

Medial gastrocnemius flap for the treatment of infected knee prostheses

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Abstract. – OBJECTIVE: Muscular flaps may represent a valid treatment option for prosthetic infection after knee arthroplasty.

PATIENTS AND METHODS: We present the results of 20 consecutive patients treated with the use of medial gastrocnemius flap for the management of different types of injuries or integumentary defects after total knee arthroplasty. Tissue necrosis or dehiscence occurred within 1 and 2 months after arthroplasty. The mean follow-up was 23.4 (12-60) months. Clinical outcome was evaluated according to the infection control rate and post-operative Knee Society Score (KSS).

RESULTS: Prosthesis salvage and complete restoration of skin coverage were achieved in all patients. Functional assessment was performed using the KSS score. The final knee KSS score was classified as excellent (score: 80-100) in 0 patients, good (score: 70-79) in 17 patients, fair (score: 60-69) in 2 patients, and poor (score: 60) in 1 patient. Residual Extension Deficit: 0-20°; Very Satisfactory in 17 patients. 30-70° Satisfactory in 2 patients, 80-90° Unsatisfactory in 1 patient. Patients who successfully underwent flap treatment experienced a much greater increase in both components of the KSS score.

CONCLUSIONS: The results highlight the effectiveness of medial gastrocnemius muscular flap for the treatment of prosthetic knee infection, in terms of function, limb salvage, cost-effectiveness and post-surgery quality of life. Further larger studies may consolidate these findings.

Key Words:

Arthroplasty, Knee replacement, Joint infection, Knee prosthesis, Muscular flaps.

Abbreviations

Knee Society Score (KSS), Total knee arthroplasty (TKA), Vacuum closure devices (VAC).

Introduction

Total knee arthroplasty (TKA) is a successful treatment for osteoarthritis of the knee with a revision rate of less than 5% within 10 years; however, many potential complications may occur¹.

Prosthetic infection is the second leading cause of knee arthroplasty failure and the third leading cause of hip arthroplasty failure, with aseptic loosening being the most common reason for failure in the knee and the second most common in the hip^{2,3}. Although prosthetic infection is a relatively rare complication (1-2%)⁴, it can be devastating and catastrophic in terms of patient morbidity and institutional costs, so clinicians must continue improving strategies for the management of infection in the presence of TKA⁵.

The main causes of failure after TKA include mechanical wear and tear and failure of bone fixation⁶. Factors influencing success are host factors, such as nutrition, metabolism, steroid use, smoking, and lack of adequate coverage due to skin necrosis of the knee, vascular thrombosis, decubitus ulcers, bone fistulae, hyperextension and deep infection. The incidence of many of these wound-related complications, which require surgical intervention again, ranges from 0.33% to 5.3%⁷ and may be at least partially prevented. Some early signs and symptoms, such as persistent pain, swelling, erythema and drainage may be indicative of impending prosthetic infection. Therefore, all healing problems should require prompt attention and aspiration of the joint before starting antibiotics, as many wound complications are highly associated with prosthetic infection⁸⁻¹¹. Tissue defects arising from wound healing problems after knee replacement

are difficult to manage mainly if prosthetic infection is already present, or if there is exposure of the prosthesis or of the bone.

Flaps have been widely used in orthopedic surgery for the management of infectious diseases and on the basis of anatomical content they can be divided into: skin flaps, muscle and myocutaneous flap and fascia or fascio-cutaneous flap¹²⁻¹⁴. Soft tissue coverage of the knee, in most cases, can lead to good functional and even aesthetic results, avoiding the appearance of bone sequelae and accelerating the healing process by providing adequate local blood supply with faster and complete absorption of antibiotics.

The choice of the type of the flap is determined by many factors, such as the general conditions of the patient, the concomitant injuries and pathologies, the possible functional sequelae, and of course by the type of wound the surgeon has to deal with¹⁵⁻¹⁸. We present the results of the first 20 consecutive patients treated with the use of medial gastrocnemius flap for the management of different types of injuries or integumentary defects after total knee arthroplasty.

