

ASRM Scientific Paper Presentations: Outcomes Studies Research

Tuesday, January 16, 2018, 7:30am – 9:15am

7:30 AM - 7:35 AM

RM 129. **Rate of Blood Glucose Level Change (RBGC) Measurement for Flap Monitoring**

The University of Tokyo Hospital, Tokyo

Presenter: Ryo Karakawa, MD

Ryo Karakawa, MD(1), Hidehiko Yoshimatsu, MD(2), Mitsunobu Harima, MD(3), Shuichi Nakatsukasa, M.D.(1), Shuji Yamashita, MD(3) and Takuya Iida, M.D.(4)

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Background

In a setting of flap congestion, early detection and rapid reexploration are important for flap salvage. Hara described blood glucose measurement for flap monitoring and reported that the blood glucose level of 62 mg/dl is the best cutoff value for detecting venous thrombosis. However, its sensitivity and specificity were not high enough for surgeons to determine whether reexploration should be done or not. To overcome this weakness, we focused on the rate of blood glucose level change (RBGC) in transferred free flaps. The purpose of this study was to evaluate and establish a simple and accurate method using RBGC measurement for detecting venous thrombosis and to propose an algorithm for flap salvage after congestion.

Methods

Blood glucose level was measured in 43 free tissue transfers over time postoperatively and RBGC was calculated (Figure1). When the flap congestion was suspected from the gross appearance, frequent blood glucose measurement was begun. At the same time, countermeasures, such as removing the sutures nearby the pedicle, were performed complying with an algorithm (Figure2). If the gross appearance or blood glucose level of flaps worsened in spite of such countermeasures, venous thrombus was suspected and reexploration was performed. The RBGCs at the points in time when the venous thrombosis was detected were compared with those at the points in time when the flap demonstrated no venous thrombosis.

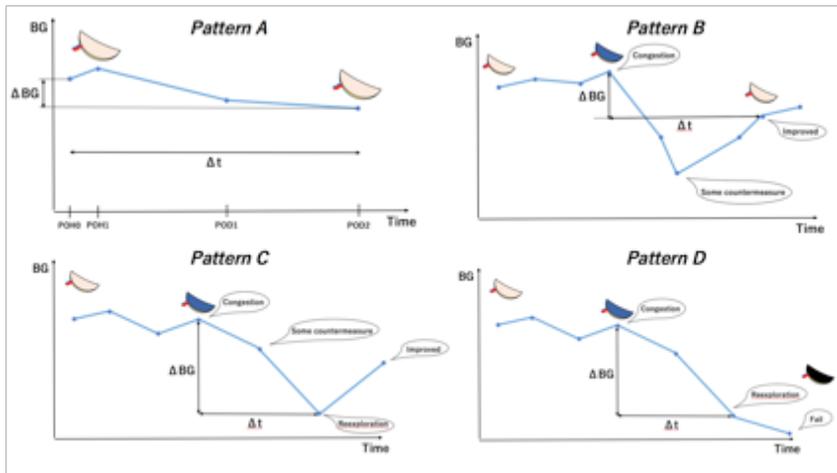
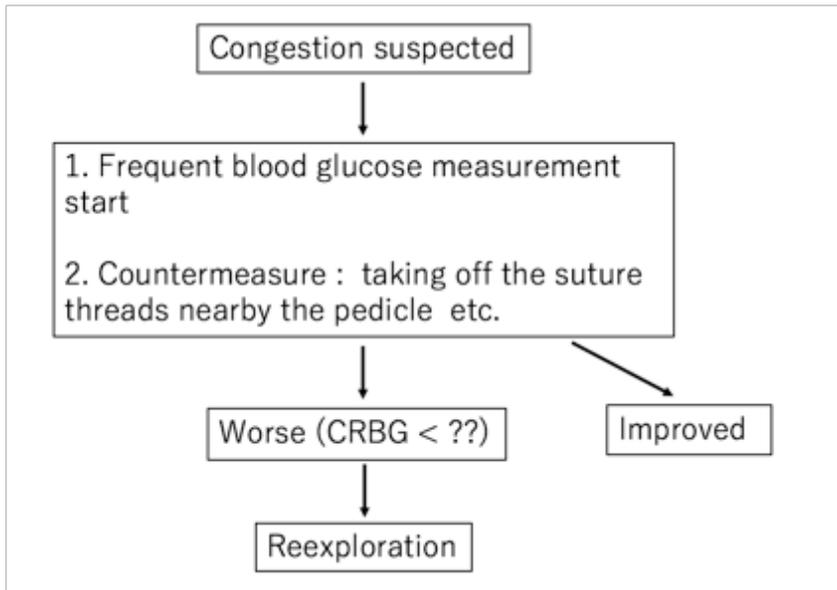
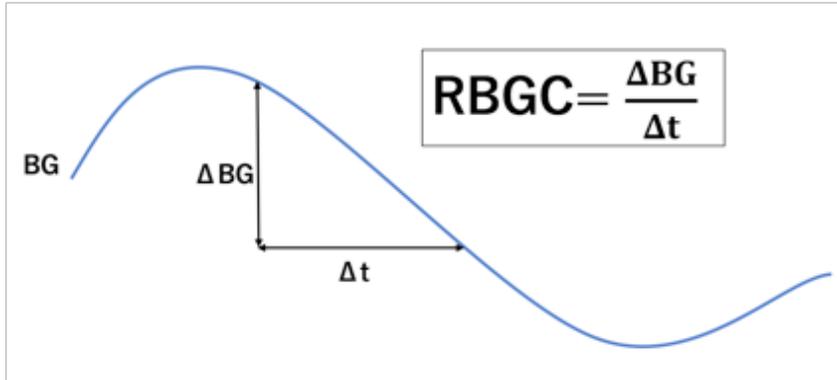
Results

Of the 43 flaps, 36 flaps showed no signs of congestion postoperatively and completely survived (pattern A), 2 flaps demonstrated signs of congestion but improved without reexploration (pattern B), 3 flaps demonstrated signs of congestion but improved after the reexploration (pattern C), and 2 flaps demonstrated signs of congestion and eventually became necrotic despite the reexploration (pattern D) (Figure3). The flaps with pattern A and B demonstrated no venous thrombosis, while those with pattern C and D demonstrated venous thrombosis. The mean RBGCs at the points in time when the venous thrombosis was detected was -6.52 and those at times when the flap demonstrated no venous thrombosis was 0.10, the former being significantly lower than the latter (Figure4).

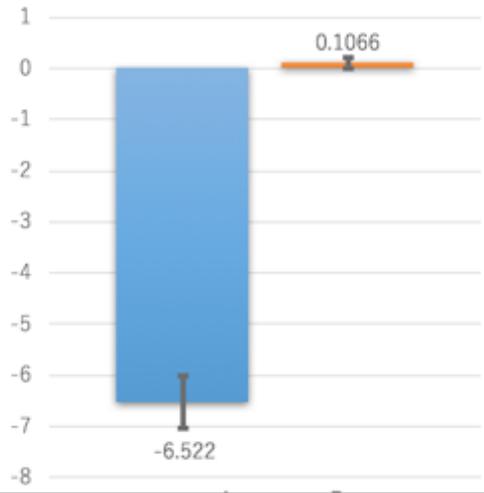
Conclusion

The flap monitoring method using RBGC measurement and the algorithm described here is simple, highly-reproducible, accurate, reliable and inexpensive. In our study, when the RBGC cutoff value was set at -4.16 mg/dl/h, 100% sensitivity and specificity were obtained. Using this

method we could salvage some flaps from the congestion due to the venous thrombosis without unnecessary reexploration.



