Wound Healing Problems in Total Knee Arthroplasty

SHAWN GARBEDIAN, MD, FRCSC; AMIR STERNHEIM, MD, DAVID BACKSTEIN, MD, MED, FRCSC

abstract

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It is important to avoid underestimating the significance of wound complications following total knee arthroplasty (TKA). Expedient and aggressive care is recommended. Understanding the blood supply to the skin around the knee and measures to prevent wound complications are fundamental to preventing wound problems. A detailed patient history and physical examination will identify high-risk patients and any modifiable risk factors. Operative techniques such as raising full-thickness skin flaps and judicious placement of skin incisions in the presence of pre-existing scars can greatly reduce the incidence of wound problems. The first step in treating wound problems is recognizing when a problem is present and knowing when a minor problem can turn into a major one. Superficial infections or stitch abscesses can be treated with conservative treatment. However, the surgeon should have a low threshold to revert to surgical management if drainage persists. Skin necrosis or non-viable skin must be excised in the operating room, and the presence of a deep infection must be diagnosed by joint aspiration. The appropriate course of action in dealing with deep infection is dependent on the duration elapsed since the index procedure. The ability to perform a medial gastrocnemius muscle flap and skin graft is an invaluable skill in complex cases where primary wound closure cannot be achieved. Meticulous attention to detail during surgery and aggressive surgical treatment of wound complications can be the difference in saving the knee.

Figure: Extensive distal skin necrosis following TKA (A). Medial gastrocnemius muscle flap after debridement of distal skin necrosis (B).

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Drs Garbedian, Sternheim, and Backstein are from Mount Sinai Hospital, and Dr Backstein is also from the Department of Surgery, University of Toronto, Toronto, Ontario, Canada.

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Correspondence should be addressed to: Shawn Garbedian, MD, FRCSC, Mount Sinai Hospital, Room 476, 600 University Ave, Toronto, Ontario, M5G 1X5, Canada (garbedian@gmail.com).

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Wound complications after total knee arthroplasty (TKA) can present with variable manifestations, including superficial skin infection, skin necrosis, deep joint infection, and wound dehiscence. Wound problems can result in significant morbidity to the patient, further surgery, and longer than expected recovery period. Regardless of the presentation, the significance of wound problems must not be underestimated by the treating surgeon and should be treated with aggressive and expedient care. The type of treatment required depends on 2 factors or variables: 1) the presence and depth of skin necrosis and 2) the presence of a deep infection.

The incidence of wound problems post-TKA requiring further surgery is low. A retrospective review of 17,000 TKAs performed at the Mayo Clinic (Rochester, Minnesota) from 1981 to 2004 found an incidence of 0.33% wound problems requiring surgery within 30 days from index surgery. The consequences of the early wound complications in this study were of great significance as the probability of further major surgery operations (removal of implants, muscle flap rotation, leg amputation) or diagnosis of deep infection were 5.3% and 6.0% respectively within 2 years of index surgery. In comparison, TKAs at 2 years with no postoperative wound complications required major operation or were diagnosed with a deep infection of 0.6% and 0.8%, respectively. Therefore, avoiding wound complications and awareness towards the importance of primary wound healing are critical for TKA success.

**Vascular Anatomy**

Understanding the blood supply to skin around the knee is fundamental to avoidance of wound problems, especially when scars from previous incisions are present. The anterior skin of the knee is supplied by an anastomotic ring of arterial vessels derived from the descending branch of the lateral circumflex, the genicular branches from the poplitea artery, and the anterior tibial recurrent artery. Perforators from these vessels come up through the fascia to form the anastomotic network, which supplies the skin (subdermal plexus). Thus, wide dissection superficial to the fascia will compromise blood supply to the skin, while deep dissection will maintain blood supply.

The vastus medialis muscle extends more distally compared to the vastus lateralis; therefore, blood supply is more at risk on the lateral aspect. Furthermore, regions where there is no muscle coverage, such as over the patella, patellar tendon, and tibia tubercle, are dependent on the subdermal plexus and delicate care of the skin is needed in this region to avoid complications. Thus, midline longitudinal skin incisions are the least disruptive to the blood supply, and the more medial the incision is made, the more risk to the lateral skin since the flap is larger with reduced oxygen tension.

**Prevention**

Risk factors for developing a postoperative wound complication can be divided into those derived from the patient, intraoperative factors, and postoperative factors. Modifiable patient risk factors include: patient malnutrition (albumin <3.4 g/dL), smoking, poorly controlled diabetes, and obesity. Preoperatively, a vascular surgeon should evaluate patients with a previous history of wound healing issues or those that have peripheral vascular disease, particularly if their ankle-brachial index is >0.9.

