

ASRM Scientific Paper Presentations: CTA/VCA

Monday, January 15, 2018, 11:45am – 12:45pm

11:45 AM - 11:50 AM

RM 74. **Whole Eye Allograft Transplantation and Immunosuppression: Survival of the Transplanted Rodent Eye Using Tacrolimus Monotherapy**

Presenter: Wendy Chen, MD, MS

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Background

Visual impairment and blindness present significant economic, social and personal burdens around the world. Whole eye transplantation (WET) is one potential solution. Our lab has established a viable rodent model and demonstrated promising results in syngeneic transplants. To establish allograft transplantation, a successful immunosuppressive pharmacotherapy regimen is required. Tacrolimus monotherapy is successful in rodent vascularized composite allotransplantation (VCA), but its efficacy in WET is unknown. Here, we present survival of allograft WET treated with Tacrolimus monotherapy.

Methods

Brown-Norway to Lewis rat whole eye transplantations were performed (n=6), followed by daily 1mg/kg Tacrolimus (FK-506) monotherapy via intraperitoneal injection. Animals were examined at post-operative week 1, 3, 5, and 6. Structure and blood flow of the eye and retina were studied using Optical Coherence Tomography (OCT). A retina specialist ophthalmologist performed anterior segment examination, funduscopy, indirect ophthalmoscopy, and tonometry for intraocular pressures. Animals were sacrificed at 6 weeks. Specimens of the transplanted globe, external ear, eyelid, bone and vessel anastomoses were stained with H&E and interpreted by an ocular pathologist.

Results

All transplanted flaps survived and healed without signs of infection or necrosis (Figure 1, 2). OCT demonstrated generally normal cornea, relative structural maintenance of the retina, and preserved blood flow in the central retinal artery and vein (Figure 3).

At one week after transplantation, most (n=3 out of 5 examined) of transplanted allograft eyes exhibited normal perfusion with pink optic nerve heads. At three weeks, the eyes trended toward increased ischemia, with atrophic fundus or 3+ ischemia (n=3 out of 5 examined). By five weeks, there was some improvement in severity, but optic nerve heads remained pale and moderate fundus ischemia was sustained to the study endpoint of 6 wks.

Intraocular pressures (IOPs, Figure 4) in the transplanted eye were within normal range, with a single exception. Average IOPs in the transplanted eyes were 10.9 mmHg (SD 2.2), 15.5 mmHg (SD 7.7), 9.9 mmHg (SD 2.7), and 10.7 mmHg (SD 2.3) at week 1, 3, 5, and 6, respectively.

Conclusion

With Tacrolimus monotherapy, transplanted globes survived for 6 weeks, with intact cornea and retinal structures and normal IOPs. Although some degree of fundus ischemia was present, the central retinal vasculature appeared preserved. Future studies of systemic and local immunosuppressive therapies including Tacrolimus monotherapy are necessary to support the structural and functional success of whole-eye allotransplantation.

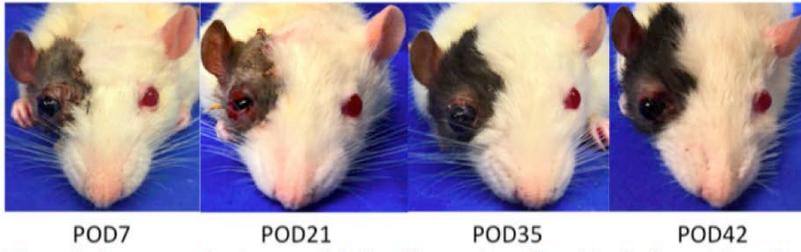


Figure 1. Representative images of the hemiface and eye flap at 1-, 3-, 5-, and 6-week examinations after allograft whole eye transplantation.

