ABSTRACT

Objectives:
- Characterize biochemical and biomechanical properties of New Zealand White rabbit septal cartilage for future utilization in rabbit septal cartilage tissue engineering studies.
- Determine whether tensile and bending properties vary when measured in different axes.

Methods:
Nasal septa were harvested from 21 adult New Zealand White rabbits post-mortem. Confined compression testing was performed. Samples cut in the vertical and anterior-posterior (AP) plane were subjected to tensile testing and 3-point bending. Biochemical assays determined the water content as well as the glycosaminoglycan (GAG), total collagen, and DNA concentrations in each sample.

Results:
- Biochemical characterization demonstrated an average concentration of 42.8±7.92 µg GAG, 102.4±31.11 µg total collagen, and 0.23±0.04 µg DNA per mg wet weight. The water content comprised 63.3±7.80 percent of the total weight.
- Confined compression demonstrated an average compressive modulus (H90) of 0.82 (±0.23 MPa).
- Tensile stiffness at failure strain for vertical (22.9±5.51 MPa) and AP (18.7±2.56 MPa) samples did not differ significantly (p > 0.05). The flexural moduli of samples cut in the vertical plane (39.3±16.6 MPa) and AP plane (39.3±20.2 MPa) were also not significantly different (p > 0.05).

Conclusions:
- Tensile strength was higher in the vertical plane than the AP plane, which may indicate anisotropic fiber orientation. Compared with published properties of human septal cartilage, rabbit septal cartilage is mechanically stronger, stiffer, and less flexible. Rabbit septal cartilage has less water content, similar DNA content (cellularity), and higher GAG and total collagen levels than values published for human septal cartilage.
- The biochemical and biomechanical properties of the New Zealand White rabbit septum are characterized in this investigation to foster development of an *in vivo* reimplantation model with the goal of translating this technology to clinical application.

INTRODUCTION

- Nasal deformities resulting from trauma, malignancy, congenital or iatrogenic causes are corrected through nasal reconstruction.
- Reconstructive goals include restoration of nasal function and refinement of the aesthetic appearance of the nose.
- Biochemical characterization demonstrated an average concentration of 42.8±7.92 µg GAG, 102.4±31.11 µg total collagen, and 0.23±0.04 µg DNA per mg wet weight. Water content represented 63.3±7.6 % of the total weight.

OBJECTIVES

- Characterize the biochemical and biomechanical properties of New Zealand White rabbit septal cartilage for future utilization in rabbit septal cartilage tissue engineering studies.
- Determine whether tensile and bending properties vary when measured in different axes.
- Confined compression demonstrated an average compressive modulus (H90) of 0.82 (±0.23 MPa).
- The flexural moduli of samples cut in the vertical plane (39.3±16.6 MPa) and AP plane (39.3±20.2 MPa) were not significantly different (p > 0.05).
- Tensile peak stress for vertically oriented samples (6.61±1.28 MPa) was significantly greater (p=0.02) than for samples cut in the AP plane (5.22±1.31 MPa).
- Tensile stiffness at failure strain for vertical (22.9±5.51 MPa) and AP (18.7±2.56 MPa) samples did not differ significantly (p > 0.05).

METHODS

- Nasal septa were harvested from 21 adult New Zealand White rabbits post-mortem.
- Circular samples were cut for confined compression testing.
- Rectangular samples were cut in the vertical and AP plane for tensile testing and 3-point bending.
- Average compressive modulus was determined for each sample.
- Paired t-test used to compare tensile peak stress, tensile stiffness at failure strain, and 3-point bending flexural moduli for vertical and AP samples respectively.
- Biochemical testing included lyophilization to determine water content and concentrations of GAG, total collagen, and DNA.

RESULTS

- 21 adult rabbits (19 F, 2 M)
- Biochemical characterization: average concentration of 42.8±7.92 µg GAG, 102.4±31.11 µg total collagen, and 0.23±0.04 µg DNA per mg wet weight. Water content represented 63.3±7.6 % of the total weight.

DISCUSSION

- Tensile strength was higher in the vertical plane than the AP plane, suggesting possible anisotropic fiber orientation.
- Differences in biomechanical properties between samples cut in the vertical vs. AP axis were not otherwise found.
- Biomechanically, rabbit septum is stronger, stiffer, and less flexible than published values for human septum.
- Biochemically, rabbit septum tends to have less water content and greater extracellular matrix component concentrations (GAG, collagen) than is reported in human septum.

REFERENCES


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