defect is done if it is less than 4cm in diameter or else covered split skin graft.<sup>57, 58, 59</sup>

### **G. Propellar flaps**

They are basically fasciocutaneous flap containing the skin, subcutaneous tissue and the deep fascia based on a single musculocutaneous perforator.

A handheld Doppler is helpful to locate the most promising perforator to use. A provisional flap design can then be drawn. Firstly the distance between the perforator and the distal edge of the defect is measured. This value is then transposed proximally, and one centimetre is added. This forms the proximal limit of the flap. Half a centimetre is added to the width to allow for tissue contraction and to facilitate easy closure without tension.

The perforator vessels are located through an exploratory initial incision. The approach to the pedicle could be supra-facial or sub-fascial, with the latter being generally easier and less bloody. . The pedicle should be cleared of all muscular side branches and all the fascial strands that could potentially cause kinking of the pedicle. Raising the rest of the flap is quick and straightforward. The flap is carefully lifted from the wound bed, attached only by its pedicle, and rotated around this pedicle into the defect in whichever rotational direction that is most comfortable for the venae comitantes. The secondary defect is either closed primarily or using a skin graft.<sup>60, 61</sup>

**The 'Throw over flap':** A modification of the propeller flap for reconstruction of non-adjacent soft tissue defects.

When there were no appropriate perforators adjacent to the defect, exploration was done for perforator away from zone of injury. A propeller flap was raised in the tissue that was not in continuity with the defect and was rotated (propelled) and thrown over normal tissue to cover the defect. After confirming the lie of the flap, an incision is made in its pathway to accommodate the narrowed bridge segment. This avoided the complexities of free flap and could be performed as a single-stage surgery.<sup>62</sup>

## **H. Free flaps**

In 1973, Daniel and Taylor reported the free transfer of groin skin and subcutaneous tissue by use of microvascular anastomoses.

Commonly used free fasciocutaneous flaps are Antero-lateral thigh flap, Radial artery forearm flap, Dorsalis pedis flap, Scapular, Parascapular, Lateral arm flap, and Posterior calf fasciocutaneous flap.

Muscle and myocutaneous free flaps commonly used for lower limb reconstruction are latissimus dorsi, gracilis, tensor fascia lata and rectus abdominis flaps.

Composite osteocutaneous free flaps used for one stage reconstruction are radial artery osteocutaneous flaps, fibula flap and deep circumflex osteocutaneous free flap. It is usually the Grade IIIb fractures of the leg, that needs free flap cover. <sup>18, 63, 64, 65</sup>

### **Antero Lateral Thigh Free Flap**

This is a versatile soft tissue flap. Skin paddle available is the largest, up to 25 X 30 cms in adult and the donor site morbidity is very low. ALT can be used as a chimeric flap i.e. vastus lateralis muscle on one branch and on separate perforator.

Pertinent anatomy: The anterolateral thigh flap is a fasciocutaneous flap based on the septocutaneous or musculocutaneous perforators of the descending branch of the lateral circumflex femoral artery.

A satisfactory perforator is generally found within 3 cm radius of the midpoint of a line connecting the anterior superior iliac spine with the superolateral border of the patella. More than half of the perforators transverse the substance of the vastus lateralis muscle. The descending branch of the lateral circumflex femoral artery and its venae-comitantes lie between the vastus-lateralis and rectus-femoris muscle.

#### Operative procedure

Patient in supine position. Draw a circle of 3 centimeters radius at midpoint on the line joining anterior superior iliac spine and supero-lateral border of patella. Identify cutaneous perforators with hand held Doppler along this line / circle. Mark skin paddle length and width as per defect. Design an elliptical flap, include the main perforator area.

Take the medial skin incision first. Incise and tag deep fascia to skin with few interrupted sutures to avoid shearing of perforators. Rectus femoris muscle is identified easily with its bipinnate nature and inverted “V” look. Raise fascia off rectus femoris muscle and identify septum between vastus lateralis and rectus femoris muscle.



Look for perforators, both direct septo-cutaneous or musculocutaneous. Dissect musculocutaneous perforators carefully through muscle up to the main pedicle. Take lateral skin incision through the fascia-lata, tag fascia to skin. Dissect from below upwards, by dissecting the fascia-lata and skin paddle off the underlying vastus lateralis muscle until the inferior-most perforator is reached.

The perforator is carefully dissected from its surrounding muscle. If a single perforator to be used, a small cuff of muscle should be included with the flap to avoid twisting of the pedicle. This is not necessary if two perforators are included in the flap.

Dissect the descending branch of the lateral circumflex femoral artery and vein superiorly to their branches to the rectus-femoris, which should be preserved. Verify perfusion, then clip and divide the pedicle. Undermine medially and laterally in the suprafascial plane for closure of wound. Close the skin in two layers. If the donor area is large skin graft may be necessary.<sup>65, 66</sup>

### **Latissimus dorsi Muscle Free Flap**

This is probably the most commonly done and reliable free flap in the whole body. Vascular supply- (Mathes and Nahai Type V) It is supplied by two separate vascular systems. Thoracodorsal artery is the dominant artery, which is the terminal branch of the subscapular artery. It also has supply from segmental

perforating branches of the intercostal and lumbar arteries. The extramuscular pedicle length is about 9cm on average.

Innervation- Thoracodorsal nerve is the motor nerve, it arises from the posterior cord of the brachial plexus and is derived from the sixth, seventh and eighth cervical nerve roots.

Surgical procedure -Mid-lateral or supine position with a sandbag. A longitudinal incision is made from the axilla to the posterior iliac crest. The skin paddle should be marked. Then, the lateral border of the muscle is exposed. The key point of the technique is the dissection at the anterior border to expose the vascular pedicle. The pedicle must be carefully dissected, and the muscle should be released from its origin.

Advantages : Large volume of tissue is available for reconstruction, long vascular pedicle offers excellent range for pedicled flaps, high caliber pedicle makes free flap vascular anastomoses technically more feasible, independent skin paddles can address complex defects, minimal donor site morbidity, and it can be combined with other sub-scapular flaps, when indicated. The latissimus dorsi free flap is well established as the workhorse in extensive defects of the lower limb but functional impairment after transfer of Latissimus dorsi muscle has been observed and quantified, many studies which show 9-10% loss of shoulder power leading to 6% loss of shoulder function.<sup>65, 67, 68, 69</sup>

## **I. Cross leg flaps**

In some clinical situations where local fasciocutaneous and myocutaneous flaps are unavailable and when a free flap has failed because of technical errors or damaged vasculature, a cross-leg flap is the best choice. The inclusion of fascia in the flap makes length-to-breath ratio 3: 1 perfectly safe. The use of external fixator avoids the problem of immobilization and facilitates its uses in whom free tissue transfer may not be optimal.

The indications may be markedly broadened especially in the centres with no access to microsurgery. It offers the possibility of salvaging limbs that are otherwise non-reconstructable. It is a backup procedure in an urgent situation and supplies a large quantity of skin. Advantages of cross-leg flap include ease of dissection, versatility, shorter operating time, minimal donor site morbidity and replacement of like tissue.<sup>17, 28</sup>

### **Usual Technical faults**

#### **Patient Selection**

1. Poor general condition
2. Malnutrition, anaemia
3. Systemic disease, smoking, drug addiction
4. Planning without assessment of local tissue affected by infection or trauma.

These conditions may adversely affect the microcirculation

## **Intraoperative**

1. Poor flap planning
2. Failure to identify deep fascia and its incorporation in the flap
3. Failure of suturing the deep fascia to the dermis
4. Coarse tissue handling
5. Locating the pedicle away from the vascular axis
6. Unnecessary undermining of the Pedicle by blunt dissection.
7. Twist and kink at the pedicle
8. Suturing under tension
9. Pressure dressing
10. Failure to put a drain under the flap

## **Postoperative management**

1. Frequent monitoring is essential
2. Elevate leg to combat edema
3. Look for haematoma, evacuate if detected
4. Prevent infection
5. Distal flap should be inspected twice a day and dressed on alternate day

## **Identification of early signs of flap necrosis**

1. Decreased temperature
2. Discolouration
3. Fine shrinkage of epidermis at the distal part
4. Small blisters formation

5. Pinprick revealing dark blood

### **Follow up**

1. Educating patient about how to take care of the flap
2. Review by surgeon at least 15 days once in the first 3 months and every two months for two years thereafter.
3. Weight bearing allowed gradually after 3 months
4. The appearance of sensation is variable. Starts appearing around 6 months and takes almost 2 years.

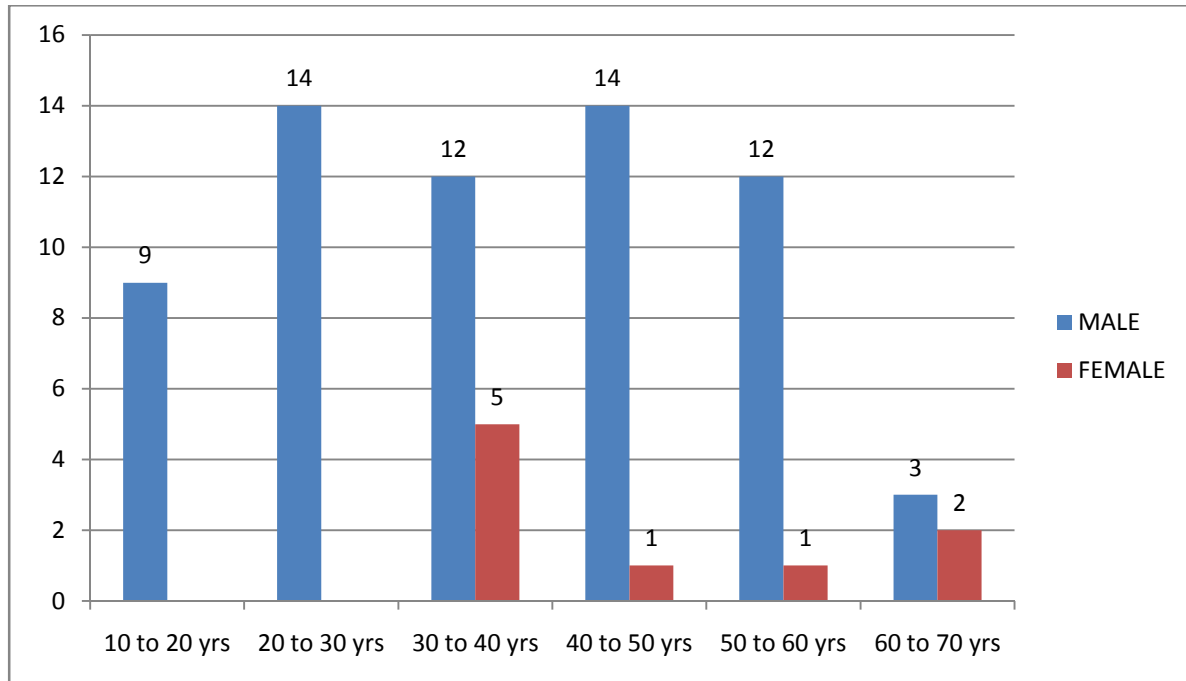
### **Donor site morbidity**

There is no functional loss. The grafted area gradually becomes soft and supple but seldom matches with the adjacent normal skin. It is usually acceptable to the patients.