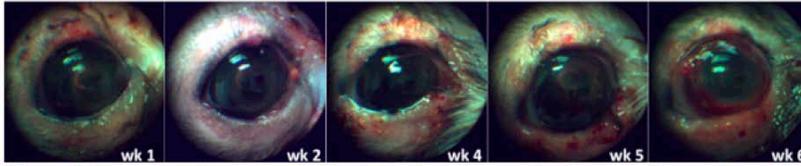


Figure 2. Representative images of the transplanted eye at 1-, 3-, 5-, and 6-week examinations after allograft whole eye transplantation.

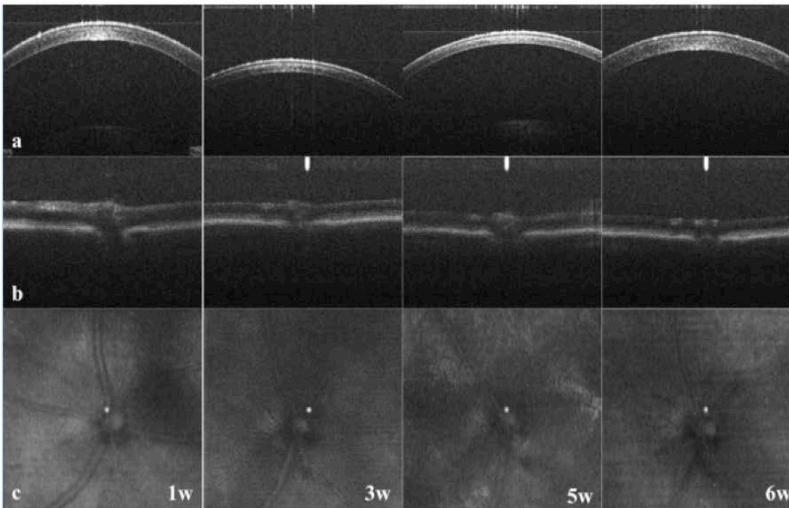


Figure 3. Optical Coherence Tomography (OCT) of transplanted eye after allograft whole eye transplantation. Representative appearance of transplanted eye at 1-, 3-, 5-, and 6-week examinations. a) cornea, b) scan of the retina (cross-sectional view), and c) fundus.

Average Daytime Intraocular Pressure of Immune Suppressed Allografts

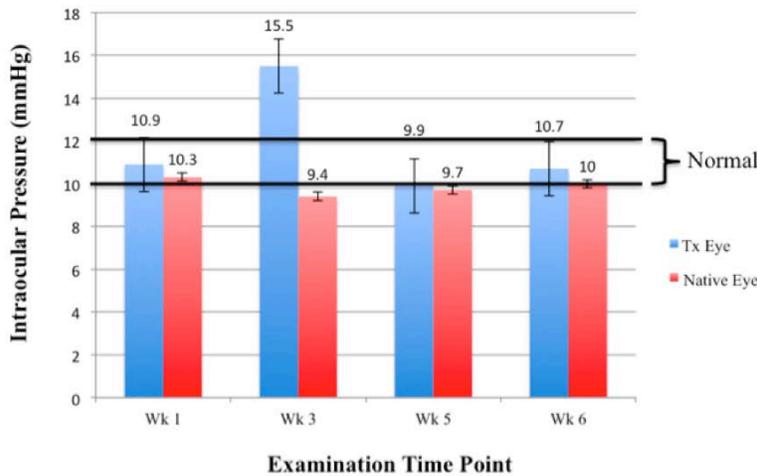


Figure 4. Intraocular pressures (IOPs) in the transplanted eye were within normal range.

11:50 AM - 11:55 AM

RM 75. Retinochoroidal Circulation is Demonstrated with Fluorescein Angiography in a Rodent Model of Whole Eye Transplantation

University of Pittsburgh , Pittsburgh

Presenter: Joshua Barnett, BS

Jila Noori, MD(1), Maxine R. Miller, MD(1), Yong Wang, MD(1), Chiaki Komatsu, MD(1), Bing Li, MD(1), Wendy Chen, MD, MS(1), Kira L. Lathrop, MAMS(1,2), Ian A. Rosner, BS(1), Joshua Barnett, BS(1), Wensheng Zhang, MD(1), Mario G. Solari, MD(1,3), Joel S. Schuman, MD(4), Andrew W. Eller, MD(1) and Kia M. Washington, MD(1,3,5)

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Background

Approximately 39 million people worldwide are blind. Whole eye transplantation (WET) could potentially provide a viable optical system to patients with irreversible vision loss. We have developed an orthotopic model for whole eye transplantation in the rat. Given that viability of the retina is crucial to functional visual return, we sought to investigate the structural integrity of the retinochoroidal circulation using wide-field fluorescein angiography (FA).

