

RM30 Early Radiographic and Clinical Outcomes of Vascularized Pedicle Bone Grafting in the Foot: A Case Series

Hospital for Special Surgery, New York

Presenter: **Francesca Rose Coxe, BS**

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Background: Navicular nonunion and talar avascular necrosis (AVN) are thought to result from limited blood supply predisposing to injury and impaired healing. Existing treatment options are unreliable, as conservative treatment fails in 1/3 of patients and surgery involving joint sacrifice is not desirable in younger populations. Nonunion may also complicate arthrodesis, particularly in the setting of bone loss. Vascularized pedicled bone grafting (VPBG) is a promising adjunct to treating these challenging conditions, offering the susceptible diseased site structural and vascular support. We report the early radiographic and clinical success of VPBG in patients with navicular nonunion, talonavicular fusion nonunion, and talar AVN.

Methods: Patients with navicular nonunion, talonavicular fusion nonunion, or talar AVN who underwent VPBG at our institution from January 2014 to February 2019 were retrospectively identified. Postoperatively, patients were monitored for radiographic evidence of healing, defined by: progression towards union on CT for nonunion, and absence of disease progression on MRI or CT for AVN. Patients were evaluated for surgical complications and need for additional surgeries.

Results: Nine patients were included and underwent VPBG for navicular nonunion (N=6), talonavicular fusion nonunion (N=1), or talar AVN (N=2) (Table 1, Figure 1). Average clinical follow-up was 9.6 months (range 4-37 months). Eight of 9 patients had ≥ 4 months postoperative radiographic follow-up with MRI or CT. Seven of 8 patients demonstrated evidence of radiographic healing (Figures 2, 3). One patient required additional surgery due to external fixator pin site infection. No other complications or reoperations were reported.

Conclusion: Treatment of talar AVN, talonavicular fusion nonunion, and navicular nonunion is a clinical challenge with unpredictable outcomes. Our results corroborate prior case series suggesting VPBG is a safe and reliable procedure for the treatment of these conditions with potential to spare or delay need for salvage procedures in the younger patient population.

RM31 Medial Femoral Condyle Vascularized Bone Graft for the Reconstruction of Pediatric Nonunions

Baylor College of Medicine, Houston

Presenter: **Katarzyna E Kania, MD, MPH**

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Background Nonunions in the pediatric population pose a challenge in clinical practice, often requiring bone grafting. The medial femoral condyle (MFC) vascularized corticoperiosteal flap has been successfully used for bone loss, leading to higher union rates. The MFC has been infrequently used in the pediatric population and has been rarely described in the literature, likely due to uncommon indication and the concern for disrupting epiphyseal plates of skeletally immature children. This series describes our patient experience at Texas Children's Hospital.

Methods In 2018, seven patients aged 15 to 17 years underwent MFC flap for nonunion. Follow-up ranged from 2 months to 8 months. Radiographic and functional outcomes were analyzed post-operatively.

Results Of the seven patients, four had scaphoid nonunion, one had a large pre-maxillary cleft with an oronasal fistula, one had tibial nonunion secondary to fracture from osteogenesis imperfecta, and one had bony loss of the index finger proximal phalanx secondary to a gunshot wound. All seven patients achieved bony union. The scaphoid nonunion patients all reported no or significantly decreased pain from the donor site at follow-up. The tibial nonunion patient was released to 50% weightbearing status. No limb length discrepancy was observed and there was no evidence of skeletal growth disturbance in our skeletally immature patients (n=2). The oronasal fistula patient required a subsequent free radial forearm flap for closure of a recurrent oronasal fistula secondary to partial mucosal flap loss.

Conclusion Medial femoral condyle (MFC) flaps have been rarely described in the pediatric population. It is a safe and reliable flap with low donor site morbidity that can be applied to multiple indications. There was no evidence of physeal disturbances in skeletally immature children in our series (n=2). These flaps are a versatile option for nonunions in the pediatric population and have proven to be safe.