If planning does not begin at initial evaluation, multiple poorly organised procedures may result in amputation.<sup>5, 29, 70, 71</sup>

## OBSERVATIONS AND RESULTS

**Fig.1 AGE / SEX DISTRIBUTATION**

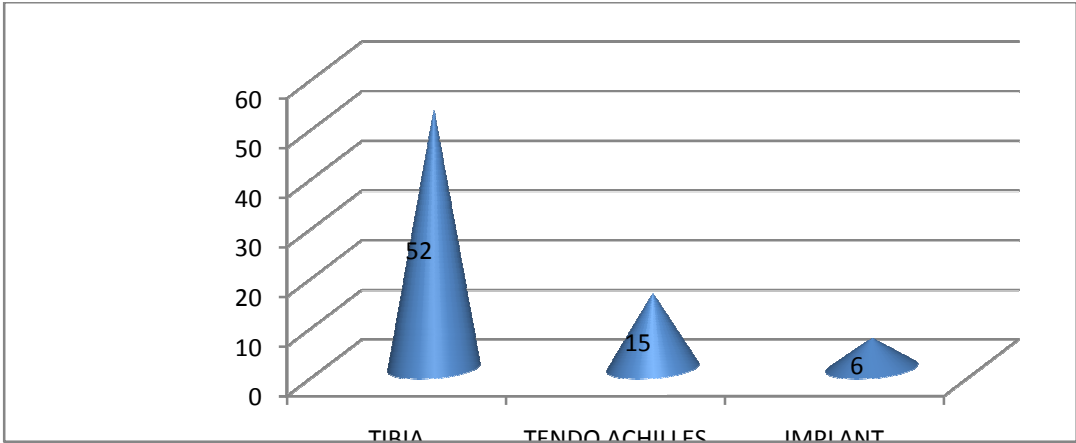


AGE IN RANGE	MALE	FEMALE
10 – 20 yrs	9	0
21 – 30 yrs	14	0
31 – 40 yrs	12	5
41 -50 yrs	14	1
51 – 60 yrs	12	1
61 – 70 yrs	3	2

The age of patients ranged from 10 to 70 years in this study. Common age group affected is between 21 to 30 years and 41 to 50 years, 19% each, n=14.

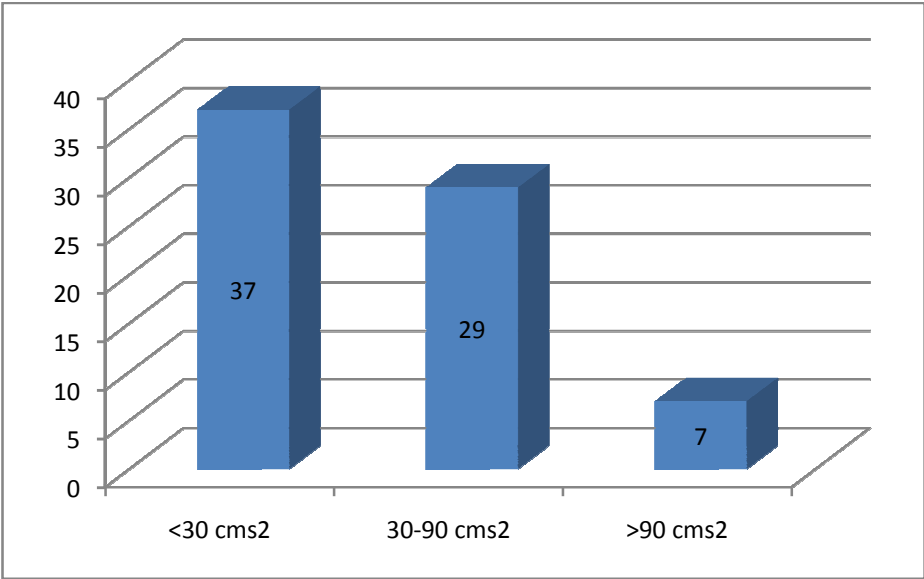
Male to female ratio is 7: 1 (M = 64, F = 9)

**FIG.2 EXPOSED PART / INDICATION FOR FLAP COVER**

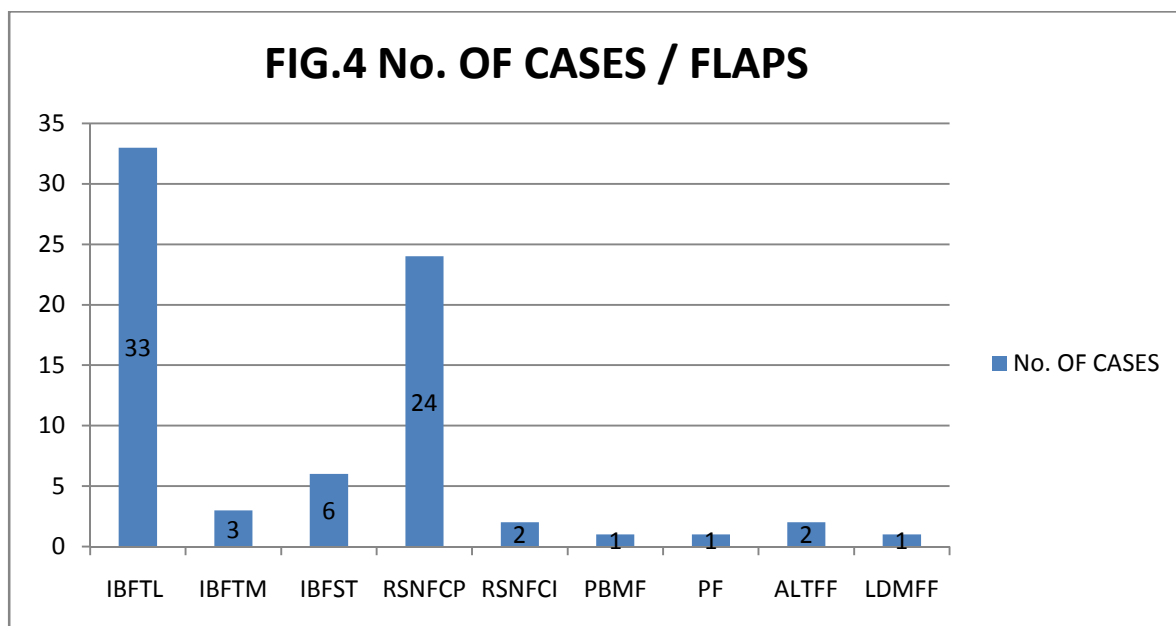


The most common indication for flap cover was exposed tibia (71%), followed by exposed tendon 21% and exposed Implant 8%.

**FIG.3 SIZE OF DEFECT**



The most common size of defect was small i.e, less than 30 cms2 (51%), followed by medium sized defects 30 to 90 cms2 (40%) & Large defects greater than 90 cms2 (9%)

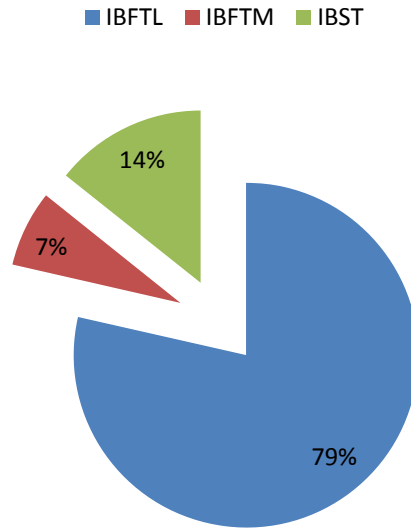


<b>NAME OF FLAP</b>	<b>No. OF CASES</b>
<b>IBFTL</b> -INFERIORLY BASED FASCIOCUTANEOUS TRANSPOSITION FLAP - LATERAL SIDE	33 (45%)
<b>IBFTM</b> -INFERIORLY BASED FASCIOCUTANEOUS TRANSPOSITION FLAP - MEDIAL SIDE	3 (4%)
<b>IBFST</b> -INFERIORLY BASED FASCIOCUTANEOUS SLIDING TRANSPOSITION FLAP	6 (8%)
<b>RSNFCP</b> - REVERSE SURAL NEUROFASCIOCUTANEOUS PEDICLED FLAP	24 (33%)
<b>RSNFCI</b> -REVERSE SURAL NEUROFASCIOCUTANEOUS ISLAND FLAP	2 (3%)
<b>PBMF</b> -PERONEUS BREVIS MUSCLE FLAP	1 (1%)
<b>PF</b> -PROPELLAR FLAP	1 (1%)
<b>ALTFF</b> -ANTERO – LATERAL THIGH FREE FLAP	2 (3%)
<b>LDMFF</b> -LATISSIMUS DORSI FREE FLAP	1 (1%)

The most commonly performed procedure is the inferiorly based fasciocutaneous flaps (45%), followed by reverse fasciocutaneous flaps (32%)



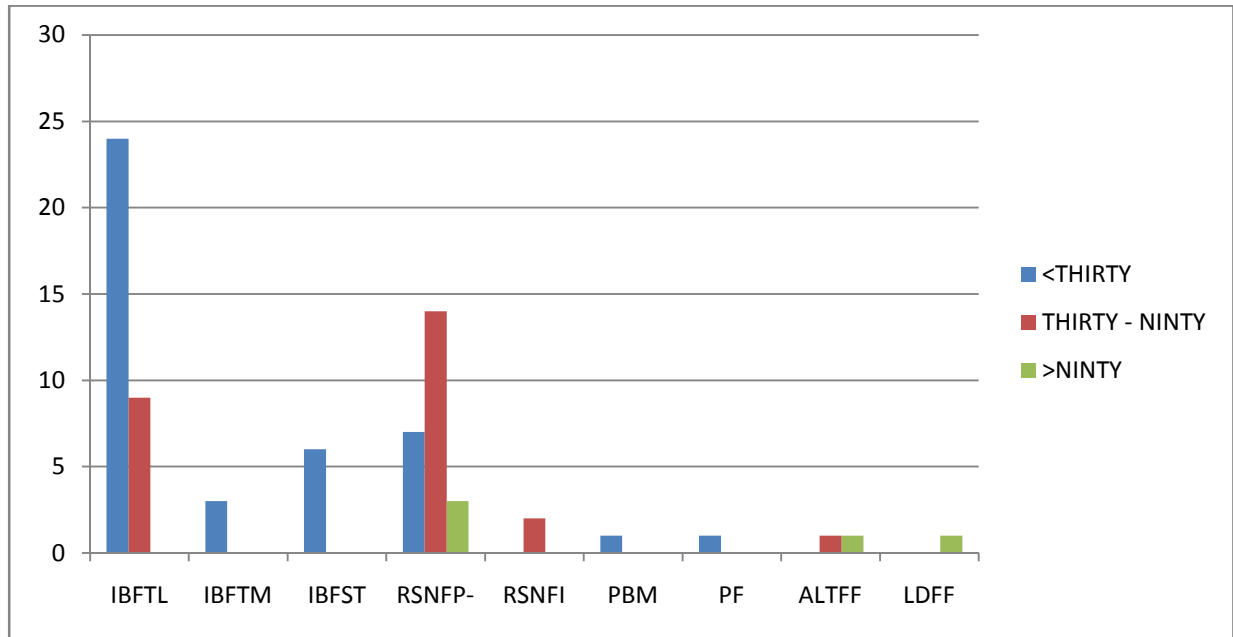
**FIG.5 VARIETY OF FASCIOCUTANEOUS FLAP**



<b>VARIETY OF FASCIOCUTANEOUS FLAP</b>	<b>NO. OF CASES</b>
IBFTL-INFERIORLY BASED FASCIOCUTANEOUS TRANSPOSITION FLAP - LATERAL SIDE	33
IBFTM-INFERIORLY BASED FASCIOCUTANEOUS TRANSPOSTION FLAP - MEDIAL SIDE	3
IBFST-INFERIORLY BASED FASCIOCUTANEOUS SLIDING TRANSPOSTION FLAP	6

Inferiorly based fasciocutaneous flap from lateral side(79%) was the most commonly performed fasciocutaneous flap because of the presence of reliable and constant perforator.

**FIG.6 SIZE OF DEFECT AND FLAP OPTIONS**



SIZ E	IBFT L	IBFT M	IBFST	RSNFP	RSNFI	PBM	PF	ALTFF	LDF
<30	24	3	6	7	0	1	1	0	0
30- 90	9	0	0	11	2	0	0	1	0
>90				5				1	1

Inferiorly based Fasciocutaneous flaps is the most common procedure performed for small to medium sized defect.

