Electrospinning for mechanical reinforcement of vascular grafts

Shaked Roll BSc, Udi Nussinovitch MD PhD

MEIR MEDICAL CENTER
Tel Aviv University

INTRODUCTION

Cardiovascular diseases are the number one cause of death globally. The demand for appropriate substitutes for autografts in the field of vascular transplants is high and development in the field is essential. The use of synthetic grafts is restricted mainly to those of large diameter, while small diameter (less than 6 mm) synthetic grafts have low mechanical patency. Various methods were tested to create a functional, small diameter tissue-engineered vascular graft (TEVG) with appropriate mechanical properties.

OBJECTIVES

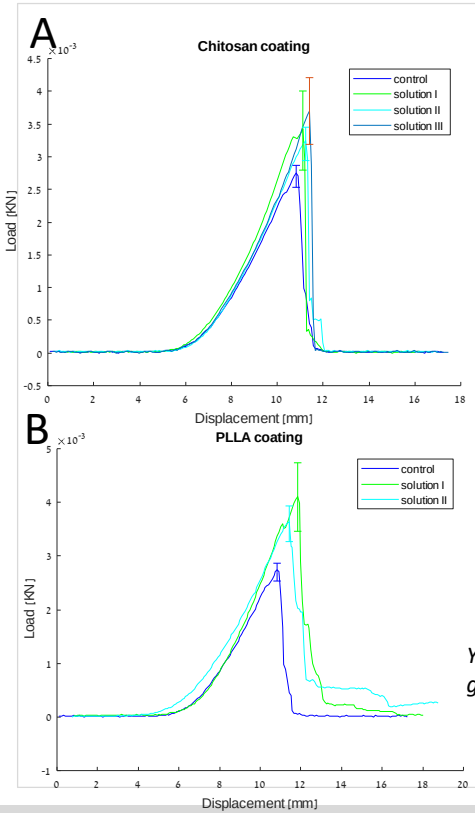
Although significant advances have been accomplished, construction of a synthetic graft with mechanical properties identical to those of native blood vessels remains a desirable goal. The current study investigated an approach for reinforcing a small diameter TEVG with various coatings using electrospinning coating methodology.

METHODS

A custom-made electrospinning system was built for coating 5 mm diameter Artegraft Collagen Vascular Graft™ rings. Coating solutions made from PLLA or Chitosan in varying concentrations was investigated. Tensile force tests were conducted using an Instron testing system. Mechanical properties of the coated graft rings were compared to a control ring.

RESULTS

PLLA 3.33 w/v% solution reached highest tensile stress load of all solutions tested, with 52.6% improvement comparing to control group. All coatings showed relative improvement compared to the control group. Young's Modulus was 3.33 w/v% and 1.67 w/v% for the PLLA and Chitosan solutions, respectively. These values were significantly higher than those recorded for a control solution (p-value of 0.0005 and 0.06, respectively).



A. Load-displacement graph for mean chitosan coating (I, II & III) tensile test results compared to control group
B. Load-displacement graph for mean PLLA coating (I & II) tensile test results compared to control group

	Young's modulus [MPa]	
Group	Mean	SD
Control	0.275061	0.001381
Chitosan I	0.333883	0.042688
Chitosan II	0.27941	0.014165
Chitosan III	0.289389	0.042789
PLLA I	0.322815	0.007864
PLLA II	0.291724	0.044249

Young's modulus for each experimental group, (mean and standard deviation)

CONCLUSIONS

PLLA and Chitosan coatings reached higher tensile stress loads than non-coated grafts. Specifically, PLLA coating exhibited superior mechanical properties in comparison to Chitosan. It remains to be determined whether this approach will provide a sustainable mechanical advantage *in vivo*.