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Original Research Article

Comparison of Gastrocnemius Myocutaneous Flaps with Gastrocnemius Muscle Flaps for Upper Third Leg and Knee Defects

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Abstract:

Introduction: Gastronemius muscle and myocutaneous flaps are most commonly used flaps for reconstruction of traumatic upper third leg defects. The myocutaneous flaps have advantage of reaching a higher defect compared to the mucle flaps. Myocutaneous flaps have the advantage of lesser adhesions and easier closer in the reexporation of defects for any definitive fixation of fractures.

Objectives: The objective of the study is to evaluate the advantages of Gastronemius myocutaneous flaps over gastronemius muscle flaps in covering upper third traumatic leg defects.

Methods: This was a comparative study of 30 cases of combined gastronemius muscle and myocutaneous flaps done for the traumatic upper third leg defects between January 2020 and December 2022. The advantages and disadvantages of gastronemius myocutaneous flaps over muscle flaps like in covering the larger defects and in reexploration of the traumatic defects for any definitive fracture stabilisation were analysed and outcomes evaluated.

Results: 20 cases of upper third leg defects were covered with gastrocnemius muscle flaps and 10 cases with gastronemius myocutaneous flaps for upper third and knee defects. Both the flaps were effective in covering the defects with no any complications or flap failure. The gastronemius myocutaneous flaps had the advantage of reaching the defects over knee and middle third leg and covering large wound defects. The re exploration of the fracture site for any definitive fixation was better with gastrocnemius myocutaneous flap because of less adhesions and easier wound closure.

Conclusion: The gastronemius muscle and myocutaneous flaps are very reliable flaps for covering traumatic upper third leg defects. The very ease of harvesting these flaps with reliable blood supply makes it a simple alternative flap cover option for upper third leg defects as compared to free tissue transfers. The gastronemius myocutaneous flaps have the advantage of covering larger wound defects and good skin resurfacingthat makes eventual revision easier.

Keywords: Traumatic upper third leg defect reconstruction, Gastronemius myocutaneous and muscle flaps, Advantages, Disadvantages.

Introduction

The gastronemius flaps are one of the most commonly used flaps for covering the soft tissue defects over upper third leg and over the knee areas [1]. Conventionally they can be harvested as proximally based medial or lateral gastrocnemius muscle or musculocutaneous flaps. The other available flap options include the cross leg flap and the microvascular free flaps.

The cross leg flap being age old method with cumbersome positioning and discomfort to the patients. The free flaps have the risk of failure especially in severe trauma limbs.

The gastrocnemius flap was originally described as a muscle flap .High success rate , easy harvesting with minimal donar site morbidity, capacity to fill dead space and efficacy against infections are

major advantages of this flap [2-4] But it presents some limitations: the size of flap may be too small to cover large defects; a tight suture is sometimes difficult to achieve at the superior and inferior edges in case of anterior defect because of its narrowness and 90-degree rotation that is necessary to cover anterior knee joint; split skin graft is required on the transposed muscle and prolonged immobilisation needed to facilitate healing. Incision and closure over the grafted site is a major disadvantage when the defect requires a reexploration and a definitive fixation procedure required for any fracture. In 1978 McCraw et al [5-6] demonstrated that the transposition of the overlying skin with medial and lateral head of gastronemius muscle was possible because of blood supply from muscle perforator vessels. The medial and lateral heads of the gastronemius are respectively vascularised by medial and lateral sural arteries and direct branches of popliteal artery. The sural artery enters the muscle just beneath the joint space and perforator vessels from the muscle supply directly to the overlying skin plus 5cm beyond the distal end of the muscle 5. Most of the perforators of the medial gastronemius myocutaneous flap are located 7 to 18 cms from the popliteal crease. It is accepted that the medial gastronemius myocutaneous flap by virtue of its larger belly has ability to support large skin paddle. The number of musculocutaneous perforators traversing the medial belly is also more compared to lateral muscle belly [7, 8]. Thus the myocutaneous flaps technique improves the performance of gastrocnemius flap around the knee defects, combining muscle flap and fasciocutaneous flap advantages.