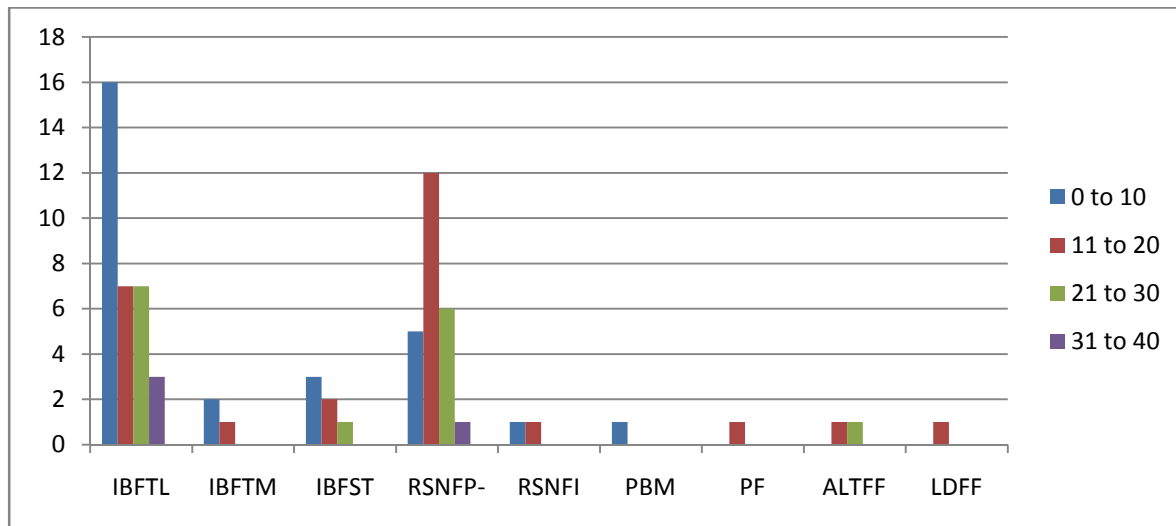
Neurofasciocutaneous flaps are excellent choice for medium to large size defect.

We have done a muscle flap for smaller defect

Propeller flap was done in one patient with small defect.

Free flaps were done in three patients with large sized defects.

**FIG.7 CORRELATION BETWEEN DURATION OF HOSPITALISATION AND FLAP USED**

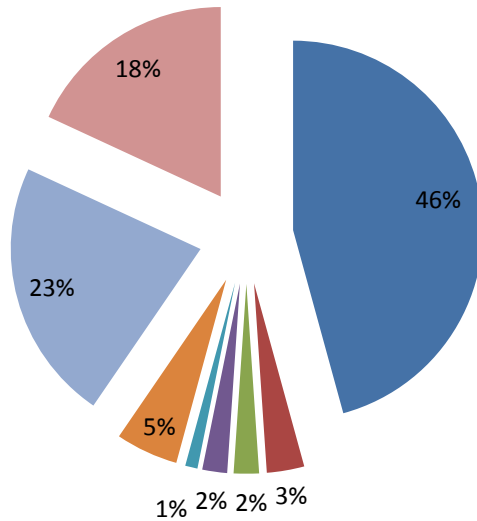


DAYS IN HOSPITAL	IBFLT	IBFTM	IBFST	RSNFP	RFNFI	PB	PF	ALTFF	LDF
0-10	16	2	3	5	1	1			
10-20	7	1	2	12	1		1	1	1
20-30	7		1	6				1	
30-40	3			1					

The average duration of hospitalization was least for fasciocutaneous flaps – (57% of patients were discharged within 10 days) and longest for pedicled Neurofaciocutaneous flaps and free flaps (2 to 5 weeks).

**Fig.8 COMPLICATIONS**

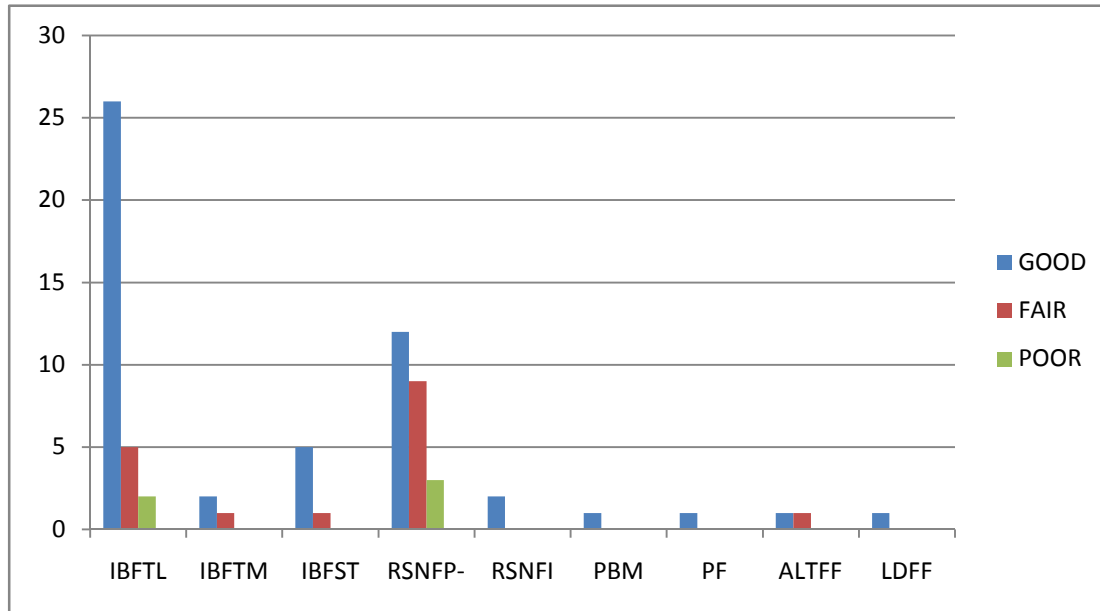
■ nil                      ■ partial necrosis                      ■ dehiscense                      ■ complete necrosis  
■ graft loss                      ■ superficial necrosis                      ■ oedema                      ■ minor infection



COMPLICATIONS	No. OF CASES
NIL	43 (46%)
PARTIAL NECROSIS	3 (3%)
DEHISCENSE	2 (2%)
COMPLETE NECROSIS	2 (2%)
GRAFT LOSS	1 (1%)
SUPERFICIAL NECROSIS	5 (5%)
OEDEMA	21 (23%)
MINOR INFECTION	17 (18%)

Oedema and infection were the common complications encountered 23 and 18 % respectively.

**Fig.9 PATIENT SATISFACTION VS FLAPS USED**

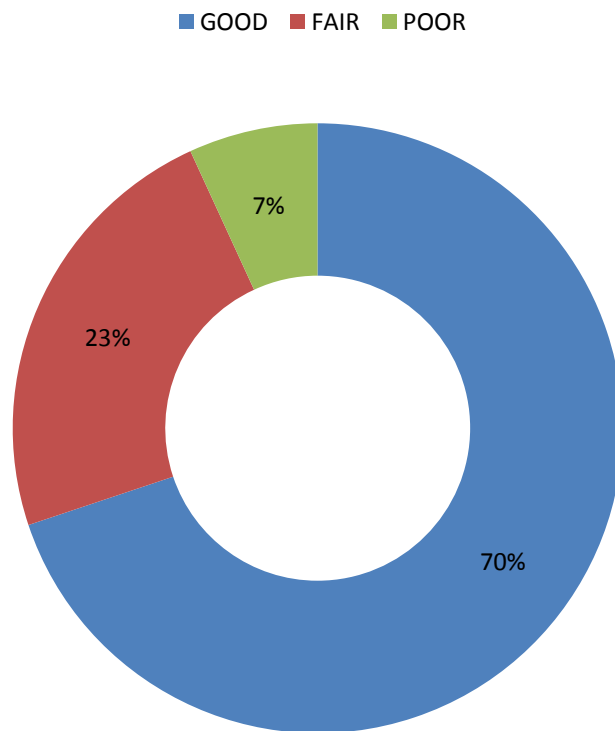


PATIENT SATISFACTION	IBFTL	IBFTM	IBFST	RSNFP	RSNFI	PBM	PF	ALTFF	LDF
GOOD	26	2	5	12	2	1	1	1	1
FAIR	5	1	1	9	0	0	0	1	0
POOR	2	0	0	3	0	0	0	0	0

Of the 46 patients who rated the reconstruction as Good, 26 (57%) had underwent distally based fasciocutaneous flap from lateral side, 12 (26%) had underwent distally based reverse neurofasciocutaneous flap of them rated the reconstruction as good, 2 islanded RSA, 1 muscle flap, 1 propellar flap, 1 ALT and 1 LD.

Of the 5 patients who had rated the reconstruction as poor 3(60%) had underwent distally based reverse neurofasciocutaneous flap and 2 (40%) distally based fasciocutaneous flap.

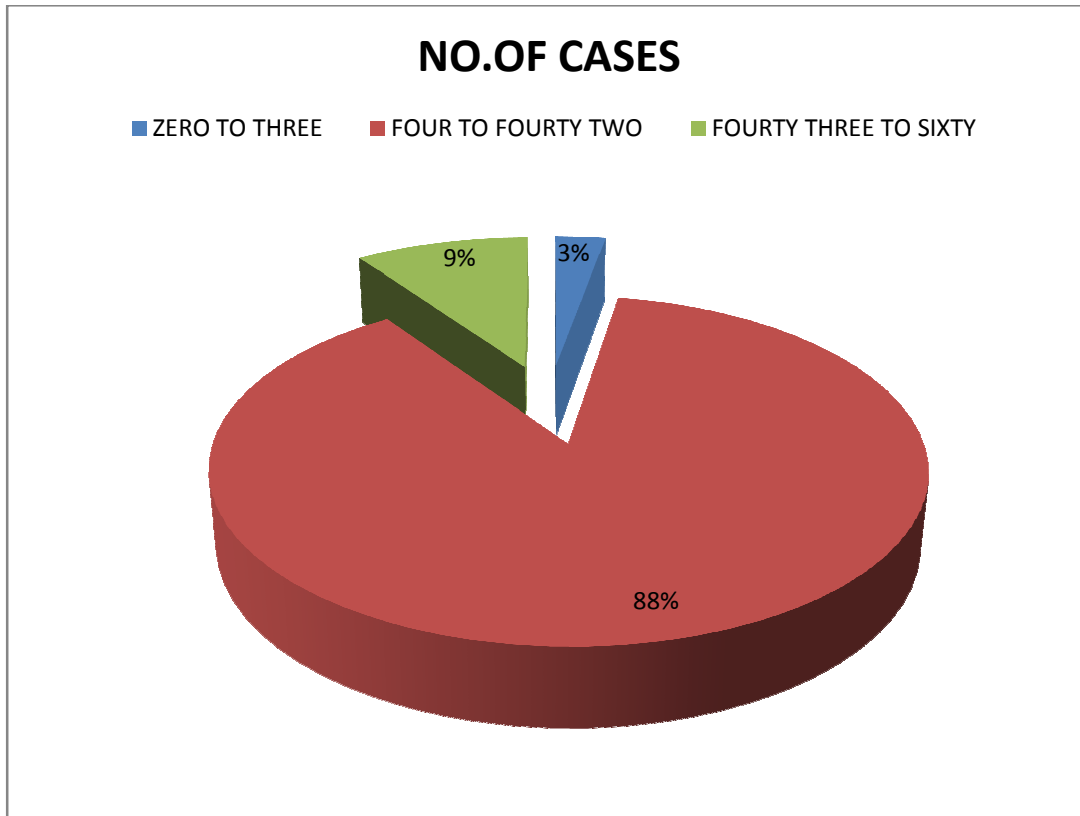
**Fig.10 PATIENT SATISFACTION**



<b>PATIENT SATISFACTION</b>	<b>No. OF CASE</b>
GOOD	51
FAIR	17
POOR	5

70% of patients graded the reconstruction as Good, 23% as Fair and 7% as poor.

