In Vivo Responses to Urological Biomaterials as Utilized for Urological Reconstruction

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Statement of Purpose: Biological tissues are widely used in urological surgeries to treat conditions like pelvic organ prolapse and stress urinary incontinence (SUI). Autografts are a good choice as there is a smaller chance of graft rejection and fewer health risks, but postoperative pain and morbidity can be associated with these materials. Thus, other biological materials can be utilized as alternative. Allografts and xenografts are processed and sterilized using different patented techniques that work to eliminate the cellular content and inactivate infection/disease causing agents. However, several cellular reactions occur after implantation. There have been limited studies that comparatively investigate the biocompatibility of commercial available biologic tissues. In this study, we examine the in vivo response to urological tissue samples currently used clinically as implants for urological reconstruction.

Methods: Four commercially available tissue samples were evaluated from three different companies: Small intestine submucosa (SIS) (Cookbiotech). Tutoplast Fascia lata (FL) (Mentor Corp). Tutoplast Fascia dermis (FD) (Mentor Corp) and Pelvicol (P) (C.R. Bard). The biomaterial was implanted intraperitoneally at the bladder neck of Balb/c mice. Animals were sacrificed at 2, 4, 8, or 12 weeks post-implantation. Bladder and implants were extracted and fixed for histological analysis. Tissue sections were stained with Masson's Trichrome for evaluation of fibrous capsule and tissue incorporation. H & E staining was also conducted to examine cell number and morphology. Image analysis using image J software was performed to determine capsule thickness (μm), cell number (mm^2), and aspect ratio. The measurements were statistically analyzed with SPSS analytical software.

Results/Discussion: Tissue extracts were recovered with no noticeable macroscopic inflammatory signs. Animal bladders were all histologically normal. However, the histological responses to the biomaterials were quite different. Implants from the SIS group were the only group to show a significance decrease in capsule thickness from 2 to 12 weeks of implantation ($p=0.01$). Figure 1 depicts capsule thickness over time for each biomaterial tested. When examining cell number, we determined that FL and P displayed a decrease in cell number, SIS remained relatively constant and FD increased with time. Interestingly, the aspect ratio of each group was the opposite with FL and SIS having an increasing aspect ratio, while FD and P demonstrated a decreasing ratio with time as shown in figure 2.

Figure 1.

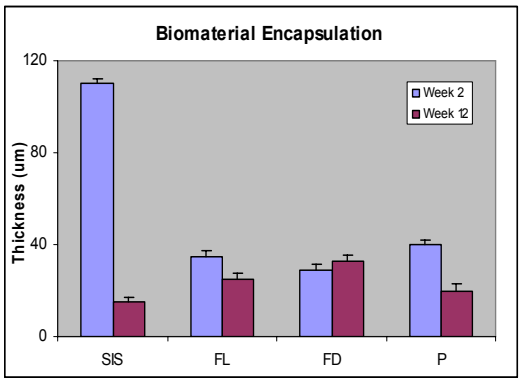
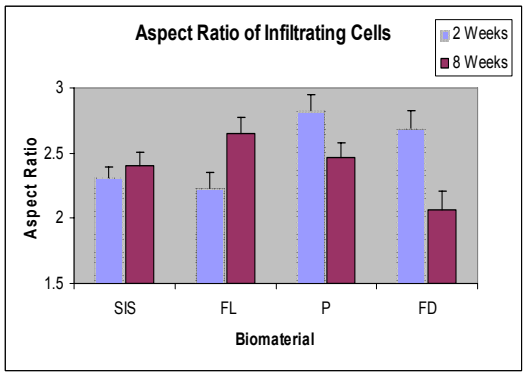


Figure 2.



Conclusion: The purpose of comparing biologic tissues for urological reconstruction was to assess the biocompatibility of biologically derived implants within its urological environment. The biocompatibility was assessed by capsule formation, tissue ingrowth, cell number and morphology. SIS induced a less pronounced inflammatory response since the capsule thickness decreased with time and the aspect ratio increased, both of which demonstrate signs of biocompatibility. Through commercial processing, tissues are claimed to be devoid of cells. However, other antigens may be present which elicit inflammatory reactions, thus limiting the implant incorporation and use for long term urological therapies.