Methods

Brown Norway rats underwent syngeneic whole eye transplantation (n=4). Animals were examined at post-operative week 1. Wide-field FA images and fundus photographs were obtained to evaluate retinochoroidal blood flow. Ocular examinations were performed by an ophthalmologist with retina specialization to evaluate the anterior and posterior segments of the eye. Unoperated eyes of Brown Norway rats (n=3) served as controls.

Results

FA imaging revealed that 2 of 4 rats had transplanted eyes that exhibited normal choroidal flush and arterial and venous filling patterns, normal optic disc appearances, normal retinal vessel caliber and no retinal vessel leakage comparable to the eyes of control animals. Taken together with the results of ocular exams and interpretation of fundus photographs, it was confirmed that there were no signs of retinal ischemia, vessel narrowing or arteritis/phlebitis present in the eyes of these animals. The remaining 2 of 4 rats had transplanted eyes with normal choroidal, arterial and venous filling patterns and no signs of arteritis/phlebitis or vessel leakage. Attenuated retinal vessels were seen on color fundus photographs and FA imaging in the study eyes. Correlated with ocular exam results and evaluation of the retina as captured on fundus photographs, there appeared to be decreased retinal perfusion in these animals as compared to controls.

Conclusion

FA results have confirmed that retinochoroidal blood flow can be established after WET in a rat model. Imaging of 2 of 4 rats revealed that there was no difference in retinochoroidal circulation as compared to the eyes of control animals. In 2 of the 4 rats, transplanted eyes appeared to have decreased retinal perfusion. In all rats, the pattern of vascular filling was normal, and the absence of vessel leakage indicates that the structural integrity of ocular blood vessels can be maintained after WET. The etiology of vascular attenuation and presumed decrease in retinal perfusion will be investigated in future studies.

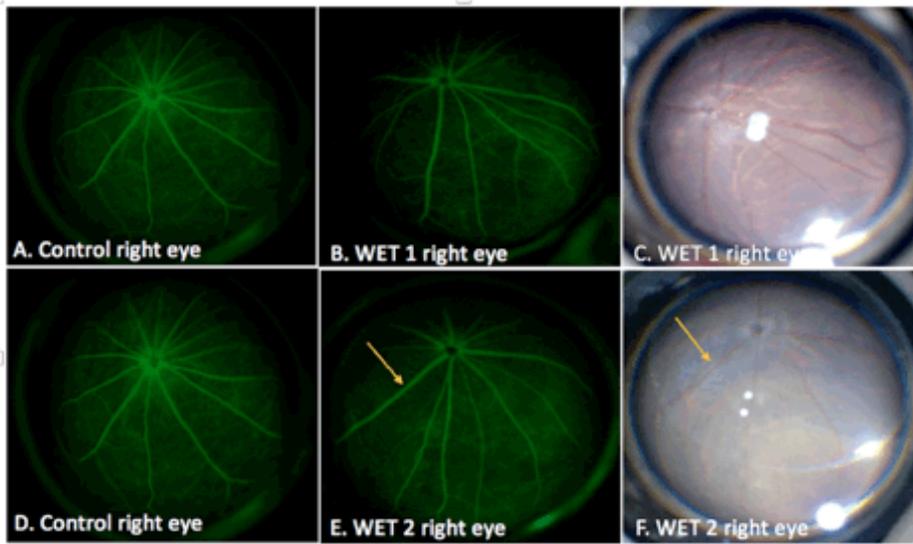


Figure. Fluorescein angiography of transplanted eyes of two animals, WET 1 and WET 2 (B and E) 1 week after whole eye transplantation as compared to a control eye (A, D) Corresponding fundus photographs of WET 1 and WET 2 are featured in C and F. B, C: WET 1, no signs of vessel narrowing E, F: WET 2, narrowed retinal vessels are noted (arrows)

