Original Article

In Situ Casting of Platelet Rich Plasma/SiO_2/Alginate for Bone Tissue Engineering Application in Rabbit Mandible Defect Model

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KEY WORDS
Bone;
Tissue Engineering;
Platelet Rich Plasma;
Silicones;
Alginate;

Received: 8 May 2021;
Revised: 31 July 2021;
Accepted: 29 August 2021;

ABSTRACT

Statement of the Problem: The administration of both platelet rich plasma (PRP) and silicon dioxide (SiO_2) to the bone defects accelerates bone repair and regeneration. Application of both of them may show synergistic regenerative effects.

Purpose: Our objective was to evaluate the possible synergistic osteogenic effects of PRP and SiO_2 by injecting them using an ad hoc device.

Materials and Method: In this experimental study, PRP/SiO_2 scaffolds were fabricated by in situ casting method with the help of $CaCl_2$ as the gelation factor and alginate as the stroma; and then, the biodegradability and spatial arrangement were assessed. The injectable scaffold was introduced into the 40 rabbit mandibular defects by an ad hoc two-channel injecting device. Five defects received PRP/SiO_2/alginate as the treatment; the other sets of defects were treated by PRP/alginate, SiO_2/alginate, and the last five defects served as the control groups by getting only alginate injections. The osteogenicity of the scaffolds was evaluated by radiological and histological procedures; they were then compared with each other. Analysis of variance and least significant difference tests were used to analyze the data.

Results: The SiO_2-treated group showed a significant higher bone area compared to PRP/SiO_2-treated groups on day 40 (p= 0.013). The number of osteocytes was higher in SiO_2-treated than the control groups on both 20 and 40 days (p= 0.032 and 0.022, respectively). The number of osteoclast was also higher in SiO_2-treated than PRP-treated group (p= 0.028). In addition, the cells of this group had just started to create Haversian systems in newly formed bone tissues.

Conclusion: Silica demonstrated a superior osteogenic activity over PRP in both short and long term periods. Evidently, they showed no synergistic regenerative effects. Our ad hoc device was efficiently capable of inserting the scaffolds into the injured sites with no difficulties or complications.

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Cite this article as: Gholijani A, Tavanafar S, Zareifard N, Vojdani Z, Namavar MR, Emami A, Talaei-Khozani T. In Situ Casting of Platelet Rich Plasma/SiO_2/Alginate for Bone Tissue Engineering Application in Rabbit Mandible Defect Model. *J Dent Shiraz Univ Med Sci.,* 2022 September; 23(2 Suppl): 349-360.

Introduction

The incidence of skeletal defects due to inactivity and obesity, particularly in societies with old population and advanced bone degenerative diseases, has dramatically increased and is expected to double this year [1]. In addition, the worldwide rate of accidental bone injury had a steeply upward trend over the past few years [2] and yet it remains a major challenge in the field of orthopedic surgery. Functional defects of the skeletal system usually happen as a result of trauma, injuries and diseases that can cause considerable complications and also various social and economic predicaments [3].

for radiological and histological assessments in shorter period after the surgery in order to shed light on the probable significant differences in the osteogenic function of the scaffolds. Secondly, radiology images could not be acquired continuously during the postoperative period because of the difficulty in the process of anesthesia and high risk of death of rabbits through it. Thirdly, the calcification rate of the scaffolds could be evaluated to indicate the mineral density and reveal the possible differences between them. Lastly, it would be much more helpful if the gene expressions related to osteogenesis were assessed to clarify the pathways responsible for bone regeneration process.

Conclusion

That the results of the current study showed that osteogenesis was superior in SiO_2-treated defects compared to the other groups. The combination of PRP and SiO_2 did not show any synergistic influence on bone regeneration. Besides, the injectable scaffold could be introduced into the defect by ad hoc device without any adverse impact.

Acknowledgements

We would like to thank vicechancellor of Shiraz University of Medical Sciences for supporting this work financially (grant no: 10533). The authors wish to thank Dr. Vahedi and the other personnel in the center of comparative and experimental medicine, Shiraz University of Medical Sciences. We appreciate the collaboration of the personnel in the central lab of Shiraz University and Fars blood transfusion center, Shiraz, Iran. This manuscript was extracted from a thesis by A. Gholijani as a part of fulfillment to obtain MSc degree. The authors would like to thank Shiraz University of Medical Sciences, Shiraz, Iran, and also Center for Development of Clinical Research of Nemazee Hospital and Dr. Nasrin Shokrpour for editorial assistance.

Conflict of Interest

The authors declare that they have no conflict of interest.

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