Purpose: Secondary lymphedema may be a lifelong and debilitating consequence of lower extremity oncologic resection and reconstruction. Our goal was to identify risk factors for the development of lymphedema in patients treated for thigh sarcoma.

Materials and Methods: We retrospectively analyzed all patients who underwent thigh sarcoma resection and reconstruction at the Mayo Clinic between 1993 and 2014. We compared the demographics, tumor characteristics, surgical management, and complications of patients who developed lymphedema against those who did not develop lymphedema postoperatively.

Results: There were a total of 161 patients identified during this time frame; 13 were excluded for pre-existing lymphedema. Of the remaining 148 patients, 12% of patients developed lymphedema postoperatively during an average follow up duration of 26 months. There were no differences in age, BMI, or prior history of DVT/venous stasis; however, there was a higher rate of prior MI or CHF in patients who developed lymphedema postoperatively (p<0.05). There were no differences in wound dimensions or type of reconstruction performed. Two patients underwent lymph node dissection but neither developed lymphedema. Defect location in the lateral thigh trended towards a lower risk of lymphedema (OR 0.08, p=0.079) while a medial thigh defect was associated with an increased risk of lymphedema (OR 2.81, p < 0.05). There was no difference in the use of neoadjuvant and adjuvant radiation between the two groups. Twenty two percent of patients who ultimately developed lymphedema also experienced wound dehiscence postoperatively compared to the 4.6% rate of dehiscence in their lymphedema-free counterparts (p < 0.05).

Conclusions: Lymphedema is not uncommon following major oncologic resection and reconstruction. Pre-existing cardiac disease and a medial thigh location contributed to the development of lymphedema postoperatively, while a lateral thigh defect likely minimizes the
risk but further study in a larger population is required to make this determination. This difference in lymphedema risk is likely related to the density of lymphatic channels in these regions of the thigh, and care should be taken to minimize unnecessary disruption of these lymphatics when possible, especially in the face of radiation. Non-infectious wound dehiscence may represent an early indicator of patients that will ultimately develop lymphedema, and we recommend that these patients be monitored closely.

7:35 AM - 7:40 AM
**Anatomical Study and Surgical Correlation of Superficial Branch of SCIA for SCIP flap elevation; using CT angiography analysis of 165 patients**
Asan Medical Center, Seoul, South Korea
Hyun Suk Suh, MD; YoonKyu Chung, MD, PhD; Joon Pio Hong, MD, PhD, MMM; 1Asan Medical Center, 2Wonju Christian Hospital Yonsei University School of Medicine

Superficial circumflex iliac artery perforator (SCIP) flap is the thinnest skin flap and has the potential to become 'the flap' of decade. Nevertheless, SCIP flap is not that popular as ALT or DIEP flap yet. One of the reason for unpopularity is puzzling anatomical variation of groin area. The objective of this study is to clarify the anatomy of superficial branch of superficial circumflex iliac artery (SCIA) with CT angiography to make flap design and elevation more reliable without the fear of anatomical variation.

Retrospective review of consecutive 165 patients who had CT angiography with maximum intensity projection image reconstruction before SCIP flap was done for this study. In 23 patients (13.9%) superficial branch could not be found or distinguished from other vessel because of thin soft tissue (<3mm) or improper timing of scanning. In 142 patient and 284 images, superficial branch was visible in 270 images (95%).

Superficial branch of SCIA was branching from femoral artery in most of the cases (84.8%) and it penetrated deep fascia after less than 1 cm of travel (Figure 1). Superficial branch was penetrating deep fascia more medial and cephalic to the deep branch. 55.6% of superficial branch had perforator type branch, i.e. superficial branch had only one perforator just after penetrating deep fascia. 44.4% superficial branch was axial type perforator i.e. superficial branch was traveling through superficial fatty layer above the superficial fascia and headed toward anterior superior iliac spine sprouting multiple perforators (Figure 2).

Therefore, to use superficial branch as a source pedicle of the flap, design should be more medial not to injure the vessel (Figure 3).

For this reason our flap elevation above the superficial fascia is safe if medial border of flap lays over the femoral artery. By using superficial branch as a pedicle vessel, flap can be elevated super thin from the beginning of elevation and dissection of deep fat layer around the lymph node can be minimized (Figure 4).
Figure 1. Location of deep fascia penetration by superficial branch

*: where superficial branch penetrates deep fascia
Figure 2.

Figure 3. If flap is located lateral to the critical point, superficial branch can be injured or not include in the flap.
Subtalar Fusion with Iliac Bone Free Flap after Recalcitrant Nonunions
Saint Louis University Hospital, Saint Louis, MO, USA
Ignacio Roger, MD2; Alicia Worden, MD1; Joao Panattoni, MD1; 1Saint Louis University,
2Hospital Fremap Majadahonda

Introduction: Fractures of the calcaneus are associated with secondary osteoarthritis of the subtalar joint. Operative treatment is subtalar fusion which can be complicated by nonunion. In a persistent nonunion, vascularized bone flaps offer superior biologic and mechanical properties as well as accelerates joint fusion and decreases morbidity. We report the successful technique of using vascularized iliac bone free flap for treating subtalar failed fusions.

