ASRM Scientific Paper Presentations: Extremities
Sunday, January 15, 2017, 7:45am – 8:45am

13. Superficial Circumflex Iliac Artery (SCIA) Based Iliac Bone Transfer for Reconstruction of Bony Defects

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Introduction

Superficial circumflex iliac artery (SCIA) based iliac bone transfer was first reported by Iida in 2013. The SCIA runs superficial to the iliac bone, and thus no deep dissection is required. Recently, we have successfully transferred vascularized iliac bone flaps in 9 cases.

Materials and Methods

From June of 2014 to June of 2016, transfer of SCIA-based iliac bone was performed in 9 cases for reconstruction of bony defects. The location of the bony defects was the lower extremity in 4, the head in 4, and the hand in 1. The causes of the defects were chronic osteomyelitis in 4, tumor ablation in 4, and toe tip harvest in 1. Required volume of the iliac bone was harvested after confirming one or more branches, coming from either the superficial or deep branch of the SCIA, penetrating the periosteum of the iliac bone. The deep branch was used as the pedicle in 6 cases, and the superficial branch in 3 cases. The size of the transferred bone ranged from 0.5 x 1.0 x 2.0 cm to 3.0 x 5.0 x 6.0 cm. In all cases, bleeding from the edges of the bone was confirmed at the time of harvest.

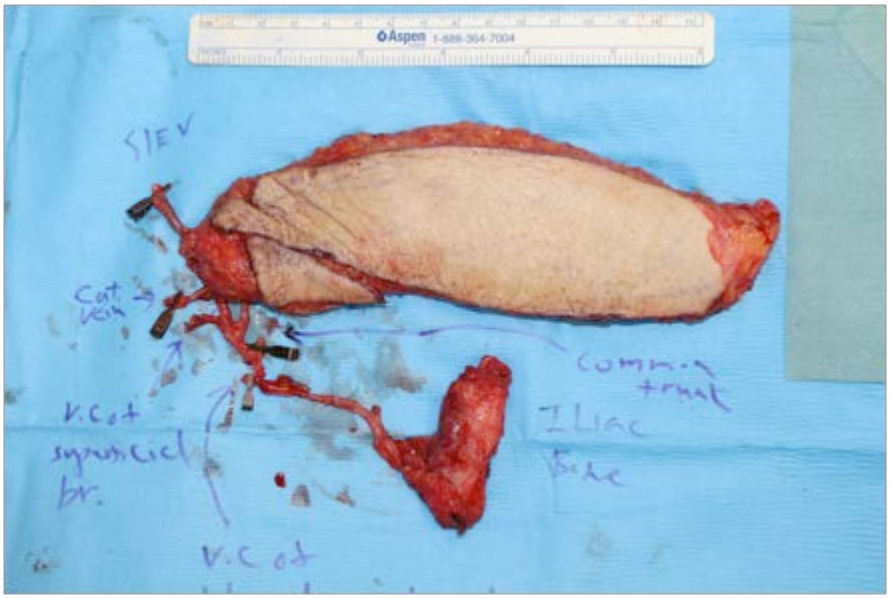
Results

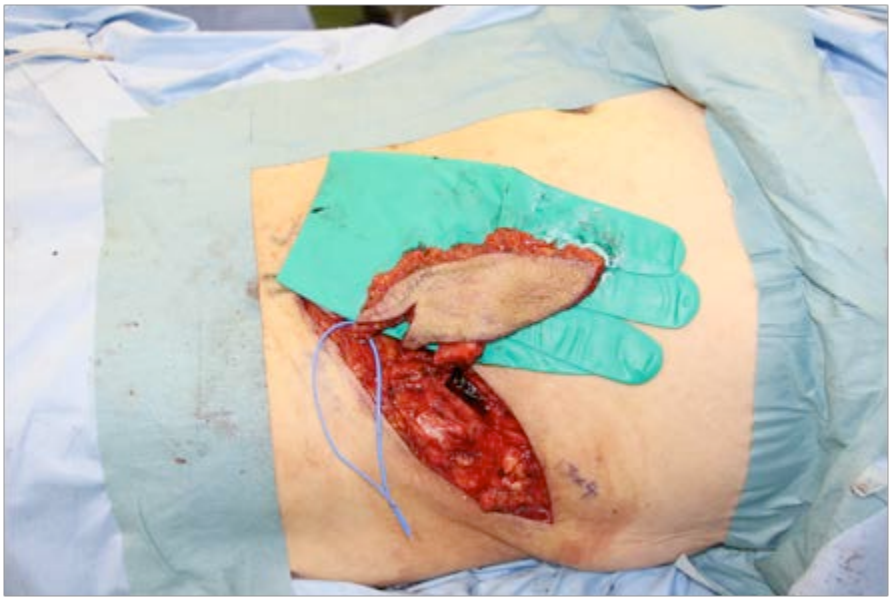
Perfusion to the transferred iliac bone was confirmed with bone scintigraphy in 7 cases 2 to 3 weeks after the surgery. Bone scintigraphy could not be performed in 2 cases due to postoperative condition of the patient. Bone union was confirmed in 8 cases with plain radiographs and CT scans. Of the 4 patients with osteomyelitis, 3 patients were cured, but one patient deceased on postoperative day 22 due to sepsis. There were no complications at the donor sites.

