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Development of Synthetic Barrier Dental Membrane for Guided Bone Regeneration

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***Abstract*—The barrier membrane three-layer construction is designed to attract, trap, and retain fibroblasts and epithelial cells while maintaining space around teeth for development of bone and periodontal support tissues. The scaffold is characterized by a highly interconnected macroporosity, with macropores of 0.3 –5 mm and improved mechanical properties with respect to the polymer alone, producing excellent dimensional stability.**

I. INTRODUCTION

Periodontal disease is a major health problem with the increasingly old age rate of the population. Conventional periodontal treatments such as Open Flap Debridement (OFD) provide critical access to establish improved periodontal forms and architecture. However, proliferation of fibroblasts in defect area after OFD prevents the formation of a healthy cementum. Guided Tissue Regeneration (GDR) provides an area for periodontal tissue regeneration using a barrier membrane around the periodontal defect to prevent epithelial growth and fibroblast proliferation in the wound cavity. First-generation PTFE and titanium barrier membranes, developed in the 60's, aimed at achieve a combination of appropriate physical properties and minimal toxic response in the host. However main disadvantage of those membranes was requirement of removal [1]. The second generation of barrier membranes was designed with resorbable polymers to avoid second surgical operation. As the tissue engineering approaches has improved, third-generation membranes also developed, which not only act as barriers but also release bioactive agents at the wound site to direct natural wound healing in a better way [2].

Powerbone multilayered barrier membrane is designed to provide third generation membrane requirements by enhancing bone growth while preventing the gingival tissue down-growth. The first layer, produced by the solvent casting method, avoid to fibroblast proliferation due to the low porosity. The specially designed spray-spinning system is developed to simulate the biomimetic synthetic matrix structure of barrier membranes used for periodontium reconstruction, with suitable fiber size. Intermediate and inner layers with have different pore size and porosity, produced with spray system. The inner layer with its biomimetic structure with average 400 µm pore size, improve cell attachment and facilitating early cell differentiation. Powerbone membrane is designed to support the activity of Powerbone bone substitutes which already received CE mark and has been in medical market for more than two years.

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The multilayer membrane consists of poly-lactic acid andcopolymers with excellent biocompatibility and optimum resorption ratio.

II. MATERIALS AND METHODS

The exterior layer, produced by the solvent casting method, avoid to fibroblast proliferation due to the nonporous structure. The specially designed jet spray system is developed to simulate the biomimetic synthetic matrix structure of barrier membranes used for periodontium reconstruction, with suitable fiber size. Intermediate and interior layers with have different pore size and porosity, produced with spray system. The interior layer with its biomimetic structure with average 400 µm pore size, improve cell attachment and facilitating early cell differentiation. Powerbone membrane is designed to support the activity of Powerbone bone substitutes which already received CE mark and has been in medical market for more than two years. The multilayer membrane consists of polylactic acid and copolymers with excellent biocompatibility and optimum resorption ratio.

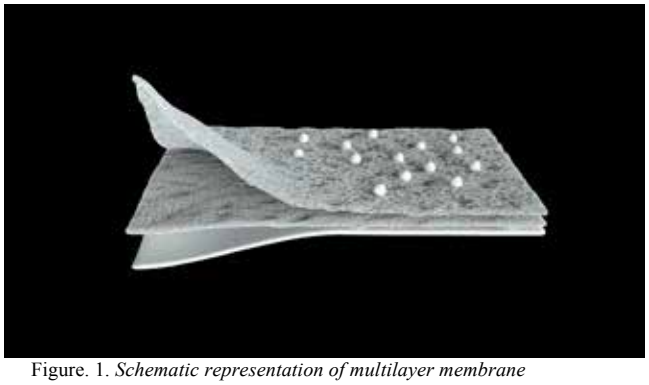

Figure. 1. *Schematic representation of multilayer membrane*

III. RESULTS

As seen in SEM images, jet-spray parameters regulated to have various fiber diameter up to 500 nm to 5 µm. The interior layer with its biomimetic structure with average 400 µm pore size, improve cell attachment and facilitating early cell differentiation.

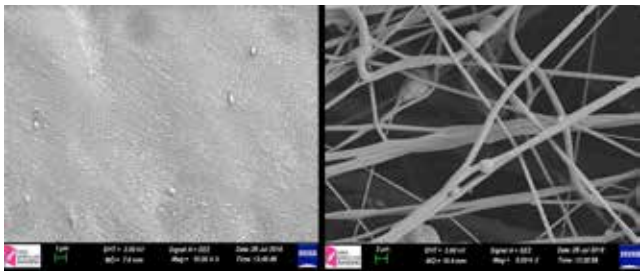

Figure. 2. *SEM images of Exterior and interior layers of multilayer membrane*

The mechanical flexibility of dental membranes under wet conditions is one of the most important properties of GBR membranes because it ensures easy handling in surgical use. The dense layer provided a certain amount of rigidity, while the micro-fibrous layer ensured good adherence to the bone surface. Furthermore, the mechanical strength of the Powerbone membrane was enough to bear handling with surgical instruments, as well as suturing to soft tissues and comparable to reported values for other dental membranes.

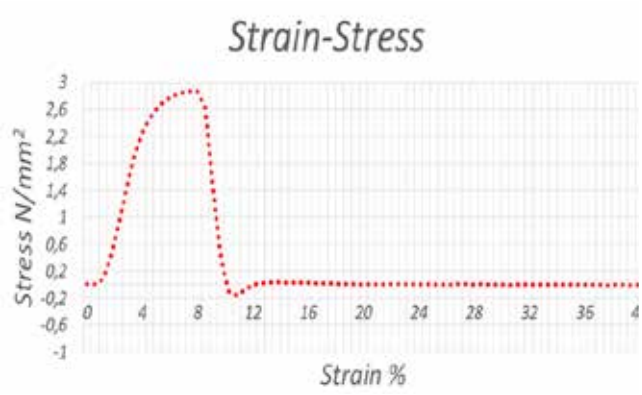

Figure. 3. *Strain-Stress curve of multilayer membrane.*

IV. Conclusion

Powerbone membrane is designed to support the activity of Powerbone bone substitutes which already received CE mark and has been in medical market for more than two years. The multilayer membrane consists of poly-lactic acid and copolymers with excellent biocompatibility and optimum resorption ratio.

References

[1] Melcher, A. H. (1976). On the repair potential of periodontal tissues. Journal of periodontology, 47(5), 256-260.

[2] Sam, G., & Pillai, B. R. M. (2014). Evolution of barrier membranes in periodontal regeneration-"are the third generation membranes really here?. Journal of clinical and diagnostic research: JCDR, 8(12), ZE14.