Segmental Tracheal Defect Repair Using Engineered Cartilage Sheets
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Introduction
There is no adequate treatment for tracheal defects and, as a result, the only alternative for patients is tracheostomy. The goal of this study is to engineer a functional replacement for large segmental tracheal defects.

Materials and Methods
Second passage auricular chondrocytes were loaded into 4 x 4 cm custom designed bioreactors at 5.0 x 10^7 cells per bioreactor; defined medium was exchanged every other day. At 4 weeks, the cartilage sheet was peeled off the bioreactor membrane and transferred into a 150 mm large culture dish for an additional 4 weeks. Six New Zealand White rabbits were implanted with neotracheal constructs placed paratracheally. A midline neck incision was made, strap muscles identified, a bipedicled muscle flap consisting of both sternohyoid muscles raised, wrapped around a 7.5mm x 30 mm silicone tube and secured with 5-0 Vicryl sutures (Fig. 1). Three layers of 1 mm thick autologous scaffold free cartilage were wrapped around the silicone-muscle construct and secured with 4-0 Vicryl sutures. Segmental tracheal reconstruction was performed 12-14 weeks following neotracheal implantation. A midline incision was made, and trachea and neotrachea identified and exposed, and the silicone tubes removed. A 2cm long segment of the cervical native trachea was resected and upper and lower end-to-end anastomosis was performed by using 4-0 Vicryl sutures.

Results
None of the rabbits’ neotracheas showed signs of a wound infection and there were no signs of rejection. All engineered neotrachea maintained viability, shape and mechanical integrity throughout. However, all 6 animals expired due to tracheal obstruction by 39 days post-op. Two rabbits expired due to venous obstruction of the muscle flap with edema and tracheal obstruction within 24 hr. To overcome this problem, the neotrachea sternohyoid muscle flap was resected, with or without silicone tube reinsertion for an additional 6 weeks. The rabbits from the resection-only group survived 12 and 39 days, and those from the resection-reimplantation group 14 and 29 days. These last 4 rabbits expired due to intraluminal fibrosis.

Discussion and Conclusions
These results demonstrate that engineered cartilage sheets can be used to fabricate a biomechanically functional airway. The next challenge is to overcome the problem of fibrosis, perhaps by engineering an epithelial layer.

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Disclosures
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