Methods: Our two cases sustained calcaneal fractures which were initially or subsequently treated with subtalar arthrodesis. Case one developed septic subtalar nonunion during treatment and case two failed three attempts at subtalar arthrodeses.

In this technique, the iliac crest bone flap harvested measured 4x4 cm (case one) and 3x3 cm (case two). It was supplied by the deep circumflex iliac artery and was anastomosed to the recipient anterior tibial artery.

Results: No flap donor or recipient site complications occurred. Fusion was confirmed on CT scan and weight bearing was initiated at 5-6 months. At latest follow up (1-2 years), no complications occurred.

Conclusions: Various studies have demonstrated that vascularized bone grafts in orthopaedic and foot reconstructive surgery offer superior biologic and mechanical properties over nonvascular bone grafts as well as accelerating joint fusion and decreasing morbidity. Our results show that the subtalar nonunion treatment with a vascularized iliac bone flap may be feasible and such a reconstruction could be clinically successful.
Discussion

Telescoping Vascularized Fibular Graft (VFG): A New Method For Bridging Bone Defects With Shortening
Upper Limb, Hand and Reconstructive Microsurgery Unit, Assiut, Egypt
Mohamed Mostafa Kotb, MD, Orth; Assiut University Hospital

Abstract:
Introduction: Post traumatic and congenital bone defects with shortening represent a challenge with no definite solution. The aim is convert the segmental defect into a segmental fracture with vascularized middle segment that heals without creeping substitution. Methods: Congenital tibial pseudoarthrosis, all neurofibromatosis (5 cases), Other pathology including post traumatic (n=7). Average age at surgery 12.6 yrs (5 - 18). Average limb length discrepancy 9cm (7 - 13). Latency period before lengthening 15-21 days postoperatively. Contralateral Osteoseptocutaneous vascularized fibular graft (VFG) with either ilizarov or monlateral LRS frame were used. Initial rate of lengthening 0.5 mm/day then adjusted. Removal of frame was done when bridging callus was seen at least 3 cortices. Results: All cases went to union, 3 cases needed secondary procedure, iliac bone graft or frame re-adjustment. Length gain: 7.4 cm (4.4 - 8.7). Healing index: 89 day/cm (22 - 280). Discussion and Conclusion: Vascularized bone
transplant is a useful technique in reconstruction of bone defects, the additional use of external fixator provides additional benefit for management of shortening e.g. after pseudoarthrosis resection, and provides one stage reconstruction for combined bone and soft tissue defects (Unique). The use of telescoping technique, allows simultaneous correction of shortening while treating the non-union in a single-stage operation. This method avoids corticotomy in the congenitally or traumatically affected bone and markedly shortens the time of frame application.

7:53 AM - 7:58 AM
Knee Joint Reconstruction after Hemiarticular Resection Using Pedicled Patella and Vascularized Fibular GRAFT
Upper Limb, Hand and Reconstructive Microsurgery Unit, Assiut, Egypt
Mohamed Mostafa Kotb, MD, Orth; Assiut University Hospital

A report nine patients had resection of tumors around the knee joint that involved half of the articular surface of the femoral or tibial side. Average age of the patients was 28 years (range, 14–40). Tumor pathology was giant cell tumor in six patients, osteoblastoma in two, and benign fibrous histiocytoma in one patient. Two patients had recurrent tumors. The tumor was located in the distal femur in seven patients and in the proximal tibia in the remaining two. The ipsilateral patella pedicled on the infrapatellar fat pad was used to substitute the resected articular surface and a vascularized fibula osteoseptocutaneous flap was used to reconstruct the metaphyseal defect. Average follow-up period was 6.5 years (range, 3.5–10 years). All flaps survived. Average time to bone union was 3.5 months (range, 3–4 months), and average time to full weight-bearing was 5 months (range, 4–6 months). No radiological signs of avascular necrosis of the patella were observed in any patient. Two patients required secondary procedures for correction of instability. One patient had local recurrence. At final follow-up, the median range of knee motion was from 108 to 1008. The average Knee Society Score (KSS) was 76 points (range; 50–85 points), and the average KSS functional score was 76.6 points (range, 70–90 points). In conclusion, the procedure is a reliable option for after resection of tumors that involve half the articular surface of the femur or the tibia.