Intraoperative risk factor can be greatly reduced with careful planning. Patients with multiple scars around the knee can present an operative dilemma, as the surgeon must choose the approach of least risk (Figure 1). A pre-existing transverse incision should be crossed as close to perpendicular as possible. When multiple parallel longitudinal incisions exist, the general rule is to use the most lateral incision possible, as the medial blood supply to the skin covering the anterior knee predominates over the lateral. It is best to provide at least a 7-cm skin bridge between incisions.

The distal aspect of the incision is the most common region for complications. By placing the distal aspect of the incision slightly medial to the tubercle, the tendon itself will be protected and soft tissue coverage will be optimized. The use of full-thickness skin flaps, avoiding undermining the skin, will significantly reduce the risk of skin necrosis. In the context of peripheral vascular disease, use the lowest possible tourniquet pressure, as these individuals are at higher risk of wound complications.

Patients with contracted and adherent skin pose a particular challenge when planning a TKA. A planned medial gastrocnemius flap at the time of the TKA (Figure 2), or the use of soft tissue expanders preoperatively, which are gradually expanded over 6 to 8 weeks and removed at the time of joint replacement can be a solution when the skin is severely contracted. Additional operative techniques that assist in blood supply preservation include preserving the lateral genicular artery supply if a lateral release is required and keeping the patella fat pad. To minimize the occurrence of a large postoperative hematoma, a watertight closure of the arthrotomy will prevent the collection of subcutaneous blood.

Postoperative risk factors for wound complications include tight dressings and large subcutaneous hematomas. Although the use of drains for TKA is controversial, the senior author (D.B.) feels they are beneficial in his practice for high-risk patients, as they decrease the chance of a large subcutaneous hematoma within the first 24 hours of surgery. Additional postoperative factors that decrease wound issues are the use of supplemental oxygen, avoiding very aggressive physiotherapy early on for high-risk pa-
that, and avoidance of continuous passive motion, as it can reduce the transcutaneous oxygen saturation.1,5,6

TREATMENT OF WOUND PROBLEMS

The first part of treating wound problems is recognizing when a problem is present and knowing when a minor problem can turn into a major one. Skin abscesses are a common problem that must not be taken lightly. They can typically present as a small area of superficial necrosis or eschar (Figure 3). The first line of treatment is to temporarily decrease the intensity of physiotherapy (specifically knee range of motion), and provide local wound care with the supplementation by oral or intravenous antibiotics. If drainage continues for >5 days and there are any signs of deep infection, aspiration of the knee is indicated. If drainage persists past 7 to 10 days, a thorough irrigation and debridement of the wound and closure in the operating room is recommended.7

Postoperative skin necrosis around TKA is a difficult problem for orthopedic surgeons (Figures 4, 5). Any necrotic or non-viable skin must be excised in the operating room and the treatment algorithm starts with determining if a deep infection coexists. If only the skin is involved, then superficial debridement of the necrotic region followed by primary wound closure or the appropriate soft tissue coverage closure (medial gastrocnemius flap, skin graft, etc) should be performed. The diagnosis of postoperative total knee infection with an aspirate has been studied extensively, and accepted diagnostic values have evolved. A study by Mason et al8 determined the criteria for a positive aspiration for infection to consist of 2500 wbc/mL and PMN >60%. A more recent report by Ghanem et al9 in 2008 considers a positive postoperative joint infection when the aspirate reveals more than 1100 wbc/10³cm³ and a PMN% of >64%.9

A necrotic wound with an associated deep infection following TKA is serious, and in severe cases, limb-threatening.1 Determination of the duration elapsed between implantation and onset of deep infection following the surgery plays a pivotal role in the treatment algorithm. If the diagnosis of a deep infection is made acutely, 2 to 4 weeks postoperatively, a salvage procedure of the infected tissue is excised to healthy bleeding tissue, and prosthesis exchange, remains an acceptable choice for an acute infection. After the necrotic skin tissue is excised to healthy bleeding tissue, primary closure can be attempted. If primary closure without significant tension is not possible, a gastrocnemius rotation flap along with a split-thickness skin graft should be performed. Having the skill set to perform a gastrocnemius flap is invaluable as it is not always possible to have a plastic surgeon available to assist during difficult cases, particularly when issues with closure are unexpected. When diagnosis of deep infection is made beyond 4 weeks after index surgery, the situation is considered a chronic infection and should be dealt with accordingly, using a 2-stage surgical revision approach.

SUMMARY

It is important to recognize and act aggressively when a postoperative wound complication following a TKA is encountered. Any wound problem should be dealt with promptly and directly. Watchful waiting with antibiotics usually delays the inevitable, and a minor problem may become a major problem with further operations and morbidity for the patient. A thorough preoperative history and physical examination will identify at-risk patients so preventative measures can take place. Preoperative planning allows optimization of the resources available to avoid further complications intraoperatively. Meticulous attention to detail during surgery, aggressive surgical treatment, and management of postoperative wound complications can be the difference in saving the knee.

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