Methods and Materials

30 patients with post traumatic upper third and middle third leg defects were treated with gastronemius muscle and myocutaneous flaps between January 2020 and December 2022 in our trauma institute. All patients were cases of road traffic accidents with associated fractures of both bones of upper third leg with or without distal femur fracture. Of the 30 cases 22 patients had proximal tibia fracture for which external fixator was applied in 12 cases and fracture fixation with plates and screws was done in 10 patients. Of the 10 patients with plates and srews in 5 patients the infected plates and srews were removed and converted to external fixation and the other 5 underwent flap cover over the exposed implant plates [9]. 8 patients with associated distal femur fractures were stabilised with knee spaning external fixator. All cases with open fractures were initially treated with wound debridement where all nonviable and poorly vascularised tissues were removed and fracture stabilised with external fixator. Closed fractures were treated with open reduction and internal fixation of fractures with plates and screws. Wound debridement and flap cover was done when overlying skin got broken down with exposure of underlying implant.

Vacuum Assisted wound closure was done when wounds were infected before proceeding for flap cover surgery.

20 of the patients with an average wound defects of 6x6 cm size were covered with gastronemius muscle flaps and other 10 patients with defects ranging from 10x8cm to 15x10 cm were covered with gastrocnemius myocutaneous flaps. All the flap cover surgeries were done after the initial primary wound debridement and fracture stabilisation surgery. The age of the patients ranged from 16 years to 68 years .The flap cover surgeries was done under regional anaesthesia with patient lying in supine position and tourniquet applied over the operating limb.

19 of the 20 patients, who underwent gastronemius muscle flap, had medial gastronemius muscle cover and 1 patient had lateral gastrocnemius muscle flap cover. Posteriomedial incision was made on the upper third leg and the gastrocnemius muscle was dissected from the underlying soleus muscle. The medial part of gastronemius was split from the lateral part and cut distally over the gastro soleus tendon. The medial gastronemius muscle was tunnelled underneath the skin bridge if any to reach the wound defect. Scoring the underneath of muscle was done to expand the muscle width and then the muscle flap was sutured to the skin edges. The raw area over the muscle was covered with split thickness skin graft. The lateral gastrocnemius muscle was harvested similarly with a posterolateral incision and dissecting the lateral part of gastronemius muscle.

10 patients had undergone gastronemius myocutaneous flaps for defects ranging from 10x8cm to 15x10cm. 9 patients had undergone medial gastronemius myocutaneous flaps and 1 patient had undergone lateral gastronemius myocutaneous flap. According to the defect, skin paddle was planned and marked over medial or lateral head of gastrocnemius muscle. Midline and popliteal creases were marked. Skin incision was given over the previously marked site and extended distally to the tendoachilles region .The gastronemius muscle was identified and separated from soleus muscle and the attachment with Achilles tendon was divided. Musculocutaneous flap was elevated till the knee joint with preservation of vascular pedicle. To increase the reach of the flap, muscle was divided from the origin. Suction drainage and postoperative splinting if required was done. Patient was discharged from hospital after wounds and skin graft healed and was followed up as outpatients for 3-6 months during

which advantages and disadvantages of muscle and myocutaneous flaps analysed.

Results

The study included 30 cases of post-traumatic upper third and knee defects which required flap cover. 25 of this patients were male and 5 were female. Most patients were of the age group between 16 to 50 years. 22 of these patients had fracture of proximal tibia and 8 patients had distal femur fracture along with the proximal tibia fracture. All patients were admitted in our trauma institute where initial wound debridement was done when patient had a open fracture with a wound defect. Fracture stabilisation was also done. 20 0f this patients underwent gastronemius muscle flap to cover the wound defects and the other 10 patients underwent gastronemius myocutaneous flaps. 28 patients had undergone medial gastronemius muscle and myocutaneous flaps and 2 patients had lateral gastrocnemius muscle and myocutaneous flaps. Table 1 demonstrates the age, sex distribution of flaps. Most of the defects were of the size 6x6 cm in size where a gastrocnemius muscle flap was used to cover the defect. The maximum size of the flap with gastronemius myocutaneous flap was 15x10cm and the defects were of the size from 10x8 cm to 15x10cm. Table 2 shows the size of the defect and flap used to cover the defects.

