Areas of Application of Natural Biomaterials in the Pediatric Age Group and Meta-
Analysis of Infections: Implication for Future Tissue Engineering Applications
Richard Ackbar, Herwig Ainoedhofer, Christoph Castellani, Johannes Schalamon and Amulya K. Saxena
Corresponding Author: richardackbar@hotmail.co.uk
Department of Pediatric- and Adolescent Surgery, Medical University of Graz, Austria

Introduction
Over the past 4 decades commercially available natural and synthetic biomaterials have been employed for various reconstructive procedures in the pediatric population. The aim of this study was to identify the types of commercially available natural biomaterials and their areas of application in the pediatric age group. Furthermore, to perform a meta-analysis of the infections associated with the use of natural biomaterials in the pediatric population and to identify areas of application and types of biomaterials that have increased susceptibility to infections.

Materials and Methods
A literature search was performed to identify all biomaterials that were commercially available and were implemented in pediatric surgical patients. The list of biomaterials was limited to natural biomaterials that demonstrated properties of integration as well as biodegradation. Areas of the biomaterial application were also correlated with the type of biomaterial applied. The biomaterials investigated were Integra® (Integra Life Sciences Corp., Plainsboro, NJ, USA), Surgisis® (SIS – Small Intestine Submucosa) (Cook Surgical, Bloomington, IN, USA), Pelnac® (Gunze Co., Osaka, Japan), Permacol® (Covidien, Mansfield, MA, USA), Tutopatch® and Tutomesh-H® (Tutogen GmbH, Neunkirchen am Brand, Germany) and Tutoplast-dura® (Tutogen GmbH, Neunkirchen am Brand, Germany)

Results
In the reviewed publications 298 patients were identified in the pediatric age group, where during one of the above biomaterial was implanted. In the entire series of biomaterials investigated, major infection occurred only in 15 patients (5%). In this group most of the patients were those with acute burn wounds, where infection rate was higher:5-33%. This high infection rate was similar in the control group where the biomaterial was not used. Hence, biomaterials themselves were not the only etiologic factor for elevated rate of infections.

The review further pointed out that the infection was most likely to start during the implantation of the biomaterial; however there are also different points where the infection could occur.

Discussion and Conclusions
The demand for biomaterials has exponentially increased due to the increase in tissue engineering research. Even using the appropriate techniques of implantation and professional postoperative care, biomaterial associated infections cannot be completely eliminated. The current rate of infections is not a limiting factor for using the biomaterials in surgery.

Acknowledgments
This research is funded by the European Union within the 6th Framework Program (EuroSTEC; LSHC-CT-2006-037409). We thank Prof. Wout Feitz (Radboud University Medical Centre, Nijmegen, The Netherlands) and Mrs. Anna Kuess (Department of Pediatric Surgery, Medical University of Graz, Austria), for the valuable contributions toward this study.

Disclosures
Authors have nothing to disclose.