The Journal of Arthroplasty 31 (2016) 1529–1538

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Revision Arthroplasty

# Soft Tissue Reconstruction and Flap Coverage for Revision Total Knee Arthroplasty

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ARTICLE INFO

*Article history:*
Received 24 August 2015
Received in revised form
22 December 2015
Accepted 28 December 2015
Available online 31 March 2016

*Keywords:*
total knee arthroplasty
revision arthroplasty
flap
gastrocnemius
reconstruction

ABSTRACT

*Background:* Total knee arthroplasty is a successful operation for treatment of arthritis. However, devastating wound complications and infections can compromise the knee joint, particularly in revision situations.
*Methods:* Soft tissue loss associated with poor wound healing and multiple operations can necessitate the need for reconstruction for wound closure and protection of the prosthesis.
*Results:* Coverage options range from simple closure methods to complex reconstruction, including delayed primary closure, healing by secondary intention, vacuum-assisted closure, skin grafting, local flap coverage, and distant microsurgical tissue transfer.
*Conclusion:* Understanding the advantages and pitfalls of each reconstructive option helps to guide treatment and avoid repeated operations and potentially devastating consequences such as knee arthrodesis or amputation.



Total knee arthroplasty (TKA) is a recognized procedure for the management of disabling knee arthritis with successful outcomes resulting in marked pain relief and improved patient functionality. Studies have cited survivorship of TKA of over 90%, 80%, and 70% at 10, 15, and 20 years, respectively [1,2]. Complications after TKA include persistent pain, stiffness, instability, or infection and can necessitate a need for revision surgery [3]. In a large meta-analysis of 9879 TKA patients followed for an average of 4.1 years, 89.3% achieved a good or excellent result, 10.7% were fair or poor, and 3.8% underwent revision [4]. Other authors have reported the incidence of deep infection associated with TKA to range from 1.0%- 12.4%, all requiring revision [5,6]. With an increasing elderly population, the number of primary TKAs is projected to increase 673% by 2030, and revision total arthroplasty will likely mirror this trend, especially as patients continue to live longer [7].

Revision TKA for instability, stiffness, or persistent pain can often be accomplished in a single stage [8]. In the setting of periprosthetic joint infection (PJI), however, 2-stage reimplantation is widely accepted to be the standard of care in the United States [3,4,6,7]. The first stage involves the removal of all prosthetic material and foreign material from the joint, followed by extensive debridement, irrigation, and reaming of the medullary canals [5]. The joint is then loaded with a static or articulating antibiotic cement spacer followed by closure of the soft tissues. Provided a reaspiration of the joint is negative for persistent infection and there are no additional complications, return to the operating room is usually planned within 6-12 weeks for reimplantation [5].

Wound complications after revision TKA can present a significant problem for the surgeon and the patient including delay of reimplantation due to persistent infection, additional surgery for debridement of skin necrosis and/or flap coverage, and a longer than expected recovery period. A retrospective study at the Mayo Clinic from 1981 to 2004 found that of the 17,000 primary TKAs, there was a 0.33% incidence of wound problems requiring surgery within 30 days of index surgery [9]. Despite a low incidence, the probability of further major surgery (removal of implants, muscle flap rotation, and leg amputation) or diagnosis of deep infection in these patients was 5.3% and 6.0%, respectively, within 2 years of index surgery. In contrast, TKAs at 2 years with no postoperative wound complications had a 0.6% and 0.8% incidence of needing a major operation or a diagnosis of a deep infection, respectively. Additional patient factors to consider include patient advanced age,

One or more of the authors of this paper have disclosed potential or pertinent conflicts of interest, which may include receipt of payment, either direct or indirect, institutional support, or association with an entity in the biomedical field which may be perceived to have potential conflict of interest with this work. For full disclosure statements refer to http://dx.doi.org/10.1016/j.arth.2015.12.054.

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http://dx.doi.org/10.1016/j.arth.2015.12.054
0883-5403/

diabetes mellitus, connective tissue disease, malnutrition, rheumatoid arthritis, vascular insufficiency, smoking, and steroid use, which can further delay wound healing [10-13]. Ultimately, measures that can be taken to minimize wound complications would translate into improved patient outcomes and prevent potential loss of the prosthesis or even of the limb [14].

Wound complications and multiple reoperations may compromise the soft tissue coverage of the knee, requiring treatment to fill dead space, protect the prosthesis, and close the wound. Skin or muscle flap coverage is often required in these situations, either as prophylactic treatment for anticipated wound complications or during revision. Markovich et al described 12 patients who were treated with muscle flaps used for different treatment purposes: (1) prophylactic soft tissue coverage before definitive reconstruction, (2) muscle flaps for treating infected prostheses with deficient soft tissue coverage, and (3) salvage muscle flaps for wound dehiscence or necrosis in the immediate postoperative period. At an average 4.1-year follow-up, the wound was revascularized in 100% of knee, and the prosthesis preserved in 83% [11].