Ratio of Blood Glucose Level Change



7:35 AM - 7:40 AM

RM 130. Microsurgical Breast Reconstruction in the Obese: Is it a better option than tissue expander/implant reconstruction?

Presenter: John A LoGiudice, MD

John A LoGiudice, MD(1), John Hijjawi, MD(2), Mohammed S Alghoul, MD(3) and Kristen Klement, MD(4)

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Background Obesity has reached epidemic proportions, with over one third of U.S. adults or 72 million people classified as obese in 2010. This significant increase in obese patients is reflected on the breast cancer population seeking breast reconstruction. Previous studies have demonstrated increased complication rates and decreased satisfaction in the obese patients undergoing breast reconstruction. Our study aims to directly compare prosthetic and autologous reconstruction in the obese population by evaluating surgical outcomes and patient satisfaction.

Methods In an IRB-approved study, a retrospective chart review was conducted on patients with a BMI 30.0 or greater who underwent breast cancer reconstruction after mastectomy with either a free tissue transfer from the abdomen or prosthetic reconstruction over a three-year period. We identified 96 patients with 141 reconstructions. Demographics, intraoperative and postoperative variables were collected. All patients were sent the BREAST-Q questionnaire via mail to study the impact and effectiveness of breast surgery from the patient's perspective. Statistical analysis was completed with Fisher's exact test, Mantel-Haenszel chi-square test, Pearson's chi square test or Mann-Whitney-Wilcoxon test.

Results Prosthetic-based breast reconstruction had increased major breast complications ($p < 0.001$), mastectomy skin flap necrosis ($p = 0.009$), infection ($p = 0.006$) and overall reconstructive failure ($p < 0.0001$) compared to autologous reconstruction. When evaluating the results of the Breast-Q studies, the autologous reconstruction group had improved satisfaction with breasts ($p < 0.0001$), satisfaction with outcome ($p = 0.01$), psychosocial well-being ($p = 0.007$) and sexual well-being ($p = 0.006$).

Conclusion In the obese population, reconstruction with free tissue transfer from the abdomen resulted in decreased complications of the breast reconstruction site and improved patient satisfaction with outcomes when compared to prosthetic reconstruction

7:40 AM - 7:45 AM

RM 131. DIEP Flaps in Women with Abdominal Scars: A Comparison of Complication Rates Between Different Abdominal Incisions

Beth Israel Deaconess Medical Center, Boston

Presenter: Andres F Doval, MD

Andres F Doval, MD

Beth Israel Deaconess Medical Center, Boston, MA

Background:

There are still concerns that abdominal surgery can compromise an abdominally based perforator flap in microsurgical breast reconstruction. With this study, we take a closer look at the effect of prior abdominal incisions on Deep Inferior Epigastric Artery Perforator (DIEP) flap and donor site complications, with a particular focus on the different types of incisions and their influence on surgical outcomes.

Methods :

A retrospective case-control study was conducted over a 6-year period. 544 consecutive DIEP flaps were divided into a control group without previous abdominal surgery, and an incision group with previous abdominal surgery. A comparison between both groups was made in terms of flap and donor site complications, followed a sub-group analysis based on the type of abdominal incision.

Results :

223 flaps were included in the incision group and 321 in the control group. There were no significant differences between groups in terms of age, flap weight, smoking history, prior radiation history and comorbidities. We found a higher BMI in the incision group ($p=0.01$). *There were* no significant differences between the control group and the incision group in terms of flap complications (complete flap loss, partial flap loss and fat necrosis). However, donor site complications, specifically wound separation was found to occur at a higher incidence in the incision group ($p=0.0001$). In the sub-group analysis, patients with a low transverse incision had higher rates of fat necrosis (8.0% vs 23% $p=0.0001$) and donor site wound separation (9.0% vs 23% $p=0.002$). No statistically significant differences were found between patients in the control group and those with laparoscopic incisions on the one hand, and those with a combination of laparoscopic and low transverse incision on the other.

Conclusion :

The results from this large series of consecutive DIEP flaps from our institution confirms that autologous breast reconstruction with a DIEP flap can be safely performed in patients who have had previous abdominal surgeries; however, patients must be made aware of the increased risk of donor site complications.

Table 1. Demographic Data

Characteristics	Control Group (n = 321)	Incision Group (n = 223)	<i>p</i> -value
Age (years)	50.51 (9.05)	50.31 (8.67)	0.797
Mean Body Mass Index (Kg/m ²)	28.35 (17.6 – 42.06)	29.52 (19.2 – 51.58)	0.01
Mean Flap Weight (g)	661.05 (194 – 1590)	707.6 (166 – 1872)	0.056
Smoking History (%)	49 (15.3)	37 (16.6)	0.676
Prior Radiotherapy History (%)	114 (44.9)	93 (41.7)	0.465
Coronary Artery Disease (%)	---	3 (1.3)	0.068
Hypertension (%)	56 (17.4)	52 (23.3)	0.091
Diabetes Mellitus (%)	11 (3.4)	12 (5.4)	0.256
Coagulopathy (%)	---	2 (0.9)	0.168
Hyperthyroidism (%)	17 (5.3)	2 (0.9)	0.006
Hypothyroidism (%)	39 (12.1)	31 (13.9)	0.603

Table 2. Complications rates in Control and Incision Groups.

	Flap Complications			Donor Site Complications				
	Complete Flap Loss (%)	Partial Flap Loss (%)	Fat Necrosis >2cm (%)	Seroma (%)	Infection (%)	Donor Wound Open (%)	Abdominal Bulge (%)	Abdominal Hernia (%)
Control (n = 321)	0.7	1.9	8.4	8.7	5.9	9.0	0.9	---
Incision (n = 223)	---	1.8	12.1	4.5	7.2	20.6	---	0.9
<i>P</i> -value	0.508	1.000	0.156	0.056	0.557	0.0001	0.273	0.168

Table 3. Complications rates Controls Vs Laparoscopy Groups.

	Flap Complications			Donor Site Complications				
	Complete Flap Loss (%)	Partial Flap Loss (%)	Fat Necrosis >2cm (%)	Seroma (%)	Infection (%)	Donor Wound Open (%)	Abdominal Bulge (%)	Abdominal Hernia (%)
Control (n = 321)	0.7	1.9	8.4	8.7	5.9	9.0	0.9	---
Laparoscopy (n = 59)	---	---	6.8	3.4	6.8	13.6	---	---
<i>P-value</i>	1.000	0.596	0.801	0.198	0.768	0.281	1.000	---

Table 4. Complications rates Control Vs Low Transverse.