12 patients had to undergo reexploration of fracture sites for definitive fracture fixation. 7 patients with gastrocnemius muscle flaps and 5 patients with gastrocnemius myocutaneous flaps had undergone re exploration of the fracture sites. It was found that it was easier to make incisions over the myocutaneous flap edges and elevate the flap for fracture site re exploration. It was difficult to make incisions over skin graft over the muscle and resuture the muscle flaps.

Table 3 lists the various complications of gastrocnemius mucle and myocutaneous flaps. There was no case of complete flap loss in any of the cases. 2 patients of gastrocnemius mucle flaps and 1 patient of myocutaneous flap had partial flap loss which required debridement and skin grafting. No functional deficit of donor site was noted in any cases. Partial graft loss occurred over the muscle flaps in 3 patients which healed by regular dressings. There was partial graft loss over the donor site in 2 patients of myocutaneous flaps which healed with regular dressings. Partial wound dehiscence occurred in 2 patients of muscle flap and 1 patient of myocutaneous flap which healed with regular dressings. Patients were followed up for 3 to 6 months during which all the wounds healed completely with no any complications.

Table 1: Age and sex distribution of cases

Age(in Years)	Male(N=25)	Female(N=5)	Total
0-15	2	0	2
16-25	9	1	10
26-50	11	3	14
>50	7	1	8

Table 2: Size of the flaps

Defect Size (in Cms)	Medial Gastrocnemius Muscle flap	Medial Gastrocnemius Myocutaneous Flap	Lateral Gastrocnemius Muscle Flap	Lateral Gastrocnemius Myocutaneous Flap	Total(N=30)
0-5	5	1	1	0	7
5-10	10	1	0	1	12
10-15	4	4	0	0	8
>15	0	3	0	0	3

Table 3: Complications of different flaps

Complications	Gastronemius Muscle Flaps	Gastronemius Myocutaneous Flaps
Partial Flap Necrosis	2	1
Wound Dehiscence	2	1
Partial Graft Loss Over Flap	3	0
Complete Flap Loss	0	0
Partial Graft Loss Over Seconadary Defect	2	2
Functional Deficit	0	0