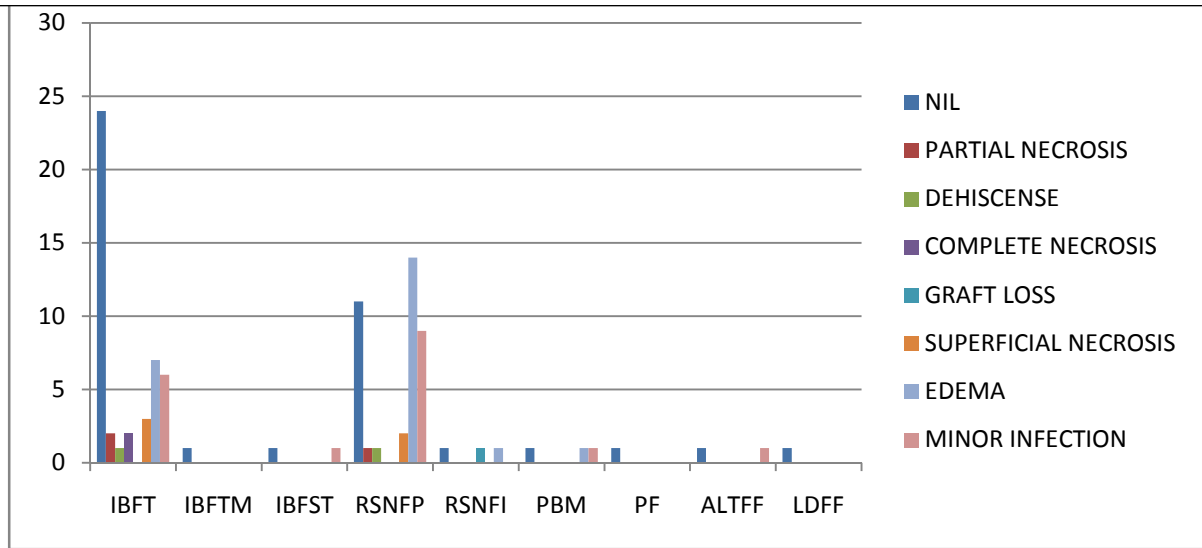
**Fig.11 PHASE OF COVERAGE**



PHASE IN DAYS	NO. OF CASE
0-3	2 (3%)
4-42	64 (88%)
43-60	7 (9%)

Of the 73 patients, 64 were operated in the sub-acute phase (88%), 7 (9%) were operated in the chronic phase and 2 (3%) in the acute phase.

**Fig.12 CORRELATION BETWEEN COMPLICATION AND FLAPS**



COMPLICATION	IBFTL	IBFTM	IBFST	RSNFP	RSNFI	PBM	PF	ALTF	LDFF
NIL	24	1	1	11	1	1	1	1	1
PARTIAL NECROSIS	2	0	0	1	0	0	0	0	0
COMPLETE NECROSIS	1	0	0	1	0	0	0	0	0
DEHISCENSE	2	0	0	0	0	0	0	0	0
GRAFT LOSS	0	0	0	0	1	0	0	0	0
SUPERFICIAL NECROSIS	3	0	0	2	1	0	0	0	0
OEDEMA	7	0	2	11	0	0	0	1	0
MINOR INFECTION	6	0	1	9	0	1	0	1	0

**IBFTL** NIL WAS-53%,PARTIAL NECROSIS WAS 5%,COMPLETE NECROSIS-2%,DEHISCENSE-4%,GRAFT LOSS-0%,SUPERFICIAL NECROSIS-7%,EDEMA-16%,MINOR INFECTION-13%

**IBFTM** NIL-50%, PARTIAL NECROSIS-50%

**IBFST** NIL-50%, MINOR INFECTION-50%

**RSNFP** NIL – 36%, PARTIAL NECROSIS-3%, COMPLETE NECROSIS-3%, SUPERFICIAL NECROSIS-6%, EDEMA-23%, MINOR INFECTION-29%

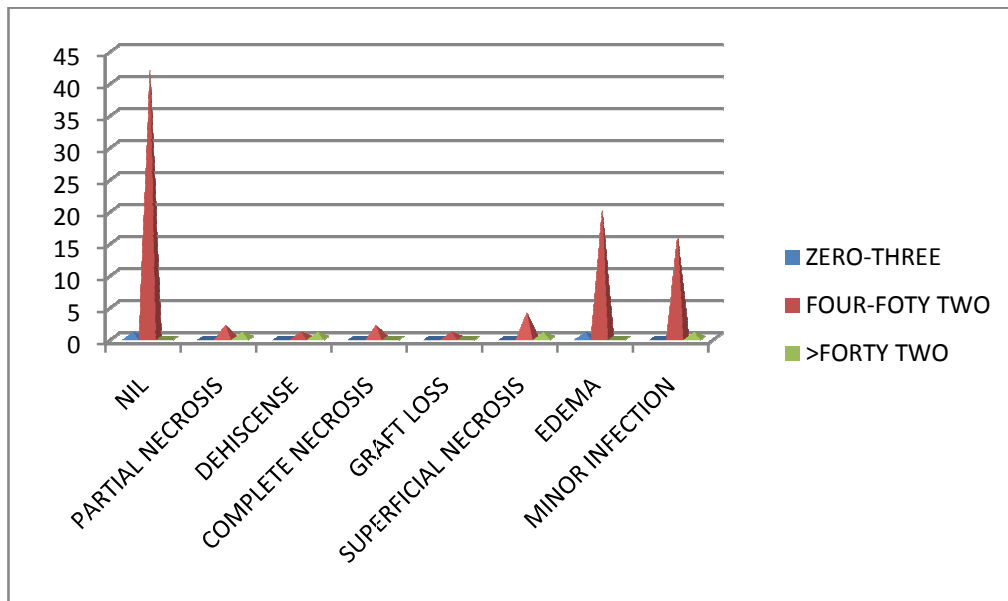
**RSNFI** FLAP NIL-34%, SUPERFICIAL NECROSIS-33%, GRAFT LOSS-33%

**PF** AND **LDFF** NIL WAS 100%

**PBM**, **ALTF** FLAPS NIL-50%, MINOR INFECTION-50%



**Fig.13 COMPARISON OF PHASE OF COVER vs COMPLICATION**



COMPLICAIONS	0-3	4-42	>42
NIL	1	42	0
PARTIAL NECROSIS	0	2	1
DEHISCENSE	0	1	1
COMPLETE NECROSIS	0	2	0
GRAFT LOSS	0	1	0
SUPERFICIAL NECROSIS	0	4	1
OEDEMA	1	20	0
MINOR INFECTION	0	16	1

## PERCENTAGE

**FROM 0 – 3 days:** NIL-50%, OEDEMA 50%

**FROM 4-42 days:** NIL-56%, SUPERFICIAL NECROSIS – 7%, PARTIAL NECROSIS – 3%, OEDEMA-26%, MINOR INFECTION-21%

**>42 days:** PARTIAL NECROSIS 14%, GRAFT LOSS-14%, COMPLETE NECROSIS-29%, MINOR INFECTION-14% DEHISCENSE-29%

## **Discussion**

The wound coverage of lower one third of leg is a challenging problem because of its anatomical features. The tibia and fibula are vulnerable to injury, open fractures being more common due to paucity of soft tissues around them. And as most muscles become tendons at this level, flap cover becomes mandatory in the event of trauma.

The basic objectives in reconstruction of leg defect are:

- a. Good and early healing of bone
- b. Good movement of contiguous joints
- c. An aesthetically acceptable stable cover

Early return to work and restoration of near normal functionality should be the aim of reconstruction of the lower extremity.

Our study was a prospective descriptive study which studied 73 patients who underwent reconstruction of lower one third leg soft tissue defect during the study period from August 2010 to January 2013.

### **INCIDENCE - YEARLY**

1. Aug 2010- Dec 2010 - 12 patients
2. Jan 2011 - Dec 2011 - 28 patients
3. Jan 2012 - Jan 2013 - 33 patients

## **ETIOLOGICAL INCIDENCE**

1. Road Traffic Accident - 69 patients
2. Fall from Height - 3 patients
3. Train Traffic Accident - 1 patient

The etiological indications for Lower one third leg soft tissue defect in this study showed Road traffic accidents to be the most common cause at 94 %.

In concordance with Fabio and Santanelli<sup>73</sup>, Road traffic accidents continue to be the major cause of soft tissue defect in a developing country like ours just as in the developed nations.

In this study the age of the patients varied from 10 years to 70 years with the mean age of 30 years. In the series of Gururaj and Suri MP et al (25-35 years mean age).<sup>2</sup>

Common age group affected is between 21 to 30 years and 41 to 50 years, 19% (n=14) each.

In this study 87% of those operated were males while other studies have quoted 64% (Gururaj and Akthar et al). Male to female ratio is 7: 1 (M = 64, F = 9)<sup>2, 3</sup>

Most patients presented with injury on the right side (59%)

The most common indication for flap cover was exposed tibia (71%) which is the same in other studies as well.<sup>1</sup>

The most common size of defect was small i.e, less than 30 cms<sup>2</sup> (51%),

followed by medium sized defects (40%) and 9% with defect > 90 cms<sup>2</sup>.

Almost 88% (n=64) of patients in this study were stabilised with external fixator despite conclusive studies by Trabulsky et al fixators et al proving nonreamed locked nails were more effective than external fixators.<sup>43</sup>

Again this may reflect availability rather than personal preference.

In this series maximum number of flaps was done in the sub-acute phase – 88% and the least in the acute phase 3%, chronic phase being 10%.

This is in total contrast to literature elsewhere where early cover is recommended. (Godina et al, Byrd et al).<sup>9, 18</sup>

The reasons for the decreased immediate cover were:

1. Co existing head injury taking priority for management.
2. Lack of immediate referral by orthopaedicians.
3. Doubtful vascularity of the limb.
4. Co existing wounds on the leg requiring skin grafting.
5. Co morbid illnesses with patients on Aspirin for ischaemic heart disease.
6. Delayed skeletal stabilisation where internal fixation was used.
7. Shortage of plastic surgery team members.

The results from other studies showed that immediate wound reconstruction is preferred to delayed wound reconstruction in that it shortens the period of hospital stay significantly, few dressing changes, fewer operations, decreased infection rate and secondary necrosis of exposed tissues. Thus, early consultation for soft tissue reconstruction is advised and all attempts should be

done to perform immediate reconstruction. These results are in agreement with previous studies.

We emphasize the importance of co-operation at the time of primary surgery between orthopaedic and plastic surgeon to preserve access to potential flaps. The technique of bony fixation of the tibia may prevent the use of this flap, especially in the presence of external fixation pins which may injure perforating vessels or tether the flap, restricting its range of transposition.

The most commonly performed procedure is the inferiorly based fasciocutaneous flap (57%), followed by reverse fasciocutaneous flaps (36%)

Inferiorly based Fasciocutaneous flap from lateral side is the most common procedure (45%) performed for small to medium sized defect as the perforator is constant and reliable in the lower lateral aspect of the leg.

Neurofasciocutaneous flaps are excellent choice for medium to large size defect.

Peroneus muscle flap was done for smaller defect.

Propeller flap was executed in one patient with small defect.

Three patients with large defects underwent free flaps

(Two patients – Antero-Lateral thigh free flap)

(One patient – Latissimis dorsi muscle free flap with skin graft)

The use of microsurgical techniques for the difficult problems revolutionized the field with literally limitless tissue available for transfer and defects deemed to be unsalvageable were suddenly salvageable, but with the advent of newer

techniques like perforator flaps and neurocutaneous flaps there is a resurgence of interest in non microsurgical reconstructive options. This is of special significance in a resource challenged centre like ours. In this study we have attempted to explore the above mentioned reconstructive strategies for lower 3<sup>rd</sup> leg reconstruction.