	Flap Complications			Donor Site Complications				
	Complete Flap Loss (%)	Partial Flap Loss (%)	Fat Necrosis >2cm (%)	Seroma (%)	Infection (%)	Donor Wound Open (%)	Abdominal Bulge (%)	Abdominal Hernia (%)
Control (n = 321)	0.7	1.9	8.4	8.7	5.9	9.0	0.9	---
Low Transverse (n = 61)	---	1.6	23	9.8	8.2	23	---	---
<i>P-value</i>	1.000	1.000	0.0001	0.780	0.502	0.002	1.000	---

7:48 AM - 7:53 AM

RM 132. Perforator-to-Perforator Anastomosis as a Salvage Procedure During Flap Harvesting

Mayo Clinic, Rochester

Presenter: M. Diya Sabbagh, MD

M. Diya Sabbagh, MD(1), Kian Adabi, BA(2), Oscar J Manrique, MD(1), Pedro Ciudad, MD, PhD(3), Ricardo Galan, MD(4) and Hung-Chi Chen, MD, PhD, FACS(5)

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Background

With the current advances in microsurgery and a better understanding of the perforator anatomy, the use of perforator flaps is becoming a more common tool of our reconstructive armamentarium.

However, in some occasions, these small perforators can be unexpectedly divided, leading to rescue maneuvers in order to save the reconstructive efforts.

PURPOSE

To describe a possible salvage maneuver, a “perforator-to-perforator” anastomosis, to repair the unexpectedly damaged perforator during flap dissection and identify the variables associated with poor outcomes

Methods

Retrospective review of patients that required free tissue transfer and that during flap dissection the flap perforator was unexpectedly damaged.

Patient demographics, type of flap, size of perforator, distance from perforator-flap entry point to the damage point, suture size, etiology of damage, other required salvage maneuvers and complications were recorded and analyzed.

Results

From 2000-2017, a total of 16 patients had accidental damage of the perforators during dissection. 14 were men and 2 were women. The average age was 44 (range 25-52). The type of flaps included (n=4) free groin flaps, (n=3) SCIP flaps, (n=3) osteocutaneous fibula flap and (n=6) ALT flaps. The average size of the perforator was 10 mm (range 8-15 mm). Average distance from entry to damage point was 22 mm (range 18-26 mm). The type of suture used was Ethilon 12-0 (n=10) and Ethilon 11-0 (n=6). Etiology of damage (n= 5) bipolar burn, (n=11) sharp cut. Only one flap (ALT) required a vein graft. Regarding complications, there was 3 partial flap necrosis and 2 complete flap losses. Univariate analysis showed that when these complications were combined, such as bipolar burn ($p<0.05$), perforator vessel was less than 10 mm ($p<0.03$) and distance from skin to damage point was less than 20 mm ($p<0.05$) it was associated with complete flap loss.

Conclusion

When a perforator is unexpectedly damaged during flap dissection, a “perforator-to-perforator” anastomosis might allow for perforator repair and flap salvage. However, in the presence of a burned, small perforator and damaged point closer to the flap entry point, dissection of a new flap is recommended.

7:53 AM - 7:58 AM

RM 133. Optimizing Reconstructive Microsurgery with Thromboelastography and Intraoperative Heparin

Houston Methodist Hospital, Houston

Presenter: Dmitry Zavlin, MD

Dmitry Zavlin, MD(1), Kevin T. Jubbal, MD(2), Nikhil A. Agrawal, MD(3) and Aldona J. Spiegel, MD(4)

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Background

Maintaining optimal coagulation is vital for successful microvascular flap transfer. Hypercoagulate states are risk factors for pedicle thrombosis and flap loss. Therefore, identifying patients who are at risk for such events is paramount. The viscoelastic Thromboelastography (TEG) is a modern method to assess a patient's coagulation status and in the past, it has predominantly been used in critical care, cardiac or trauma surgery. The aim of our study was to evaluate its diagnostic capabilities, its role compared to classic coagulation tests, and the effect of low-dose heparin in reconstructive breast microsurgery.

Methods

After approval from the institutional review board, clinic charts of our senior author were analyzed for all patients between 2012 and 2016 who underwent autologous free flap breast reconstruction and received perioperative TEG. Patient demographics, their medical history, clinical and operative details were documented. All coagulation studies, such as thrombocyte count, prothrombin time (PT), activated partial thromboplastin time (aPTT), and the numerous TEG parameters were gathered for baseline, the intraoperative, and the first two postoperative days (POD1, POD2). Statistical calculations sought to determine any risk factors associated with adverse outcomes of reconstructive microsurgery.

Results

100 patients were subsequently identified who underwent 172 abdominal-based free flaps for breast reconstruction. Intraoperatively, 91 patients received unfractionated heparin (UFH) as their TEG-G values were significantly more hypercoagulable at baseline and again on POD1 and POD2. Intraoperative TEG-G was indifferent and borderline hypocoagulate for both the 91 heparin and the 9 non-heparin patients. PT/aPTT showed no changes perioperatively. Thrombocytes slightly decreased due to blood dilution.

Within a mean follow-up of 17.4 ± 11.1 months, 3 bleeding, 6 wound/infection, and 6 thrombotic complications occurred. Of the latter group, 2 resulted in flap loss (1.2%). Wound complications were related to high BMI ($p = 0.022$) and diabetes (0.028). Intraoperative bleeding was related to high aPTT (0.029). The 6 thrombotic events had much steeper increases of TEG-G between surgery and POD2 ($p = 0.003$). The 2 flap losses occurred in 2 patients with a history of abdominal surgery despite intraoperative UFH.

Conclusion

TEG is more dynamic and accurate to show the effects of intraoperative anticoagulation than conventional coagulation tests. Our applied heparin regimen was successful to avoid significant detrimental outcomes. The 2 flap losses were associated with previous abdominal surgery and scarring.

7:58 AM - 8:03 AM

RM 134. Does the Orthopaedic Trauma Association – Open Fracture Classification Predict Complications in Free Tissue Transfer?

University of Maryland Shock Trauma Center, Baltimore

Presenter: Anthony Ding, MD

Ray Pency, MD(1), Anthony Ding, MD(2), Julio Jauregui, MD(3) and Renan Castillo, PhD(4)
(1)Department of Orthopaedic Surgery, University of Maryland, Baltimore, MD, (2)Orthopaedic Surgery, University of Maryland, Baltimore, MD, (3)University of Maryland, Baltimore, MD, (4)Johns Hopkins University, Baltimore, MD

Background

While the Gustilo-Anderson (GA) Classification system is widely used in open fractures, it fails to describe the wide range of injury patterns, particularly among type IIIB fractures requiring free tissue transfer. Although success >90% is reported in free tissue transfer, this does not apply to every IIIB open fracture, as the zone of injury, vascular status, and skin loss play important roles. The Orthopaedic Trauma Association Open Fracture Classification system (OFC) incorporates degree of bone, skin, muscle, arterial injury, and contamination, providing information that may refine risk stratification in these injuries. We hypothesize that the OFC will be predictive of free tissue complications and failure and that individual domains will prove independently predictive.