Conclusions

The greatest advantage of SCIA-based iliac bone transfer is that relatively large volume of cancellous bone can be procured with relatively lower donor site morbidity. The dissection remains at a more superficial level when compared with DCIA-based iliac bone transfer. Unlike fibula procurement, the procedure will not decrease perfusion of the lower extremity, which can cause complications in elderly or diabetic patients. It also leaves an inconspicuous scar, which can be hidden by underwear.

Although dissection of the pedicle requires special techniques to some extent, SCIA-based iliac bone transfer is a feasible option for reconstruction of small to moderate sized bony defects, especially in elderly patients considering its low donor site morbidity.





14. Stay within One Leg: The Ipsilateral Island Fibula Transfer for Tibial Reconstruction

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Ten patients with segmental tibia defects were treated with an ipsilateral island fibula transfer in an antegrade, retrograde or bipedicled fashion. Antegrade-flow pedicled flaps supplied by the peroneal vessels as in a conventional fibula free flap were used for proximal or middle one-third tibia defects, whereas retrograde-flow pedicled flaps based on the communicating branch between the peroneal and posterior tibia vessels were used for middle or distal-third tibia defects. The ipsilateral fibula was also transferred without transection of the peroneal vessel (bipedicled) for middle tibia defects. Eight patients also had a fibula fracture in the same leg, which was ultimately used as one of the osteotomy sites. All of the transferred fibulas showed hypertrophy after weight bearing. Non-union of one end and stress fracture occurred in two patients, which were successfully managed with a cancellous bone graft and application of the Ilizarov device. Previously, we performed this procedure only in patients with a failed free flap, below-knee amputation of the opposite leg or who refused surgery of the contralateral sound leg. But we are now applying this operation in all patients with a large tibia defect unless there is a severe comminution of the ipsilateral fibula or injury of the posterior tibia vessels. The advantages of the ipsilateral fibula transfer include avoidance of microvascular anastomosis and violation of a sound leg. The arc of flap rotation was not a problem because we were able to use one of three pedicle options. The drawback of this method is flap elevation in an inflamed and scarred surgical field. It is of paramount importance that placement of the fibula be in the line of maximal compression. Although hypertrophy of the transferred fibula will occur, increment of the bone will not be satisfactory if the fibula is eccentrically positioned. The island fibular transfer can considered as an alternative to a free flap.

15. Reverse Digital Arterial Arch in Zone 1 Digital Replantation

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Introduction: Refinements in microsurgery have made distal finger replantation an established technique with high success rates and good functional and aesthetic outcomes. However, it still represents a technically demanding procedure due to the small vessel caliber and frequent lack of vessel length, requiring the use of interpositional venous grafts in some instances. We describe a new technique for arterial anastomosis in zone 1 digital replantation, whereby the need for venous grafts is eliminated.

Materials and Methods: At the level of the nail base, the ulnar and radial digital arteries anastomose, forming the distal transverse palmar arch. By ligating one side of the arch, we can mobilize it and turn it distally for anastomosis in the distal stump or proximally for arteriovenous shunting. Applying this technique, ten cases (5 males and 5 females; age range, 18-54 years) of zone 1 digital replantation, according to Tamai classification, were performed between January 2011 and May 2016. This technique was used for arterial anastomosis in nine cases and arteriovenous shunting for venous drainage in one case. A retrospective case review was conducted. The technical description and clinical outcome evaluations are presented.

Results: Nine of the 10 replanted digits survived, corresponding to an overall success rate of 90%. One replant failed due to venous insufficiency. Blood transfusions were not required for any of the patients. Follow-up (range 1.5 to 5 months) revealed near-normal range of motion and good aesthetic results. All of the replanted digits developed protective sensation. The average length of hospital admission was 5 days. All patients were satisfied with the results and were able to return to their previous work.

Conclusions: The use of the reverse digital arterial arch is a novel and reliable technique in distal digital replantation when an increase in vessel length is required, allowing for a tension-free vessel repair without the need for vein grafts.

Key words: distal replantation, fingertip replantation, reverse digital arterial arch

16. The Use of the Corticoperiosteal Flap for Difficult Non-Unions of the Upper Limb

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Objective: Bone flaps have been successfully applied for the reconstruction of bone defects. Their use is widely accepted for the treatment of nonunions with long bone defects. However their use for small defects is less popular. This study aimed to evaluate the medium to long-term results with the vascularized corticoperiosteal flap from the medial femoral condyle in the persistent nonunions of the upper extremities

Material and Methods: 40 patients (35 males and 5 females) with persistent nonunion were evaluated from October 2007 to June 2015. Average age was 42 years (range of 26-63). Average size defect was 2,73 cm (±1,085 cm, range of 0,6-5,0). Every patient was treated 1 time at least (1-3). Bones involved were 17 ulna, 4 radius, 4 humerus, 3 scaphoid, 2 metacarpal, 9 phalanxes, 1 clavicle. Rigid internal fixation was obtained and the corticoperiosteal flap was dissected according to Sakai-Doi technique. Additionally time of consolidation, postoperative complications, and final outcome were recorded.