However the indications and the criterion of selection of a particular technique for a particular defect are not well established and is rather a matter of personal judgement.

51% (n=37) of patients had small sized defects, 40% (n=29) had medium sized defects and only 6% (n=7) presented with large defects.

The size of the defect and the experience of the centre in microvasuclar surgery was a significant factor in deciding reconstructive options

**Perforator plus technique :** While raising the local fasciocutaneous flap we always tried to include the perforator at the base of the flap, which was identified pre-operatively with hand held Doppler.<sup>52</sup>

The average duration of hospitalization was least for fasciocutaneous flaps. (57% of patients who underwent fasciocutaneous flaps were discharged or transferred to ortho ward before 10<sup>th</sup> day) and longest for pedicled neurofaciocutaneous flaps and free flaps.

Oedema (n=21) and Infection (n=17) was the most common complication in this series, it was managed by conservative measures – Anti-oedema measures, appropriate antibiotics / Irrigation, but one case necessitated a sequestrectomy in the operation theatre.

Partial flap loss in three patients ( 2 Reverse sural artery neurofasciocutaneous flaps and 1 distally based fasciocutaneous flap) was managed in 2 ways

1. Where bone was not exposed, wound was allowed to granulate after removing the necrosed part and later covered with split skin graft.
2. Where bone was exposed, the patient was taken to the operation theatre and the flaps were adjusted after shifting the pedicle further distally as needed.

Total flap loss in 2 cases( 1 Reverse sural artery neurofasciocutaneous flaps and 1 distally based fasciocutaneous flap) were covered with a skin graft after allowing it to granulate after making drill holes in the exposed bone and the other reconstructed with alternate flap cover- Reverse sural artery flap.

Resuturing or strapping was done for two patients with minimal dehiscence

Complications were greatest in the subacute phase, the chronic cases surprisingly mirrored the early phase, perhaps owing to adequate preparation with repeat debridements, sequestrectomy, antibiotic cover and wound homeostasis in the interim period with adequate skeletal stabilisation.

Complication rate was least in those cases given early cover, highest in the sub acute phase and in chronic cases the complication rate was comparable to acute phase.

The complication rates for the acute and sub acute phases were correlating with Byds's series where he had complication rates of 18% and 50% respectively.<sup>9</sup>

This once again emphasises the need for early cover.<sup>59</sup>

The patients were asked to rate the reconstruction. 93 % of the patients in this study were satisfied with the surgery and the outcome. As expected local flaps had a high satisfaction rates while distant flaps had fair or poor satisfaction rates, but we have to take into consideration that these patients had significantly more severe injuries than those who underwent local and regional flaps, hence identification of these patients and early education regarding the possible functional outcomes will mentally prepare the patient for the long road ahead and significantly improve the long term functional outcome after such difficult reconstruction.

With the knowledge of perforators supplying the lower third leg, perforator flaps are now being done. They are to be done with equal care as though performing a micro-vascular procedure.

Though free tissue transfer has revolutionised coverage of lower 1/3<sup>rd</sup> leg defects it may not be feasible to have the personnel with the necessary skill and facilities at that time.



Fasciocutaneous flaps and reverse neurofasciocutaneous flaps still have well established roles to play in lower extremity reconstruction.

Limb reconstructive is a long and complicated process in which unlike other surgical emergencies protocols are still evolving and evidenced based guidelines are not available.

In present scenario the healthcare delivery is influenced by cost of care. And hence the surgeon needs to choose the procedure which in his hands would give best result, keeping in mind, the best interest of patient.

## CONCLUSION

1. Though Free flaps are the gold standard for coverage of lower 1/3 leg soft tissue defects, distally based fasciocutaneous flaps and distally based reverse neurofaciocutaneous flaps are still very useful in a set up like ours where sophisticated instruments, prolonged theatre time, back-up anaesthesia team for re-exploration is not available all the time, and also because of the long wait list of trauma patients for surgery as ours is a tertiary care centre. Fasciocutaneous flaps are reliable, safe, and fast to learn.

### Merits and Demerits of various flaps

<b>Merits of Muscle flaps</b>	<b>Demerits of Muscle flaps</b>
<ol style="list-style-type: none"><li>1. Obliterate dead space</li><li>2. Increase perfusion and resistance to infection</li><li>3. Provide functional innervated coverage</li><li>4. Cover exposed vital structures</li><li>5. Superior adherence to deep irregular complex wound base</li></ol>	<ol style="list-style-type: none"><li>1. Functional loss</li><li>2. Skin graft over muscle less appealing</li><li>3. Loss of skin graft</li><li>4. Difficulty in monitoring muscle flap</li><li>5. Difficult dissection</li><li>6. Atropies over time</li><li>7. Only few options and small muscles available in lower one third leg</li></ol>

**Merits of fasciocutaneous flaps**

1. Simple concept
2. Easy dissection and lesser operating time
3. Minimal bleeding
4. Similar texture, thickness and color
5. Axial vessels protected
6. Perforating and conducting vessels readily seen
7. Less bulky than musculo-cutaneous flaps
8. No functional disturbance
9. Donor site readily grafted
10. Length-breadth ratio more flexible
11. Reliable results
12. Staged procedures can be carried out at a later date
13. No need for special set up, training or instruments
14. Easy post-op care

**Demerits of Fasciocutaneous flaps**

1. Flap donor site grafting
2. Loss of graft
3. Lesser arc of movement (except in reverse neurofasciocutaneous flaps)
4. Does not fill cavity
5. Not resistant to infection as compared to muscle flaps
6. If surrounding skin is damaged the skin may not be available for reconstruction
7. Secondary procedures like pedicle division and flap thinning may be necessary as in reverse neurofasciocutaneous flaps
8. Neurofasciocutaneous flaps sacrifices nerve

<b>Merits of Free flaps</b>	<b>Demerits of Free flaps</b>
<ol style="list-style-type: none"> <li>1. While planning for free flaps, the size or geometry of the defect is not an issue.</li> <li>2. The recipient vessels can be sourced away from the zone of injury.</li> <li>3. There is no additional scarring in surrounding area</li> <li>4. In a well-planned surgery, the success rate reaches 98%.</li> <li>5. According to need of the defect, particular flaps can be choosed</li> </ol>	<ol style="list-style-type: none"> <li>1. Technically challenging</li> <li>2. Microscope and other sophisticated instruments are required</li> <li>3. Long operative time</li> <li>4. Back-up team is required</li> <li>5. Donor site morbidity</li> <li>6. Rigorous monitoring in the posr-op period</li> <li>7. Even minor Technical error leads to 100% flap loss</li> </ol>

### **Merits of propeller flap**

- Greater arc of rotation - up to 180 degrees.
- Rest as those of fasciocutaneous flap

### **Demerits of propeller flap**

- Technically challenging
- Needs experience in using hand held Doppler
- Rest as those of fasciocutaneous flap

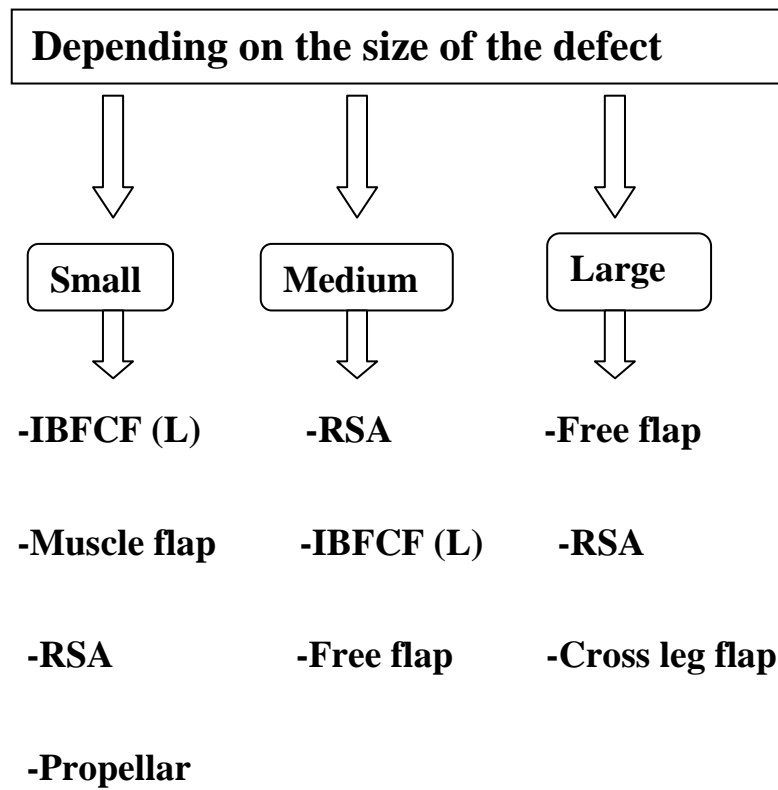
**Cross leg flaps.** As of today, cross leg flaps are used in special salvage situations like, when a recipient artery is not available for free tissue transfer or microsurgical facilities are not available. Requires a long period of immobilization, hence chances of contracture formation and deep vein thrombosis are very high. We have not done cross leg flaps in our institute during the study period.

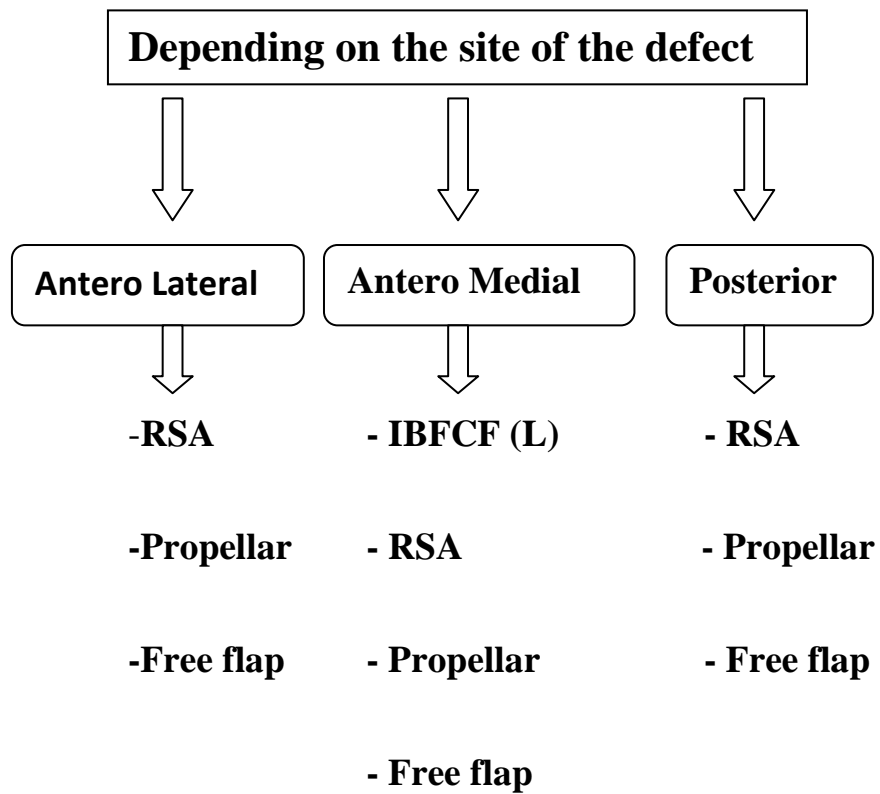
2. Most cases in this study were operated on in the sub-acute phase which had the highest complication rates, indicating the need for early reconstruction. We emphasize combined team approach along with orthopedician and general surgeons, and planning initiated in the trauma ward itself. Flap coverage is best done within 72 hours of injury.