Case 1 : Upper and middle third leg large defect

Figure 1: Defect after debridement

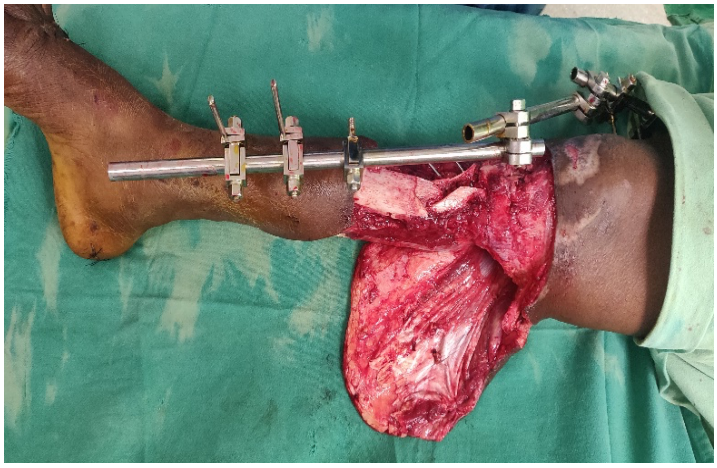

Figure 2: Medial gastronemius musculocutaneous flap harvested

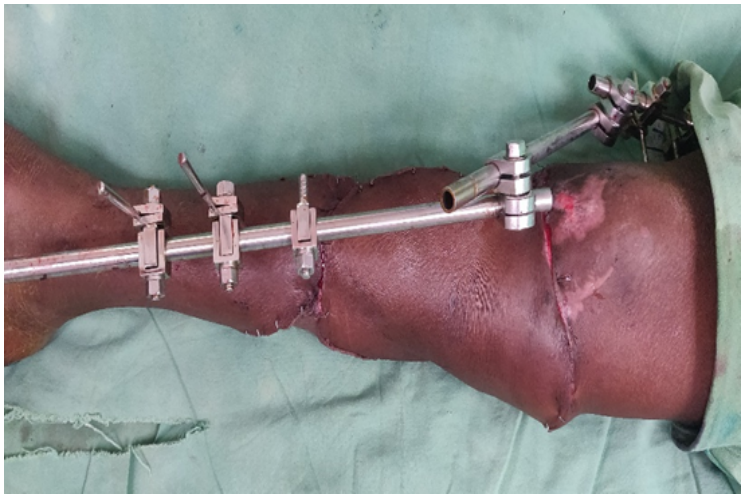

Figure 3: Defect after flap insert

Case 2: Lateral Knee defect

Figure 4: Large lateral knee defect

Figure 5: Lateral gastonemius musculocutaneous flap planned

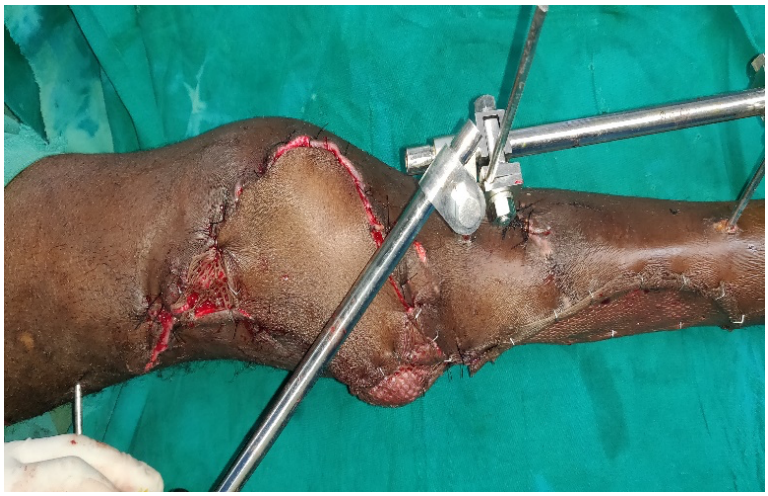

Figure 6: Lateral gastronemius musculocutaneous flap inserted

Case 3: Large medial knee defect with exposed implant

Figure 7: Medial knee defect

Figure 8: Medial musculocutaneous flap

Case 4 : Anterior knee defect

Figure 9:

Figure 10:

Case 5: Knee and lower thigh defect

Figure 11:

Figure 12:

Case 6: Lateral knee defect

Figure 13:

Figure 14: Medial gastronemius muscle flap

Discussion

The defects over area between upper and middle third or transition zone between two has limited options for coverage like cross leg flap, gastronemius flap and free flap. Cross leg flap is not preferred due its long term morbidity and discomfort to patients due to their cumbersome position.

Free flap is the most commonly used flap for coverage of any defect. But free flap leads to donor site morbidity and needs expertise, with chances of flap failure in traumatised limb. Intensive postoperative monitoring, requirement of healthy recipient vessel and chances of re exploration are the concerned areas with free flaps .Gastronemius muscle and myocutaneus flaps are preferred flaps for upper third and knee defects with minimal donor site morbidity. Gastronemius muscle flaps are preferred flaps when the defects are of small size and limited to upper third of the leg. The muscle flaps can be tunnelled through skin bridge and flap site incisions closed primarily with no any secondary defect. The disadvantage of muscle flaps is that it cannot reach more proximally over the knee joint or distally over the middle third leg. Incision over the muscle and overlying skin graft for any re exploration of fracture site had the disadvantage of adhesions and resuturing the flap edges. McGraw et al described the use of gastrocnemius myocutaneous flap for coverage of upper tibia, knee joint and popliteal fossa. Sanders et al used this flap in a series of 8 cases for coverage of exposed implants. The advantage of Gastronemius myocutaneous flap is that it can be used to cover large defects extending over the upper third, middle third leg and over knee. The advantage of the myocutaneous flaps is in re exploration of the fracture sites for definitive fixation as the flap edges can be easily resutured. Islanding the skin paddle reduces the donor site morbidity.

Conclusion

The gastronemius muscle and myocutaneous flaps are very reliable flaps for covering traumatic upper third leg defects. The very ease of harvesting these flaps with reliable blood supply makes it a simple

alternative flap cover option for upper third leg defects as compared to free tissue transfers. The gastronemius myocutaneous flaps have the advantage of covering larger wound defects and good skin resurfacing that makes eventual revision easier for any definitive fracture fixation. The gastronemius myocutaneous flaps are preferred over the muscle flaps when covering large wound defects over upper third of leg and knee and when re exploration of wound defects is needed later .

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