

## Management of Defects Around the Knee Joint by Gastrocnemius Muscle Flap

YASSER EL HAWARY, M.D.

*The Department of Plastic and Reconstructive Surgery, Faculty of Medicine, Tanta University*

### ABSTRACT

*Background and Objectives:* Management of defect around the knee joint as a result of any injury is challenging condition. The difficulties come from poor vascularity of the area with high incidence of infection rate especially in delayed management waiting for the granulation tissue. However, the versatility of the gastrocnemius muscle flap for reconstruction of defects in the knee region from upper one-third of the calf to lower third of the thigh is well known. The objective of the study is to evaluate the results of the gastrocnemius muscle flap used as cover for defect around the knee joint and its complications.

*Methods:* Among 15 cases in between 2010-2012 with different type of injuries to the lower limb, the gastrocnemius muscle flap used to cover exposed upper third tibia and the knee joint.

*Results:* All flaps survived, however minor complications such as infection, partial loss of the graft, or hematoma, were encountered in 5 cases (30%).

*Conclusion:* The study reports the safe and successful management of defects around the knee joint by using of the gastrocnemius muscle flap.

### INTRODUCTION

Management of compound fracture of tibia Gustilo type III, with involvement of knee joint, present difficult problem to orthopedic and plastic surgeon. Reconstructive procedure is frequently required to cover the exposed bones or joints, to obliterate the dead space and help eradicate infection and vascularize the wound for subsequent bone grafting even in complex wound such as chronic osteomyelitis [1].

Muscle flaps have gained wide popularity in this context since their first use by Ger [2]. Muscle flaps are also suitable for coverage of open joints and exposed orthopedic implants [3]. Early cover has been found to considerably reduce the incidence of complications [4].

The gastrocnemius muscle flap is the workhorse of all muscle flaps for soft tissue coverage around the knee [5].

This type I muscle flaps with their unique and independent vascular anatomy, one pedicle (sural artery) at the level of the knee joint situated close to its origin provide blood supply to the heads of the gastrocnemius muscle. These vessels arise from the popliteal artery above the level of the knee joint. Each course a few centimeters with its venae comitantes before entering the anterior aspect of the proximal muscle belly with the innervating branches of the tibial nerve [6].

The purpose of this study was to evaluate the results of the gastrocnemius muscle flap used to cover defects around the knee joint.

### MATERIAL AND METHODS

Between December 2010 and December 2012, gastrocnemius muscle flap transposition was done in 15 patients to cover a defect in the upper tibia and the knee joint. Medial gastrocnemius was used in 12 cases and lateral gastrocnemius in 3 cases. In no case both heads of gastrocnemius were required.

All patients were operated under tourniquet. Thorough debridement was done to ensure complete removal of necrotic tissues and osteomyelitic bone.

Defect was assessed for the adequacy of muscle coverage. For medial gastrocnemius, incision was given 2-3cm behind the medial border of tibia avoiding the great saphenous vein extending from the popliteal fossa to below mid-calf level.

Incision was deepened to deep fascia and medial head of gastrocnemius was identified and separated from underlying soleus muscle.

Distal end of the muscle was sharply divided from the achilles tendon taking care to include some portion of tendinous material with the muscle belly as this improved suture holding.

It was then divided and separated from lateral gastrocnemius at the midline raphe. Care should be taken to avoid injury to sural nerve and short saphenous vein.

Muscle was then transposed anteriorly to cover the defect. The skin graft take is also facilitated. Primary skin grafting of muscle was done in all cases.

Table (1): Patients' classification.

Patient number	Sex	Age	Cause	Head used	Side
1	Male	23	Trauma	Medial	Right
2	Female	28	Trauma	Lateral	Right
3	Male	33	Osteomyelitis	Medial	Right
4	Female	39	Trauma	Medial	Right
5	Male	41	Bullet	Medial	Left
6	Female	27	Trauma	Medial	Right
7	Male	22	Bullet	Medial	Right
8	Female	39	Trauma	Medial	Left
9	Male	37	Trauma	Medial	Right
10	Female	44	Trauma	Lateral	Right
11	Male	51	Osteomyelitis	Medial	Right
12	Female	53	Bullet	Medial	Right
13	Male	48	Trauma	Medial	Left
14	Female	31	Trauma	Lateral	Right
15	Male	38	Trauma	Medial	Right

## RESULTS

In all 15 patients, adequate coverage was provided by gastrocnemius muscle flap. Minor complications were noted in 5 patients but they all settled with conservative management. No case of muscle flap necrosis was found. The period of hospitalization was 5-7 days.

The follow-up period for earlier operated patients is one year. Two patients underwent further surgery by orthopedic surgeons after two months of flap surgery for knee joint reconstruction.

The approach was made through the muscle flap and even in these cases the portion of flap distal to incision was found to be normal.

All muscle flaps showed some decrease in the bulk after about three months of transfer. In ten patients, excellent result was found with no evidence of complication. Five patients had minor complications (infection 1, haematoma 2 and partial skin graft loss in 2) that settled with conservative management.

Donor site morbidity was no a problem with gastrocnemius muscle flap. All patients were satisfied with the long-term result of surgery.

Table (2): Results of the gastrocnemius muscle flap.

Complications	Number of patients	Percent
Hematoma	2 patients	13.2
Infection	1 patient	6.6
Partial loss of the skin graft	2 patients	13.2



Fig. (1): Post-traumatic skin defect with exposure of the knee joint.



Fig. (2): Rotation of the medial head of gastrocnemius muscle flap to cover the defect.