RM32 Choose Wisely - Muscle Flaps for Lower Extremity Coverage Present Problems Compared to Fasciocutaneous Flaps at the Time of Subsequent Orthopedic Procedures

Medical College of Wisconsin, Milwaukee

Presenter: **Meng Guo, MD**

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Background

Lower extremity orthopedic wounds that require soft tissue reconstruction are often associated with fractures or bony defects treated with hardware fixation. These may be complicated by infection, nonunion, and persistent pain that ultimately leads to hardware removal, revision, or bone grafting after initial successful flap reconstruction. In this study, we compare wound complication rates for secondary orthopedic procedures in patients who underwent either muscle or fasciocutaneous flaps.

Methods

An IRB-approved retrospective chart review study was conducted on all lower extremity soft tissue reconstructions performed by a single surgeon at a tertiary care center from 7/1/2007 to 8/31/2014. Data were manually extracted into a data collection form with de-identified patient information. A subgroup of patients who underwent subsequent secondary orthopedic procedures including hardware removal, hardware revision, and bone grafting after flap reconstruction was used for data analysis. Wound complications following secondary procedures were identified and classified into one of three groups: superficial wounds requiring local wound cares only, wounds that required debridement and additional skin grafting, and wounds that required debridement and additional flap reconstruction. Complication types and rates were compared between patients who had primary muscle or fasciocutaneous flaps.

Results

A total of 355 lower extremity soft tissue reconstructions for orthopedic coverage were performed in the time period specified. Of these, 102 patients underwent subsequent orthopedic procedures after flap reconstruction (28.73%). This group was further divided into two subgroups: those who received muscle flaps (n=54, 52.94%) and those who received fasciocutaneous flaps (n=48, 47.06%). Percentage of superficial wounds in the muscle flap group was 0% (n=0) versus 4.17% (n=2; p=0.130) in the fasciocutaneous flap group. Flap loss requiring additional skin grafting in the muscle flap group was 3.70% (n=2) versus 4.17% (n=2; p=0.904). Flap loss requiring additional flap reconstruction in the muscle flap group was 18.52% (n=10) versus 2.08% (n=1; p=0.008). Comparisons between pedicled and free flaps within each subgroup demonstrated no statistically significant difference for the three categories of wound complications.

Conclusion

Successful initial soft tissue flap transfer does not ensure that subsequent orthopedic procedures will be free of complications from a wound healing perspective. In our series, muscle flaps were associated with higher wound complications at the time of secondary orthopedic procedures. Anatomically, fasciocutaneous flaps are easier to elevate for exposure during subsequent surgeries than muscle flaps. Therefore, the authors recommend fasciocutaneous flap transfer for orthopedic lower extremity coverage if technically feasible, especially if subsequent orthopedic procedures are planned.

RM33 Clinical, Functional, Psychosocial and Sensorial Outcomes from the First 20 Agonist-Antagonist Myoneural Interface (AMI) Lower Extremity Amputations

Brigham & Women's Hospital, Boston

Presenter: **Matthew J. Carty, MD**

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Background

The agonist-antagonist myoneural interface (AMI) is a surgical construct in which naturally opposed, neurotized muscles are biomechanically linked in order to recreate the neural feedback loops present in intact human joints. We have developed modified approaches to lower limb amputation at both the below knee (BKA) and above knee (AKA) levels that incorporate AMI design.

Methods

We performed modified BKA and AKA procedures in a cohort of patients at Brigham & Women's Faulkner Hospital (BWFH) over the period 7/2016-7/2019. Outcomes for those undergoing these experimental procedures were assessed prospectively over time and were clinical (demographics, surgical parameters, complications, atrophy rates), functional (construct excursion, prosthesis control), psychosocial (multiple patient-reported outcomes metrics), and sensorial (residual limb pain, phantom pain, proprioception) in nature.

