Case Report

Autologous direct stem cell application in periodontal regeneration technique in the treatment of periodontal intrabony defects: An 1-year follow-up study

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Abstract

Langer in 1993 proposed tissue engineering as a possible technique for regenerating lost periodontal tissues. This field builds on the interface between materials science and biocompatibility, and integrates cells, natural or synthetic scaffolds, and specific signals to create new tissues. We used soft tissue harboring the PDLSCs adherent to the root of an extracted impacted wisdom tooth along with its cementum and dentin shavings using gelatin sponge as scaffold to restore the periodontal intrabony defect of another molar of the same patient. The current approach resulted in improvement in clinical parameters and radiographic improvement in periodontal intrabony defect. SAI-PRT has emerged as a constructive avenue in treatment of periodontal osseous defects. Moreover the clinical feasibility, success and cost effectiveness over currently available techniques are encouraging.

Key words: Osseous defects, periodontal regeneration, stem cells

INTRODUCTION

Use of periodontal ligament stem cells (PDLSCs) in periodontal regeneration is very promising.[1] Vandana *et al*., 2015,[2] have reported autologous stem cell application in periodontal regeneration technique (SAI-PRT) which abides by tissue engineering triad by utilizing PDLSCs. Hence, novel cell-based approaches have been tried in periodontal regeneration in a more predictable manner.

Based on the current literature on tissue engineering and use of PDLSCs, a novel approach called "SAI-PRT" based on direct application of autologous PDLSCs (stem cells), cemental and dentin scrapings (signaling molecules), and gelatin sponge (scaffold) was tried in the treatment of intrabony defects in the current case report.

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CASE REPORT

An apparently healthy 28-year-old male reported to the Department of Periodontics, College of Dental Sciences, Karnataka, India, with the chief complaint

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of food lodgment in the lower left back tooth region for 8 months. Based on this history, clinical findings, and radiographic evaluation, a diagnosis of localized periodontitis (periodontal pocket) was reached upon.

The study protocol was approved by the Institutional Review Board of College of Dental sciences and was in compliance with Rajiv Gandhi University of Health Sciences, India.

Following etiotropic phase, a full-thickness mucoperiosteal flap was raised [Figure 1]. Complete debridement of the intrabony defect of 37 was done followed by extraction of the impacted maxillary left third molar.

The transplant consisted of periodontal ligament (PDL) soft tissue adherent to the root of an extracted third molar[3] and the extraction socket[4] which harbored the PDLSCs and cementum scraping which was obtained by gently scraping the tooth root and extracted socket using a sterile curette [Figure 2] and mixed with Abgel®©™ [Figure 3] to the selected intrabony defect. The presutured knot was tightened, and periodontal dressing was placed. Postoperative instructions were given, and suture removal was done after 10 days.

The control site (16 region) was treated by open flap debridement. Clinical examination was performed at baseline and at 1 month, 6 months, and 1 year postsurgery [Table 1]. In test group, 1-year follow up revealed 5 mm reduction in periodontal pocket and gain in attachment level of 5 mm measured from a fixed reference point (stent) with negligible change in gingival marginal position [Table 1].

Radiographic evaluations were performed at baseline, 6 months, and 1 year [Figures 4-7]. The percentage of defect fill was 75% with minimal alveolar crestal changes, and a change in radiodensity (as calculated by histogram using Adobe Photoshop) was observed in the defect area, suggestive of improvement in newly formed bone [Figure 5]. The radiographic images were measured using CorelDraw Graphics Suite X6, and the density changes were measured using Adobe Photoshop CS3.