7:58 AM - 8:03 AM
Does skin perforator flap accommodate foot growth in children?
Asan Medical Center, Seoul, South Korea
Jae Young Cho; Sanggye Paik Hospital, inje University College of Medicine; Joon Pio Hong; Asan Medical Center

Backgrounds: Reconstruction of soft tissue defects in children is still challenge for most reconstructive surgeons. Several factors such as adequate growth or functional aspect should be considered. Adequate musculoskeletal growth is important for future growth of children, especially in joint area. Perforator flaps have gained wide popularity for diversity of use and now considered as first choice in most soft tissue problems. We evaluate growth accommodation of perforator flaps in pediatric patients in foot and ankle area reconstruction.
**Methods:** From 2003 September to 2014 February, a retrospective review was performed to all pediatric patients (<16 years of age) who had foot and ankle area soft tissue defects and underwent microsurgical reconstruction with skin perforator flaps in Asan Medical Center. We evaluate flap growth in two ways. First, compare flap dimension with foot length growth obtained by multiplying long axis and short axis of the flap during follow up. Second, compare ratio of flap area to foot area in intraoperative and follow-up clinical photographs using photo-anthropometric technique. Proportionality indexes (PI) defined as the ratio of the flap area to the foot area. All values were measured and statistically evaluated by Pearson’s correlation analysis and Paired T test. Subsequent complications and functional results were also evaluated.

**Result:** Twenty-eight patients met the selection criteria. The mean patients’ age was 9.8 years, and the mean follow-up period was 56 months. The mean intra-operative flap area was 78.91㎠ and mean postoperative flap area was 99.48㎠. The mean intra-operative foot length was 217mm and mean postoperative foot length was 240mm. The mean intra-operative PI was 0.3. The mean post-operative PI was 0.2475. By statistical analysis, foot length growth and flap dimension growth had positive correlation and there was statistically significant difference between two PI. None of these patients suffered from growth disturbance or functional impairment.

**Conclusion:** Although flap growth seemed relatively small for foot growth, overall flap growth accommodated compare to foot growth. Skin perforator flap showed growth as musculoskeletal growth and can be considered as reliable and feasible option in pediatric reconstructive surgery.

**Discussion**

8:06 AM - 8:11 AM

**The venous anatomy of the Superficial Circumflex Iliac Perforator flap**

Singapore General Hospital, Singapore, Singapore

Jeremy Sun, MBBS, MRCS; Bien Keem Tan; Christopher, Hoe Kong Chui, Mbbs, Mrcs, Mmed; Kok Chai Tan; Chee Liam Foo; Terence Goh; Singapore General Hospital

**Introduction:**

Reconstructive surgeons frequently face the problem where the flaps they use do not match the thin nature of the surrounding recipient site soft tissue especially in the lower limb. Hence, walking and shoe fitting becomes difficult and the patient has to undergo multiple debulking procedures of the flap. The superficial circumflex iliac perforator (SCIP) flap is raised supra-fascial and has been gaining popularity due to its super thin nature and well-concealed donor site. A common complication of this flap is venous congestion. We aim to clarify the venous anatomy of this flap by performing a clinical and cadaver study.

**Method:**

10 cadaveric hemi-groins were dye injected and dissected. The focus of the dissection is to study the course of the superficial vein, as well as, the deep veins in correlation to the main pedicle. 16 consecutive patients underwent reconstruction of lower limb defects with the SCIP flap. The
venous anatomy was recorded and correlated with the cadaveric dissections to identify the predominant draining vein, the vessels' lengths and calibre and the incidence of venous congestion and flap survival.

Results:

The superficial vein was present in all cases and it was noted to be the predominant draining vein. It is of larger calibre and runs within 1-2 cm of the main pedicle. 8 of 16 cases were reconstructed using the superficial vein only and 8 of 16 cases had dual venous anastomosis. All SCIP flaps survived in this series but 5 out of the 16 cases showed signs of venous congestion. There was no statistical difference in the rates of venous congestion between the superficial vein only SCIP flap and the dual venous anastomosis SCIP flap.

Conclusion:

The SCIP flap can be reliably raised based on one artery and one superficial vein with low rates of venous congestion. Microsurgical anastomosis involving only the deep venous system is not encouraged, as it is likely to lead to severe venous congestion.

Figure 1. Intra-operative photo of the wound with external fixators

Figure 2. Ambulating with footwear at 6 weeks post flap surgery after superficial vein only SCIP flap.
Figure 3. Superficial vein (green clip) and the SCIP and accompany VC pointing downwards.

8:11 AM - 8:16 AM

Expanding the Application of the Profunda Artery Perforator Flap with a Vertical Design
Louisiana State University Health Sciences Center, New Orleans, LA, USA
James L. Mayo, MD1; Robert J. Allen, MD, FACS1; John T. Lindsey, MD, FACS2; Charles L. Dupin, MD, FACS1; Hugo St. Hilaire, MD, DDS, FACS1; 1Louisiana State University Health Sciences Center, 2Tulane University

BACKGROUND

The profunda artery perforator free flap (PAP), also known as an adductor flap, has not gained widespread acceptance for non-breast reconstruction. This is likely due to the presence of a proven workhorse in the anterolateral thigh flap (ALT). Versatility of the ALT does not necessarily overcome its disadvantages, namely the location of the scar, the potential neurosensory dysfunction and the weakness of the vastus lateralis in cases of an intramuscular perforator. The PAP flap, when harvested in a vertical orientation, offers excellent fasciocutaneous free flap coverage with the benefits of a medial donor site, a consistent anatomy and relative ease of dissection. These characteristics support its use for free flap coverage of a variety of applications. The authors review the anatomy, describe harvest technique and review their series of vertical PAP reconstructions.