Results

Twenty (20) experimental amputations were performed in total; 17 (85%) were BKA and 3 (15%) were AKA. Patients were evenly split between men (10, 50%) and women (10, 50%). The etiology of injury leading to amputation varied across the cohort, including trauma (13, 65%), congenital (3, 15%), iatrogenic (3, 15%), and thermal (1, 5%). Mean patient age at time of amputation was 40.1 years. Mean operative time was 309 minutes for BKA, 531 minutes for AKA. Mean residual limb volume preservation was 101% of preoperative state. Average construct excursion evidenced by ultrasound was 15mm, with strain relationships paralleling those of normal muscle dynamics. AMI patients demonstrated significantly more accurate and efficient control of virtual and adapted prosthetic limbs than standard amputee controls. PROM results were universally improved in intervention patients compared to their preoperative results. All patients reported resolution of preoperative limb pain and the development of functional phantom limb perception, including phantom proprioception.

Conclusions

Novel lower limb amputation procedures incorporating AMI design improve volitional muscle control, restore proprioception and prevent atrophy in the residual limbs of patients in patients who have undergone them at the BKA and AKA level.

RM34 Free Flap Reconstruction of Traumatic Pediatric Foot and Ankle Defects: An Analysis of Safety, Clinical Outcomes, and Long-Term Functional Outcomes

Washington University School of Medicine in St. Louis, Saint Louis

Presenter: **Rajiv P Parikh, MD, MPHS**

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Background: Traumatic lower extremity injuries can have devastating consequences, including potential limb loss. Defects involving the foot and ankle represent a complex challenge as a functional reconstruction requires durable coverage that contours appropriately to facilitate ambulation. To date, there are limited reports on free flap reconstruction of foot and ankle defects in children. The purpose of this study is to evaluate the safety, clinical outcomes, and long-term functional outcomes of free flaps for traumatic pediatric foot and ankle injuries.

Methods: This is a retrospective review of a prospectively maintained database of microsurgical cases at a Level 1 Pediatric Trauma Center. Patients undergoing free flap reconstruction for traumatic foot and ankle defects between January 1st, 2000 and July 1st, 2014 were identified. Patients with less than 5-years of follow-up were excluded. Demographics, clinical characteristics, and postoperative outcomes were evaluated. Functional outcomes were assessed on clinical exam and with the Lower Extremity Functional Scale (LEFS). Categorical and continuous variables were analyzed with chi-square or Fisher's exact tests and Wilcoxon rank-sum test, respectively.

Results: Thirty patients undergoing 30 free flaps constituted the study population. The mean age was 11.3 years (range, 2 to 17 years) and mean follow-up was 8.5 years. Reconstruction with muscle flaps were more common ($n = 21$, 70%) than fasciocutaneous flaps ($n = 9$, 30%). Limb salvage was achieved in 97% of patients ($n = 29$). The overall complication rate was 30.0% ($n = 9$), with wound breakdown ($n = 5$, 16.7%) and partial flap loss being most common ($n = 3$, 10.0%). When comparing muscle flaps to fasciocutaneous flaps, no significant differences were observed in rates of limb salvage, total or partial flap loss, or donor-site complications ($p > 0.05$). Muscle flaps were more prone to wound breakdown on the weight-bearing surface when compared to fasciocutaneous flaps (16.7% versus 0.0%, $p < 0.05$). However, fasciocutaneous flaps were more likely to require revision procedures for contour (20.0% versus 6.7%, $p < 0.05$). Ninety-seven percent of patients ($n = 29$) returned to ambulation without a prosthesis. The median LEFS scores were not significantly different when compared to published normative values for healthy volunteers with any history of lower extremity fracture or surgery.

Conclusion: Free flap reconstruction of pediatric foot and ankle defects is associated with a high rate of limb salvage. An overwhelming majority of patients will return to independent ambulation and have favorable long-term functional outcomes.