Methods

After IRB approval, we reviewed all free tissue transfers done acutely for long bone injuries from August 2010 to August 2015. We identified 32 eligible patients, 23 male, 9 female, with a mean age of 41 years (range 17-79), mean time from injury to flap procedure of 7 days (2-21), and average follow-up of 630 days. Outcomes included flap and non-flap related complications and reoperations. The severity of injury within each domain (skin, bone, muscle, arterial injury, contamination) was combined to develop a composite measure. The most severely injured group had ≥ 3 domains rated at high-severity, the middle group had ≥ 3 domains rated at mid-severity, and the lowest group had ≤ 2 domains rated at mid-severity. Fisher's exact test was used to compare OFC severity with outcomes. Multivariate analyses were used to examine the relationship of individual domains with outcomes.

Results

Our cohort had a mean OFC score of 11 points (range of 7-15). All 32 cases had the skin domain rated as mid or high severity (47% and 53%, respectively). The composite OFC severity measure included 12 in both the highest and lowest groups, and 8 in the middle severity group. We identified four (13%) acute (<5 days) flap related complications, two (6%) partial and two (6%) total failures, 32 re-operations (22 patients), and 21 unplanned returns to the OR. The composite OFC severity groups were significantly correlated with flap failure ($p=0.03$). We also identified the bone domain as an independent risk factor for flap failure, with an odds ratio of 4.88 [95% CI: 0.8-30.0].

Conclusion

Our results demonstrate a correlation between the OTA-OFC score and acute flap failure. Additionally, the bone injury component represents an independent risk factor for flap failure and related complications.

8:06 AM - 8:11 AM

RM 135. **Clinical Outcomes Following Reconstructive Surgery in Management of Soft Tissue Sarcoma**

Presenter: Anita T Mohan, MRCS MBBS

Anita T Mohan, MRCS MBBS(1), Daniel Lindberg, BS BA(2), Soyun Michelle Hwang, BS(2), Arya Akhavan, MD(2), Zhen Wang, PhD(3), Peter S. Wu, MD, MS(1), Brian Carlsen, MD(4), Jorys Martinez-Jorge, M.D.(5), Karim Bakri, MBBS(3), Samir Mardini, M.D.(5) and Michel Saint-Cyr, MD(6)

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Background: Soft tissue sarcoma (STS) is a rare heterogeneous group of connective tissue tumors. Treatment involves radical resection followed by adjunctive therapy and reconstruction. This study demonstrates the differential contribution of important risk factors for surgery and systematic approaches to reconstruction flap choice in STS reconstruction

Methods: A retrospective review of patients who underwent reconstruction following sarcoma resection between May 2009 and May 2015 was conducted at Mayo Clinic, MN. Patient demographics, adjunctive therapy, defect characteristics, procedural notes, post-operative complications, and length of stay were examined

Results: 130 patients (144 flaps, 70 males, 60 females) with a mean age of 56 years were included. 66.9% pedicled, 23.9% local, and 9.2% free flaps were performed, of which 33.8% were fasciocutaneous, 18.5% musculocutaneous, 45.4% muscle only and 2.3% a combination of flap types. Defect location or size, comorbidities, or radiotherapy exposure did not influence the selection process of the flap types. However, pedicled flaps were preferentially selected for reconstructing deeper tissue defects (muscle and below, $p=0.04$). Free flaps were associated with longer hospital stay compared to pedicled or local flaps (13.1 days, 8.5 days, and 5.9 days respectively, $p=0.02$). The two most common post-operative complications were infection (13.0%) and lymphedema (12.3%). Previous radiation therapy (RT) resulted was comparable to non-RT in the overall complication rate, but resulted in increased risk of infection ($OR=4.78, p=0.03$). However, obesity ($BMI >30$) was the single greatest risk factor for post-operative infection ($OR=6.70, p=0.01$). The risk of developing lymphedema significantly increased in lower extremity resections ($OR=6.9, p=0.04$) and substantially increased in patients who previously received chemotherapy ($OR=3.5, p=0.06$). Total flap loss ($n=1$) and partial flap necrosis ($n=4$) were observed within the RT group however due to the infrequent occurrence no statistically significant risk was associated.

Conclusion: Regional and local flap reconstruction can be safely performed in STS reconstruction even in the setting of radiotherapy, and can shorten operative time, encourage earlier mobilization, and reduce hospital stay. With the evolution of free-style perforator flaps and better understanding of anatomy, this can expand our repertoire of regional reconstructive options. Although radiotherapy increased the risk of infection, other intrinsic comorbidities, such as obesity and defect location, are more significant risk factors for the development of post-operative complications, and should be carefully considered during surgical planning, flap selection and preoperative patient counseling.

8:11 AM - 8:16 AM

RM 136. Functional Outcomes Following Soft Tissue Reconstruction and Attempted Limb Salvage After Lower Extremity Trauma

Los Angeles County Hospital , Los Angeles

Presenter: Ido Badash, BA

Ido Badash, BA(1), Karen Burtt, BS(1), Hyuma Leland, MD(1), Daniel Joseph Gould, MD PhD(2), Alexis Rounds, BS(1), Jennifer S. Kim, B.S.(3), Ketan M Patel, MD(1) and Joseph N Carey, MD(1)

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Background: Lower extremity traumatic injuries with extensive soft tissue damage require flap coverage for limb salvage. With increasing limb salvage rates in the United States, focus is now directed towards optimizing functional outcomes. The purpose of this study was to determine the functional recovery of patients who have undergone soft tissue reconstruction for lower extremity traumatic injuries, as well as patient factors which impact functional outcomes.

Methods: A retrospective review was performed on patients undergoing soft tissue reconstruction for lower extremity trauma at LAC-USC Medical Center between July 2007 and December 2015. Patients were administered clinically validated SF-36v2 and LEFS surveys over the phone following discharge. Out of 147 patients who were called, 44 patients completed the survey (29.9% response rate) at an average follow-up of 47 (range: 14-105) months. Patient functional outcomes were evaluated and compared across comorbidities, flap types, and perioperative complications.

Results: The mean age of the 44 patients was 41 ± 15 years, and the mean BMI was 28.5 ± 6.4 . Four patients (9.1%) were amputated following reconstructive surgery. Based on SF36v2 scores out of 100 possible points, patients ≥ 40 years old had worse scores on physical functioning (34.8 vs. 59.1, $p < 0.01$) and emotional well-being (59.4 vs. 75.9, $p = 0.01$) than younger patients. Female patients had greater role limitations due to emotional health than male patients (26.7 vs. 79.9, $p = .05$). Patients who were injured from falls had worse physical functioning than patients injured by other mechanisms (28.9 vs. 48.1, $p < .01$). Additionally, patients receiving a free flap had greater role limitations due to physical health (19.5 vs. 47.32, $p < .01$), and patients undergoing amputation following reconstruction had greater role limitations due to physical health (15.6 vs. 39.4, $p = .02$).

Conclusion: Patient demographics, including age and gender, may impact functional outcomes following soft tissue reconstruction. Additionally, injuries due to falls, use of free flaps and secondary amputation may result in worse functional recovery following attempted limb salvage.

