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Reconstruction of Segmental Trachea Defects based on Laser Micropore Technique and Decellularization Method

Yong Xu*, Liang Duan and **Gening Jiang**
Tongji University, China

Objective: Reconstruction of segmental trachea using laser micropore technique and decellularization method.

Methods: Allogenic trachea, stripped of overlying soft tissue, was processed using a BD-01 CO2 laser cutting machine. Key parameters, including output power, pulse width, spot diameter and repeat times were investigated to optimize the porosity and mechanical strength of samples; LMT-treated trachea was decellularized using conventional detergent-enzymatic method and digested at three different temperatures (4°C, 25°C, and 37°C), in order to obtained a scaffold with sufficient mechanical property. After chondrocytes were combined with LMT-treated DTM (LDTM) and cultured for 8 weeks in vitro, it was observed whether chondrocytes could grow into bilateral surfaces of scaffolds and micropores and formed integral tubular cartilage; Then, the complex was implanted into the subcutaneous of nude mice and rabbits to further demonstrated that this complex can form more mature tubular cartilage in vivo environment; Pre-cultured in vitro for 8 weeks, the neocartilage was implanted into the left sternohyoid muscles for 4 weeks, in order to achieve pre-vascularization of the trachea. Finally, the muscles were fully freed under the premise of protecting blood vessels to form double-pedicle muscle flaps. Then the trachea was transplanted in situ and observed the postoperative survival rates.

Result: The laser micropore technology turns the acellular matrix into a porous structure, which is beneficial to both the decellularization process and the growth of cells into the matrix. Decellularization can be performed 12 times at an enzyme digestion temperature of 25°C to achieve thorough decellularization and ensure sufficient mechanical property. Chondrocytes combined with laser microporous acellular matrix can regenerate neocartilage *in vitro* and *in vivo*; this new vascular tube cartilage can achieve long-term segmental tracheal repair in rabbit model.

Conclusion: LDTM is an ideal tissue engineering tracheal regeneration scaffold, providing a new idea for functional tubular tracheal reconstruction.

Biography:

Dr. Yong Xu received his bachelor and master degree from Tongji University, Shanghai, China, in 2015, 2018, respectively. And now, he is pursuing a PhD degree for thoracic surgery in Shanghai Pulmonary hospital. His supervisor is Professor Gening Jiang. He has been engaged in the study of tissue engineered trachea since 2015. His research results were published in Acta biomaterialia, Journal of the Mechanical Behavior of Biomedical Materials, ACS applied materials & interfaces et al.