



The Biomechanics of ProLayer™ Acellular Dermal Matrix:

biocompatibility
study

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ProLayer Acellular Dermal Matrix

Abstract

Dermal acellular matrices may be used to replace or repair integumental soft tissues compromised by disease, injury or surgical procedures.

A primary consideration when utilizing this biomaterial in vivo is its biocompatibility and immunogenicity, both of which influence its incorporation into the surrounding tissue.

In an animal model, ProLayer Acellular Dermal Matrix was implanted into 12 rats. There was no effect on metabolic function, and subsequent necropsy analyses indicated tissue incorporation and blood vessel infiltration with no untoward tissue reaction, including encapsulation (the formation of scar tissue), in each case.¹

Introduction

ProLayer Acellular Dermal Matrix [Figure 1] (AlloSource, Centennial, CO), is produced through a proprietary process of cleaning, rinsing and decellularizing donated human dermal tissue, with significant removal of cellular debris (including DNA and RNA), proteins and antigens.¹ The process does not require the use of detergents or enzymes, which may reduce the possibility of harmful residuals in the tissue. Further, the product has been shown by biocompatibility testing to be non-cytotoxic. The decellularization process also inactivates microorganisms through cellular disruption, and as a result the likelihood of both immunogenic rejection and inflammatory response by the recipient may be minimized.

The tissue undergoes a terminal e-beam sterilization procedure, resulting in a 10^{-6} Sterility Assurance Level (SAL), meeting the same stringent sterility levels required by the U.S. Food and Drug Administration for implantable medical devices.¹⁰

Because of its terminal sterilization, ProLayer Acellular Dermal Matrix (ADM) can be stored at room temperature for up to two years. Unlike some other acellular dermal matrices, the tissue is prehydrated and ready for immediate use without requiring a lengthy rehydration period. In addition, due to its handling characteristics, ProLayer ADM can be easily placed in a variety of anatomical areas.

The ProLayer ADM proprietary process results in a three-dimensional, collagen-rich, biocompatible, non-cytotoxic matrix that retains its biomechanical properties. This process and resulting properties are designed to help ensure it may be accepted by the recipient through subsequent revascularization and cell repopulation.

The purpose of this study was to evaluate the biocompatibility of ProLayer ADM through an animal model.

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Materials and methods

Biocompatibility

In an in vivo tissue graft environment, biocompatibility results in the incorporation of the implanted graft into the host tissue to the point where there is no discernible difference between the two in form and function. Vascularization and the absence of an immune response (a precursor to tissue rejection) are key factors indicating biocompatibility. In contrast, encapsulation is a foreign body response in which inflammatory cells surround the graft with resulting scar tissue.² Encapsulation is an indication of poor biocompatibility and this complication can necessitate a revision surgery.



Figure 1. ProLayer ADM Tissue

Methods and process

A standard in vivo study was conducted in which 12 rats were implanted subcutaneously with sections of ProLayer ADM from four different donors [Figure 2]. A doctor of veterinary medicine monitored the animals' well-being and conducted the clinical

assessments of the animals following the implantation procedures.

The animals were sacrificed at three time intervals: two weeks, six weeks and twelve weeks postimplantation. After euthanasia the implants [Figure 3] were removed and submitted to

a board-certified veterinary pathologist for a histological assessment of the integrity of the implant and the infiltration of blood vessels into the graft. Standard, documented procedures^{3,4} were used in the assessment.

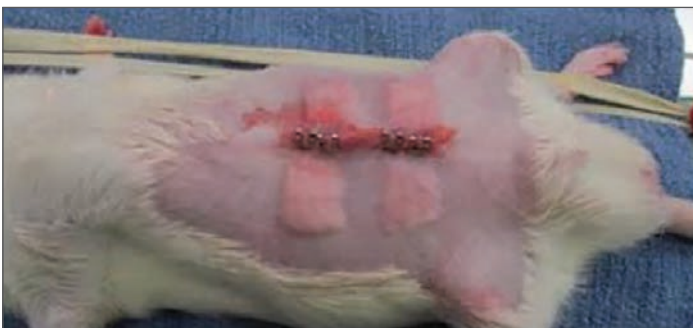


Figure 2. Initial implant of ProLayer ADM at time 0.



Figure 3. Implanted ProLayer ADM at 14 days.