The fact that there was no difference between free flaps and fasciocutaneous flaps in terms of flap loss in the early and chronic phases indicate that where facilities for microsurgical transfer are not available, the fasciocutaneous flaps can be safely done in the emergency sitting in the trauma theatre itself after bony stabilization by orthopaedic colleagues in the same sitting,, with the added advantage of decreased operating time.

Overall early surgery significantly reduces patient's morbidity, decreased hospital stay and early return to work

### Algorithm for Reconstruction of lower leg soft tissue defects





**IBFCF (L) – Inferiorly based fasciocutaneous flap from lateral side**

**RSA – Reverse sural artery neurofasciocutaneous flap**

**Inferiorly based fasciocutaneous Transposition flap from Lateral side**





**Inferiorly based fasciocutaneous Transposition flap from Lateral side**



**Inferiorly based fasciocutaneous Transposition flap from Lateral side**



**Inferiorly based fasciocutaneous Transposition flap from Lateral side**



**Inferiorly based fasciocutaneous Transposition flap from Lateral side**



## Sliding fasciocutaneous Transposition flap from Lateral side



**Sliding fasciocutaneous Transposition flap from Lateral side**



**Sliding fasciocutaneous Transposition flap from Lateral side**



## Pedicle Reverse sural artery Neurofasciocutaneous flap



**Pedicle Reverse sural artery Neurofasciocutaneous flap**



**Pedicle Reverse sural artery Neurofasciocutaneous flap**





## Pedicle Reverse sural artery Neurofasciocutaneous flap



# Islanded Reverse sural artery Neurofasciocutaneous flap



## Islanded Reverse sural artery Neurofasciocutaneous flap



**Islanded Reverse sural artery Neurofasciocutaneous flap(contd..)**



## Peroneus brevis muscle flap with Skin graft



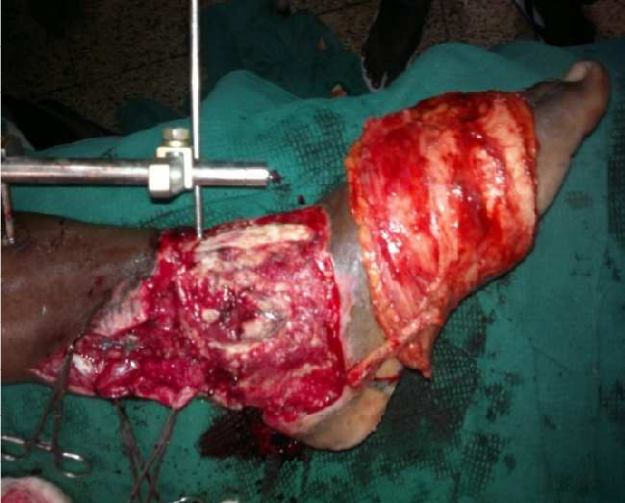
## Propellar flap



## Antero-Lateral Thigh Free Flap



# Antero-Lateral Thigh Free Flap





## Latissimus dorsi Muscle Free Flap



## Common Presentation

### Bone Exposed



**Common Presentation contd.,**

**Tendon Exposed**



**Common Presentation contd.,  
Implant Exposed**



## Complications



**Infection + Dehiscence**



**Partial Necrosis**



**Superficial necrosis**



**Infection + Oedema**

**Complications Contd.,**



**Superficial necrosis**



**Superficial necrosis**



**Partial necrosis**



**Dehiscence**



**Infection + Complete necrosis**

**aDEPARTMENT OF PLASTIC & RECONSTRUCTIVE SURGERY**  
**MADURAI MEDICAL COLLEGE, MADURAI**  
**RECONSTRUCTIVE STRATEGIES FOR LOWER ONE THIRD LEG**  
**SOFT TISSUE DEFECT**

**PROFORMA**

Name : Age: Sex:  
Address : IP No:

DOA :

DOS :

DOD :

Complaints :

Smoking :

Co-morbid illness :

Etiology :

Local Examination :

Side - Right/Left

Size- CM2

Exposure – Tibia/ Tendo Achilles/Implant/Others

Fracture – Tibia/ Both bones/Calcaneum

Bone Loss – CMs

Joint stiffness- Yes/no

Sensation- Yes/no

Nerve injury – Yes/no

Infection – Yes/no

**Debridement :**

Date –

Details –

**Fixation :**

Date –

Details –

**Reconstruction :**

Date –

Details –

**Bone reconstruction:**

Complication:

Patient satisfaction



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MASTER CHART

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14	PON RAJ MAH	35 92 2	1 3	1	20	2	36	1	1	0	0	1	0	1	2	1	3	0	5+6	3	
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16	MMA L PERI YASA	36 25 3	5 0	2	24	2	22	3	0	0	0	0	1	1	2	2	1	0	5	3	
17	MY	56 74 1	6 2	1	22	1	25	1	1	0	0	0	0	0	1	1	1	1	0	0	5
18	KALI RAJ NAG ARA	40 15 7	2 0	1	14	1	20	1	1	0	1	0	0	0	1	1	7	0	0	4	
19	THIN AM MUN	71 86 4	5 2	1	17	2	22	2	1	0	0	0	0	0	1	1	1	0	1+6	1	
20	IYAN DI	75 16 1	4 2	1	12	2	10 5	2	1	0	0	0	0	1	1	1	8	0	3+7	3	
21	RAJK	33	5	1	61	1	30	1	0	0	1	0	1	1	2	1	1	0	0	4	
22	UMA	06	5	1	61	1	30	1	0	0	1	0	1	1	2	1	1	0	0	4	

	R	8	2																			
	VAR	29																				
2	ALA	20	4																			
2	XMI	6	5	2	42	2	95	1	1	0	0	0	0	2	0	1	1	4	0	6	4	
	SAK	36																				
2	KAIL	61	2																			
3	AN	3	9	1	35	2	33	1	1	0	0	0	0	0	1	2	1	4	0	1+7	1	
	SIVA	42																				
2	SIVA	73	3																			
4	RAJ	0	5	1	37	2	22	1	1	0	0	0	0	0	0	1	1	3	0	7	3	
	MAN	43																				
2	MAN	67	2																			
5	I	5	8	1	24	1	32	1	0	0	0	1	1	0	0	1	1	1	0	5+6	2	
	AMM	67																				
2	AMM	91	4																			
6	AL	5	0	2	21	2	25	1	1	1	0	1	0	0	0	1	1	1	1	0	4	
	PERI	63																				
2	AKA	80	4																			
7	RU	3	5	1	33	2	23	1	1	0	0	0	1	0	0	1	2	1	0	0	5	
	MUR	74																				
2	UGA	28	3																			
8	N	1	0	1	38	2	22	1	1	0	0	0	1	0	0	1	1	1	0	0	4	
	THA	72																				
2	NGA	16	6																			
9	VEL	0	0	1	12	2	36	2	1	0	0	0	1	0	1	2	1	5	1	4	1	
	PAN	45																				
3	PAN	82	3																			
0	DY	2	5	1	29	1	44	1	1	0	1	0	0	0	0	1	1	4	0	6+7	5	
	JEYA	47																				
3	KUM	83	5																			
1	AR	4	4	1	32	1	33	1	0	0	0	0	1	0	0	0	1	4	0	0	5	
	MEE	45																				
3	MEE	84	6																			
2	RA	4	5	2	40	1	26	1	1	0	0	1	0	1	1	2	1	1	0	6	2	
	MUT	60																				
3	MUT	94	1																			
3	HU	7	8	1	12	1	22	3	1	0	0	0	1	0	0	1	1	1	1	0	4	
	SHA	74																				
3	SHA	73	4																			
4	NTHI	6	0	2	26	2	32	1	1	0	0	0	0	0	0	1	1	2	0	0	4	
	DHA	72																				
3	NAB	13	3																			
5	AL	9	7	1	47	1	36	2	1	0	0	0	1	0	0	1	1	4	0	6+7	4	
	KAR	68																				
3	KAR	93	2																			
6	UPU	0	3	1	32	1	36	3	0	0	0	0	0	0	0	1	1	1	0	0	5	
	MAN	84																				
3	ICHA	19	3																			
7	M	1	0	1	14	1	25	1	1	0	0	0	0	0	0	1	1	1	0	0	3	
	DHA	91																				
3	AXM	23	5																			
8	I	2	0	1	25	2	34	1	1	0	0	1	1	1	1	2	1	3	0	0	4	
	VEE	87																				
3	RASA	86	1																			
9	MY	9	7	1	37	1	33	1	1	1	0	1	0	0	0	1	1	4	1	1+7	2	
	RAJA	31																				
4	AME	31	2																			
0	D	44	5	1	10	2	0	1	1	0	0	0	0	0	0	1	1	9	0	0	4	
	PALA	83																				
4	MMA	22	4																			
1	L	1	0	2	26	2	36	1	1	0	0	0	0	0	0	1	1	4	0	0	4	
	KAD	12																				
4	KAD	06	5																			
2	HIR	3	5	1	36	2	20	1	0	0	0	0	1	0	0	1	1	4	0	0	3	
	MAN	22																				
3	I	9	6	1	27	1	35	1	1	0	0	0	0	0	1	1	1	2	0	6+7	4	
	MAN	24																				
4	ICKA	04	3																			
4	M	8	1	1	34	2	20	2	1	0	0	0	1	0	0	1	2	1	0	6+7	3	
	RAM	26																				
4	RAM	26	5																			
5	ANA	43	0	1	53	1	22	2	2	0	0	0	1	1&	1	1	1	1	1	0	7	4

N	1	2																			
	KAR	36																			
4	UPUS	81	3																		
6	AMY	2	5	1	44	2	32	1	1	0	0	0	1	0	0	1	1	1	0	2	1
		42																			
4	SIVA	73	4																		
7	RAJ	0	5	1	12	2	22	1	0	0	0	0	1	0	0	1	1	1	0	0	5
		42																			
4	PAN	95	3																		
8	DI	6	7	1	14	1	31	1	1	0	0	0	1	0	1	1	1	4	0	0	4
	RAN	58																			
4	GAS	64	4																		
9	AMY	2	5	1	15	2	92	1	1	1	0	0	1	1	0	1	1	4	1	0	5
	ASIR																				
5	VAT	62	4																		
0	HAM	58	5	1	16	1	34	3	1	0	0	0	0	0	0	1	1	4	0	0	4
		66																			
5	PRAB	71	2																		
1	U	2	3	1	22	2	20	1	1	0	0	0	1	0	0	1	1	1	0	0	4
	MAR	73																			
5	IMUT	38	2																		
2	HU	5	2	1	29	1	21	1	2	0	0	0	1	0	1	3	1	1	0	1	2
	KAT	82																			
5	HIRA	71	3																		
3	VAN	1	6	1	13	1	36	1	1	0	0	0	1	0	0	1	1	4	0	5	2
	SUBR	90																			
5	AMA	25	5																		
4	NI	7	0	1	43	2	25	2	2	0	0	0	0	2	1	1	1	1	0	3+7	3
	KAR	90																			
5	THIC	53	2																		
5	K	6	5	1	33	1	22	2	0	0	0	0	0	0	0	1	1	3	0	0	4
	SUD	50																			
5	HAV	01	6																		
6	AH	0	5	1	37	2	23	1	1	0	0	1	1	1	1	1	2	1	0	0	2
		52																			
5	PITC	51	2																		
7	HAI	0	6	1	24	1	26	1	1	0	1	1	1	0	0	1	1	1	1	0	4
		44																			
5	KAM	56	6																		
8	ALI	4	6	2	26	2	24	1	1	0	0	0	0	0	1	3	1	1	0	0	4
		57																			
5	JEYA	43	2																		
9	PAL	2	2	1	29	1	0	1	2	0	0	0	0	0	0	1	1	4	0	6+7	2
	PAR																				
	AMA	29																			
6	SIVA	09	5																		
0	M	7	0	1	12	2	21	1	1	0	0	0	0	0	0	1	1	1	0	0	5
	KUN	53																			
6	CHA	61	5																		
1	RAN	6	8	1	19	1	38	1	0	0	0	0	1	2	0	1	1	4	0	6+7	3
		73																			
6	RAJA	19	5																		
2	N	8	7	1	42	1	29	1	1	1	0	0	1	1	0	1	1	1	0	7	4
		63																			
6	VEE	74	5																		
3	MAN	3	2	1	12	1	22	1	2	0	0	0	1	1	1	2	1	1	0	6	2
6	PAN	67	3																		
4	DI	92	4	1	34	2	20	2	2	0	0	0	1	0	1	2	1	1	0	0	4
6	KAR	41	6																		
5	UP	46	7	1	37	2	15	1	2	0	0	1	1	2	1	2	1	4	1	0	4
	ESW	13																			
6	ARA	79	1																		
6	N	3	8	1	26	1	28	2	1	0	0	0	1	0	0	1	1	3	0	0	4
		70																			
6	MUT	98	3																		
7	HU	3	2	1	19	1	24	1	1	0	0	0	1	2	1	2	1	1	0	0	4
	JEYA	72																			
6	MAR	81	1																		
8	Y	2	4	1	20	1	40	1	2	0	0	0	0	0	0	1	1	4	0	6	4
		88																			
6	DINE	73	1																		
9	SH	9	8	1	33	2	37	1	2	0	0	0	0	0	0	1	1	5	0	0	5
7	EDW	34	3																		
0	ARD	76	0	1	12	1	35	2	2	0	0	0	0	0	0	1	2	4	0	7	4

