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The distally pedicled gracilis flap for salvage of complex knee wounds

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ABSTRACT

Introduction: Soft tissue defects around the knee joint resulting from trauma or because of wound breakdown after total knee arthroplasty present a challenge in a group of patients that often suffer from other co-morbidities. A pedicled gastrocnemius muscle flap remains a workhorse for this kind of wound. However, where the defect lies in the supero-lateral aspect of the proximal knee area, an alternative solution is required. The distally based pedicled gracilis flap has been described as an option for these cases where free-tissue transfer may not be an option and the pedicled gastrocnemius is not sufficient or has already been used. The purpose of this review is to evaluate the usefulness of this flap in the nine cases in which we have utilized it in our unit.

Methods: Nine patients underwent reconstruction of complex proximal knee wound defects with a distally based pedicled gracilis muscle flap. The mean age was 62 years (range 23–83). Five patients had wound breakdown following total-knee arthroplasty (TKR) and four patients had wound complications after road traffic accidents (RTA). Three of the nine flaps were delayed.

Results: Eight of the nine patients had successful salvage of the knee with the use of the distally based gracilis flap. Although four of the flaps suffered partial loss, this did not compromise the joint salvage. The patients were moderately satisfied with the reconstruction and achieved a mean range of movement of 75° (±12°).

Conclusion: The distally based pedicled gracilis flap can be a salvage solution for complex soft tissue defects with exposed knee joint, patella or proximal part of knee or exposed knee prosthesis in cases where a pedicled gastrocnemius muscle is inadequate or the patient is not suitable for a free flap.

Evidence Level IV.

Introduction

Soft tissue defects around the knee joint resulting from trauma or because of wound breakdown after total knee arthroplasty present a challenge in a group of patients that often suffer from other co-morbidities. A pedicled gastrocnemius muscle flap either as a muscle only or a myocutaneous flap remains a workhorse for this kind of wound. However, certain more complicated cases may arise in which the gastrocnemius is insufficient. This is mainly in cases where the defect lies in the supero-lateral aspect of the proximal knee area. Free-tissue transfer is a good option in these difficult cases [1], but may not be suitable when a relatively short operative time is required. In such patients, the options are limited and one described solution is to use a distally based gracilis flap [2]. The purpose of this review is to evaluate the usefulness of this flap in the nine cases in which we have utilized it in our unit.

The gracilis muscle, based on the minor pedicles would seem to run counter to our current appreciation of the vascular anatomy of this type II flap. In type II flaps, it is generally believed that such a flap cannot survive in its entirety on the minor vascular pedicle(s) unless delayed for 10–14 days [3]. However, recent cadaveric and CT angiogram work has suggested that these minor pedicles may be sufficient to sustain the muscle without a delay procedure, successfully used in three cases [2].

We report here the successful use of the distally based pedicled gracilis flap (DBGF) for knee salvage in eight patients with either a very short or no delay.

Materials and methods

During a period of 5 years, between October 2008 and November 2012, nine patients in our institution underwent

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Table 1
Characteristics and clinical histories of patients.