11:55 AM - 12:00 PM

RM 76. Augmented/Mixed Reality and Three Dimensional Printed Models for Planning and Execution of Facial Vascularized Composite Allotransplantation

Cleveland Clinic, Cleveland

Presenter: Kihyun Cho, MD, MSc

Kihyun Cho, MD, MSc(1), Jeff Yanof, PhD(2), Francis A. Papay, MD(1), Karl West, MS(2), Ryan Klatte, BS(2), Bahar Bassiri Gharb, MD, PhD(1) and Graham S Schwarz, MD, FACS(1) (1)Plastic Surgery, Cleveland Clinic, Cleveland, OH, (2)Biomedical Engineering Department, Cleveland Clinic, Cleveland, OH

Background: Computer aided three-dimensional (3D) modeling of the head and neck has improved efficiency and outcomes of complex reconstruction. The advent of 3D printing has allowed a tangible and highly accurate reproduction of complex craniofacial anatomy of the recipient during planning and execution of facial vascularized composite allotransplantation (VCA). Time constraints related to organ procurement and cost of fabrication make this modality less useful when rendering the donor. A holographic model using mixed reality technology has the potential to provide rapid, high-fidelity, 360 degree, 3D visualization with infinite perspective for surgical planning with lesser resources.

Purpose: To evaluate the accuracy of linear measurements on rendered holographic skull models, and on 3D printed models, when compared to those obtained by digital microcaliper on a corresponding physical specimen. Secondly, to evaluate the clinical utility of these advanced adjuvant technologies.

Methods: Seven adult dry human skulls were selected based on stable occlusion. Stereolithography (STL) files were generated from CT imaging data acquired with a standardized protocol and loaded onto HoloLens mixed reality headsets (Microsoft, Seattle, WA.). 3D printed models were also generated. Two researchers performed two repeated measurements on actual skulls (gold standard) and 3D printed skulls with digital micro-calipers. Holographic measurements were made by selecting two holographic surface points. Bland and Altman analysis was utilized to assess agreement. 95% Confidence intervals were determined and the significance was set at $P < 0.05$. Time and cost of 3D print and holographic renderings were recorded.

Results: HoloLens and direct microcaliper measurements were within 95% limits of agreement and there was no significant bias between them. Microcaliper measurements from skulls were not significantly different relative to those taken from 3D print counterparts ($p < .05$). Holographic models required less time and cost and provided more comprehensive visualization of 3D spatial relationships than the corresponding 3D printed model. Fabricated 3D printed models provided tactile and structure specific surface anatomy available within an operative field.

Conclusion: HoloLens augmented reality and 3D print technologies have sufficient accuracy for linear anatomical measurements important in planning and surgical guidance in facial VCA. With lower cost and rapid preparation time, however, on-the-fly holographic planning provides superb visualization and perspective, the facility to superimpose potential donor and recipient surgical plans, and real time image segmentation.

12:03 PM - 12:08 PM

RM 77. Reporting Practices on Immunosuppression and Rejection Management in Face Transplant Patients

Albert Einstein College of Medicine, Bronx

Presenter: Giulia Daneshgaran, BS

Giulia Daneshgaran, BS(1) and Evan Garfein, MD(2)

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Background: Face transplantation is a demanding operation requiring complex pre-operative planning, expert technical performance, and multidisciplinary post-operative care. Perhaps the factors most critical to the long-term success of this procedure are not surgical but medical, including immunosuppression, graft surveillance, management of rejection, and graft failure. While the documentation of the aesthetic and functional successes of the first face transplants is impressive, there are large lacunae in reporting of institutional protocols for the other critical components of this operation. The purpose of this review is to assess protocol reporting by face transplant teams, in order to determine where we, as a plastic surgery community, can improve.