		3																			
		45																			
7	PARI	86	4																		
1	L	7	0	1	33	1	22	1	1	0	0	1	1	0	1	2	1	1	0	6	5
		83																			
7	CHA	65	3																		
2	RLES	5	5	1	7	1	95	2	0	0	0	0	0	0	0	1	1	8	0	6+7	4
	MUN	89																			
7	IYA	40	5										1&								
3	MA	9	6	2	33	1	33	1	1	0	1	1	0	2	1	2	1	4	1	6+7	4

## KEY TO THE MASTER CHART

SEX	DURATION	SIDE	SIZE	EXPOSURE	FRACTURE	BONE LOSS	FIXATION
1-MALE	DAYS	1-RIGHT	Sq Cm	1-TIBIA	0-NO FRACTURE	CMs	0-NONE
2-FEMALE		2-LEFT		2-TENDO ACHILLES	1-TIBIA	0-NO	1-EXTERNAL FIXATOR
				3-IMPLANT	2-BOTH BONES	1-YES	2-PLATE AND SCREW

SENSATION	INFECTION	JOINT STIFFNESS	SMOKING	QOL	Grade
0-NORMAL	0-NO	0-NO	0-NO	Excellent	4-5
1-IMPAIRED	1-PRESENT	1-PRESENT	1-YES	Fair	2-3
				Poor	1

COMORBID ILLNESS	FLAPS	COMPLICATION
0-NO ILLNESS	1 INFERIORLY BASED FASCIOCUTANEOUS TRANSPOSITION FLAP - LATERAL SIDE	0-NIL
1-DIABETES	2- INFERIORLY BASED FASCIOCUTANEOUS TRANSPOSITION FLAP - MEDIAL SIDE	1-PARTIAL NECROSIS
2- HYPERTENSION	3-INFERIORLY BASED FASCIOCUTANEOUS SLIDING TRANSPOSITION FLAP	2-COMplete NECROSIS
	4- REVERSE SURAL NEUROFASCIOCUTANEOUS PEDICLED FLAP	3-DEHISCENCE
	5- REVERSE SURAL NEUROFASCIOCUTANEOUS ISLAND FLAP	4-GRAFT LOSS
	6-PERONEUS BREVIS MUSCLE FLAP	5-SUPERFICIAL NECROSIS
	7- PROPELLAR FLAP	6-OEDEMA
	8- ANTERO-LATERAL THIGH FREE FLAP	7-MINOR INFECTION
	9- LATTISIMUS DORSI MUSCLE FREE FLAP	

ABBREVIATIONS	FULL FORM
DUR	DURATION
JT	JOINT STIFFNESS
CI	COMORBID ILLNESS
DB	NUMBER OF DEBRIDEMENT
BR	BONE RECONSTRUCTION
COMP	COMPLICATION
QOL	QUALITY OF LIFE

ABBREVIATIONS	FULL FORM
EXP	EXPOSURE
#	FRACTURE
SEN	SENSATION
INF	INFECTION
FIXTN	BONE FIXATION

## Your digital receipt

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A DISSERTATION ON STUDY OF RECONSTRUCTIVE STRATEGIES FOR LOWER ONE THIRD

LEG SOFT TISSUE DEFECT In partial fulfillment of the regulations for the award of the degree of

MASTER OF CHIRURGIE (MCh.) Degree BRANCH – III – PLASTIC SURGERY THE TAMILNADU

DR. M.G.R. MEDICAL UNIVERSITY CHENNAI, TAMIL NADU. AUGUST 2013 1

INTRODUCTION

Increasingly, urban trauma is becoming a major health care issue. Large emergency departments are

inundated with patients with multiple injuries, requiring state-of-the-art care. Most of these complex

injuries involve trauma to the extremities, often due to motor vehicle accidents. In a study by MacKenzie et al. It was shown that lower extremity injuries accounted for...

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BY SRINIVAS RAJADORAIE 18102102 M.CH. PLASTIC RECONSTRUCTIVE SURGERY

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Text-Only Report



Ref No. 3104/E4/3/2012

Govt.Rajaji Hospital, Madurai.20.

Dated: .03.2012

Institutional Review Board / Independent Ethics Committee.

Dr. A. Edwin Joe, M.D (FM), BL.,

Dean, Madurai Medical College & 2521021 (Secy)

Govt Rajaji Hospital, Madurai 625020.

Convenor

grheticssecy@gmail.com.

**Sub:** Establishment-Govt. Rajaji Hospital, at Madurai-20-  
Ethics committee-Meeting Agenda-communicated-regarding.

The Ethics Committee meeting of the Govt. Rajaji Hospital, Madurai was held at 11.00 Am to 1.00Pm on 29.03.2012 at the Dean Chamber, Govt. Rajaji Hospital, Madurai. The following members of the committee have been attended the meeting.

1. Dr.N.Vijayasankaran,M.ch(Uro.) 094-430-58793 0452-2584397	Sr.Consultant Urologist Madurai Kidney Centre, Sivagangai Road, Madurai	Chairman
2. Dr.P.K. Muthu Kumarasamy, M.D., 9843050911	Professor & H.O.D of Medical, Oncology(Retired)	Member Secretary
3. Dr.T.Meena,MD 094-437-74875	Professor of Physiology, Madurai Medical College	Member
4. Dr. S. Thamilarasi, M.D (Pharmacol)	Professor of pharmacology	
5. Dr.Moses K.Daniel MD(Gen.Medicine) 098-421-56066	Professor of Medicine Madurai Medical College	Member
6. Dr.M.Gobinath,MS(Gen.Surgery)	Professor of Surgery Madurai Medical College	Member
7. Dr.S. Dilshadh, MD(O&G) 9894053516	Professor of OP&Gyn Madurai Medical College	Member
8. Dr.S.Vadivel Murugan., M.D, 097-871-50040	Professor of Medicine Madurai Medical College	Member
9. Shri.M.Sridher,B.sc.B.L. 099-949-07400	Advocate, 2, Deputy collectors colony 4 <sup>th</sup> street KK Nagar, Madurai-20.	Member
10. Shri.O.B.D.Bharat,B.sc., 094-437-14162	Businessman Plot No.588, K.K.Nagar, Madurai.20.	Member
11. Shri. S.sivakumar, M.A(Social) Mphil 093-444-84990	Sociologist, Plot No.51 F.F, K.K Nagar, Madurai.	Member

Following Projects were approved by the committee

Sl. No	Name of P.G.	Course	Name of the Project	Remarks
1.	Sheik Iliayas, Scientist C	NIRT/ICMR	Tuberculosis preventive therapy in people with HIV infection	Approved
2.	Arunadevi. B	PG, M.Ch (Plastic)	Clinical study of reconstructive procedures in head and neck cancer	Approved
3.	Srinivas ER,	PG, M.Ch (Plastic)	Clinical study of reconstructive procedures in defects of lower third of leg	Approved
4.	Azeem Ahamed	PG, M.D (genl Med)	Serum magnesium in the systemic inflammatory response syndrome.	Approved
5.	Suja. A	PG, M.D (genl Med)	Clinical study of hypertensive crisis	Approved
6.	Sateeshkumar.	PG, M.D (genl Med)	Pulse oximetry to assess lower limb ischemia in asymptomatic diabetics	Approved
7.	Saddik Basha. K	PG, M.D (genl Med)	Clinical and biochemical study of diabetic ketoacidosis	Approved
8.	Indumathy. C	PG, M.D (genl Med)	24-hour urinary Na and K excretion and blood pressure	Approved
9.	Upama. G	PG, M.D (genl Med)	Ultrasound evaluation of volume of gall bladder in diabetics	Approved
10.	Vasanthamalar. C	PG, M.D (Paed)	Salbutamol in bronchial asthma by nebulization vs. MDI + spacer device	Approved
11.	Sabarinath .M	PG, M.D (paed)	Clinical study of congenital anomalies in newborn	Approved
12.	Moogambigai	PG, M.D (ob gyn)	Maternal pre-pregnant weight and fetal-maternal outcome	Approved
13.	Aishwarya Jayam	PG, M.D (ob gyn)	Clinical study of ovarian tumours	Approved
14.	Aishwarya Jayam	PG, M.D (ob gyn)	Clinical study of cerebral venous thrombosis in puerperium	Approved
15.	Gayathri. S	PG, M.D (ob gyn)	Jaundice complicating pregnancy and fetal-maternal outcome	Approved
16.	Prasanna .N	PG, M.D (ob gyn)	Ultrasound assessment of cervical length in predicting preterm labour	Approved
17.	Gayathridevi .S	PG. M.D (ob gyn)	Clinical study of medical terminations of pregnancy	Approved
18.	Uma. M	PG, M.S (gen surg)	Educational and socioeco status as predictors for early diagnosis of breast cancer	Approved

19.	Vankata subramanian. A	PG, M.S (gen surg)	Study of laparoscopic cholecystectomy converted to an 'open' procedure	Approved
20.	Mohan,	PG, M.S (gen surg)	Clinical study of breast masses, including mammography, FNAC and ultrasound	Approved
21.	Hema. D	PG, M.S ( Ophthal)	Clinical study of central retinal vein occlusion in non-diabetics	Approved
22.	Nithya. R	PG, M.S ( Ophthal)	Clinical study of the Management of orbital fractures	Approved
23.	Vijayalakshmi. A	PG, M.S ( Ophthal)	Clinical study of cystoid macular edema following cataract surgeries.	Approved
24.	Govindaraj. B	PG, M.S ( Ophthal)	Primary intraocular lens implantation in traumatic cataracts	Approved
25.	Venkatesan .C	PG, M.S ( Ophthal)	Predictors for posterior capsular opacification following cataract surgery	Approved
26.	Juliana R Stephen	PG, M.S ( Ophthal)	Clinical study of penetrating eye injuries	Approved
27.	Pallavi Kamath,	PG, M.S ( Ophthal)	Gonioscopy vs. ultrasonic bio-microscopy for measuring angle of anterior chambers	Approved
28.	Andal. P	(Ph.D)	Sacred Hearts Nursing College: Effectiveness of cardiac rehabilitation program.	Approved

Please note that the investigator should adhere the following: She/He should get a detailed informed consent from the patients/participants and maintain Confidentially.

