Knee joint reconstruction using regional flaps: an aesthetic approach to extensive defects following fourth-degree contact burns

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Flap surgery may be required in cases of severe contact burns. The authors report a patient with an exposed knee joint. A 47-year-old man experienced a wide and deep contact burn on his right knee from a stove while under the influence of alcohol. The patient underwent escharectomy, medial and lateral gastrocnemius muscle flap surgery, pedicled anterolateral thigh flap surgery with a meshed scalp split-thickness skin graft, and secondary antegrade peroneal fasciocutaneous flap surgery with a thigh split-thickness skin graft. The patient was able to walk with a hinged brace at 2 months after surgery.

Keywords Knee joint / Burns / Surgical flaps / Transplants

INTRODUCTION

The reconstruction of complex and extensive defects involving the knee joint represents an aesthetic and functional challenge. The knee joint is one of the most complex structures of the body in terms of dimensional architecture, thickness, reliability, and its functional role. Defects affecting the total thickness of the knee joint have negative effects on patients' social function, quality of life, physical health, and satisfaction with their appearance when wearing shorts. Therefore, aesthetic outcomes after the coverage of soft tissue defects for reconstruction are important.

Soft tissue coverage for defects around the knee joint has been performed using different types of pedicled flaps and free flaps [1].

Gastrocnemius muscle flaps have been used for decades to reconstruct defects of the proximal tibia and knee caused by trauma, tumors, and infections around the knee, and to reconstruct extensor mechanism discontinuities with and without total joint arthroplasty [2]. Furthermore, antegrade peroneal fasciocutaneous flaps

may be useful for reconstruction of the inferior knee joint.

Herein, the authors report a case of a fourth-degree contact burn on the knee joint that was reconstructed using medial and lateral gastrocnemius muscle flaps, pedicled anterolateral thigh flap, peroneal fasciocutaneous flap, and split-thickness skin grafts (SSGs) harvested from the scalp and thigh. Four types of pedicled flaps were needed because this patient had an extensive, deep defect in the right knee joint, which is an exceedingly rare condition.

CASE REPORT

A 47-year-old man suffered from a contact burn from a stove (total body surface area, 4%; 200 cm²) on the anterolateral aspect of his right knee while under the influence of alcohol (Fig. 1A). The distal part of the vastus lateralis muscle, the lateral part of the quadriceps tendon, the lateral retinaculum, and the anterior cortex of the patella were damaged, and the iliotibial band was exposed after escharectomy. Preoperative magnetic resonance imaging (MRI) showed damage to the vastus lateralis muscle without bone involvement.

Removal of the damaged tissue and cortex of the patella resulted in a wide wound, exposing the knee joint (Fig. 1B). Medial and lateral gastrocnemius muscle flaps were harvested through a posterior midline incision in the lower leg (Fig. 1C). The vastus lateralis muscle defect, the exposed quadriceps tendon, and the iliotibial band were covered with the lateral gastrocnemius muscle flap, and the decorticated patella and patellar tendon were covered with the medial gastrocnemius muscle flap. An anterolateral thigh flap and

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Fig. 1. Reconstructive procedures of the right knee joint. (A) A 47-year-old man developed a contact burn on the anterolateral aspect of his right knee from a stove while under the influence of alcohol. (B) Removal of damaged tissue of the distal part of the vastus lateralis muscle, the lateral part of the quadriceps tendon, the lateral retinaculum, and the cortex of the patella caused a wide wound, resulting in knee joint exposure. (C) Medial and lateral gastrocnemius muscle flaps were harvested through the midline incision of the lower leg. (D) The knee joint was exposed due to loss of the skin graft over the iliotibial band. (E) The peroneal fasciocutaneous flap included three perforators. (F) The wide defect of the right knee was reconstructed by four flaps, including the scalp and thigh split-thickness skin grafts.

meshed scalp SSG (0.406-mm thick, 250 cm² in area) covered the medial and lateral gastrocnemius muscle flaps and the remaining wound on the lower leg. The knee joint was exposed due to loss of

the skin graft over the iliotibial band (Fig. 1D). Therefore, a second antegrade peroneal fasciocutaneous flap was needed.