METHODS

Between May 2014 and May 2015, the authors performed twenty-two vertical profunda artery perforator flaps in twenty. The flaps were utilized in lower extremity (n=11), upper extremity (n=2), head and neck (n=6), and breast (n=3) reconstructions. We assessed indication for coverage, flap anatomy, harvest technique, and outcomes (both donor and recipient). Details
reviewed include wound etiology, flap size, perforator number, recipient vessel, and complications. Follow up ranged from 30 to 400 days.

RESULTS

Twenty patients underwent free flap reconstruction with vertical PAP flaps (VPAP). Five patients were under eighteen years of age (4-17 years old). Adult flap sizes ranged from 72-225 cm². The median flap width was 7.1cm and length 18.4cm. The pedicle length ranged from 7 to 10 cm, 8.75 cm average. Three flaps (14%) had two perforators joining within the muscle to a single pedicle. There were no flap losses. One breast reconstruction developed fat necrosis. A tongue reconstruction developed a posterior dehiscence treated with washout and closure. One patient had a seroma at the medial thigh requiring washout and re-closure. No patients developed sensory disturbance, and there was no donor site wound dehiscence.

CONCLUSION

The VPAP flap is a safe and effective option for perforator-based free flap reconstruction. The anatomy is quite consistent making this flap an excellent alternative to the anterolateral thigh flap. Due to ease of harvest and proven versatility of application, the VPAP is recommended as a strong consideration when fasciocutaneous free flap coverage is required. We believe that with increased familiarity in harvesting this flap, the VPAP may replace the ALT in multiple clinical situations.

8:16 AM - 8:21 AM
The further advancement of SCIP flap (superficial circumflex iliac artery perforator flap)
The University of Tokyo Hospital, Tokyo, Japan
Mitsunobu Harima; Shuji Yamashita; Isao Koshima; The University of Tokyo Hospital

(Background)

With the recent development of perforator flaps, the major pedicle vessels of musculocutaneous or fasciocutaneous flaps have been replaced by small perforators and whole muscle and fascia and major vessels are sacrificed without any decrease of skin territories.

This concept of perforator flaps can be also applied to the conventional axial pattern flap such as groin flap. SCIP [skip] flap with only a perforator and a small segment of the superficial circumflex iliac vessel has been installed in 2004 Recently, application of SCIP flap has been expanding. We would like to show advancement of SCIP flap.

(Materials and Method)

We have performed about 140 cases using SCIP flap. In this presentation we will present some cases. First case is using SCIP flap as thin flap to cover the donor site of big toe after wrap-around flap(Fig.1). Second case is 24 years old GID. We made a penis using adiposal ostero cutaneous SCIP flap with separated iliaccrest(Fig.2). Third case is 40 years
old chondromucoidfibroma. We transferred vascularized iliac bone flap nourished by SCIA after the resection (Fig.3). Fourth case is facial reconstruction. We transferred SCIP adiposal flap intra-orally (Fig.4). Fifth case is nerve reconstruction. Vascularized lateral femoral cutaneous nerve flap with SCIA was elevated to intermit between radial nerve after resection of neuroma (Fig.5). Sixth case is breast reconstruction. SCIP and DIEP combined flap was elevated and anastomosed to internal mammary artery and vein and lateral thoracic artery and vein (Fig.6). Seventh case is reconstruction of lower extremities. SCIP-TAP combined mega flap which is more than 50 cm was transferred to leg. (Fig.7)

(Result)

Almost all cases were succeeded. Total necrosis occurred in only 3 cases and partial necrosis were 5 cases.

The result of any presented cases was good. There were no necrosis or absorption of bone.

(conclusion)

SCIP flap has more applications as followings: SCIP OC flap for urethropenile, vaginal, and fingertip reconstruction, adiposal flap for facial (intraoral approach) and breastaugumantation (under local anesthesia), small flap for donor of wrap around flap, block for reconnection of transected muscle in facial synkinesis, free nerve flap, mega flap with AMT for extremity and pharyngoesophagus etc.

The territory of SCIP flap has many components such as skin, bone, nerve, fascia, and lymph node. So SCIP flap can be used for many types of reconstruction. Also near the SCIA system there are many other famous perforators such as SIEA, ICAP, TAP, ALT, AMT. So we can use SCIP flap as combined and mega flap.