Patient	Age	History	PMH	Operations	Prosthesis removed	Complications
1	42, M	Stiff knee post RTA	Overweight asthma	1. Quadriceplasty + medial thigh flap 2. Debridement + DBGF flap + SSG 3. Tangential excision of gracilis 4. Washout + gracilis muscle advanced + closure	N/A	Infection, wound dehiscence + sinus medial aspect knee
2	84, M	TKR	Atrial fibrillation, transient ischaemic attack, hypertension on warfarin	1. 1st stage revision TKR-temporary spacer + antibiotic beads 2.Exchange cement spacer + local gastrocnemius flap 3.DBGF flap	Yes	Infection, wound breakdown-exposed tendon, proximal patella, metal work
3	82, M	TKR	Atrial fibrillation, NIDDM TIA, HTN pacemaker on warfarin	1. 1st stage revision TKR + spacer insertion 2. Radical debridement exchange for articulating spacer + pedicle gastrocnemius flap + DBGF flap 3. Excision of partial gracilis flap necrosis + local flaps	Yes	Haematoma, wound breakdown
4	76,M	TKR	AF, angina, on warfarin	1. Debridement + pedicle gastrocnemius flap 2. 1st stage revision + insertion of spacer + 1st stage DBGF 3. 2nd stage DBGF	Yes	Infection, wound broken down proximaly
5	23, M	RTA Multiple open # both lower limp	IDDM	1. Treated originally (one month previously) in another hospital with pedicle medial gastrocnemius flap 2. 1st stage DBGF 3. 2nd STAGE DBGF + SSG	N/A	Exposed ORIF for Rt open comminuted #distal femur + knee-pus + exposed proximal joint cavity
6	79, M	TKR	Hypertension CABG MI	1. 1st stage revision TKR + insersion spacer + pedicle medial gastrocnemius flap 2. Debridement + 1st stage delayed DBGF 3. 2nd stage DBGF 4. Debridement of superficial gracilis muscle necrosis + SSG		Chronic infection with sinuses.
7	50,M	RTA Multiple #-free ALT for Rt tibial open #	Hypertension Depression	1. Debridement + DBGF 2. Excision of necrotic flap tip + muscle advancement + SSG 3. Arthroscopic knee release	N/A	Chronic wound-exposed left femoral condyle
8	63, F	TKR	Metallic aortic valve on warfarin	1. Debridement + pedicle gastrocnemius muscle 2. Dedridement + insertion of spacer + DBGF 3. Evacuation of haematoma on gracilis donor site 4. AKA	Yes	Haematoma, wound breakdown
9	51, F	RTA	MS arthitis	1. Debridement + Quadriceplasty + DBGF + SSG	N/A	Unstable scar

reconstruction of complex knee wounds with distally based pedicled gracilis flaps. The mean age was 62 (range 23–83). Five cases had defects following complications after total-knee replacement) and the other four cases were post road traffic accident (RTA). All patients had complex knee wounds, co-morbidities and had undergone previous surgical attempts at reconstruction. The characteristics and clinical histories of our patients are presented in Table 1.

We did not obtain preliminary computed tomographic angiogram in any of our patients. Technique: Primary cases (six) were dissected according to standard technique with the patient supine and the ipsilateral hip abducted, using palpation of the anteriorly located adductor longus as the landmark for the more posterior gracilis muscle (Fig. 1a). The major pedicle of the gracilis was dissected and temporarily clamped using an HDD clamp (Fig. 1b and c) once the first distal (minor) pedicle had also been visualized (Fig. 1d). We did not skeletonize or dissect the secondary pedicle up to its origin to the superficial femoral or popliteal artery. The wound was then assessed and prepared for reconstruction whilst the clamp remained on the major pedicle for a minimum of 1 h. After this time the gracilis muscle was assessed for viability and if adequate, then immediate transfer was executed with a large sub-cutaneous tunnel (Fig. 1e). The flap was inset with the knee in 20° of flexion and a split thickness skin graft applied to it (Fig. 1f). The flap donor site was directly closed.

Delayed cases (three) were dissected as for primary cases but if the viability of the muscle was dubious after clamp application, the major pedicle was ligated and the muscle left in situ without any dissection from its origin so that muscle length was maintained. The wound was debrided and a topical negative-pressure dressing applied. The patient was returned to theatre 48 h later and the muscle viability verified prior to transfer.

In the five cases of infected knee prostheses, these were removed prior to flap transfer and antibiotic impregnated cement spacers inserted thus representing stage one of a two-staged knee replacement.

The post-operative care was the same for both primary and delayed transfers. The knee was immobilized in extension for a period of 5 days until the first skin graft check, after which mobilization was begun using a continuous passive motion device (CPM). This gradually increased the passive range of knee motion until a functional range was safely achieved. The reconstruction was carefully monitored during mobilization to ensure that the muscle flap had not pulled away from its inset. Following successful knee mobilization, patients were then allowed to weight bear on that limb as tolerated.

The mean follow up duration after the operation was 25 months (range 8–60). Seven out of the nine patients completed the Modified Enneking score at least 6 months post operatively, with one patient lost to follow up and one excluded due to above knee amputation. The use of the Modified Enneking score has previously been validated in lower limb trauma [1]. Range of motion of the knee was assessed at the last attended clinical appointment using measurements of true lateral photographs in maximal passive extension and flexion (Fig. 2a–c). Descriptive statistical analysis was conducted using Microsoft Excel 2003, reported as mean (±standard error of the mean), though due to limited sample size, formal tests for differences were not conducted.