DISCUSSION

PDLSCs are multipotent and have demonstrated their ability to differentiate into osteoblasts, fibroblasts, and

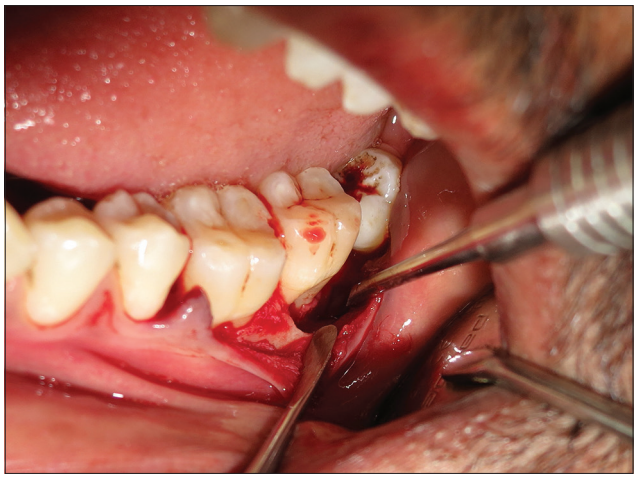

Figure 1: Intrabony defect in 37 region

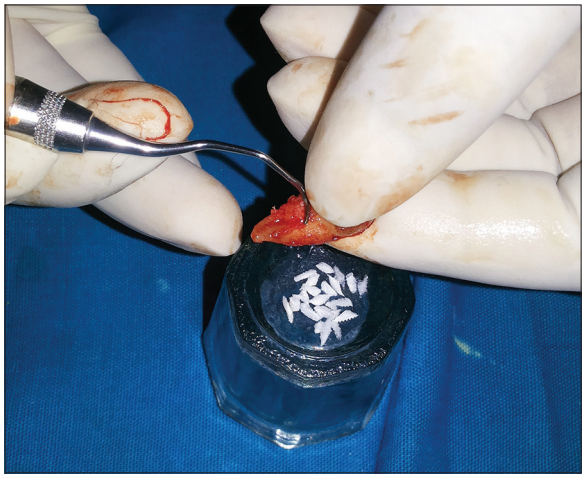

Figure 2: Soft tissue adherent to the root of an extracted third molar, and the extraction socket harboring the periodontal ligament stem cells and Abgel®©™ (1 mm × 1 mm)

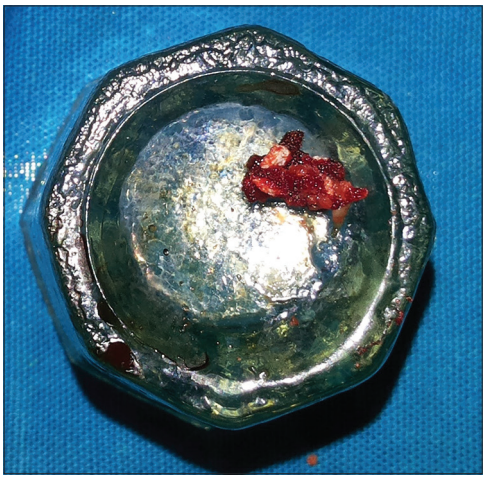

Figure 3: Transferable mass consisting of soft tissue adherent to extracted third molar, cementum scraping, and scraping from alveolar socket mixed with Abgel®©™

Table 1: Clinical parameters at different time intervals

Clinical variables (mm)	Stem cell therapy (test group)			OFD (control group)		
	Baseline	6 months	1 year	Baseline	6 months	1 year
PPD	12	10	7	8	5	5
CAL	11	9	6	6	4	4
Gingival marginal position	5	4.5	4.5	5	5	5
Gingival thickness	1.5	1.5	1.5	1.2	1.2	1.2

OFD: Open flap debridement, PPD: Probing pocket depth, CAL: Clinical attachment levels

