Study of the Viscoelastic Architecture in Fibrin and Fibrin-Agarose Corneal Constructs
Ricardo Gómez-Sotomayor,1 Miguel Alaminos,1 Modesto López-López,2 Juan de Dios García,2

Corresponding Author: malaminos@ugr.es

1Tissue Engineering Group, Department of Histology, University of Granada, Spain; 2Department of Applied Physics, University of Granada, Spain

Introduction
Because a major function of the extracellular matrix is to support cell structure, mechanical characterization of bioengineering constructs must complement characterization of reconstituted networks. Extracellular matrix viscoelasticity and its ability to withstand applied stress are crucial to explain cellular functions (cell division, cell spreading, and cell adhesion) and this is why during the last decade to more and more studies focusing on determining the rheological behavior of the biomaterials. In previous works we have reported the designed of a novel biomaterial based in a mixture of human fibrin and agarose that allowed us to analyse some mechanical properties1. Our goal in this work is to evaluate the lowest shear stress for provoking a viscous flow of an artificial corneal stroma substitute based on fibrin and fibrin with 0.1% agarose concentration.

Materials and Methods
Two types of partial human cornea substitutes were developed using human fibrin stroma, and human fibrin with 0.1% agarose stroma, both with human keratocytes immersed within (an average of 250,000 cells were added). After 28 days in culture using specific culture media, the viscosimetric and oscillometric measures of the artificial corneal tissues were analyzed by determining the strength of the plastic response in a period of 28 days data using a Bohlin CS10 rheometer in a plate-plate configuration. The statistical analysis was computed by using SPSS 15.0 software.

Results
The rheological characterization of the two types of cornea substitutes showed that the plastic response in the fibrin with 0.1% agarose samples increased through time and it is higher than the samples containing fibrin only. Plastic viscosity (\(\eta_p\)) is enhance significatively by the agarose, and, on the other hand, improve the viscoelastic properties of the constructs as data of the storage modulus (\(G'\)) and loss modulus (\(G''\)) shows, which is desirable for a corneal substitute. Further experiments must include different pore sizes to analyse the structure exposed to the cells.

Discussion and Conclusions
There is a strong correlation between the scaffold microarchitecture and cell attachment. Cell attachment is primarily influenced by scaffold pore sizes. The structure of the fibrin-agarose constructs displays bigger pore sizes and enhance cell attachment and proliferation. The total surface of the structure exposed to the cells is defined by the specific surface area of the scaffold which depends on the density of the available ligands.

References

Acknowledgments
Supported by Junta de Andalucía, Spain (project PI-0132/2007) and (project P08-FQM-3993)