Results: Average follow up was 23 months (4-96). Bone union was obtained in every case. Clinical evidence of consolidation was observed as soon as 3-5 months postoperatively although radiologic evidence of bone union took more than 6-10 months in some cases. With protected rehabilitation all patients regained a functional range of motion and rejoined work. Donor-site complications were few and transient (paraesthesia, seroma, suture intolerance, painful squatting). No femoral fracture or knee instability was encountered.

Conclusions: Although most non-unions can be successfully treated by rigid fixation and nonvascularized bone grafting, the corticoperiosteal flap from the medial femoral condyle is an excellent alternative for difficult and persistent nonunions of the upper limb. We believe that this flap deserves a role when dealing with difficult nonunions as it affords healing in a single stage with minimal morbidity.

17. Vascular Supply of the Proximal Fibula and Its Implications in Free Epiphyseal Transfer

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Introduction:

Free proximal fibular epiphyseal transfer has been employed for the treatment of loss of the growth plate in a growing child. The optimal pedicle for this transfer has been debated since its introduction. This study addresses the detailed anatomy of vessels supplying this region, which will aid in optimizing the technique for this procedure.

Methods:

22 lower extremities were injected with ward's red latex. Through a posterior midline incision, the popliteal artery was identified at the popliteal fossa. Major branches and contributing vessels to the proximal fibula were dissected documenting the course, diameter, anatomical relations, and further branches.

Results:

A rich anastomotic network was identified around the fibular head in all specimens. Six consistent vessels were present contributing to this anastomosis, namely the inferior lateral genicular artery (ILGA), circumflex fibular artery (CFA), posterior tibial recurrent artery (PTRA), first recurrent epiphyseal artery (FREA), second recurrent epiphyseal artery (SREA), and superficial peroneal accessory artery (SPAA) (Figures 1 and 2), with average diameters of 1.5, 1.3, 1, 1, 0.7 and 1.4mm respectively. ILGA originated from the popliteal, giving an average of 3 branches to the fibular head. CFA was present in 21 specimens and absent in 1, originating from the anterior tibial in 7 specimens, popliteal in 6, tibio-peroneal trunk in 6, peroneal in 1, and an anomalous anteriortibial-peroneal trunk in 1. PTRA originated from the anterior tibial in 17 specimens and from the popliteal in 5. FREA originated from the anterior tibial in 14 specimens and from the anterior tibial recurrent artery (ATRA) in 8. SREA originated from ATRA in all specimens. SPAA originated from the anterior tibial in all specimens, which gave a branch travelling proximally to the fibular head before following the superficial peroneal nerve along the rest of its course.

Conclusion:

The ILGA and the anterior tibial artery are the main contributors to the blood supply of the proximal fibula. A rich anastomosis exists nourishing the area, and preserving it during harvest is crucial for the viability of the transferred growth plate whichever vessels are chosen as the pedicle.