Methods: A systematic review of PubMed was conducted to identify all literature on face transplants published from November, 2005 starting with the first successful transplant to July, 2016. All English-language articles were reviewed for reporting of protocols on antimicrobial prophylaxis, immunosuppression, graft surveillance, and management of rejection and graft failure.

Results: A total of 37 face transplantation patients were identified during the study period. Protocols for perioperative prophylaxis, immunosuppressive induction, and maintenance immunosuppression were reported for 43%, 57% and 54% of patients, respectively. Protocols for graft surveillance and pharmacological management of rejection were reported for 49% and 54% of patients, respectively. Surgical salvage strategies to manage graft failure were documented for 30% of patients (Table 1).

Conclusion: The current literature on face transplantation does not include uniform reporting of critical aspects of patient care. For facial vascularized composite allotransplantation, medical protocols outlining guidelines for antimicrobial prophylaxis, immunosuppression, graft surveillance, management of rejection, and management of graft failure are the most critical factors determining overall transplant success. However, they are underreported in the literature. The field of face transplantation has the potential to offer groundbreaking treatment options for patients with severe facial defects for which there are no other acceptable alternatives. Development and communication of standardized protocols in the treatment of face transplant recipients is essential to improve patient outcomes and maximize the results of this already high-cost procedure.

	Total number of studies	Reporting frequency
Perioperative prophylaxis	16/37	43%
Immunosuppressive induction	21/37	57%
Immunosuppressive maintenance	20/37	54%
Graft surveillance	18/37	49%
Pharmacological management of rejection	20/37	54%
Surgical management of graft failure	11/37	30%

Table 1: Incidence of protocol reporting for the 37 face transplants performed worldwide

12:08 PM - 12:13 PM

RM 78. Comparison of the Engraftment Efficacy of Pro-Tolerogenic Human Hematopoietic Chimeric Cells Following Intravenous and Intraosseous Delivery

University of Illinois at Chicago, Chicago

Presenter: Maria Siemionow, MD PhD DSc

Maria Siemionow, MD PhD DSc, Ewa Bryndza Tfaily, PhD, Joanna Cwykiel, MSc, Safak Uygur, MD and Erzsebet Szilagyi, MD, PhD

University of Illinois at Chicago, Chicago, IL

Background: Vascularized composite allotransplantation (VCA) aims to address the reconstructive needs of patients suffering from massive face and limb injuries. Application of cellular therapies to support transplant survival and eliminate life-long immunosuppression showed promising results; thus we introduce a new customized human hematopoietic chimeric cell (HHCC) therapy created by *ex vivo* fusion of CD34 bone marrow derived cells. The aim of this study was to assess *in vivo* the difference in engraftment and survival of HHCC after intravenous or intraosseous cell delivery in an athymic nude rat model.

Methods: Thirty-eight *ex vivo* fusions were performed to create HHCCs. Briefly, CD34+ cells from two bone marrow (BM) donors were stained separately with PKH26 and PKH67 dyes, and fused with polyethylene glycol. Double PKH26 and PKH67 stained HHCC ($1-2 \times 10^6$) cells were sorted and injected intravenously or intraosseously to the athymic nude rat recipients. The presence of HHCC in peripheral blood, bone marrow, liver and lymphoid organs, such as spleen and lymph nodes, was detected using anti-human HLA-ABC staining and evaluated by confocal microscopy and flow cytometry.

Results: *In vivo* studies confirmed that HHCC were present in the peripheral blood of the athymic nude rat recipients up to 6 weeks after cells intraosseous and intravenous delivery. Additionally, HHCC migrated from the injected to the contralateral femur bone and to the lymphoid organs (lymph nodes, spleen) and liver. At 6 weeks after injection the number of HHCC in the nude rat peripheral blood and bone marrow compartment was higher after intraosseous cell delivery (0.58% and 6.58%, respectively) compared to intravenous cell delivery (0.11% and 1.8%, respectively).