1. She/He should carry out the work without detrimental to regular activities as well as without extra expenditure to the institution to Government.
2. She/He should inform the institution Ethical Committee in case of any change of study procedure site and investigation or guide.
3. She/He should not deviate for the area of the work for which applied for Ethical clearance.

She/He should inform the IEC immediately, in case of any adverse events pr Serious adverse reactions.

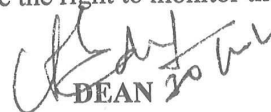
4. She/he should abide to the rules and regulations of the institution.

5. She/He should complete the work within the specific period and apply for if any Extension of time is required She should apply for permission again and do the work.

6. She/He should submit the summary of the work to the Ethical Committee on Completion of the work.

7. She/He should not claim any funds from the institution while doing the word or on completion.

8. She/He should understand that the members of IEC have the right to monitor the work with prior intimation.

  
DEAN

To  
All the above members and Head of the Departments concerned.  
All the Applicants.

## MASTER CHART

SL NAME	LP No.	AGE	SEX	DUR	SIDE	SIZE	EXP	#	BONE	JT	SEN	SMOKE	CI	INF	DB	FIXTN	FLAP	BR	COMP	QOF
1 VALLI	79329	40	2	23	1	45	1	1	0	0	1	0	0	0	1	1	4	0	7	3
2 SURESH	78072	26	1	27	1	30	3	1	0	0	0	1	0	1	1	1	1	0	0	5
3 RAJENDRAN	78921	60	1	32	1	15	1	1	0	0	0	0	0	0	0	1	6	0	0	4
4 RAVI	79001	45	1	12	1	42	1	1	1	0	0	1	0	0	1	2	4	1	6	4
5 SEKAR	79132	60	1	16	1	92	1	1	0	0	0	1	1δ	1	2	1	4	1	5+6	3
6 KARTHIK	79390	28	1	25	1	32	3	0	0	0	0	1	0	1	1	1	3	0	6	4
7 RAKKAM	79636	55	1	32	2	32	2	2	1	0	0	1	0	1	1	1	4	1	2	1
8 NAGA	46411	45	1	40	1	32	1	1	0	0	1	0	0	0	1	1	4	1	0	4
9 RAJA	79852	45	1	30	2	25	1	1	0	0	1	1	1	1	2	1	1	0	7	4
10 SEVAGAM	79975	50	1	37	1	35	1	1	0	0	0	0	0	0	1	2	2	0	6	3
11 KAMARAJ	17779	19	1	18	1	22	2	0	0	0	1	1	0	0	2	1	1	0	0	5
12 ARUMUGAM	20994	58	1	25	1	20	1	1	0	0	1	1	2	0	1	1	1	0	0	5
13 PERIYAKALYAN	28179	65	1	25	1	30	1	1	1	0	0	0	1δ	1	1	1	1	1	0	4
14 PONRAJ	35922	13	1	20	2	36	1	1	0	0	0	1	0	1	2	1	3	0	5+6	3
15 MAHALINGAM	38307	17	1	33	1	31	1	1	0	0	0	1	0	1	2	1	4	0	3+6	2
16 PANDIAMMAL	36253	50	2	24	2	22	3	0	0	0	0	0	1	1	2	2	1	0	5	3
17 PERIYASAMY	56741	62	1	22	1	25	1	1	0	0	0	0	0	0	1	1	1	0	0	5
18 KALIRAJ	40157	20	1	14	1	20	1	1	0	1	0	0	0	0	1	1	7	0	0	4
19 NAGARATHINAM	71864	52	1	17	2	22	2	1	0	0	0	0	0	0	1	1	1	0	1+6	1
20 MUNIYANDI	75161	42	1	12	2	105	2	1	0	0	0	0	0	1	1	1	8	0	3+7	3
21 RAJKUMAR	33068	55	1	61	1	30	1	0	0	1	0	1	1δ	1	2	1	1	0	0	4
22 VARALAXMI	29206	45	2	42	2	95	1	1	0	0	0	0	2	0	1	1	4	0	6	4
23 SAKKAILAN	36613	29	1	35	2	33	1	1	0	0	0	0	0	1	2	1	4	0	1+7	1
24 SIVARAJ	42730	35	1	37	2	22	1	1	0	0	0	0	0	0	1	1	3	0	7	3
25 MANI	43675	28	1	24	1	32	1	0	0	0	1	1	0	0	1	1	1	0	5+6	2
26 MANAMMAL	67915	40	2	21	2	25	1	1	1	0	1	0	0	0	1	1	1	1	0	4
27 PERIAKARU	63803	45	1	33	2	23	1	1	0	0	0	1	0	0	1	2	1	0	0	5
28 MURUGAN	74281	30	1	38	2	22	1	1	0	0	0	1	0	0	1	1	1	0	0	4
29 THANGAVEL	72160	60	1	12	2	36	2	1	0	0	0	1	0	1	2	1	5	1	4	1
30 PANDY	45822	35	1	29	1	44	1	1	0	1	0	0	0	0	1	1	4	0	6+7	5
31 JEYAKUMAR	47834	54	1	32	1	33	1	0	0	0	0	1	0	0	0	1	4	0	0	5
32 MEERA	45844	65	2	40	1	26	1	1	0	0	1	0	1	1	2	1	1	0	6	2
33 MUTHU	60947	18	1	12	1	22	3	1	0	0	0	1	0	0	1	1	1	1	0	4
34 SHANTHI	74736	40	2	26	2	32	1	1	0	0	0	0	0	0	1	1	2	0	0	4
35 DHANABAL	72139	37	1	47	1	36	2	1	0	0	0	1	0	0	1	1	4	0	6+7	4
36 KARUPU	68930	23	1	32	1	36	3	0	0	0	0	0	0	0	1	1	1	0	0	5
37 MANICHAM	84191	30	1	14	1	25	1	1	0	0	0	0	0	0	1	1	1	0	0	3
38 DHANALAXMI	91232	50	1	25	2	34	1	1	0	0	1	1	1	1	2	1	3	0	0	4
39 VEERASAMY	87869	17	1	37	1	33	1	1	1	0	1	0	0	0	1	1	4	1	1+7	2
40 RAJA MOHAMED	3144	25	1	10	2	110	1	1	0	0	0	0	0	0	1	1	9	0	0	4
41 PALANIAMMAL	83221	40	2	26	2	36	1	1	0	0	0	0	0	0	1	1	4	0	0	4
42 KADHIR	12063	55	1	36	2	20	1	0	0	0	0	1	0	0	1	1	4	0	0	3
43 MANI	22989	36	1	27	1	35	1	1	0	0	0	0	0	1	1	1	2	0	6+7	4

44 MANICKAM	24048	31	1	34	2	20	2	1	0	0	0	1	0	0	1	2	1	0	6+7	3
45 RAMANAN	26431	50	1	53	1	22	2	2	0	0	0	1	18	1	1	1	1	0	7	4
46 KARUPUSAMY	36812	35	1	44	2	32	1	1	0	0	0	1	0	0	1	1	1	0	2	1
47 SIVARAJ	42730	45	1	12	2	22	1	0	0	0	0	1	0	0	1	1	1	0	0	5
48 PANDI	42956	37	1	14	1	31	1	1	0	0	0	1	0	1	1	1	4	0	0	4
49 RANGASAMY	58642	45	1	15	2	92	1	1	1	0	0	1	1	0	1	1	4	1	0	5
50 ASIRVATHAM	6258	45	1	16	1	34	3	1	0	0	0	0	0	0	1	1	4	0	0	4
51 PRABU	66712	23	1	22	2	20	1	1	0	0	0	1	0	0	1	1	1	0	0	4
52 MARIMUTHU	73385	22	1	29	1	21	1	2	0	0	0	1	0	1	3	1	1	0	1	2
53 KATHIRAVAN	82711	36	1	13	1	36	1	1	0	0	0	1	0	0	1	1	4	0	5	2
54 SUBRAMANI	90257	50	1	43	2	25	2	2	0	0	0	0	18	1	1	1	1	0	3+7	3
55 KARTHICK	90536	25	1	33	1	22	2	0	0	0	0	0	0	0	1	1	3	0	0	4
56 SUDHAVAH	50010	65	1	37	2	23	1	1	0	0	1	1	1	1	1	2	1	0	0	2
57 PITCHAI	52510	26	1	24	1	26	1	1	0	1	1	1	0	0	1	1	1	1	0	4
58 KAMALI	44564	66	2	26	2	24	1	1	0	0	0	0	0	1	3	1	1	0	0	4
59 JEYAPAL	57432	22	1	29	1	100	1	2	0	0	0	0	0	0	1	1	4	0	6+7	2
60 PARAMASIVAM	29097	50	1	12	2	21	1	1	0	0	0	0	0	0	1	1	1	0	0	5
61 KUNCHARAN	53616	58	1	19	1	38	1	0	0	0	0	1	2	0	1	1	4	0	6+7	3
62 RAJAN	73198	57	1	42	1	29	1	1	1	0	0	1	1	0	1	1	1	0	7	4
63 VEEMAN	63743	52	1	12	1	22	1	2	0	0	0	1	1	1	2	1	1	0	6	2
64 PANDI	6792	34	1	34	2	20	2	2	0	0	0	1	0	1	2	1	1	0	0	4
65 KARUP	4146	67	1	37	2	15	1	2	0	0	1	1	18	1	2	1	4	1	0	4
66 ESWARAN	13793	18	1	26	1	28	2	1	0	0	0	1	0	0	1	1	3	0	0	4
67 MUTHU	70983	32	1	19	1	24	1	1	0	0	0	1	18	1	2	1	1	0	0	4
68 JEYAMARY	72812	14	1	20	1	40	1	2	0	0	0	0	0	0	1	1	4	0	6	4
69 DINESH	88739	18	1	33	2	37	1	2	0	0	0	0	0	0	1	1	5	0	0	5
70 EDWARD	34763	30	1	12	1	35	2	2	0	0	0	0	0	0	1	2	4	0	7	4
71 PARIL	45867	40	1	33	1	22	1	1	0	0	1	1	0	1	2	1	1	0	6	5
72 CHARLES	83655	35	1	7	1	95	2	0	0	0	0	0	0	0	1	1	8	0	6+7	4
73 MUNIYAMA	89409	56	2	33	1	33	1	1	0	1	1	0	18	1	2	1	4	1	6+7	4

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Reconstructive strategies for lower one third leg soft tissue defect

BY SRINIVAS RAJADORAIE 18102102 M.CH. PLASTIC RECONSTRUCTIVE SURGERY



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**A DISSERTATION ON**

**STUDY OF**

**RECONSTRUCTIVE STRATEGIES FOR LOWER ONE THIRD LEG SOFT TISSUE DEFECT**

In partial fulfillment of the regulations for the award of the degree of

**MASTER OF CHIRURGIE**

**(MCh.) Degree**

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Paper ID	310899382
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E-mail	drshrii@rediffmail.com
Submission time	27-Mar-2013 04:19PM
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A DISSERTATION ON STUDY OF RECONSTRUCTIVE STRATEGIES FOR LOWER ONE THIRD LEG SOFT TISSUE DEFECT In partial fulfillment of the regulations for the award of the degree of MASTER OF CHIRURGIE (MCh.) Degree BRANCH – III – PLASTIC SURGERY THE TAMILNADU DR. M.G.R. MEDICAL UNIVERSITY CHENNAI, TAMIL NADU. AUGUST 2013 1 INTRODUCTION Increasingly, urban trauma is becoming a major health care issue. Large emergency departments are inundated with patients with multiple injuries, requiring state-of-the-art care. Most of these complex injuries involve trauma to the extremities, often due to motor vehicle accidents. In a study by MacKenzie et al. It was shown that lower extremity injuries accounted for...