The role of gastrocnemius muscle flap for reconstruction of large soft tissue defects after infected total knee arthroplasty

Ingo Schmidt

ABSTRACT

The surgical management of infected total knee arthroplasty remains a challenging therapeutic problem. The two-stage management has proven to be the reliable method of choice. The use of the gastrocnemius muscle flap has become a great “classic” for coverage of large soft tissue defects of the knee and proximal third of lower leg. A short review of literature including two short case presentations will highlight that procedure with or without required removal of implant and the specificities of the use of medial or lateral gastrocnemius muscle head are shown.
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Introduction: The surgical management of infected total knee arthroplasty remains a challenging therapeutic problem. The two-stage management has proven to be the reliable method of choice. The use of the gastrocnemius muscle flap has become a great “classic” for coverage of large soft tissue defects of the knee and proximal third of lower leg. A short review of literature including two short case presentations will highlight that procedure with or without required removal of implant and the specificities of the use of medial or lateral gastrocnemius muscle head are shown.

Keywords: Coverage, Gastrocnemius muscle flap, Infection, Soft tissue defect, Total knee arthroplasty

INTRODUCTION

The surgical management of infected total knee arthroplasty (TKA) remains a challenging therapeutic problem, and severe infections with large soft tissue defects in elderly high-risk patients can potentially lead to limb amputation. The infection rate in patients sustaining a primary TKA is normally below 2%, but it increases up to 40% in patients who underwent a revision TKA [1], and infections with multiresistant bacteria have been shown to increase the rate of relapses up to 19% [2]. Early non-infected wound complications after primary or revision TKA, that is significantly associated with a history of diabetes mellitus, and resulting in exposure of bone or implant may have a risk of subsequent infection up to 20% [3, 4].

If a soft tissue defect after TKA with or without infection is present, a surgical intervention should follow as soon as possible. The one-stage management can be done in patients with no reduced general state of health, absence of multiresistant bacteria, adequate bone stock, and non-chronic infection. For the other patients, the two-stage management (TSM) is to be considered as the method of choice and can avoid limb amputation in 85% of patients who underwent a revision TKA [5].

CASE SERIES

Case 1

A 76-year-old male presented with a chronic and deep high-grade TKA. Assessment by culture and
histology revealed bacterial load with multiresistant Staphylococcus aureus. First: the implant was removed, accompanied with multiple debridements and incorporation of a polymethyl methacrylate (PMMA) spacer containing vancomycin, and multiple negative-pressure vacuum assisted closure (VAC) therapies of the resulting large soft tissue defect (Figure 1A). Second: after consolidation of deep infect, assessed by culture and histology, the defect was covered with the use of a medial gastrocnemius muscle flap (Figure 1B), and additional split-thickness skin grafts. After that, the wound healing was uncomplicated (Figure 1C); and eight weeks after the first step of surgical intervention, a new TKA could be performed. Six months after insertion of the new TKA, the function was satisfactory (Figure 1D), and the patient could be mobilized with full weight-bearing on the affected leg (Figure 1E).

Case 2

A 85-year-old female presented with an acute and low-grade revision TKA infection right, assessment by culture and histology revealed bacterial load with Staphylococcus epidermidis. The TKA was done six weeks ago due to a pronounced primary osteoarthritis.

Primary surgical treatment consists of multiple debridements, incorporation of collagen drug carriers containing gentamycin, multiple negative-pressure VAC therapies, and the revision TKA was not removed (Figure 2A). Second: after consolidation of low-grade infect, assessed by culture and histology, the defect was covered with the use of a lateral gastrocnemius muscle flap (Figure 2B), and additional split-thickness skin grafts. After that, the wound healing was uncomplicated (Figure 2C), and the patient could be mobilized with full weight-bearing on the affected leg.

DISCUSSION

The first step of TSM includes radical debridement of soft tissue combined with negative-pressure VAC therapy, and systemic and/or local antibiosis using drug carriers such as collagen [2, 6], followed by coverage of soft tissue defect. The VAC therapy before coverage provides a sterile and controlled environment that can lessen the duration of wound healing, promotes better capillary circulation, and decreases the bacterial load [7]. The implant should be removed in patients with chronic or high-grade infection [5], accompanied with incorporation of a PMMA spacer containing antibiotics such as gentamycin or vancomycin. Implant preservation can be achieved when an acute low-grade infect is consolidated, assessed by culture and histology, and early closure of defect can be done [8].

The use of local flaps for coverage of soft tissue defects around the knee joint is an option for treatment in patients who are not willing or healthy enough to undergo free microvascular tissue transplantation, and do not
require microsurgical expertise. Muscle flaps promotes better capillary circulation and decreases the bacterial load, hence, muscle flaps are not contraindicated when superficial bacterial contamination or infection is present. However, muscle flaps generally are not free of complications. Neale et al. [9] reported on major and minor complications in 32% of a total of 95 muscle flaps and they agreed that the causes were mainly technical errors, inadequate debridement, use of diseased and traumatized muscle, and unrealistic objectives.

The gastrocnemius muscle flap has proven to be a suitable and reliable option for coverage of soft tissue defects after TKA or posttraumatic conditions, and it is probably one of the safest flaps [5, 10–13]. There is only one vasculonervous pedicle for each of both muscle heads composed of a sural artery and one or two veins, and is classified as type I according to the classification of Mathes and Nahai [14]. The blood supply allows to divide the muscles in two sections longitudinally according to the needs. The lateral muscle head must be rotated around the proximal fibula, therefore, it has a lower rotation angle than the medial head. Hence, the lateral muscle must be shifted under the peroneal nerve to prevent nerve compression. According to local specificities, the transposition each of both muscle heads can be done over an incision of the adjacent skin bridge, or with preserving of the adjacent skin bridge. There is an option to safely harvest a skin paddle overlaying the muscle [15]. Additionally, the use of gastrocnemius muscle flap allows the reconstruction of knee ligaments or extensor tendon [12, 16]. Fansa et al. [12] reported on a flap survival of 100% in 11 patients after primary TKA, and TSM for re-implantation of implants was superior to a single-stage procedure. Suda et al. [5] reported on a required revision rate of 15.8% in 38 patients after revision TKA. If gastrocnemius muscle flap is not possible, simple random pattern skin flaps can be an option for coverage. Haroon-Ur-Rashid et al. [17] published results of 21 patients treated with distally pedicled random skin flaps for coverage of the upper two-thirds of the lower leg, all flaps survived, and the maximum size of flap was 15x7 cm.

The second step of TSM includes re-implantation of an implant or knee arthrodesis. Essential prerequisite for re-implantation of an endoprosthesis is sufficient exclusion of persistent bone infection, assessed by culture and histology. Knee arthrodesis is indeed an alternative to achieving stable lower limb with reduced pain [5].

CONCLUSION

The use of gastrocnemius muscle flaps for coverage of large soft tissue defects following primary or revision total knee arthroplasty is an excellent surgical option. The removal of implant depends on the grade of local infection.

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Authors declare no conflict of interest.

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REFERENCES


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