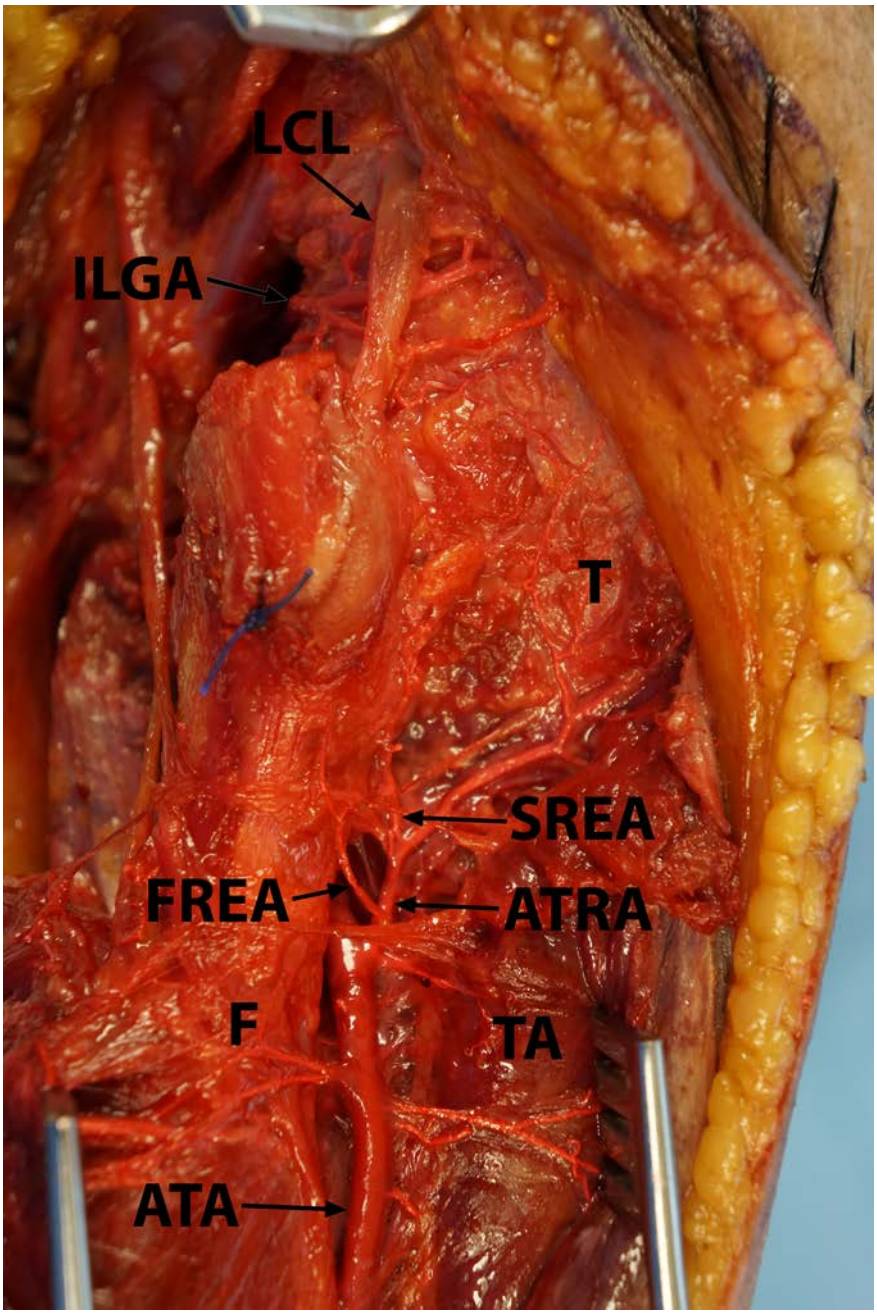

Figure 1:

Anterior view of the proximal tibia and fibula showing the supplying vessels to the fibular head. T, tibia; F, Fibula; LCL, Lateral collateral ligament; TA, tibialis anterior muscle; ATA, anterior tibial artery.