As a conclusion, SCIP flap has many possibilities.

Fig.1
Fig. 6

Fig. 7

8:21 AM - 8:24 AM
Discussion
Ex-Vivo Normothermic Perfusion to Optimize Limb Preservation
Cleveland Clinic, Cleveland, OH, USA
Eliana F. R. Duraes, MD; Kashyap Tadisina, MD; Maria Madajka; Russell Frautschi, BA; Qiang Liu, MD; Cristiano Quintini, MD; Francis Papay, MD; Antonio Rampazzo, MD, PhD; Bahar Bassiri Gharb; Cleveland Clinic

Introduction:

Traumatic hand amputations are devastating injuries with significant psychological and socioeconomic consequences. Although advances in medical technology and surgical skills allow replantation of most amputated parts, only about 14% undergo replantation. With the technical demand of replantation surgery, the time commitment to the procedure and postoperative care, fewer surgeons are performing replantation procedures. In extremities, irreversible ischemic injury occurs in muscle after 2-4 hours of warm ischemia and 6-8 hours of cold ischemia, hence the importance of minimizing ischemia time. Normothermic ex-vivo perfusion has the potential to extend the time between amputation and the actual replantation/transplantation, making it possible to improve viability of the limbs and allow procurement from remote, distant locations. Our research goal was to establish a model of normothermic ex-vivo limb perfusion as an alternative to cold preservation.

Methods:

Twelve porcine limbs underwent ex-vivo limb perfusion. All limbs were perfused using perfusion parameters as previously described and with the objective to perform 12 hours of ex-vivo perfusion followed by 2 hours of simulated transplant reperfusion. Hemodynamics, Complete Blood Count (CBC), arterial and venous blood gases, pH, electrolytes, limb compartment pressure, and muscle contractility were measured to assess viability of the limb. Creatine Kinase (CK), Lactate Dehydrogenase (LDH) were measured as markers of muscle tissue injury and H&E staining was performed to assess muscle, skin and nerve histology. Control limbs were preserved at 4°C (cold storage) and 25°C (room temperature).

Results:

All limbs were successfully perfused for an average of 10.5 hours, with 9 of twelve limbs undergoing 12 hours of perfusion. Average warm ischemia time was 1 hour 56 minutes (range 39 minutes – 3 hours 45 minutes). Average cold ischemia time was 54 minutes (range 0 – 4 hours 30 minutes). Perfusion was performed at 32 °C in 9 limbs, at 22°C in 2 limbs, and at 39 °C in one limb. Reperfusion was successfully carried out in 8 limbs with whole blood. Compared with control limbs, the perfused limbs maintained contractility.

Minimization of warm ischemia time, use of oxygen carrier in perfusate solution, and correction of acid-base abnormalities were associated with favorable perfusion based on maintenance of optimal perfusion parameters (i.e. 100mmHg systolic pressure, physiologic blood pH, and muscle contractility/compartment pressure < 32mmHg) were the.
Conclusions:

Preliminarily results of normothermic ex vivo perfusion show promise in allowing preservation of function and architecture of the tissues in a more physiologic manner compared to cold storage.

8:29 AM - 8:34 AM
Proximal-to-Distally Elevated Superficial Circumflex Iliac Artery Perforator Flap Enabling Hybrid Reconstruction
University of Tokyo Hospital, Tokyo, Japan
Hidehiko Yoshimatsu, MD; Takumi Yamamoto; Akitatsu Hayashi; Takuya Iida; University of Tokyo

Introduction

Recently, the use of superficial circumflex iliac artery perforator (SCIP) flap has gradually become common. Most authors elevate the flap from the lateral edge of the skin paddle, as in elevating a groin flap. While this method may seem straightforward, perforator identification can be treacherous for surgeons not familiar with dissection of perforators with small diameters. In this study, we introduce a new technique in elevation of a SCIP flap, which starts out from identification of the pedicle arteries (proximal-to-distal elevation).

Materials and Methods

Proximal-to-distally elevated SCIP flap was used in 24 patients. There were 16 male and 8 female patients with an average of 52.9 years (range, 19-84 years). Preoperative identification of the SCIA was made using handheld Doppler ultrasound. The femoral artery, pubic tubercle, and anterior superior iliac spine (ASIS) were also marked. The incision was made on the markings between the femoral artery and ASIS. The vessels were located and carefully dissected in the adipose tissue layer. In cases where vascularized fascia, vascularized iliac bone, or the sartorius muscle were required, the deep branch of the SCIA was identified and dissected, and branches to each of the structures were confirmed.

Results

Flaps survived completely in all but 2 cases. In one case, postoperative compression of the cast caused epidermal necrosis in a small region. In another case, the flap was removed on postoperative day 10 by the patient.