8:16 AM - 8:21 AM

RM 137. **Bridging the Gap: Extending Free Flap Pedicle Length with Interposition Vein Grafts and Arteriovenous Loops**

Johns Hopkins University School of Medicine, Baltimore

Presenter: Tobias J Bos, BSc

Tobias J Bos, BSc(1), Nicholas A Calotta, MD(1), Michelle Y Seu, BA(1), Brian H Cho, MD(1), Aladdin H Hassanein, MD, MMSc(2), Gedge D Rosson, MD(3), Damon S Cooney, MD, PhD(4) and Justin M Sacks, MD, MBA, FACS(5)

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Background: Free tissue transfer in complex oncological and traumatic defects may require extension of the vascular pedicle to reach recipient vessels and complete microvascular anastomosis. This can be accomplished by using vein grafts as a bridging medium. When interposition vein grafts (IVG) are needed for extension of both the arterial and venous conduit, a temporary arteriovenous fistula (AV loop) can be constructed as an intermediary step. The purpose of this study is to assess clinical outcomes for utilization of vein grafts and arteriovenous loops in the context of free flap reconstruction.

Methods: Following approval by our Institutional Review Board, we retrospectively analyzed patients requiring free flap reconstruction between March 2007 and June 2017.

All patients utilizing any vein graft in this context were identified. Data collection included demographic, medical, surgical, and outcome variables.

Results: A total of 90 IVG were used in 56 patients, receiving a total of 54 free flaps. Reconstructive sites included: head/neck (29; 51.8%), breast (13; 23.2%), upper extremity/trunk (9; 16.1%), and lower extremity (5; 8.9%). Twenty out of 26 AV loops created received flaps (11 immediate; 9 staged). Five AV loops thrombosed in staging and were discarded; one patient died in staging due to medical comorbidity. The duration of staging ranged from 1 to 59 days (median=4). Forty-two procedures (44 flaps) utilized vein grafts in the index flap surgery, of which 10 (11 flaps) were taken back for emergent flap salvage (2 AV loops, 8 IVG group). Seven cases (8 flaps) were successfully salvaged. In 13 cases (14 flaps) IVG was utilized for free flap salvage, with a 78.6% successful flap salvage rate (n=11). Out of 54 flaps overall, 11 flap failures occurred (20.3%; 95% CI 10.6-33.5%). All flap failures occurred in the patients that used any IVG (with or without AV loop) for immediate reconstruction or in salvage procedures utilizing IVG. Of the nine staged AV loops that received flaps, flap survival was 100%.

Conclusion: IVG and AV loops offer practical solutions for pedicle lengthening in order to successfully perform microvascular anastomosis, but increase risk of take-back and flap failure when utilized in the index flap surgery. Our data demonstrate that staged AV loops may be superior to immediate AV loops, owing to a de facto pre-identification of patients who may otherwise develop a flap complication after immediate reconstruction. Additionally, IVG appears to be an especially effective tool in cases of free flap salvage.

8:24 AM - 8:29 AM

RM 138. The Impact of Blood Thinners on Flap Failure and Hematoma Rates in Patients Undergoing Non-Breast Flap Reconstruction: Analysis of 79,915 patients

Beth Israel Deaconess Medical Center, Boston

Presenter: Anmol Chattha, BA

Anmol Chattha, BA(1), Qing Z Ruan, MD(2), Alexandra Bucknor, MBBS, MRCS, MSc(1), Austin D. Chen, BS(1), Bernard T. Lee, MD, MBA, MPH, FACS(3) and Samuel J. Lin, MD, MBA, FACS(3)

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Background

There is no uniform consensus on the use of antithrombotics and other blood thinners in flap reconstruction. Previous animal studies have demonstrated protective effects of antithrombotics through inhibition of anastomotic venous thrombosis and improvement in microcirculatory perfusion. However, these results have yet to translate into definitive clinical benefits in human studies; moreover, many have shown an increase in hematoma development. We aim to revisit this topic with the use of national data, in order to examine in-hospital complications, most notably flap failure and hematoma, in patients on long-term blood thinners.

Methods

Adults undergoing non-breast pedicled or free-flap reconstruction from 2013 to 2014 were identified from the Healthcare Utilization Cost Project National Inpatient Sample (NIS) Database. De-identified data on patient demographics, perioperative risk factors and complications were obtained. Outcomes of interest included flap failure and hematoma formation. Logistic regression was used to assess the adjusted effect of long-term (1) antithrombotic/anticoagulant or (2) aspirin use on flap failure and hematoma formation.

Results

The study population included 79,915 patients. Of these, 3,775 (4.7%) took an anticoagulant/antithrombotic and 4,575 (5.7%) took aspirin preoperatively. Patients on either one of the blood thinners were more likely to be male ($p<0.001$) smokers ($p<0.001$), with more comorbidities ($p<0.001$) and a greater frequency of peripheral vascular disorders ($p<0.001$), hypertension ($p<0.001$), and obesity ($p<0.001$). Overall rates of flap failure and hematoma formation were 2.5 percent and 2.6 percent, respectively. Unadjusted flap failure rates were 2.4 percent and 2.7 percent for anticoagulant/antithrombotics and aspirin, respectively. Unadjusted hematoma rates were 7.0 percent and 3.7 percent for anticoagulants/antithrombotics and aspirin respectively. On multivariate analysis, there was a significant increase in odds of hematoma formation associated with anticoagulation/antithrombotic use (OR=2.413, $p<0.001$); however, no difference in hematoma formation for those on aspirin therapy (OR=1.070, $p=0.427$). There was a non-significant reduction in flap failure rates for patients on anticoagulants/antithrombotics (OR=0.802, $p=0.062$) and no significant difference in aspirin use on flap failure rates (OR=1.146, $p=0.159$).

Conclusion

Our results show there was no significant difference in anticoagulants/antithrombotic or aspirin use in terms of flap failure, however, there was an increase in hematoma rates with the former.

Additional prospective studies should clarify whether blood thinners can improve outcomes while still minimizing complication rates in flap reconstruction.

8:29 AM - 8:34 AM

RM 139. **Staged Flap Reconstruction of Soft Tissue Sarcoma Resections using Temporizing Negative Pressure Wound Therapy**

Medical College of Wisconsin, Milwaukee

Presenter: John A LoGiudice, MD

John A LoGiudice, MD(1), John DeVries, MD(2), John Neilson, MD(2), David King, MD(2) and Donald Hackbarth, MD(2)

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Background Margin negative resection of soft tissue sarcomas (STS) is a key component to decreasing local recurrence. STS resections are often complex, requiring advanced soft tissue reconstruction solutions including rotational and free flaps. Unexpected positive margins after complex flap reconstruction can lead to challenging re-resections, wound complications and possibly removal of a contaminated free or rotational flap. Resection of STS followed by temporizing vacuum assisted closure therapy ensures pathology to confirm negative margins are obtained prior to complex soft tissue reconstructions.