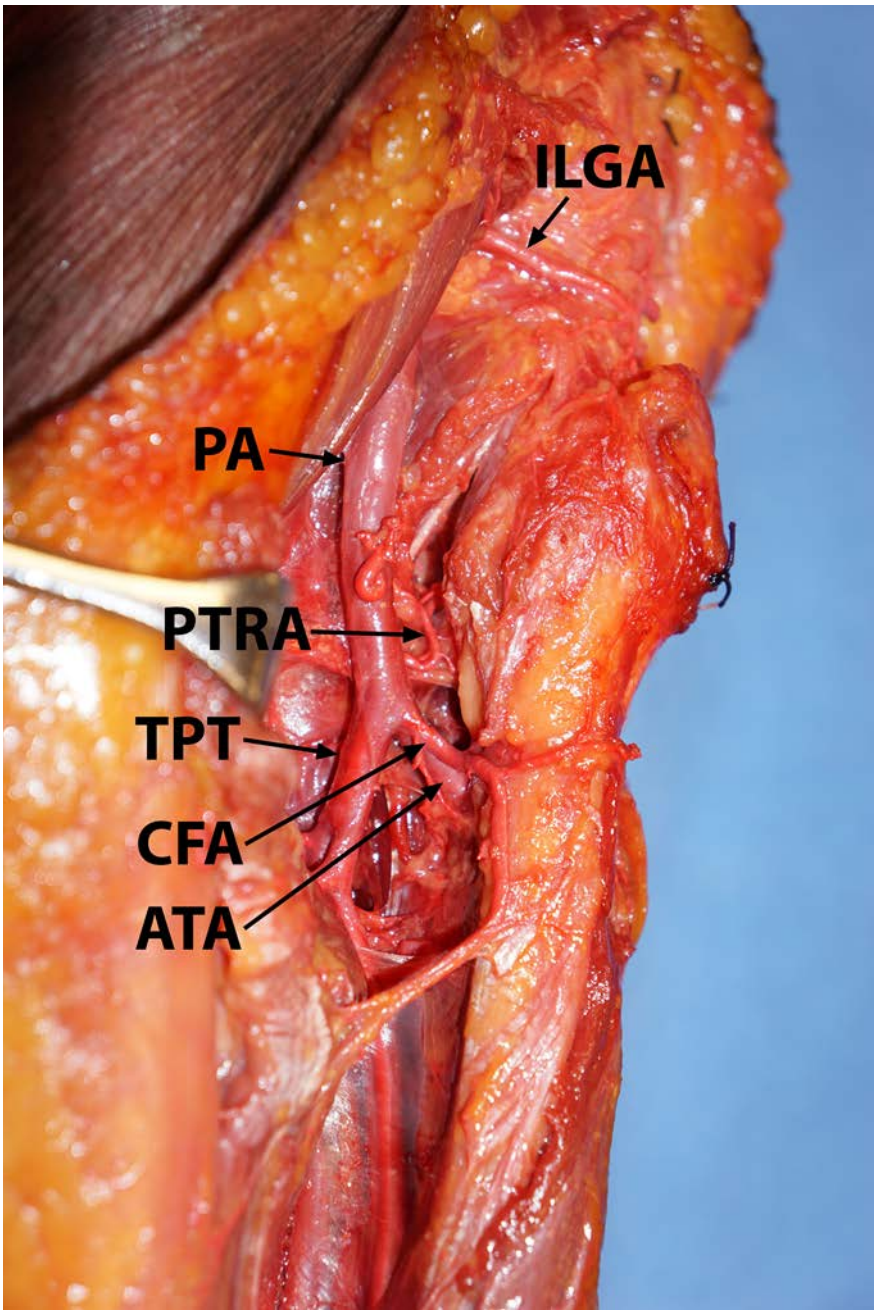

Figure 2:

posterior view of the proximal fibula showing the supplying vessels to the fibular head. PA, popliteal artery; TPT, tibioperoneal trunk; ATA, anterior tibial artery

18. An Alternative Thumb Reconstruction by Double Microsurgical Transfer from the First and Second Toe

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Restoring function and aesthetic appearance of the hand after traumatic loss of the thumb is the main goal in thumb reconstruction. When dealing with an amputation at the base of the first metacarpal bone, the main difficulty is to provide adequate bone length and soft tissue coverage including a suitable first web space to the reconstructed thumb.

Our purpose is to describe an alternate technique for reconstructing a thumb amputation at the level of the metacarpal base. A free great toe and a vascularized metatarsophalangeal (MTP) joint, including the second metatarsal, where transferred over the same pedicle.

Two patients who had a combined soft tissue defect and amputation of the thumb at the metacarpal base were reconstructed by a trimmed toe transfer on the medial side of the hallux, using the first dorsal metatarsal artery (FDMA) as a single pedicle to create a compound flap including the great toe and vascularized MTP joint from the second toe. The shaft of the second metatarsal was used to provide adequate length. An additional ALT flap in one case and a gracilis muscle flap were used for an appropriate coverage of the hand and first web space. Finally, a transposition of the second toe on top of the proximal phalanx of the hallux was performed to improve foot appearance and function.

No complications were found in terms of flap survival. They reported a very pleasant cosmetic and functional result in both donor and recipient sites.

When the level of amputation is closed to CMC level, our procedure offers the possibility to replace the native thumb like to like and restoration of hand function, associating in one stage thumb reconstruction with aesthetic refinements.

19. Free Vascularized Iliac Bone Flap Using SCIP(Superficial Circumflex Iliac Perforator)

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Free vascularized iliac bone flap using SCIP was performed for 4 cases. As the defect, 3 cases were finger bone, 1 was head and neck, and 1 was penis.

1st case was 18 years old male who had a defect at alveolar bone(Fig.1). We transferred a free vascularized iliac inner cortex with superficial circumflex iliac system(Fig.2).

2nd case was 40 years old male who suffered from mucofibroma at right thumb. We resected the tumor and transferred a 1 cm small vascularized iliac mini bone flap and this flap had a monitoring flap using a skin perforator(Fig.3,4,5).

3rd case was 36 years old male who suffered a thumb amputation and we reconstructed the thumb using SCIP vascularized mini bone flap(Fig.6,7).

4th case was GID(F to M) patient. We reconstructed a penis using 30cm big SCIP flap which include a vascularized iliac bone nourished by the bone branch of SCIA(Fig.8,9).

The minimum size of the harvested iliac bone was 1x1cm and maximum was 10')"

Ian Taylor first reported vascularized iliac bone flap nourished by DCIA in 1979. After that, iliac bone flap has been used for mainly used head and neck reconstruction. But DCIA iliac bone flap take a much time to harvest also cannot combined a big skin flap. However SCIP iliac bone flap is easy to harvest and less invasive and can combined a 30cm large skin flap.

As a bone reconstruction, fibula, scapula and medial condyle of femur are used as a donor site. But using SCIP, the scar can be hidden by an underwear and donor site morbidity is small.

We think SCIP vascularized iliac bone is desirable especially for small bone defect such as hand. This SCIP mini bone flap will be a one of best choice for small bone reconstruction.

Also SCIA system has many branches and nourishes a lot of components such as nerve, bone and lymph node. Using these branches, SCIP flap has a lot of possibilities other than bone flap.