The superficial branch of the SCIA was used as the sole pedicle in 18 cases, the deep branch in 2 cases, and both branches were used in 4 cases. Vascularized anatomical structures included were: sartorius muscle in 3 cases, iliac bone in 3 cases, lymph node in 2 cases, and deep fascia in 1 case. There were no complications at the donor sites.

Conclusions
This proximal-to-distal elevation confers several advantages: First, the surgeon can decide which part of the SCIA to use as the pedicle depending on his or her microsurgical skills. Second, should the superficial branch be damaged during pedicle dissection of a SCIP flap, flap elevation can be resumed by switching the pedicle to the deep branch of the SCIA, which can always be found under the deep fascia, medial to the anterior superior iliac spine. Third, various vascularized structures can be procured from the same region.
The Lateral Femoral Condyle Flap Based on The Superior Lateral Genicular Artery: Anatomical Study and Harvest Technique
Mayo Clinic, Rochester, MN, USA
Mohamed Morsy, MBBCh; Yoo Joon Sur, MD, PhD; Osman Akdag, MD; Michel Saint-Cyr, MD; Steven L. Moran, MD; Mayo Clinic

Introduction:

The superior lateral genicular artery (SLGA) is the main blood supply to the lateral femoral condyle (LFC). This study addresses the detailed anatomy of this artery, and the harvest technique of a vascularized bone flap from the LFC.

Methods:

17 fresh frozen lower extremities were injected with ward's red latex. Through a posterior incision at the popliteal fossa, the SLGA was identified at its origin from the popliteal artery, and meticulously dissected distally along its course. The course, diameter, anatomical relations, length and branches were documented. An additional lower extremity was used to illustrate the harvest technique.

Results:

The SLGA was consistent in all specimens. It originated from the popliteal artery at a mean distance of 43.22 mm proximal to the knee joint line. The mean diameter at origin was 1.88 mm. It ran laterally posterior to the femur, until the lateral intermuscular septum. Posterior to the septum, it divided into superficial and deep branches. At this point, a sizable skin perforator emerged and ran laterally posterior to the intermuscular septum (Figure 1). The superficial branch travelled anteriorly to end at the patella. The deep branch pierced the intermuscular septum to travel on the lateral surface of the femur, giving branches to the vastus lateralis, periosteum and ending by terminal branches to the LFC (Figure 2). Mean length from origin of the SLGA to the termination point of the deep branch was 55.41 mm. Harvest of the flap is depicted in figures 3-8.

Conclusion:

SLGA has very consistent anatomy, formidable length and suitable diameter at origin for microvascular anastomosis. These, together with the straightforward harvest technique, make it a good pedicle for a vascularized bone flap from the lateral femoral condyle.
Figure 1: Posterolateral view of the supracondylar femoral area with the biceps removed. (A) Popliteal artery, (B) SLGA, (C) Superficial branch, (D) Deep branch, (E) Skin perforator, (F) Lateral condyle, (G) Vastus lateralis, (H) Deep fascia
Figure 2: Terminal branches of the SLGA supplying the LFC
Figure 3: Incision designed on the posterolateral thigh in relation to the biceps muscle (red)
Figure 4: The SLGA located between the vastus lateralis (A) and the biceps femoris (B)
Figure 5: SLGA supplying the LFC shown after retraction of vastus lateralis anteriorly
Figure 6: Flap design
Figure 7: Dissection of the pedicle to the popliteal vessels after harvest of the bone flap
Introduction:

Lower extremity trauma accounts for over 300,000 injuries annually, accounting for over 36% of all reported injuries. Local or free microvascular tissue transfer can be used to achieve definitive closure of lower extremity fractures, but functional outcomes remain unclear. This study investigates the functional outcomes of patients following lower extremity fracture and definitive wound closure by local or free microvascular tissue transfer.
Methods:

A retrospective review of all patients requiring definitive tissue coverage by the Plastic and Reconstructive Surgery service in a metropolitan Level 1 trauma center between October 2013 and March 2015 was conducted. Outcomes were evaluated using odds ratios with a confidence interval of 95%.

Results:

Of 48 patients meeting study criteria, 30 (63%) presented with open tibial fractures, of which 1 (3.3%) was classified as Gustilo-Anderson grade 1, 9 (30%) grade 2, 1 (3.3%) grade 3a, 16 (53.3%) grade 3b, and 3 (10%) grade 3c. Definitive bone fixation was performed through plate and screw in 17 (56.67%), intramedullary nail in 6 (20%), or external fixator in 5 (16.67%), while 2 patients were lost to follow up. Definitive closure was achieved in 12 (40%) through local rotational (33.3% gastrocnemius, 66.67% soleus), and in 16 (53.3%) by free tissue transfer (18.8% ALT, 25% rectus, 25% latissimus, 18.8% gracilis, 13% other). Of the 10 patients with 6 or more months of follow up, 5 (50%) patients achieved union or delayed union at 216 days (range 84-441 days). Seven (70%) patients were able to return to their pre-injury level of function, 3 (30%) required use of an assistance device, and none were non-ambulatory at 7 months follow up. Flap survival rate was 100%. Eight patients with physical therapy records required 5.9 months of therapy (range 1.8-9 months). Use of a local flap was predictive of ambulation at discharge (OR 0.26; p=0.05).