This peroneal fasciocutaneous flap included three perforators

Fig. 2. Postoperative magnetic resonance imaging (MRI) and bone scan. (A) The MRI findings showed fracture-like lines on the left condyle of the femur and tibia and the head of the fibula at 2 months after surgery. (B) The bone scans showed a cold defect on the lateral side of the right knee and increased bone uptake along the fracture lines of the right knee 2 months after surgery.

(Fig. 1E). The defect on the right knee joint was reconstructed again with an antegrade peroneal fasciocutaneous flap and thigh SSG (0.305-mm thick, 40 cm² in area). The wide defect of the right knee was reconstructed using four flaps, including the scalp and thigh SSGs (Fig. 1F). The patient was satisfied with the aesthetic outcomes following knee joint reconstruction using multiple pedicled flaps. Therefore, these reconstruction methods may result in higher satisfaction with the knee joint shape and graft inseting among patients with extensive defects of the knee joint, and may achieve aesthetically satisfactory results with safe tailoring. The patient was able to walk with a hinged brace 2 months after surgery.

Preoperative MRI did not show bony involvement. However, postoperative MRI (Fig. 2A) and bone scans of the right knee using Tc-99m-HDP (25 mCi) (Fig. 2B) showed partial avascular ischemic damage of the lateral condyles of the femur and tibia and the head of the fibula at 2 months after surgery.

DISCUSSION

Soft tissue defects may occur around the knee joint from wound breakdown following surgery or trauma and deep burns. Early aseptic closure of the exposed knee joint should be performed to achieve adequate functional and cosmetic results with minimal donor site morbidities. Various reconstructive methods exist, and the appropriate method is selected depending on the location, size,

and depth of the defect relative to the knee joint [1,3].

A free musculocutaneous flap could have been an option for reconstruction in this patient, but our clinic was unable to perform microsurgery. Therefore, the authors chose regional flaps.

The medial head of the gastrocnemius muscle in adults measures 15–20 cm in length and 8 cm in width. The lateral head of the gastrocnemius muscle measures 12–17 cm in length and 6 cm in width [4]. The gastrocnemius muscle flap is considered to be the main pedicled flap for soft-tissue defect reconstructions in the knee. When this flap is not available, pedicled options include a reversed anterolateral thigh flap or peroneal artery flap [5]. Little data have been published on the use of this peroneal flap for knee reconstruction [6,7].

The extent of knee joint exposure in this present patient was large, and the defect was not properly reconstructed with medial and lateral gastrocnemius flaps and an anterolateral thigh flap. Therefore, a second antegrade peroneal fasciocutaneous flap was needed.

The wide fascia (9 × 10 cm) of the antegrade peroneal fasciocutaneous flap reinforced the iliotibial band defect. The donor defect (40 cm²) was covered with a thigh SSG. The patient was able to walk with a hinged brace.

Avascular ischemic injuries to the lateral condyles of the femur and tibia, as well as to the fibular head of the right knee, gradually lead to bone destruction. Therefore, serial MRI studies of the right knee joint are needed during the postoperative period. If unstable

movement occurs due to bony involvement in the right knee joint, knee joint replacement surgery may be required later.

Based on our experience, knee joint reconstruction using multiple pedicled flaps, including medial and lateral gastrocnemius muscle flaps, an anterolateral thigh flap, and peroneal flaps may be a useful way to obtain satisfactory functional and aesthetic outcomes.

NOTES

Conflict of interest

No potential conflict of interest relevant to this article was reported.

Ethical approval

The study was approved by the Institutional Review Board of Bes-tian Seoul Hospital (IRB No. 2020-10-001) and performed in accordance with the principles of the Declaration of Helsinki.

Patient consent

The patient provided written informed consent for the publication and the use of his images.

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