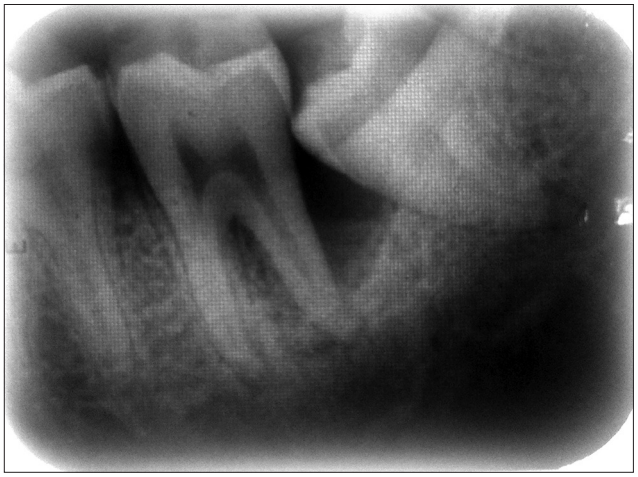

Figure 4: It is baseline intraoral periapical radiograph of 37

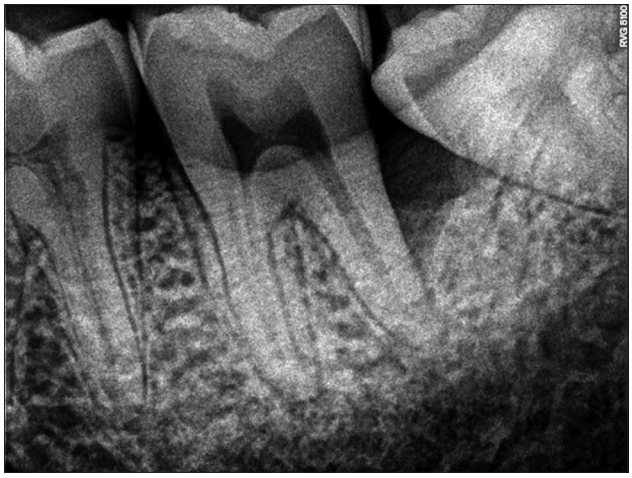

Figure 5: The striked text has to be changed to radiovisiography(RVG) 37 region, 1-year follow-up

tooth cementoblasts to form cementum- and PDL-like tissues.[3] Cementum appears to play a critical role in the regeneration as its matrix is a rich source of many growth factors such as insulin-like growth factor, fibroblast growth factor, bone morphogenetic proteins, and many more, which influence the activities of various periodontal cell types.[5] Moreover, dentin and cementum contain proteins common to bone, such as osteopontin, bone sialoprotein, osteocalcin, dentin sialoprotein, dentin matrix protein-1, and Type I collagen. These are reportedly involved in bone formation and resorption.[6,7] A gelatin sponge owing to its flexibility, biocompatibility, and biodegradability, and potential to be used as a scaffold to support osteoblasts and to promote bone regeneration in defective areas was considered.[8]

The basis of SAI-PRT undoubtedly depends on Feng *et al*.'s (2010)[1] study, the first one to demonstrate the use of *ex vivo* processed PDLSCs in periodontitis treatment and successfully reported the phenotype characterization of PDLSCs and PDL progenitor cells which showed the similar proliferation rate and expressed positive mesenchymal-associated markers capable of periodontal regeneration.

The basic problem faced in *ex vivo* cell culture is that the sensitive nature of the procured PDLSCs from the extracted tooth root to survive for culture expansion. Several attempts were made by researchers to succeed in the stem cell survival, as the first step in *ex vivo* cell culture expansion. Keeping this in mind, the authors of this study attempted to place the PDL tissue adherent to the root directly into the selected osseous defect following extraction of impacted tooth in the same patient. In fact, on microscopic examination, this tissue contains all the cells favorable for tissue regeneration.[3] The crucial step of cell survival by direct placement served the best of tissue engineering as chairside reality instead of arduous laboratory procedures.

Based on the current literature on the use of *ex vivo* culture and associated problems, a humble attempt was made to harvest autologous PDLSCs for direct application using Abgel®©™** (gelatin sponge) as scaffold in the regeneration of intrabony periodontal defect bypassing *ex vivo* culture was attempted for the first time which satisfies and it abides tissue engineering triad consisting of PDLSCs (cells), Abgel®©™** (gelatin sponge–scaffold), and cementum and dentin scrapings (signaling molecules).[5-7] This technique resulted in successful clinical and radiographic parameters such as clinical