Results

Two days after implantation procedures, visible swelling and erythema were resolved normally, an initial indication of graft incorporation. Similarly, all of the animals gained weight at rates consistent with normal rats, evidence that the grafts did not inhibit metabolic growth. At the time of explantation, all of the animals were deemed healthy by the veterinarian, suggesting there was no significant immunogenic response to the graft.

Upon necropsy, all animals were determined to have developed normally during the period and no untoward tissue rejection was apparent. Histological examination of the explanted tissue indicated cell and vessel infiltration for all three time periods [Figures 4 and 5]. No significant levels of graftencapsulation were observed, indicating the absence of inflammatory response tissue rejection.

Infiltration of blood vessels into the grafts was apparent, providing further evidence of tissue incorporation. This vascularization was confirmed through immunohistochemistry staining [Figure 6] for the presence of Von Willebrand factor (vWF), a key component of the blood clotting cascade and a reliable marker protein for endothelial cells of blood vessels.⁵ Thus, the presence of vWF in blood vessels is a strong

indication of vascularization.⁶ Finally, even though ProLayer ADM was implanted without suturing and no encapsulation was found, the grafts stayed in place with very little evidence of migration, suggesting there was incorporation of ProLayer ADM.

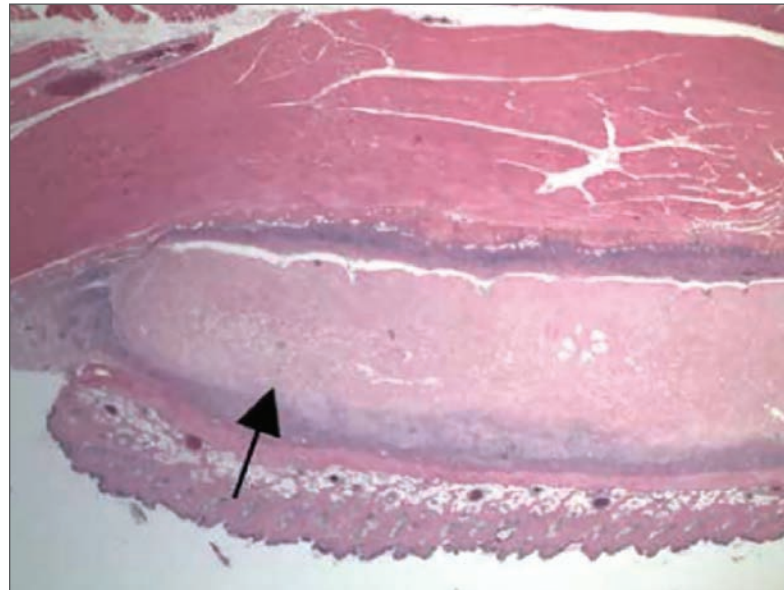


Figure 4. Graft implantation (arrow) at two weeks.

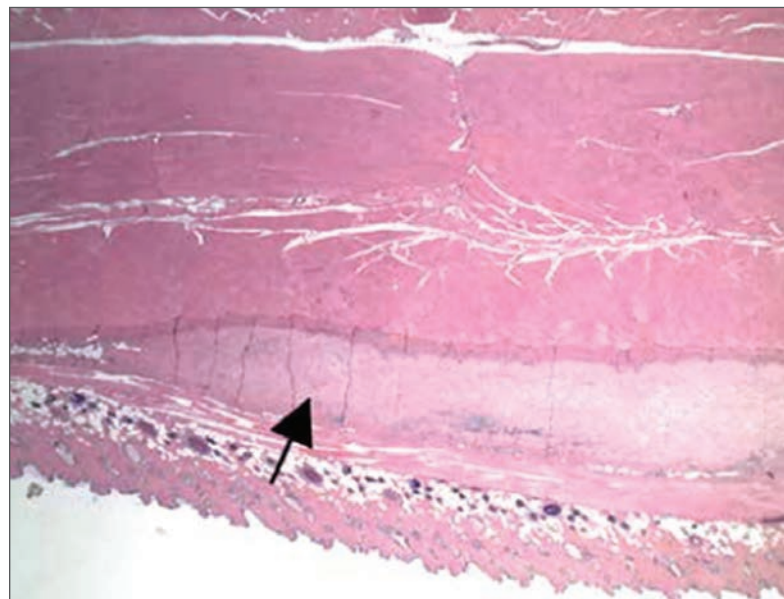


Figure 5. Graft implantation (arrow) at 12 weeks.