Fig.1

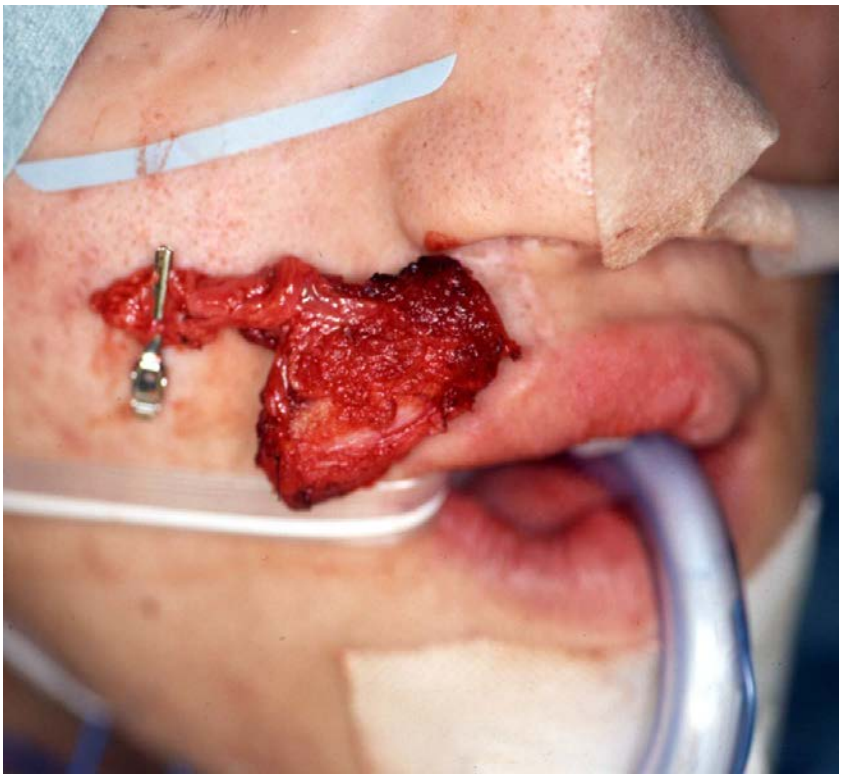

Fig.2

Fig.3

Fig.4

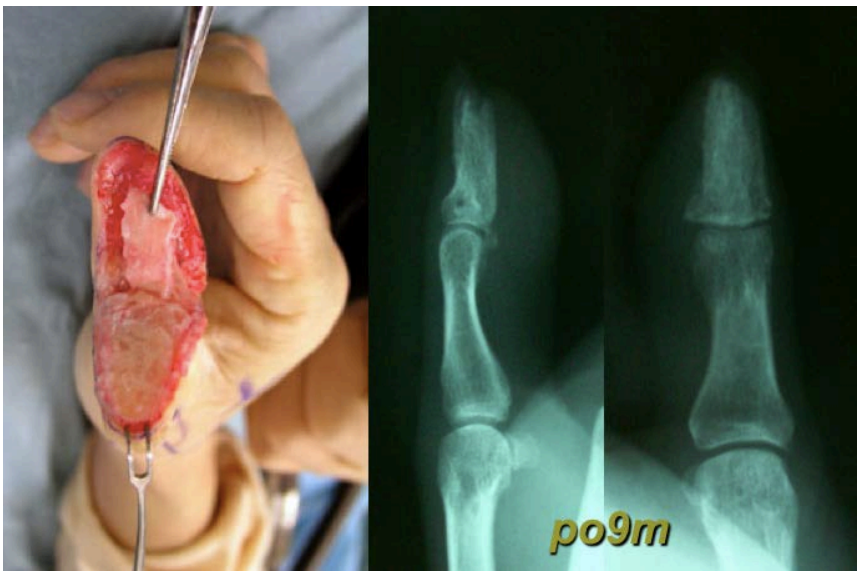

Fig.5

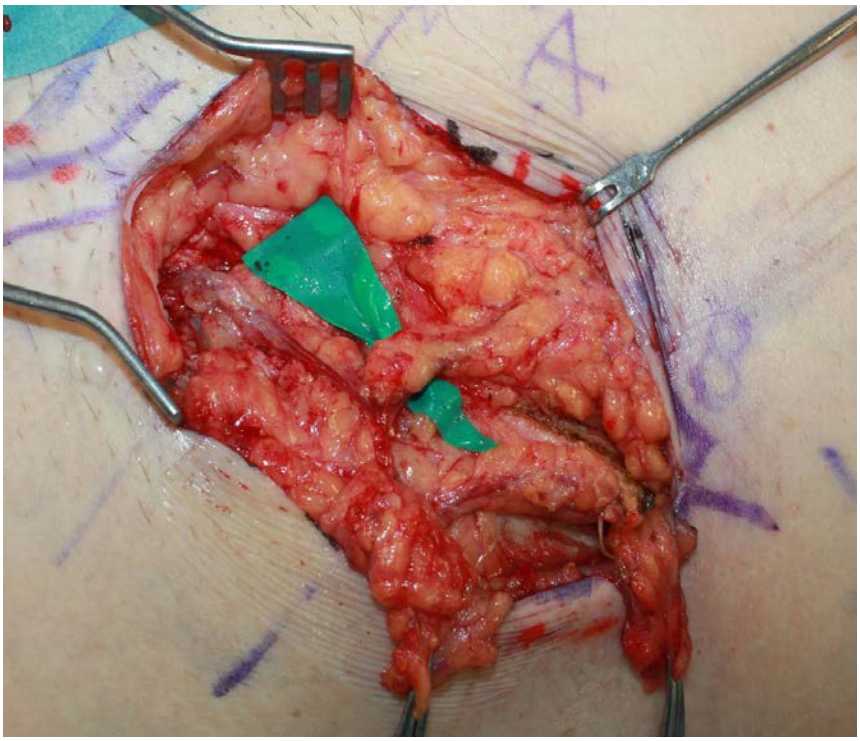

Fig.6

Fig.7

Fig.8

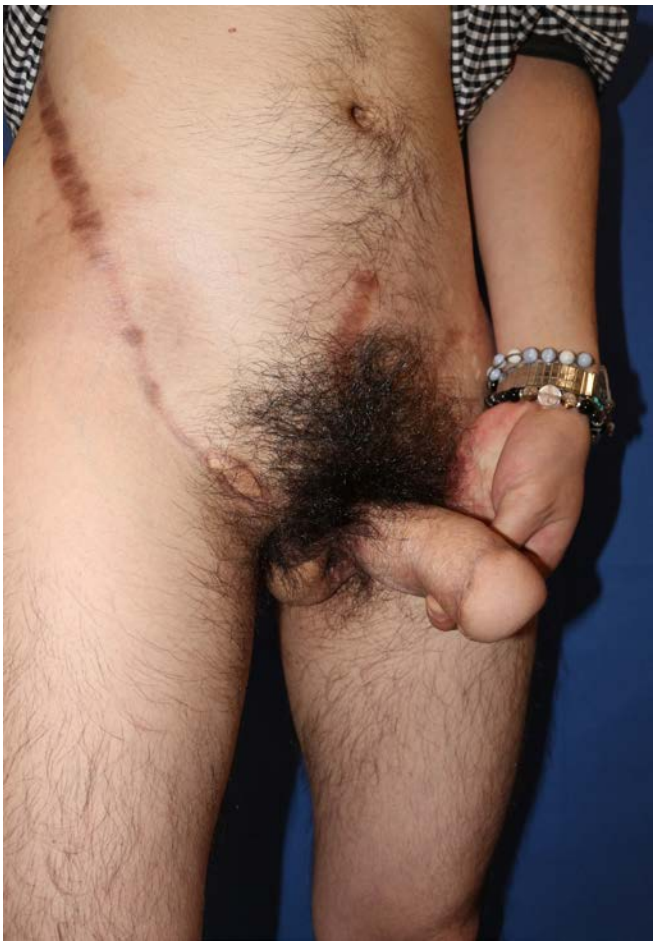

Fig.9

20. Functional Gracilis Muscle Transfer for Knee Extension and Limb Salvage

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PURPOSE: Loss of the quadriceps muscles or the femoral nerve either to satisfy adequate oncologic margins in tumour extirpation, or as a consequence of trauma, results in the loss of knee extension. Functional muscle transfer offers an option for limb salvage and restoration of ambulation. Larger muscle groups have traditionally been favoured to restore knee extension owing to a greater contractile force generated by a larger muscle cross-sectional area. Consequently, the smaller diameter gracilis muscle has been disregarded in the literature as unsuitable to support active knee extension. We present our center's experience with obtaining successful restoration of knee extension and resumption of ambulation using a transfer of a single functional gracilis muscle.

MATERIALS AND METHODS: A retrospective chart review was undertaken including all patients requiring restoration of knee extension as a result of trauma or oncologic reconstruction. Free or pedicled gracilis transfers were utilized in all cases. Patients were followed-up until functional ambulation was achieved or as part of routine oncologic surveillance. Major outcomes of interest included time in hospital, extensor motor strength, and ambulation status at final follow-up.

RESULTS: 4 patients were included in the study. Loss of knee extension resulted from an *en bloc* sarcoma extirpation in three patients and a traumatic injury to the anterior compartment in one. A free gracilis muscle was utilized in one case and pedicled transfers in the remainder. Three cases required additional microvascular skin and soft tissue coverage. The mean age at the time of surgery was 53.7 years (range 25-74 years). The maximum hospital admission was 10 days. At one-year follow-up, British Medical Research Council (BMRC) grade 4/5knee extension was achieved in all surviving patients. There were no occurrences of muscle flap failure or necrosis. Follow up MRI demonstrates significant hypertrophy of the gracilis muscle when functioning as a knee and hip extensor.