Conclusion:

Following lower extremity fracture, 70% of patients returned to their previous level of function. While long term follow up was found to be low in the county healthcare system, use of a local flap for definitive wound closure was associated with early ambulation at the time of discharge.

8:47 AM - 8:52 AM
Vascular Anatomy of the Inferior Medial Genicular Artery for Design of a New Vascularized Bone Flap from The Proximal Tibia
Mayo Clinic, Rochester, MN, USA
Mohamed Morsy, MBBCh; Yoo Joon Sur, MD, PhD; Osman Akdag, MD; Michel Saint-Cyr, MD; Steven L. Moran, MD; Mayo Clinic

Introduction

the inferior medial genicular artery (IMGa) is the main blood supply to the medial proximal tibia on which a new vascularized bone flap can be designed. This study addresses the detailed anatomy of this artery from the reconstructive surgeon's point of view, for the possibility of harvesting a vascularized bone flap.

Methods

17 fresh frozen lower extremities were used for this study. These limbs were injected with ward's red latex, then left to cool for 24-48 hours. A posterior incision was done in the popliteal fossa
and blunt dissection was performed until the popliteal vessels were identified. The IMGA was identified at its origin from the popliteal artery then meticulous dissection was carried out following the artery distally along its course. The course, diameter, anatomical relations, length and branches were documented. The last 3 specimens were injected with a mixture of latex and barium sulphate. These specimens were CT scanned using the ultra-high resolution mode before dissection, to characterize the vascular anatomy before tissue disruption.

**Results**
The IMGA followed a very consistent course in all specimens. It originated from the popliteal artery at a mean distance of 5.08 mm proximal to the knee joint line. The mean diameter at origin was 1.49 mm. It ran medially posterior to the tibia, accompanied by two venae comitantes, until it reached the posteromedial border, where it traveled deep to the superficial part of the medial collateral ligament (Figure 1), and then it emerged on the anteromedial surface where it gave off many branches to supply the medial proximal tibia (Figure 2), one or two skin perforators and ended by joining the anastomosis around the patella. Mean length from origin to the midpoint of the anteromedial border is 83.83 mm.

The arterial course was demonstrated using the 3D reconstruction from ultra-high resolution CT renderings (Figure 3).

**Conclusion**
The IMGA has a very consistent anatomy with a very suitable length as a pedicle. It also has a suitable diameter at origin for microvascular anastomosis. These merits make it a potential pedicle to harvest a vascularized bone flap upon from the medial proximal tibia.
Figure 1: Posteromedial view of the proximal tibia with the medial head of Gastrocnemius removed. (A) Popliteal artery, (B) IMGA, (C) superficial MCL, (D) Semimembranosus, (E) Popliteus
A very small free flap from the radial side of the fingers
University of Tokyo Hospital, Tokyo, Japan
Hidehiko Yoshimatsu, MD; Takumi Yamamoto; Akitatsu Hayashi; Takuya Iida; University of Tokyo

Introduction

In some cases, a very small free flap can be useful. Previously, small free flaps have been harvested from the medial plantar region, the forearm, the thenar region, the ulnar side of the palm, and the wrist. We postulated that if we could elevate a flap from the radial side of the middle or ring fingers, between the space between the proximal interphalangeal (PIP) and the MP creases where the donor site could be closed primarily, it would be an ideal option for reconstruction of very small defects.

Materials and Methods
In 20 fingers (10 middle fingers and 10 ring fingers respectively) from 10 volunteers, perforators from the radial proper digital artery was checked between the PIP and MP creases using ultrasonography. When a perforator was found, its diameter and the distance from the PIP crease were recorded. Based on this information, the free lateral digital flap was used for reconstruction of fingertips in 3 cases. The flap size was 2 by 1 cm, 2.5 by 1.5 cm, 2.2 by 1 cm respectively.

Results

Perforators could be found in all digits between the PIP and MP creases. The average diameter of the perforator was 0.6 mm, and the average distance from the PIP crease was 9 mm. In 3 clinical cases, all flaps survived with pleasing cosmesis. There were no complications at the donor sites.

