Characterization and optimization of forelimb autotransplantation for reconstruction of battlefield injuries in a swine model (Sus scrofa)

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Background: Every year, an estimated 7 million people in the United States need vascularized composite tissue reconstruction secondary to surgical excision of tumors, accidents, and congenital malformations. Limb amputees alone comprise 1.6 million of these individuals. The evolution of reconstructive surgery has become ever more valuable in the face of the current conflicts of Iraq and Afghanistan, where servicemen and women that would have otherwise lost their lives now present with more complex wounding patterns of the extremities. While lower extremity prostheses have allowed many individuals to regain their independence and mobility, upper extremity prostheses have not, and consequently has been the catalyst for the surge of vascularized composite allotransplantation in the form of hand transplantation.

Methods: Female swine (70-90kg) (n=10; 3 model development, 7 experimental) undergo surgical amputation of left mid forelimb after dissection and division of tendons, nerves, artery, and veins. Subsequently, the limb is re-implanted. The bones are reapproximated by 2 metal plates and the tendons and neurovascular bundles are reanastomosed using microvascular techniques. Upon completion of implantation, the forelimb is placed in a fiberglass cast and the animal is survived for 14 days.

Results: We have completed the 3 model development animals. The first 2 animals were not survivor animals, these animals were used to develop and characterize the methods of dissection of structures, amputation, reimplantation, and casting. The third model development animal will be survived for 14 days to evaluate whether the animal is still able to function (eat, drink, mobilize) after such procedure and with the presence of a casted limb. The 7 experimental animals are to follow.

Conclusion: Currently, the use of immunosuppression therapy is necessary for graft survival. The use of multiple immunosuppressive drugs however, can be avoided through the study and use of immunomodulators—agents that modulate the immune system. However, prior to the study of the effects of immunomodulators on limb transplantation, there needs to be an animal model in place that validates the feasibility of limb transplantation. The initial steps of characterizing and optimizing the autotransplantation of the forelimb in a large animal as proposed by this model will provide a platform through which we can further study the effects of certain immunomodulators in an allotransplant model, with hopes to decrease or eliminate the need for multiple immunosuppressive therapies in limb transplantation. Validating these results in an animal model will facilitate translation into the clinical setting.