CONCLUSIONS: Free or pedicled muscle transfers using a gracilis muscle alone can achieve functional knee extension sufficient for ambulation. This surgical option offers an invaluable adjunct to limb salvage strategies while conferring limited donor morbidity.

21. Utility of Preoperative Angiography and Venous Imaging for Lower Extremity Flap Planning in the Chronic Wound Patient

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Background: The chronic lower extremity wound patient may possess myriad host-factors which adversely affect free tissue transfer, including arterial ischemia and venous insufficiency. Because of this, it is necessary to optimize flap planning in order to prevent future flap breakdown which may result in limb loss. Identification of relevant pathology in arterial and venous systems may allow for optimal vessel selection and increase flap survival.

Methods: A retrospective review of a prospectively maintained database was performed for all patients who underwent free tissue transfer for chronic lower extremity wounds between April 2011 - June 2016 by a single surgeon. The cohort of patients for whom recipient vessel angiography in addition to venous duplex imaging for venous thrombosis and insufficiency were compared to the cohort of patients for whom no imaging was performed. Relevant demographic data, comorbidities, and outcomes were collected and analyzed.

Results: One hundred one free flaps were performed in 96 patients. Of these, thirty-two consecutive free flaps underwent preoperative recipient-site angiography and venous duplex ultrasonography. Abnormal angiograms were observed in 71% (n=22). These included a new diagnosis of peripheral vascular disease requiring endovascular intervention (27.2%), atretic calf vessels (72.3%), or peronea magna (9.1%). Venous duplex ultrasonography detected a pathology in 43.8% of patients. These included deep venous thrombosis in the femoral (6.3%) or peroneal vein (3.2%); as well as venous insufficiency in the proximal deep venous system (18.8%), the distal superficial system (6.3%), the distal deep venous system (6.3%), or both superficial and deep systems (3.2%). In all cases for which arterial or venous pathology was noted, the operative plan was altered to perform anastomosis only to arteries with sufficient flow or to the venous system without reflux or thrombosis. Total flap loss was thus reduced from 13.0% in the 60 consecutive flaps prior to the introduction of preoperative imaging, to 3.1% in the imaging cohort (p=0.163).

Conclusions: Free tissue transfer for treatment of lower extremity chronic wounds remains a challenging reconstructive problem given the myriad host-factors which may adversely affect flap survival. Recent studies have shown that performing more than one venous anastomosis and anastomosis to the deep venous system may enhance flap survival compared to the superficial system. However, to date the utility of objectively evaluating each system has not been evaluated. These results indicate that preoperative angiography and venous duplex ultrasonography may be useful in optimizing flap recipient vessel selection and preventing flap loss.

22. Unilateral Above or Below Knee Amputation for Non-Traumatic Etiologies Allows for Function Ambulation: Application of the Lower Extremity Function Scale (LEFS) to a Diabetic Limb Salvage Population

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Background

Upwards of 30,000 lower extremity amputations occur yearly in the United States, with an estimated 1.6 million individuals living with the loss of a limb. Nevertheless, to date no study has objectively evaluated postoperative quality of life with a validated scoring system. The Lower Extremity Function Scale (LEFS) a widely used and validated tool to assess a person's ability to perform activities of daily living. Here we use the LEFS to objectively evaluate post-amputation quality of life for patients who underwent above the knee amputation (AKA) or below the knee amputation (BKA) for non-traumatic etiologies.

Methods

A retrospective review was performed for all patients who underwent AKA between December 2010 and January 2016. The LEFS was administered during follow-up clinic appointments or via telephone at least 6 months postoperatively. Mean scores for individual patients and the entire cohort were then calculated and analyzed.

Results

Ninety-eight patients underwent unilateral AKA for non-traumatic reasons during the study period, and 174 underwent below knee amputation. Of the 98 patients who underwent AKA, 28 completed an LEFS, and 55 BKA patients completed an LEFS survey. Mean time from date of amputation to survey completion was 19.2 months (range: 6 – 37 months). Mean age in the AKA group was 65.1 years (SD = 10.5 years) compared to 64.3 years (SD = 13.1 years) in the BKA group. The average LEFS score in the AKA group was 41.5 (SD = 15.7) compared to a score of 45.8 (SD = 18.9) in the BKA group. Notably, for AKA patients, each 1-year increase in age demonstrated a mean decrease in LEFS score of 0.71 ($p = 0.01$); whereas each 1-year increase in age resulted in a decrease in LEFS score of only 0.39 in the BKA cohort ($p=0.0153$).

Conclusions

Lower extremity above or below knee amputation remains a viable option for carefully selected patients for whom other reconstructive options are no longer available. These results are consistent with our observed experience in which AKA patients are limited to mainly household ambulation, whereas BKA patients are generally active community ambulators. Notably, there is a statistically significant decline in functional score for AKA patients for each year post-surgery that is greater than that for BKA patients. This underscores the importance of limb length preservation when possible in order to limit future morbidity.