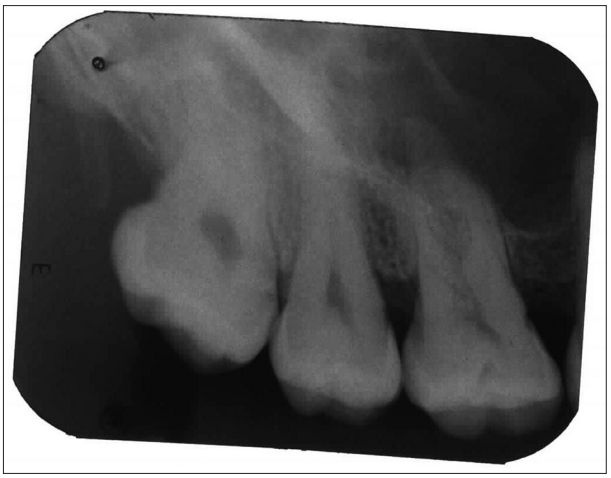

Figure 6: Baseline IOPA of 16 region in control group

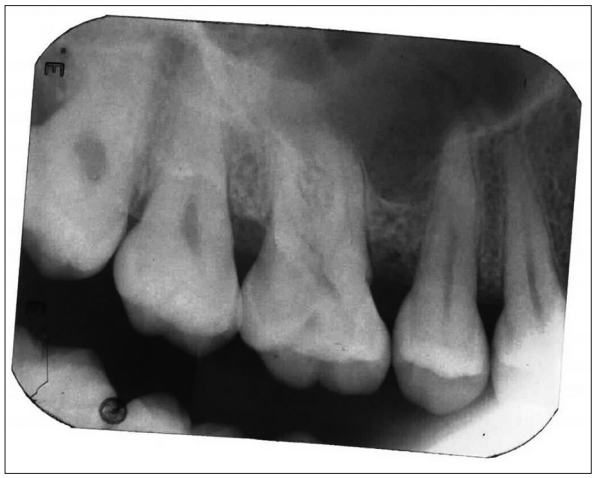

Figure 7: IOPA of 16 at 1-year follow-up in control group

attachment gain, decreased probing pocket depth, and satisfactory defect fill of intrabony defect, when evaluated for a period of 1 year. The immediate periodic healing events were uneventful. The clinical and radiographic treatment outcome in open flap debridement site was minimal and noncomparable.

At present, the limitations of the study are the uncertainty on the number and viability of cells transplanted immediately after scraping the tissues from the root surface of extracted tooth. As of now, lack of histologic evidence and *in vitro* analysis of stem cell characterization and osteogenic potential are few of the important shortcomings. Further studies are being directed, wherein 15 patients are undergoing the current therapy as randomized controlled trial with the due consideration of addressing the abovesaid shortcomings.

Direct application of PDLSCs bypassing the *ex vivo* culture has overcome the limitations and concerns of *ex vivo* cell cultures such as high cost, technique sensitivity, loss of stemness during cell passage, genetic manipulation, and tumorigenic potential.[9] Studies have proved that soft tissues on the extracted third molar root harbor PDLSCs, which have shown a clinical and radiographical improvement in the treatment of periodontal osseous defects.[1,10,11] Based on this, in SAI-PRT, we attempted to transplant the autologous PDLSCs directly into the periodontal osseous defects. As an evidence-based approach initiated in 2014, out of ten cases, the first case report of 12-month evaluation is presented in this case report. The clinical and radiographic outcome measures are highly successful as compared to control group of open flap debridement. Since there are no bone graft/substitute used in this study as used in Feng and Chen's study, direct transplantation of autologous PDLSCs-containing tissue, it is discernable that the successful clinical and radiographic changes in the treated site are attributable to the PDLSCs.

CONCLUSION

A simple task of PDLSCs procurement and immediate placement are the major advantages of the current concept, the autologous SAI-PRT that has emerged as a constructive avenue in the treatment of periodontal osseous defects. Moreover, the clinical feasibility, success, and cost-effectiveness over the currently available techniques are encouraging. The clinical utility of this novel idea is recommended.

Currently, the limitation of SAI-PRT is its utility in one or two periodontal osseous defects. As of now, other limitations such as *in vitro* evaluation of stem cell quantification, characterization, histologic evaluation of the treated sites, and advanced radiographic assessment are ongoing along with randomized controlled trial. The results of this study surely would evaluate the scientific basis of SAI-PRT.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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