RM35 Medial Femoral Condyle Free Flap Reconstruction of Complex Foot and Ankle Pathology

University of Pennsylvania Health System, Philadelphia

Presenter: **John Timothy Stranix, MD**

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Background: Complex hindfoot pathology may benefit from reconstruction with vascularized bone flaps rather than traditional bone grafting techniques, especially in salvage or secondary surgery. The medial femoral condyle (MFC) free flap enables transfer of vascularized periosteum, skin, and viable corticocancellous bone to promote osseous union. MFC outcomes in foot and ankle reconstruction warrants further investigation. **Methods:** Retrospective, single-institution cohort study of consecutive MFC free flaps performed for complicated hindfoot reconstruction between 2013-2019. Radiologic follow-up was used to assess osseous union and clinical outcomes were evaluated with the American Orthopaedic Foot and Ankle Society (AOFAS) hindfoot score. **Results:** 30 MFC free flaps were performed in 28 patients for complex hindfoot pathology. Mean age was 47.8 years (range 17 to 77) with an even gender distribution. Obesity was common with an average BMI of 31 kg/m² (range 19-45). Avascular necrosis was present in 83% and most patients had failed prior hindfoot operations (67%, mean 3.1, range 1-10). The majority of hindfoot procedures involved arthrodesis (n=24, 80%), with tibiototalcalcaneal (n=11) and talonavicular (n=7) fusions the most common. Mean osseous flap volume was 10.3 cm³ (range 1.7-18.4cm³); one flap required takeback for venous congestion but no total flap losses occurred. Of the 27 flaps with adequate clinical and radiographic follow up (mean 15.8 months (range 4-33 months)), primary osseous union was initially achieved in 20 patients (74%) by an average of 217 days (range 110-475 days). Interface nonunion occurred in 6 patients; 5 underwent revision arthrodesis and ultimately achieved union in 24 patients (89%, mean 271 days (range 110-628)). Risk factors for nonunion were BMI >30 (p=0.017) and prior arthrodesis (p=0.042). Mean AOFAS hindfoot scores increased significantly from 52.3 preoperatively to 70.7 postoperatively (p<0.001). Subscore analysis demonstrated significant improvement in postoperative pain scores from 14.2 to 27.3 out of 40 (p<0.001). **Conclusion s:** The MFC free flap provides vascularized bone for complicated foot and ankle reconstruction with low donor site morbidity, promising osseous union results, and improved functional outcomes.

RM36 Free and Perforator-Based Flap Coverage for Acute Burn and Frostbite Injuries

The University of Chicago, Chicago

Presenter: **Maureen Beederman, MD**

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Background

For the majority of patients admitted to the hospital with acute burns and frostbite, treatment options often center around expeditious debridement, coverage with skin grafts, and, in cases of severe upper or lower extremity injuries, amputation. However, in some circumstances, local perforator flaps and free tissue transfer can preserve limb length and are viable treatment options, even in cases of severe, full-thickness, >50% total body surface area (TBSA) injuries. This study describes our experience and success with use of perforator and free flap tissue reconstruction in patients with acute burn and frostbite injuries.

Methods

A chart review was undertaken of all patients admitted to The University of Chicago Burn and Complex Wound Center between January 1, 1998 and June 30, 2019 who were treated with either perforator-based or free flaps during the acute phase of their injuries. Demographic information, mechanism and location of injury, type of flap reconstruction, and outcomes (when available) were recorded.

Results

A total of 37 perforator-based flaps and 9 free flaps were performed on 30 patients admitted to the Burn and Complex Wound Center during our study period. Injuries included acute burns (n=13, 43%), frostbite (n=9, 30%), road rash (n=4, 13.3%), chemical burns (n=2, 6.7%), and electrical burns (n=2, 6.7%). Of the patients requiring flap reconstruction, 15 (50%) had lower extremity wounds requiring coverage, 12 (40%) had upper extremity/hand wounds, and 3 patients required flap coverage for both upper and lower extremity wounds. The most common complication in this patient population was partial flap necrosis. There was one total flap loss, and one patient death.

Conclusion

Perforator-based and free flap coverage of acute burn, road rash, and frostbite injuries allowed for the preservation of limb length, coverage of vital structures, and prevention of secondary contractures across joints in our patient population, with relatively few major complications.