Conclusions

Very small free flaps can be elevated from the radial side of the middle or ring fingers, resulting in minimal donor site morbidity. Unlike the ulnar side of the hand of the thenar region, the radial side of the fingers rarely comes into contact, and this makes it less likely to cause postoperative pain in the donor site. When compared with venous flaps, flap survival rate is assuring.
The “Cutaneous Upper Thigh” Free Flap: A New Direct Cutaneous Free Flap for Extremity Reconstruction
University of Manitoba, Winnipeg, MB, Canada
Avinash Islur, MD, FRCSC; Imran Ratanshi, MD, MSc; Colin W. McInnes, MD; University of Manitoba

Purpose:

The anterior /upper thigh has provided a number of new soft tissue free flaps over the past 2 decades including: ALT, medial thigh, TUG, and most recently the PAP flap. The purpose of this study is to describe a new soft tissue free flap of the upper thigh: the “Cutaneous Upper Thigh (CUT)” free flap.

Methods:

During upper medial elevation of ALT free flap skin paddle, a consistent vessel was observed entering the soft tissue of the upper portion of the thigh. This vessel arose from under the lateral portion of the Sartorius muscle. In a clinical case requiring four free flaps from a single donor
site, a CUT flap was successfully performed. Subsequent cadaveric dissection, perfusion studies, and clinical cases were then performed to determine the utility of the CUT free flap.

Results:

Eight cadaveric legs were dissected. A consistent direct cutaneous vessel was identified in all legs arising from under the lateral aspect of the Sartorius muscle. Cutaneous entrance of the vessel was 8-10 cm below the ASIS and 4 cm medial to a line drawn from the ASIS to the lateral patella. Vessel pedicle length was 7-8.5 cm. Artery diameter at its origin measured 1.2-1.5 mm while accompanying venae comitantes measured 1.9-2.2 mm. The pedicle was a direct cutaneous vessel arising from the lateral aspect of the superficial femoral artery. Eight clinical cases were performed: 6 hand and 2 lower extremity reconstruction cases. Two free flaps were innervated. Six free flaps survived completely, 1 underwent partial flap necrosis proximal to the entrance of the pedicle, and 1 flap was lost due to arterial insufficiency 3 weeks post operatively. Flap dimensions ranged from 3X3 cm to 8 cm X17 cm. Perfusion studies indicate flap perfusion in an oblique orientation parallel to the groin crease, predominantly in an antegrade direction.

Conclusions:

The CUT flap represents a new flap in the armamentarium of the microsurgeon for small to medium sized soft tissue defects. The flap can be harvested relatively quickly with minimal to no donor site morbidity and be innervated. The flap can also be applied in several circumstances: serve as a second cutaneous flap in the same donor site region as a ALT for cases requiring 2 independent flaps, serve as a bail out flap for a failed harvesting of an ALT flap, play a role in perineal/groin reconstruction if used as a pedicled flap.

9:06 AM - 9:11 AM
Thoracic Outlet Syndrome: Past and Present -- 88 operated patients in 25 years at Chang Gung
Chang Gung Memorial Hospital, Chang Gung University, Taoyuan, Taiwan
David Chwei-Chin Chuang, MD; Chang Gung Memorial Hospital, Chang Gung Medical College and Chang Gung University

Objective:

The TOS is one of the most controversial clinical entity, with little agreement on its existence, diagnosis, treatment and terminology. The purpose of this manuscript is to describe our observations and treatment for TOS in a 30 year experience at Chang Gung Memorial Hospital, to outline the TOS nomenclature, etiologies based on intraoperative findings, the most two available clinical tests, and the evolution of our surgical technique, and to conclude that TOS decompression now becomes a reliable and safe procedure in appropriately selected patients.

Methods:
During a 30 year period (1985 to 2014), a total of 80 patients with TOS were operated. Eight patients diagnosed with bilateral TOS had staged surgery. Total number for TOS decompression surgery was 88. Patients with TOS secondary to fractured clavicle and patients with TOS due to nerve sheath tumor of T1 and T2 located at the lung apex were not included in this series. They all had at least one year follow-up. Preoperative management includes symptoms and signs, provocative tests, plain X-ray of chest and cervical spine, MRA and EMG. Surgical intervention in each of the 88 TOS surgeries involved near-total resection of scalenus anterior muscle and the first rib and where presented cervical rib. This was achieved through a suprascapular fossa approach with help of Kerrison bone punch forceps specific instruments.

**Results:**

Operative time was typically two hours (range, 1.5 to 3.5 hours), postoperative complication was minimal. Almost all patients experienced significant symptoms relief of shoulder and neck or arm soreness or tightness either on the first postoperative day or within a few weeks thereafter. Three patients requested to have 2\textsuperscript{nd} surgery on the other limb on the subsequently next week. Five patients requested the 2\textsuperscript{nd} surgery on the other limb few months or years after

**Conclusion:**

TOS is diagnosed thorough clinical assessment and diagnostic studies. Once the diagnosis is made and the patient meets the strict and selective indications for surgery, decompression usually results in immediate resolution of symptoms, similar to carpal tunnel or cubital tunnel release. Our technique has evolved to a point where surgical treatment for intractable TOS carries a near 98% success rate with a favourable risk:benefit ratio.

9:11 AM - 9:16 AM

**Discussion**