Methods A retrospective study was undertaken by searching the institutional sarcoma databases for patients who underwent planned staged reconstructions following sarcoma excision. Patients were selected to undergo a staged reconstruction if they had a wound large enough requiring a formal reconstruction by a plastic surgeon and anticipated close margins. 35 patients older than 18 years of age that were diagnosed with STS of the upper limb, lower limb, or trunk by tissue pathology were investigated. These patients underwent a wide resection followed by a separate reconstructive procedure at a later date once negative margins were confirmed. The effect of this procedure on local recurrence rates, wound complication rates, metastasis rates, disease free survival, and overall mortality in the treatment of STS was evaluated.

Results The 35 patients studied had a median age of 65 years and a median follow-up of 57 months. Local recurrence was observed in three patients (8.6%), distant metastasis in eight patients (22.9%, seven with metastasis to lung), five patients died from complications of sarcoma (14.3% mortality), 23 patients with disease free survival (65.7%), five patients encountered wound complications or delayed healing (14.3%). There were no flap losses amongst the 31 free flaps and 4 pedicled flaps. Of the 35 primary resections, four (11.4%) had positive tumor margins and underwent a second wide excision before reconstruction.

Conclusion A staged reconstruction of soft tissue sarcoma resections offers a promising alternative to current methods. Large STS resections and re-excision of non-oncologically excised soft tissue sarcomas are difficult procedures requiring extensive reconstructions of the residual tissue defect. This study demonstrates that bridging definitive resection and reconstruction with negative pressure wound therapy is safe with lower rates of wound complications and local recurrence as compared to historical controls.

8:34 AM - 8:39 AM

RM 140. Evaluation of Structural Integrity and Function of the Visual System after Whole Eye Transplantation using Optical Coherence Tomography, Manganese-Enhanced Magnetic Resonance Imaging and Electroretinography

University of Pittsburgh, Pittsburgh

Presenter: Chiaki Komatsu, MD

Chiaki Komatsu, MD(1), Yolandi van der Merwe, B. Eng.(1), Lin He, MD(2), Maxine R. Miller, MD(1), Katie Lucy, BS(3), Valeria Fu, PhD(1), Hua Min Tang, MD(1), Ian A. Rosner, BS(1), Yang Li, MD PhD(1), Michael Steketee, PhD(1), Gadi Wollstein, MD(3), Mario G. Solari, MD(1,4), Joel S. Schuman, MD(3), Kevin C Chan, PhD(3) and Kia M. Washington, MD(1,4,5) (1)University of Pittsburgh, Pittsburgh, PA, (2)The First Affiliated Hospital of Xi'an Jiaotong University, Xi'an, China, (3)New York University, New York, NY, (4)McGowan Institute for Regenerative Medicine, Pittsburgh, PA, (5)VA Pittsburgh Medical Center, Pittsburgh, PA

Background

The purpose of this study is to assess structural integrity, anterograde transport of the visual system and retinal function with in-vivo optical coherence tomography (OCT), manganese-enhanced magnetic resonance imaging (MEMRI), and electroretinograms (ERG) after whole eye transplantation (WET) in a rodent model.

Methods

Orthotopic syngeneic transplants were performed in nine Lewis rats. The donor flaps, which include tissue anterior to the optic chiasm, temporal bone, eyelid and the external ear were transplanted to recipients. In recipients, optic nerves were transected at the base of the globes. Anastomoses of common carotid arteries and external jugular veins were performed and optic nerves were coapted between donors and recipients (Fig.1). OCT was performed at one week after WET (n=7) to qualitatively evaluate ocular structural integrity and retinal blood flow. MEMRI was performed at three weeks after WET to evaluate anterograde manganese transport. ERG was performed at week 7 in 2 separate animals to evaluate retinal function.

Results

OCT revealed visualization of retinal layers in 5 of 7 transplanted eyes (Fig. 2). Two of the rats had transplanted eyes with anterior segment opacities that prevented retinal evaluation. Post-manganese (Mn) injection, significant signal increase was seen along the visual pathway projected from the intraorbital optic nerve (ON) of transplanted (right) eye in comparison to pre-Mn injection ($p < 0.001$) (Figure 3 C, D). In comparison, in the native (left) eye, significant signal increase was found post-Mn injection in the left intraorbital and prechiasmatic ON and in the right LGN and SC compared to pre-Mn injection ($p < 0.0001$) (Figure 3 A, B). No apparent signal difference was observed between native and transplanted intraorbital ON post-Mn injection ($p = 0.26$) (Figs 3 A, C). ERG data revealed the presence small of a- and b-waves in response to light in the transplanted retinas.

Conclusion

OCT revealed the maintenance of gross morphology in the retinal layers after WET. MEMRI suggested the presence of anterograde manganese transport in the intraorbital ON of the transplanted eye, which was comparable to the native intraorbital ON at 3 weeks after WET. In addition, small responses to light stimuli in photoreceptors of transplanted eyes were noted on

ERG after WET. The viability of retina and optic nerves seen after whole eye transplantation offer the potential for future studies in neuroprotection and optic nerve regeneration with the goal of restoration of functional vision.

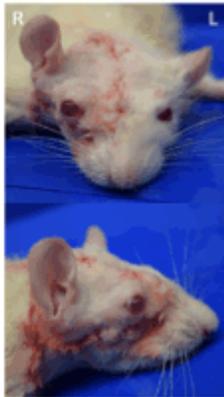


Fig1. Recipient 30mins after WET

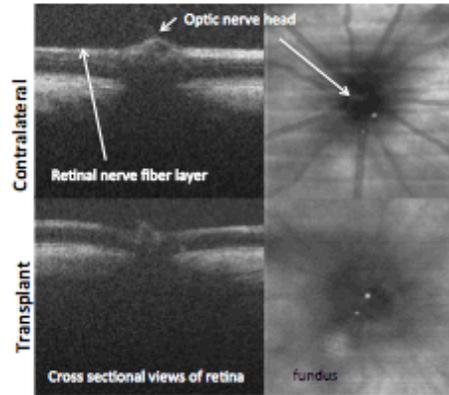


Fig2. OCT retinal images at 1 week after WET

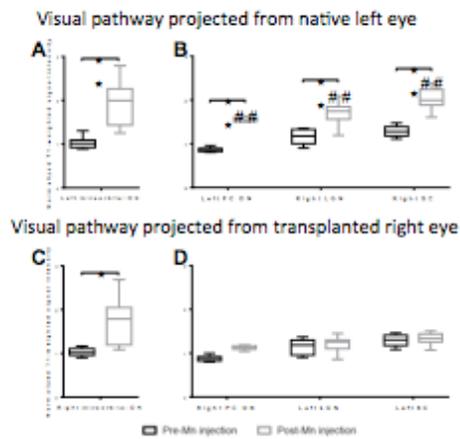


Fig 3. Normalized T1-weighted signal intensities of the intraorbital optic nerves (ON) taken from 3D MEMRI scans (A, C), and the prechiasmatic optic nerve (PC ON), lateral geniculate nucleus (LGN), and superior colliculus (SC) taken from 2D MEMRI scans (B, D). A and B show visual pathway projected from native, left eye, and C and D shows visual pathway projected from transplanted, right eye. Post-hoc Sidak's tests between pre- and post-Mn injection, * $p < 0.001$, ** $p < 0.0001$. Post-hoc Sidak's tests between left and right hemispheres, ## $p < 0.0001$. Box plots show minimum, first quartile, median, third quartile, and maximum.