Conclusion: *In vivo* studies confirmed engraftment, migratory properties and long-term survival of HHCC. Improved engraftment into the bone marrow niche was observed after intraosseous HHCC delivery. Application of HHCC as a supportive therapy via intraosseous injection represents a safe, novel approach for tolerance induction in solid organ and VCA transplantation.

12:13 PM - 12:18 PM

RM 79. Novel Approaches to Assessment of Facial Nerve Regeneration in a Swine Hemifacial Composite Tissue Flap Model: A Physiological and Histological Study

Mayo Clinic, Rochester

Presenter: Anita T Mohan, MRCS MBBS

Anita T Mohan, MRCS MBBS(1), Marissa Suchyta, BA(2), Saad A. Alsubaie, MD(3), James Schmelzer, BA(4), Karim Bakri, MBBS(2), Basel Sharaf, MD, DDS(3), Chunfeng Zhao, MD(5), Eric J. Sorenson, MD(4), Phillip A. Low, MD(4), Peter Dyck, MD(2) and Samir Mardini, M.D.(3)

(1)Division of Plastic Surgery, Mayo Clinic, Rochester, MN, (2)Mayo Clinic, Rochester, MN, (3)Plastic Surgery, Mayo Clinic, Rochester, MN, (4)Department of Neurology, Mayo Clinic, Rochester, MN, (5)Department of Orthopedics, Mayo Clinic, Rochester, MN

Background:

Functional recovery following face transplant is dependent upon nerve regeneration and re-innervation, which leads to motor control and sensory input. However, no large animal models of facial nerve regeneration exist. Current facial nerve regeneration studies utilize small animal models, which do not recapitulate the distance and time axons require to travel in human. Current swine models of face transplant do not adequately include the major swine facial nerve branches in the transplant or have not survived for long-term nerve regeneration studies. Thus, the aim of this study is to develop a swine hemifacial transplant model to study and improve facial nerve regeneration and functional neuronal recovery in facial transplantation.

Methods:

Six 10kg domestic pigs were used. Facial nerve anastomosis of the buccal, posterior auricular, and cervical branches of the facial nerve were performed in conjunction with a hemifacial composite tissue flap isolated on the superficial temporal vessels. The marginal mandibular nerve was preserved as a control. Nerve function was measured quantitatively using both serial compound muscle action potentials and electroneurograms and subjectively for functional muscle recovery for 4 months. At euthanasia four months post-surgery, facial nerves branches were collected, cross-sectioned, and stained with toluidine blue. Utilizing a novel algorithm, the nerves' axonal and fiber density, myelination ratio, and diameter were calculated along the length of the regenerating nerve.

Results:

The hemifacial composite tissue flap surgery was successful in all animals, and long-term followup to four months was thus possible. ENG and CMAP studies demonstrated results consistent with regeneration along the anastomosed nerves, including decreasing amplitude in neurophysiological readings distal to the anastomosis site. A novel algorithm analyzed histological facial nerve cross-sections, determining their fiber density, myelination, and diameter. Furthermore, an anatomical topography map of pig facial anatomy was generated.

Conclusion:

This novel swine experimental model of facial nerve regeneration can be utilized to inform post-surgical care, including immunosuppression protocols to improve facial nerve regeneration, in the context of face transplant. Histological analysis as well as electrophysiological studies also provided novel quantitative methods to assess facial nerve regeneration in face transplant.

12:21 PM - 12:26 PM

RM 80. Prevention of Ischemia-Reperfusion Injury in a Porcine Forelimb Vascularized Composite Allotransplantation (VCA) Model using a Novel Oxygenation Preservation Technique

RESTOR™ Program, 59th Medical Wing, JBSA Lackland AFB, San Antonio

Presenter: Nicholas Robbins, DO

Nicholas Robbins, DO(1), Matthew Wordsworth, MA, MRCS(2), Bijaya Parida, PhD(3), Vijay Gorantla, MD, FACS(4), Warren Breidenbach, MD(1) and Erik K Weitzel, MD(5)