Although complex wound coverage is often driven by the plastic surgeon, the orthopedic surgeon should be familiar with the reconstructive options and actively participate in decision making to facilitate a collaborative effort toward the best possible patient outcomes. In this review, the management of wound complications and soft tissue defects surrounding the knee will be discussed, with specific focus on skin grafts, local skin flaps, and free flap coverage.

## Vascular Considerations

An extensive knowledge of knee vascular anatomy is essential to guide both the orthopedic approach to revision TKA to prevent devascularization of skin or bone and when helping the plastic surgeon in reconstructive planning (Fig. 1).

The main blood supply to the knee arises from branches from the femoral artery, popliteal artery, and anterior tibial artery. The skin surrounding the knee is perfused through an anastomosis of vessels just superficial to the deep fascia, fed by underlying perforating vessels [14]. Perforators over the medial and anterior aspect of the knee are supplied by the saphenous branch of the descending genicular artery, with a small contribution anterior inferiorly from the anterior tibial recurrent artery. Perforators feeding the deep fascial plexus laterally include the superior and inferior lateral genicular branches of the popliteal artery [15]. The deep fascial vascular network sends vessels that penetrate the subcutaneous fat to reach the epidermis; however, there is little communication between vessels at the superficial level. Therefore, wide dissection superficial to the deep fascia will compromise the blood supply to the skin, whereas dissection deep to the fascia will maintain the skin blood supply [16]. This illustrates the need for elevation of full-thickness skin flaps during dissection.

The blood supply to the patella should be preserved to prevent patellar osteonecrosis and fragmentation, both of which can lead to periprosthetic and wound infections [16]. The patellar blood supply arises from an anastomotic ring fed by the muscular–articular branch of the descending geniculate artery, the 4 genicular arteries (superior medial, inferior medial, superior lateral, and interior lateral), and the anterior tibial recurrent artery, from which the transverse infrapatellar artery and the oblique prepatellar arteries arise. Importantly, this vascular network does not contribute significantly to skin blood supply because of lack of communication through the prepatellar bursa. Intraosseous blood supply to the patella arises from penetrating vessels from the inferior aspect of the patella and from the middle third of the anterior surface of the patella [17].

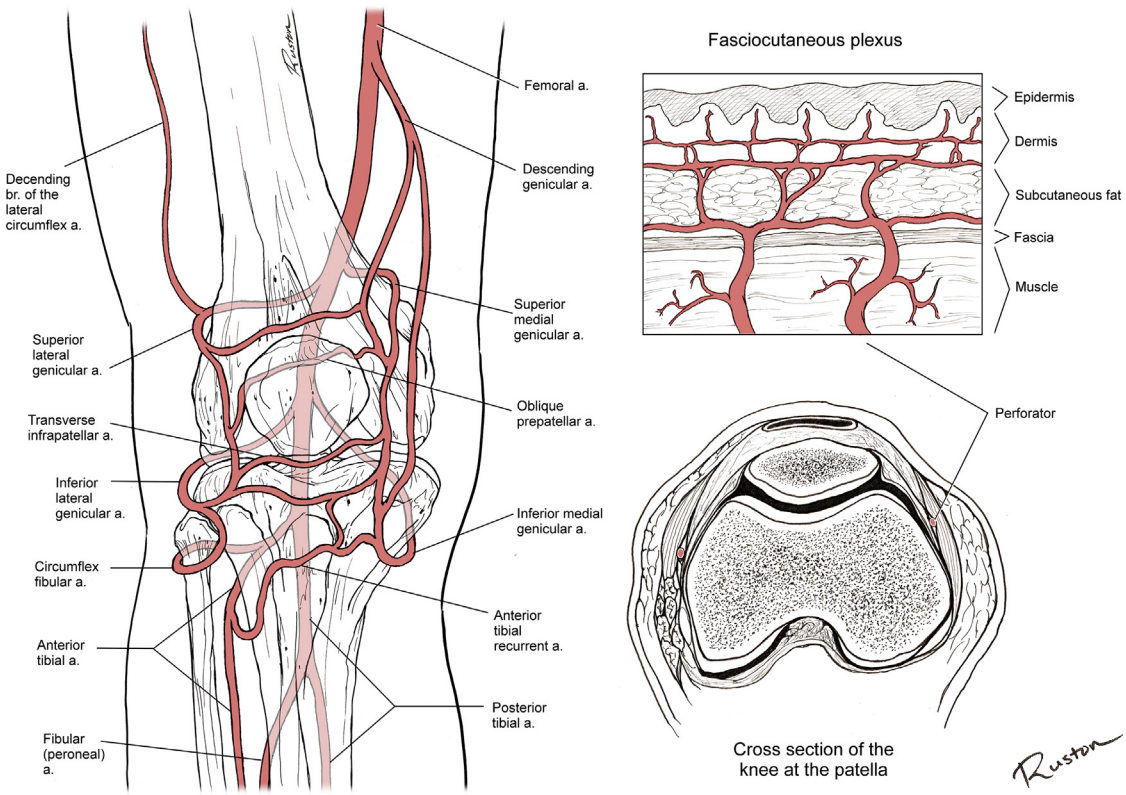


**Fig. 1.** Vascular anatomy about the knee.