Fig. (3): Closure of the donor site of the muscle flap except at the site of the pedicle.



Fig. (4): Grafting the gastrocnemius muscle flap and the pedicle.



Fig. (5): Early postoperative of the gastrocnemius muscle flap.



Fig. (6): Late postoperative of the gastrocnemius muscle flap.

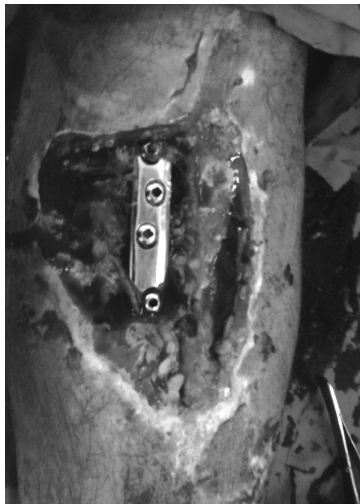


Fig. (7): Exposure of the plate after fracture of the upper 3<sup>rd</sup> of the tibia.



Fig. (8): Covering the exposed plate with the gastrocnemius flap.



Fig. (9): Early postoperative of the gastrocnemius flap.

## DISCUSSION

Reconstruction of the soft tissue defects around the knee joint should be aimed at obtaining adequate functional and aesthetic result with minimal donor site morbidity. Early aseptic closure of the knee joint is important for preservation of function. Soft tissue defects occur around the knee joint from wound break down following surgery, trauma and deep burns, and following release of burn scar contracture [7].

The reconstruction of soft tissue defects around the knee joint presents a difficult challenge to the reconstructive surgeon. The various reconstruction options depend on the location, size and depth of defect relative to the knee joint.

For extensive loss of the skin alone, debridement, followed by skin grafting, is the most common method of treatment. The vacuum-assisted closure technique has facilitated a good granulating bed for application of skin grafts in some cases.

The continuous sub-atmospheric suction greatly reduces the amount of tissue edema, diminishing the circumference of the extremity and thus decreasing the surface area of the wound [8].

Aggressive debridement with early excision of all nonviable tissue, followed by soft tissue coverage of the exposed bone and ligaments as soon as possible to prevent septic complications of the joint using local flaps, provide the best outcome.

The gastrocnemius muscle flap, usually the medial half, has been used for coverage of exposed or infected knee prostheses. The gastrocnemius muscle flap provides a well-vascularized tissue for retaining the exposed prosthesis [9].

The fact that the size of the muscle belly, its location in the dissection field, hardy in the scenario of infection and its transfer does not adversely impair function of the limb in non athletic patients make it an ideal flap to cover wound in the region [7].

Fewer complications would result with careful preoperative evaluation and surgical planning so adequate debridement of bone and soft tissue and the transfer of healthy, non-traumatized gastrocnemius muscle provide the best form of coverage for the defects around the knee joint.

The availability of local flap coverage is limited in some patients due to surrounding tissue necrosis and, therefore, the use of free tissue transfer plays an important role in limb salvage [10].

#### *Conclusion:*

In conclusion, muscle flap with axial pattern of blood supply have had significant impact on reconstructive surgery and have revolutionized the management of large composite tissue defects. Also, gastrocnemius muscle flap provides enough volume and length to repair large defects around the knee joint, and this flap is useful to reconstruct such lesions.

## REFERENCES

- 1- Ger R.: The technique of muscle transposition in the operative treatment of traumatic and ulcerative lesion of leg. *J. Trauma*, 11 (6): 502-10, 1971.
- 2- Vasconez L.O., Bostwick J. 3<sup>rd</sup> and McCraw J.B.: Coverage of exposed bone by muscle transposition and skin grafting. *Plastic Reconstr. Surg.*, 53 (5): 526-0, 1974.
- 3- Meller I., Archie A. and Sagi A.: The role of gastrocnemius muscle flap in limb sparing surgery for bone sarcoma of the distal femur: A proposed classification of muscle transfers. *Plast. Reconstr. Surg.*, 99 (3): 751-56, 1997.
- 4- Bryd H.S., Spicer T.E. and Cienney G.: Management of open tibial fracture. *Plast. Reconstr. Surg.*, 76: 719-30, 1985.
- 5- Moscona R.A., Fodor L. and Har-Shai Y.: The segmental gastrocnemius muscle flap: Anatomical study and clinical applications. *Plast. Reconstr. Surg.*, 118 (5): 1178-82, 2006.
- 6- Williams P.L., Bannister L.M. and Berry M.M.: *Gray's anatomy*. 38<sup>th</sup> ed. NewYork: Churchill Livingstone, 1995.
- 7- Mathes S.J. and Levine J.: Muscle flaps and their blood supply. In: Thorne C.H., Beasley R.W., Aston S.J., Bartlett S.P., Gurtner G.C., Spear S.L., editors. *Grabb and Smith's plastic surgery*. 6<sup>th</sup> ed. Philadelphia, PA: Lippincott Williams & Wilkins, 2007.
- 8- DeFranzo A.J., Argenta L.C., Marks M.W., et al.: The use of vacuum-assisted closure therapy for treatment of lower-extremity wounds with exposed bone. *Plast. Reconstr. Surg.*, 108: 1184-91, 2001.
- 9- Pu L.L. and Thomson J.G.: Salvage of the exposed irradiated knee joint with free tissue transfer. *Ann. Plast. Surg.*, 44: 334-9, 2000.
- 10- Yuen J.C. and Zhou A.T.: Free flap coverage for knee slavage. *Ann. Plast. Surg.*, 37: 158-66, 1996.