Patients and Methods

Between January 2016 and December 2021, soft tissue revisions using pedicle flap of the medial gastrocnemius of infected total knee re-

placements were performed at our department of orthopedics¹⁹. This study included 20 patients (Table I) with healing defect after knee replacement (Figure 1); the mean age was 67 years (range: 60-78) and it included 3 females and 17 males. Tissue necrosis or dehiscence occurred between 1 month and 2 months after arthroplasty. According to Laing et al²⁰ classification, 3 of the patients had grade I wound dehiscence, 6 had grade II and 11 had grade III. The orthoplastic approach included extensive debridement and sterilization of the region. Depending on the type of tissue injury, reconstruction surgery using the medial gastrocnemius flap²¹ was performed in all patients. Remove the prosthetic material was not necessary in any patient. All surgeries were performed by the same operator. Patients were given antithrombotic prophylaxis with low molecular weight heparin. They were mobilized without load 5 days after surgery wearing elastic stockings. Rehabilitation included minimal loading for the first 2 months and full ambulation thereafter. If the culture result was negative, then the use of cephalosporin or clindamycin alone was continued for two weeks after surgery. Rifampicin and/or quinolones were added for patients suspected of staphylococcal and/or gram-negative bacteria and associated biofilm infections. All cases were followed-up. Then, mean follow-up was 23.4 (12-60) months (Table I). The follow-up indicators included the infection control rate. The clinical

Table I. Epidemiological data.

Patients	Sex	Age	Comorbidity	Laing classification	Follow-up from Flap (mo)
1	M	68	Overweight	2	12
2	M	65	Diabetes	3	18
3	M	60	Hypertension	3	12
4	F	70	-	2	24
5	M	60	-	3	60
6	M	63	Overweight	1	24
7	M	69	-	3	24
8	M	65	Hypertension, Diabetes	2	36
9	M	58	-	3	12
10	M	73	Diabetes	3	48
11	M	64	-	2	12
12	F	71	Hypertension	1	12
13	M	78	-	2	30
14	M	72	-	3	12
15	M	71	Hypertension	2	24
16	M	66	-	3	12
17	M	69	-	3	24
18	F	62	Hypertension	3	12
19	M	66	Hypertension	2	36
20	M	70	-	3	24
		67			23.4



Figure 1. Medial gastrocnemius flap rotated into place to cover the anterior knee defect.

outcome was evaluated according to post-operative Knee Society Score (KSS) score. The original KSS has a “Knee Score” section that includes 7 items (pain, extension lag, total range of flexion, alignment, antero-posterior stability, and medio-lateral stability) and a “Functional Score” section with 3 items (walking, stairs, and walking aids used). Both sections are scored from 0 to 100 with lower scores being indicative of worse knee conditions and higher scores being indicative of better knee conditions.

Results

The mean follow-up was 23.4 months (Table I). Prosthesis salvage and complete restoration of skin coverage was achieved in all patients (Figure 1). Functional assessment was performed using the KSS score. The final knee KSS score was classified as excellent (score 80 to 100) in 0

patients, good (score 70 to 79) in 17 patients, fair (score 60 to 69) in 2 patients, and poor (score 60) in 1 patient. Residual Extension Deficit was Very Satisfactory (0-20°) in 17 patients: Satisfactory (30-70°) in 2 patients and Unsatisfactory (80-90°) in 1 patient. Patients who successfully underwent flap treatment experienced a much greater increase in both components of the KSS score. No mechanical or infectious complications occurred in the patients.

Discussion

Total knee arthroplasty is a successful surgical procedure for the treatment of osteoarthritis that improves patients’ daily activities. Despite difficulties due to the COVID-19 pandemic, TKA has remained the most common surgical procedure²². The knee implant procedure is a major surgical procedure and, as such, it can lead