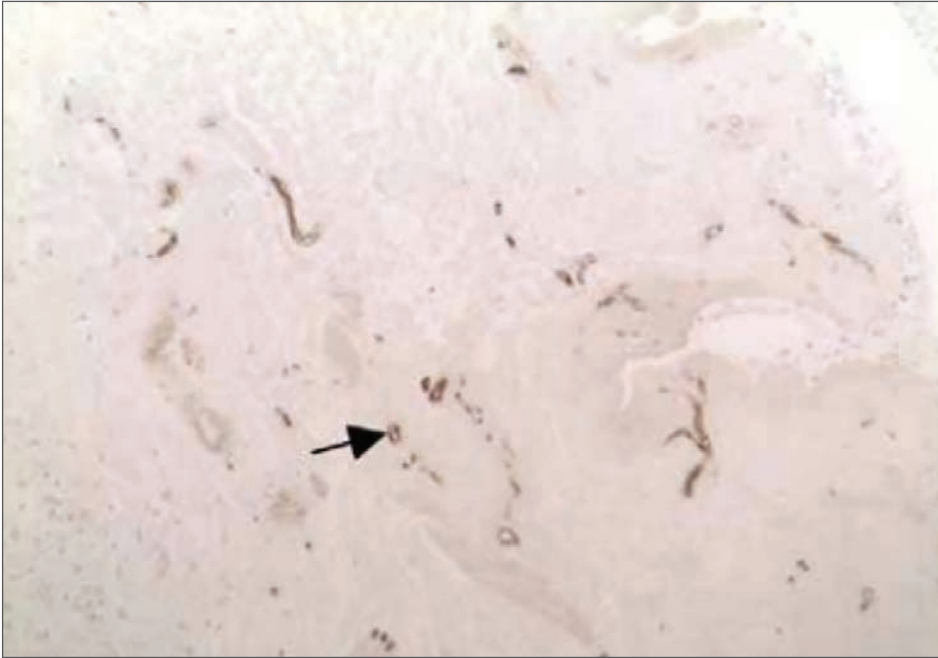


Figure 6. Immunohistochemistry staining for Von Willebrand Factor in an ProLayer graft at six weeks. Arrow indicates a blood vessel.

Conclusion

This animal study demonstrated the biocompatibility of ProLayer ADM. No unexpected tissue reaction or encapsulation was found. There was strong evidence of tissue incorporation and blood vessel infiltration. No infections were noted nor was there a discernible impact on metabolism; animal growth and development subsequent to implantation were normal.

Note:

The results were demonstrated in an animal model and may not directly correlate in humans.

References

1. Data on file at AlloSource.
2. Anderson, James M. "Biological responses to materials." Annual Review of Materials Research 31.1 (2001): 81-110.
3. Benirschke K, Garner FM, Jones TC. Pathology of Laboratory Animals. New York: Springer-Verlag; 1978.
4. Jubb KVF, Kennedy PC, Palmer N. Pathology of Domestic Animals. Orlando, FL: Academic Press, Inc.; 1993.
5. Pusztaszeri, Marc P., Walter Seelentag, and Fred T. Bosman. "Immunohistochemical expression of endothelial markers CD31, CD34, von Willebrand factor, and Fli-1 in normal human tissues." Journal of Histochemistry & Cytochemistry 54.4 (2006): 385-395.
6. Starke, Richard D., et al. "Endothelial von Willebrand factor regulates angiogenesis." Blood 117.3 (2011): 1071-1080.
7. Nieuwenhuizen, Jeroen, et al. "The use of mesh in acute hernia: frequency and outcome in 99 cases." Hernia 15.3 (2011): 297-300.
8. Brown, Rodger H., et al. "Comparison of infectious complications with synthetic mesh in ventral hernia repair." The American Journal of Surgery 205.2 (2013): 182-187.
9. Falagas, M. E., and S. K. Kasiakou. "Mesh-related infections after hernia repair surgery." Clinical microbiology and infection 11.1 (2005): 3-8.
10. FDA Medical Device Sterility Information, 2016-Jan

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