(1)59th Medical Wing, San Antonio, TX, (2)Academic Department of Military Surgery and Trauma, Birmingham, United Kingdom, (3)United States Army Institute of Surgical Research, San Antonio, TX, (4)Wake Forest University, Winston-Salem, NC, (5)Institute of Surgical Research, San Antonio, TX

Background: Modern body armor, rapid evacuation, and advanced combat casualty care have improved survival after catastrophic extremity trauma. Restoration using vascularized composite allotransplantation (VCA) has been found to be superior to conventional reconstruction in such injuries but detrimental effects on graft function and long-term viability following the necessary ex vivo ischemic phase has been a compromised entity. Cold static preservation (CSP) has remained the standard of care (SOC) for almost 40 years and relies on induced hypothermia (4°C) during obligate ischemia time. Both muscular (>4 hours) and neural (>8 hours) tissue experience irreversible deterioration with warm ischemia whereas experimental data confirm that hypothermia is neuroprotective but only so at the subnormothermic temperature range (21-28°C). Unlike organs that rely predominantly on vascular perfusion for function, VCA function relies on neuroregeneration and muscle reinnervation and hence requires advancement in the current SOC. To mitigate cold ischemic and obligate reperfusion injury in VCA, we evaluate the efficacy of a novel machine preservation/hemoglobin oxygen carrier (MP/HBOC) at subnormothermia (21°C) for up to 18 hours.

Methods: Using a proven porcine orthotopic forelimb transplant model we evaluated control forelimbs (n=6) with CSP at 4°C with University of Wisconsin (UW) solution and experimental forelimbs (n=6) with ex vivo MP/HBOC for up to 18 hours at a subnormothermic temperature of 21°C. The recipient underwent a orthotopic forelimb allotransplantation with subsequent daily evaluation for clinical and histologic evidence of viability, functionality, and neuropreservation with an end-point of 40 days. Histologic analysis was blinded and reviewed by an expert veterinarian pathologist. EEG and MRI neuro tractography at study endpoint was implemented to assess viable peripheral nervous tissue.

Results: Six porcine allotransplants are designated to the experimental group and 6 control limbs. It is anticipated study results will be similar to a previous porcine VCA flap model exposed to 14 hours of ischemia with significantly attenuated markers of ischemic-reperfusion injury, apoptosis seen on TUNEL staining, endothelial damage, intramyelinic edema, and axonal vacuolization in the CSP group compared to MP/HBOC treated limbs.

Conclusion: If VCA can be preserved for up to 18 hours in the ex vivo state, protected from ischemic damage and functional decline following allotransplant in the porcine model, the achievement would have profound experimental and clinical application in current VCA models and future tissue preservation techniques for all organ transplantation.

12:31 PM - 12:36 PM

RM 82. Personalized planning and surgical device fabrication for craniofacial allotransplantation

New York University Langone Medical Center, New York

Presenter: J. Rodrigo Diaz-Siso, MD

J. Rodrigo Diaz-Siso, MD, Natalie M. Plana, BA, Jamie P. Levine, MD, Eduardo D. Rodriguez, MD, DDS and Daniel J. Ceradini, MD

New York University Langone Medical Center, New York, NY

Background:

Craniofacial allotransplantation is especially challenging when recipient defects require skeletal components. Priorities include achieving dental occlusion and maximizing contact between donor and recipient bone, which may increase operative time. In microvascular facial reconstruction, computerized surgical planning (CSP) reduces ischemia time and total operative time, allowing for increasingly complex flap designs. CSP has been implemented successfully in craniofacial allotransplantation, however, direct comparison of surgical outcomes between CSP and non-CSP craniofacial transplants has not been performed.

