1. Introduction

The digital collateral nerves injuries account for 9% of overall finger injuries in the emergency room (1). The Nerve repair techniques have not changed for several years and neither the clinical results. The nerve biomechanics are subject of study during the cinematic of trauma, but their biomechanical properties as a material has not attracted any interests for being studied until the recent years. This study describes the digital collateral nerves biomechanical properties.

2. Methods

2.1 Harvesting nerve conservation and tensile test

Fifty-nine digital collateral nerves were harvested from fresh frozen cadavers. Each of the nerves was preserved in a NaCl 0.9% solution until testing at 20°C. The nerves were tested as fast as possible within the next 6 hours after harvest. Each was positioned in an emery paper frame, glued with a drop of cyanoacrylate and sutured to the emery paper with a 4-0 Vicryl suture. Nerves were oriented from proximal to distal in the machine. The tensile test was run at 6mm/min in an Instron machine until the nerve ruptured.

2.2 Histology and image processing of the nerve structure

Thirty of the tested nerves were preserved in 0.4% Formal solution and were submitted to histological staining with a trichrome protocol. Photos were taken with a digital optical microscope at 10X. The images were processed with Image J to segment and calculated the fascicular area and the connective tissue area. The fascicular ratio was calculated as a ratio of these two values.

3. Results & Discussion

The data presented in this study constitute a vision of nerves as a material. The description of nerves and their structure will allow to a better understanding of the biomechanical behavior of nerves. The Strain stress curves depict a big variability of nerves, the source of which is probably due to the nature of biological tissues, whose exact composition may change between individuals due to their age, the presence of pathologies and gender. Compared to the other studies (2) the present study shows different results. Goldberg et al used a different tensile protocol for testing the nerves (20mm/min) obtaining different values, which is explained by a viscoelastic behavior of digital collateral nerves (3).

Mean fascicular ratio was calculated for each finger and the mean obtained for all the fingers. This measure initially described by Tagliafico et al (4) was then adopted by Lee et al (5) to compare the structure of the nerves in ultrasonography to that in histology. This study presents the fascicular ratio as a numeric descriptor of the nerve structure.

4. Conclusion

The data presented above describes digital collateral nerves biomechanical behavior.

The fascicular ratio is an interesting way to describe nerves structure in histology plates. Further studies should be undertaken to identify the relationship among the structure, the local nerve biomechanics and the global biomechanical behavior of the nerves thru a computational model.

5. References