8:42 AM - 8:47 AM

RM 141. **Holographic Craniofacial Surgical Planning Application for Face**

Transplantation: Evaluation of Usability

Cleveland Clinic, Cleveland

Presenter: Kihyun Cho, MD, MSc

Kihyun Cho, MD, MSc(1), Jeff Yanof, PhD(2), Graham S Schwarz, MD, FACS(1), Karl West, MS(2), Hirsh Shah, BA(3), Bahar Bassiri Gharb, MD, PhD(1) and Francis A. Papay, MD(1)
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Background: Conventional craniofacial surgical planning (CFSP) software can be helpful to assist the reconstruction of complex anatomy, but these can be limited to 2D flat-screen visualization and can lack intuitive operator interaction and navigation. We have developed a novel CFSP application with enhanced visualization of complex craniofacial anatomy using HoloLens (Microsoft). HoloLens is a modern, augmented-reality (AR) head-mounted display and communication device that enables interaction with holographic projections (“Holograms”) of anatomical structures merged into the real-world planning suite. The aim of this study was to evaluate the general- and application-specific usability of this new CFSP HoloLens application.

Methods: The prototype CFSP application displayed 3D holograms which were derived from pre-operative computed tomography (CT) datasets. The application’s surgical tools enabled AR assisted skin, bone and vasculature repositioning with adjustable opacity shading for the skin layer. Evaluators could perform drawing, distance measurement, zoom in-out functions with voice commands, hand-gestures, and a holographic dashboard. A member of the design team provided approximately 10 minutes of training to each evaluator. A Likert scale questionnaire (1=strongly disagree, 5=strongly agree) was used to survey 18 plastic surgeons or residents with a range of surgical experience. The questionnaire consisted of 10 validated standard system usability (SUS) questions and 10 application-specific usability (ASU) questions grouped as Visualization, Interface, Navigation, Tools, and Overall application validation. **Results** were recorded and summarized with average and standard deviation (STD). We tested the hypotheses that mean SUS and mean ASU over all participants were > 3 ($p < 0.01$, one-sided). Holographic videos were recorded for each participant.

Results: Evaluators were able to "gaze" 360 degrees around and navigate through 3D holographic structures to appreciate complex spatial relationships between bone, skin, and vasculature. The average SUS and ASU over all questions and participants was 3.81 (STD = 0.83) and 4.06 (0.74), respectively, and were greater than 3 ($p = 0.0004$ and $p < 0.0001$), respectively. The mean values for the ASU categories were Visualization (mean=4.11, STD=0.66), User Interface (3.94, 0.68), Navigation (4.32, 0.55), Planning Tools (3.87, 0.89), and Overall application validation (4.13, 0.70).

Conclusion: Results from the SUS and ASU evaluation show that this novel application for craniofacial surgery meets standard criteria for usability. Future research will include pre-clinical studies to assess the accuracy of registration of holographic planning results to physical anatomy in the operating room.

8:47 AM - 8:52 AM

Rm 142. Risk Factors for Flap Failure and Wound Complications in Microvascular Free Flap Reconstruction for Diabetic Lower Extremity Limb Salvage

Hansjörg Wyss Department of Plastic Surgery, New York

Presenter: Z-Hye Lee, MD

Z-Hye Lee, MD(1), John T Stranix, MD(1), David Daar, MD(1), Pierre B Saadeh, MD(2), Vishal D Thanik, MD(1) and Jamie P Levine, MD(1)

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Background:

Microsurgical free tissue transfer can be an important treatment option for non-healing lower extremity diabetic wounds. While there is a few small case series reporting good success rates for free flap coverage in these patients, there is lack of data on specific patient and intraoperative factors that affect flap survival and long-term wound healing outcomes.

Methods:

A retrospective review of was conducted of 806 lower extremity free flap reconstructions performed from 1979-2016. There were a total of 33 free flaps that were used for coverage of non-healing lower extremity diabetic ulcers. Primary outcome measures were perioperative complications and long-term wound breakdown.

Results:

The average age of the patients was 54 +/- 12.3 years old. 15.1% of patients were smokers. Other comorbidities included coronary artery disease (12.1%) and end-stage renal disease (12.1%). The most commonly used flaps were rectus (10) latissimus (7), parascapular (6) and radial forearm (4). Musculocutaneous flaps predominated (75.8%) compared to fasciocutaneous flaps (24.2%). There were 7 patients (21.2%) that underwent a revascularization procedure of the same limb prior to (71.4%) or at the same time (28.6%) as the free flap reconstruction. Immediate complications occurred in 7 flaps (21.2%) with 4 partial losses (12.1%) and 3 total flap failures (9.1%). Major wound complications requiring operative debridement occurred in 18.2% of patients. An end-to-side anastomosis for the artery was used in 33.4% of flaps compared to an end-to-end anastomosis and associated with a significantly higher risk of wound complications compared to an arterial end-to-side anastomosis (45.5% vs. 0%, $p = 0.001$).

Conclusion:

The use of microvascular free flaps can be a successful treatment option for diabetic lower extremity wounds and should be considered even in the presence of co-morbidities such as cardiac and renal disease. Concomitant revascularization procedures and flap type did not affect immediate flap survival or long-term wound healing outcomes. An end-to-end arterial anastomosis was associated with higher rates of wound breakdown, likely by impairing perfusion to a distal limb with an already compromised vasculature and should be avoided if possible in this population.

8:52 AM - 8:57 AM

RM 143. Quality of Life After Fibula Bone Harvest

Foothills Medical Centre, Alberta Health Sciences, Calgary

Presenter: Rasha Baaqeel, MBBS, FRCSC

Rasha Baaqeel, MBBS, FRCSC(1), C. Schrag, MD(2)

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Background: Reconstructive surgeons are often faced with challenging composite defects in the head and neck area that require three-dimensional reconstruction to restore form and function and allow dental rehabilitation. Because of its inherent vascularity, the fibula has become the workhorse flap of choice in facial reconstruction. Despite the reported donor site morbidity, such as: chronic pain, gait abnormality, decreased range of motion and reduced muscle strength, the fibula flap is still thought of as a low morbidity flap option. Multiple studies indicated high rates of subjective ankle instability despite normal clinical and radiologic exams. This was demonstrated in a recent biomechanical paper as impairment in balance ability and power performance. For proper perioperative patient counselling and rehabilitation, the impact of these outcomes on patients' quality of life deserves more attention. To our knowledge there are no patient reported outcome studies in this population. The aim of this study is to assess the impact of harvesting the fibula on the quality of life in patients who underwent head and neck reconstruction.