to post-operative complications. One of the most insidious complications is the infection, which remains the most frequent cause of failure^{23,24}. Early diagnosis and treatment of infection can lead to retention of the prosthesis by performing aggressive debridement and effective antibiotic therapy. When the infection cannot be controlled or when the skin or soft tissue is irreparably affected, arthrodesis may be the best option^{25,26}. Amputation is reserved for special circumstances when reimplantation or arthrodesis is not possible. It must be remembered that the functional outcome of reimplantation does not achieve the same level of success as that achieved with primary TKA or in aseptic loosening revisions, which is why it is important to be able to maintain the primary implant. Peersman et al²⁷, evaluated both superficial and deep infections and observed that the risk of infections increased with the number of comorbidities. Statistically, the most significant comorbidities were previous surgery at the same site, immunosuppressive therapy, hypokalemia, malnutrition, diverticulosis, infections at other sites, diabetes mellitus, obesity, peripheral vascular disease, smoking, renal failure, hypothyroidism, and alcoholism. In our study, 90% of patients had underlying pathologies, such as diabetes, excess weight and vasculopathies. Type II diabetes mellitus has been shown to be associated with an increased risk of prosthetic infection²⁸, whereas a lower incidence of infection has been found in patients with perioperative blood glucose control^{29,30}. To date, our pre, intra, and postsurgical prophylaxis measures are proving to be effective. The total prostheses studied and treated, were transferred from hospitals outside ours. The mean time for the onset of primary TKA infection was 2 months. One of the fundamental pillars for an optimal treatment of prosthetic infection is the identification of the microorganism responsible for the infection, which in our experience was achieved in the majority of cases, in line with what described in other studies^{31,32}. The first step for the management of infection includes antibiotics administered both systemically and locally after surgery³³⁻³⁵. For small surgical wounds the use of vacuum closure devices (VAC) can be considered in order to reduce wound size by removing exudate and reducing edema, producing granulation tissue by increasing local microvascular perfusion, improving the wound bed prior to salvage surgery, and allowing for easier surgical wound closure procedures³⁶⁻³⁹. Alternatively,

the use of VAC may serve to prepare the wound bed prior to definitive treatment such as a skin graft or flap⁴⁰. When the fascial layer is affected, it is almost certain to expose the prosthesis, thus the only way to intervene is with muscle flaps, as shown in our study. Although many surgical techniques have been described, muscular flaps, and especially those closest to the lesion, are the most widely used⁴⁰.

The main advantage of muscle flaps over fascio-cutaneous flaps is the remodeling of the flap over time, as the latter changes color, and has a lower vascularity and strength index compared to muscle flaps^{41,42}. The ideal flaps are muscular flaps, such as vastus medialis and lateralis, sartorius and gracilis, latissimus dorsi free flap and anterolateral free flap of the thigh⁴³. Skin grafts cannot be used since they provide unstable coverage. The fascio-cutaneous flap is not vascularized enough^{41,42}. Free flaps are a good choice, but they may lead to a high risk of flap loss in the case of very short pedicles and very deep recipient vessels. In Gerwin's series of 12 patients with prosthesis exposure without dislocation, the medial calf flap was the treatment of choice. Ten patients retained their prosthetic components or had successful reimplantation⁴⁴. The regional gastrocnemius muscle flap is the most commonly used for leg and knee coverage since it is a double flap with good vascularity, and it allows good extension. It is generally accepted that the arc of rotation of the gastrocnemius muscle flap has sufficient range to cover the medial and inferior portions of the knee in the anterior and posterior regions of the popliteal fossa. This makes it the muscle of choice when covering defects of the knee, such as exposure due to tissue necrosis in arthroplasty. It is preferably performed after the region has been sterilized and extensively cleaned.

Conclusions

The results presented by the authors highlight the effectiveness of medial gastrocnemius muscular flap for the treatment prosthetic knee infection, in terms of function, limb salvage, cost-effectiveness and post-surgery quality of life. It can be performed under peripheral anesthesia in any patient, and it provides an excellent management option for patients with persistent infection after knee arthroplasty. Further larger studies may consolidate these findings.

Conflict of Interest

The Authors declare that they have no conflict of interests.

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None.

Authors' Contribution

The authors contributed equally.

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Not applicable.

Availability of Data and Materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics Approval

All procedures performed in the current study were in accordance with the 1964 Helsinki declaration and its later amendments. The study design was approved by the Orthopedic and Traumatology Institute and School Council "Polinclinico Universitario Agostino Gemelli IRCCS".

Informed Consent

Written informed consent was obtained from all individual participants included in the study. All the patients gave consent for their personal or clinical details along with any identifying images to be published in this study.

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