Methods:

We completed a total of 8 cadaveric craniofacial transplants, divided equally between CSP and non-CSP surgeries. A preoperative CT was obtained for each specimen, and for the CSP group, the authors collaborated with engineers to develop computerized surgical plans using CT data. Ideal osteotomy sites were identified in the virtual space, and customized osteotomy guides were designed and 3D-printed for use during the cadaveric transplants. For each group, one transplant was performed using a Le Fort II osteotomy design. The remaining three transplants included segments of vascularized bone, preserving their attachments to the soft-tissues (superior temporal septum, temporal ligamentous adhesions, zygomatic cutaneous ligaments, mandibular osteocutaneous ligaments) to prevent allograft ptosis. A postoperative CT was obtained for each specimen. For the non-CSP group, the preoperative CT was used for *post hoc* surgical planning, which served as the benchmark for postoperative outcomes comparisons using overlay technology. The duration of donor allograft procurement, recipient debridement, allograft inset, and total operative time was measured.

Results:

For the Le Fort II allograft design, qualitative analysis showed vastly improved allograft position, bone contact, and dental occlusion in the CSP transplant. All operative phases were completed more quickly in the CSP Le Fort II transplant. For the anti-ptosis allograft design, qualitative analysis also showed improved allograft bone position in the CSP transplant. The duration of donor procurement, allograft inset, and total operative time was significantly decreased in the CSP transplants. There was no significant difference in the duration of recipient debridement between the CSP and non-CSP groups.

Conclusion:

Computerized surgical planning results in faster facial allograft procurement, shorter allograft inset, and decreased total operative time. These findings, respectively, may improve coordination with solid organ transplant procurement teams, reduce ischemia time and enhance recipient safety, and alleviate recipient recovery and surgical team fatigue.

12:36 PM - 12:41 PM

RM 83. Eight-year Follow-up on the First Face transplant in the United States and the Longest Living Composite Tissue Allograft Containing Vascularized Bone

Cleveland Clinic, Cleveland

Presenter: James Gatherwright, MD

James Gatherwright, MD(1), Rebecca Knackstedt, MD, PhD(1), Frank Papay, MD(2), Steven Bernard, MD(1), Graham S Schwarz, MD, FACS(1), Brian Gastman, MD(1), Antonio Rampazzo, MD, PhD(1), Bahar Bassiri Gharb, MD, PhD(2), Mark Hendrickson, MD(1), Maria Siemionow, MD, PhD, DSc(3) and Risal Djohan, MD(1)

(1)Cleveland Clinic, Cleveland, OH, (2)Department of Plastic Surgery, Cleveland Clinic, Cleveland, OH, (3)Plastic Surgery, Cleveland Clinic, Cleveland, OH

Background:

Despite 37 documented face transplants occurring worldwide, there is a paucity of literature on their long-term follow-up.

Methods:

On December 8, 2008, the first near-total human face transplant was performed in the United States on a 45-year old female who had incurred a close range ballistic injury. The current study provides an eight-year follow-up.

Results:

Initially started on a routine transplant regimen, this has been tapered over the years and currently consist of Mycophenolate Mofetil 500 mg TID, Tacrolimus 1mg BID and Prednisone 5mg. The patient has been admitted seventeen times, resulting in 143 hospital days. She has had 8 infections requiring hospitalization. She has had sixteen procedures; eight of which were ophthalmology related. Her most recent operation was in November 2016 for a right orbital implant exposure/removal. There have been six acute rejection episodes, all of which were successfully treated with steroids and short-term medication adjustments. CT imaging at 5 year follow-up demonstrated maintenance of skeletal alignment and comparison of imaging over time reveals bone resorption at Le Fort 3 osteotomy sites, left infraorbital rim, left maxillary buttress, and anterior maxilla with bone deposition at septum and alveolar bones. The patient continues to demonstrate improvements in anxiety, depression, and re-integration; however, self-esteem and sexual function continue to not be much improved. Speech intelligibility is 90-100% with some mild dysarthria and decreased articulatory precision.

Conclusion:

This is the first report on the long-term outcomes of the longest living face transplant in the United States and the longest follow-up on an individual who received composite transplant including vascularized bone. Despite acute rejection episodes and several infectious complications, her overall health has been relatively well maintained with continued management via the lowest possible regimen of immunosuppression. Continued objective evaluation of these results both on an institutional and international level are required to provide better understanding, improved outcomes, and justification of this procedure.