Methods : Retrospectively identified patients who underwent head and neck reconstruction using a free fibula flap between 2011-2016 at our centre were evaluated using two patient reported outcome questionnaires and clinically by means of focused history and physical examination. The main outcome measure was the scores of the 5 Foot Ankle Outcome Score (FAOS) subscales: pain, symptoms, activity of daily living (ADL), Sports, and quality of life (QOL), as well as the Pain Disability Questionnaire PDQ score, and whether a relationship coexists with pertinent clinical variables.

Results: 58 patients were identified; the first 11 responders were included in this pilot. Four patients scored below 85 in the Pain (44-100), Symptoms (60-100) and ADL (63-100) subscales. Eight patients scored below 85 in the Sports (30-80) and in the QOL (37-75) subscales. Ten patients scored below 70 in the PDQ, which places them in the mild to moderate pain disability category. Main donor site morbidities included: swelling (n=5), scar sensitivity (n=3), lateral ankle pain (n=4), weakness in great toe flexion, and variable decrease in ankle and great toe range of motion. Relationship between outcome scores and variables such as: physiotherapy, age, and perceived level of function did not reach statistical significance.

Conclusion : The data shows that the quality of life was affected in more than 50% of the fibula flap patients. However, given the small number of patients, a larger study is needed.

9:00 AM - 9:05 AM

RM 144. Applications of The Combined Transverse Upper Gracilis and Profunda Artery Perforator (TUGPAP) Flap

Presenter: Pedro Ciudad, MD, PhD

Pedro Ciudad, MD, PhD(1), Oscar J. Manrique, MD(2), Mouchammed Agko, MD(1) and Hung-chi Chen, MD, PhD, FACS(3)

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Background The transverse upper gracilis (TUG) and the profunda artery perforator (PAP) flaps have been described for breast and perineum reconstruction. However, the abdomen is considered one of the primary donor sites to reconstruct these areas. However, when abdominal tissue is not available, other donor sites such as the thighs or buttocks should be considered. The aim of this study is to describe our experience using the combined TUGPAP flap, for breast and perineum reconstruction.

Methods Between January 2011 and June 2013, all patients who required breast or perineum reconstruction using the TUGPAP were recorded. All patients with previous abdominal surgery or lack of adequate donor abdominal site tissue were excluded. All TUGPAP flaps were based on two pedicles: the ascending branch of the medial circumflex femoral artery (TUG) component, and the profunda artery perforator itself for the (PAP) component. Demographics, etiology of reconstruction, flap harvest time and complications were analyzed

Results A total of 13 combined flaps were performed: 10 free flaps for immediate unilateral breast reconstruction and 3 pedicle flaps for perineum reconstruction. There were 3 men and 10 women. The mean size of the harvested skin paddle was 28.6 x 8cm² (range, 27 x 37 cm² to 30 x 39cm²). The average flap harvest time was 102 minutes (range, 95 to 120 minutes). The average pedicle length for the TUG flap was 7 cm (range: 6–8 cm) and for the PAP flap was 9 cm (range: 8.5–10 cm). The flap survival rate was 100% and no partial flap loss was reported. No major complications were seen. However, there was one case of persistent donor site seroma, which was managed conservatively.

Conclusion

When abdominal tissue is not available, the TUGPAP flap is an alternative flap for medium to large breast reconstruction and extensive perineum defects. The good pedicle length, large skin paddle and the versatility of design, makes this flap a good alternative. In addition, the TUGPAP flap can be used for other kind of reconstructions when there are limited soft tissue donor sites and large tissue volume is required. However, appropriate patient selection is important in order to obtain good results.

9:05 AM - 9:10 AM

RM 145. A Study of 39,476 Firearm Injuries in the Pediatric Population: Trends and Disparities in Flap Reconstruction

Beth Israel Deaconess Medical Center / Harvard Medical School, Boston

Presenter: Austin D. Chen, BS

Austin D. Chen, BS(1), Klaas Ultee, PhD(2), Alexandra Bucknor, MBBS, MRCS, MSc(1), Anmol Chattha, BA(3), Qing Zhao Ruan, MD(1), Salim Afshar, MD, DMD(4), Bernard T. Lee, MD, MBA, MPH, FACS(5) and Samuel J. Lin, MD, MBA, FACS(5)

(1)Beth Israel Deaconess Medical Center / Harvard Medical School, Boston, MA, (2)Erasmus University, Rotterdam, Netherlands, (3)Albany Medical College, Boston, MA, (4)Boston Children's Hospital, Boston, MA, (5)Division of Plastic and Reconstructive Surgery, Beth Israel Deaconess Medical Center / Harvard Medical School, Boston, MA

Background

Firearm injuries in children and adolescents have been examined nationally, however, there has been little analysis of regional trends or treatment modalities. Plastic surgeons have a unique role in reconstruction of firearm-related defects. We investigated national and regional trends of firearm injuries and flap reconstruction.

Methods

A retrospective analysis of the Healthcare Cost and Utilization Project Kids' Inpatient Database for the years 2000, 2003, 2006, 2009 and 2012 was carried out. Data for patients ≥ 20 years admitted with firearm injuries were retrieved. The Cochran-Armitage test was used to evaluate national and regional trends in firearm injury incidence and flap reconstruction over time. Patient characteristics, injuries and outcomes were analyzed for non-flap reconstruction (NFR) and flap reconstruction (FR).

Results

There were 39,476 pediatric patients admitted for firearm injuries over the study period. There was no change in firearm injury incidence per one million population (from 111 per million in 2000 to 92 per million in 2012) (Figure 1). Flap reconstruction has increased (2.57% to 3.34%, $p=0.003$) (Figure 2). Northeast and West regions both show a significant increase in FR from 1.90% to 3.10% ($p=0.034$ and $p=0.004$, respectively) (Figure 3). There were more male FR patients compared to NFR patients (92.3% vs. 89.9%, $p=0.009$). There were significant differences in race ($p<0.001$), insurance ($p<0.001$), and income ($p<0.001$). Compared to those undergoing FR, those not receiving flap reconstruction were more often of African American (55.6% vs. 51.2%) or Hispanic (22.5% vs. 15.4%) race, in the first quartile of income (47.8% vs. 44.0%) or self-pay (21.3% vs. 16.3%) or no charge (1.5% vs. 0.6%). There were significant differences in hospital size ($p<0.001$), teaching status ($p<0.001$) and region ($p<0.001$). Compared to FR, those not receiving flap reconstruction were more often admitted at small (6.1% vs. 3.6%) or medium (22.2% vs. 19.5%), rural (2.8% vs. 2.1%) or urban non-teaching (15.3% vs. 10.2%) centers in the Northeast (16.4% vs. 14.6%) or West (26.8% vs. 20.6%). Patients with FR had significantly more infections (4.7% vs. 1.1%, $p<0.001$), respiratory complications (10.5% vs. 8.1%, $p=0.004$), wound dehiscence (0.6% vs. 0.4%, $p<0.001$) and acute renal failure (2.7% vs. 0.7%, $p<0.001$). A significantly greater number of NFR patients had concomitant injuries ($p<0.001$).

Conclusion

There has been an increase in firearm injury flap reconstruction over time. However, there are geographical and patient-level disparities in the receipt of flap reconstruction and further research may aim to understand the reasons for these trends.

