Comparative evaluation between Autogenous Bone Graft, Osseous Resective Surgery and Open Flap Debridement in treatment of Hemiseptal Periodontal Defect - A Systematic Review.

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ABSTRACT

Aim: The present systematic review aimed to pool evidence on the comparative evaluation autogenous bone graft, osseous resective surgery, and open flap debridement in the treatment of hemiseptal periodontal defects.

Material and methods: Three databases (Pubmed, Embase, and Scopus) were searched to find relevant papers. The search was conducted using a systematic search approach that included medical subject headings and synonyms for the following terms: "open flap surgery" OR "autogenous bone graft" OR "resective osseous surgery" AND "chronic periodontitis". Two authors independently assessed the titles and abstracts, and papers that did not meet the inclusion criteria were removed. Finally, articles that met the requirements were added.

Results: The search strategy synthesize a total of 652 studies out of which 237 were eliminated for being duplicates and 359 were found ineligible based on title and abstracts screening. Remaining 56 studies were sought for full text assessment. Amongst these, 51 studies were further eliminated due to following non-eligibility factors: two or three walled defects, incomplete data on one wall defects. Thus, a total of 5 studies were included and synthesised narratively.

Conclusion: We conclude that mixed regenerative techniques, autogenous grafts and orthodontic interventions has been reportedly applied in hemiseptal periodontal defects, however, there is no study till date that compared the efficacy across the three treatment options. Future research should be focused on conducting rigorous research using controlled trials or cohort studies to test outcome of these interventions on hemiseptal periodontal defects.

Keywords: autogenous bone graft, osseous resective surgery, open flap debridement, hemiseptal defects, one wall defects, periodontitis

How to cite this article: Tiwari V, Dhadse PV, Kumbare S, Karamore R, Bhatkar A. Comparative evaluation between Autogenous Bone Graft, Osseous Resective Surgery and Open Flap Debridement in treatment of Hemiseptal Periodontal Defect - A Systematic Review. Int J Drug Deliv Technol. 2026;16(70s): 1602-1611. DOI: 10.25258/ijddt.16.70s.174

INTRODUCTION

Periodontal disease is characterized by periods of activity in which the periodontal support structures are destroyed by the action of chemical mediators of inflammation, followed by periods of quiescence with remission from the destructive process.[1] Over time, the most frequently employed treatment for bone defects has been conventional autologous bone graft. Its widespread application was facilitated by a variety of factors, including its ease of acquisition, its ability to combine osteogenic, osteoinductive, and osteoconductive properties, and its lack of immune response or infectious disease transmission.[5] Furthermore, autologous bone graft

can be harvested in a variety of forms and sizes from different donor sites.[6] Azi et al in a meta-analysis demonstrated the effectiveness of autologous graft for bone defects. They also concluded that bone defect size does not seem to have an impact on bone union when treated with autologous bone graft techniques.[8]

Periodontal tissue destruction is characterised by the formation of deep periodontal pockets and clinical attachment loss, which are accompanied by bleeding during probing. This is significantly contingent upon the restoration of physiologic osseous contours and the correction of deformities in the alveolar bone surrounding the affected teeth. The most predictable surgical treatment modality for achieving stable pocket reduction is resective osseous surgery(ROS).[9] It comprises a series of carefully orchestrated steps for appropriate re-contouring of alveolar bone and management of the overlying soft tissues being either additive or subtractive.[10]

Open flap debridement (OFD) in periodontal regeneration involves multiple facets including incision and flap design, surgical debridement and root preparation, placement and stabilization of the regenerative materials, tissue positioning and suturing. A recent systematic review by Graziani F et al., determined the clinical performance of conservative surgery (CS) for the treatment of intrabony defects and found that the treatment of intrabony defect with CS is associated with high tooth retention and improvement of periodontal clinical parameters.[13]

In terms of probing pocket depth and clinical attachment loss reductions, periodontal regenerative therapy has been found to be superior to conventional surgeries, such as open-flap debridement surgery, in the treatment of intra-bony defects, as reported by numerous authors.[14–16] Despite available literature evaluating regenerative therapy in the treatment of infrabony defects, there is limited data on hemiseptal defects. There is also limited literature on the comparison of all three techniques. Thus, the present review aimed to pool evidence on the comparative evaluation autogenous bone graft, osseous resective surgery, and open flap debridement in the treatment of hemiseptal periodontal defects.

MATERIAL AND METHODS

This systematic review closely adheres to the PRISMA criteria, and the study's protocol is registered in an international database (PROSPERO) to ensure transparency. (CRD42024570964)

2.1 **PICO development**

The reviewers established the research question for this study using the PICO format, which is listed below.

Population (P): Chronic periodontitis patients having hemi septal periodontal osseous defects

Interventions (I): An intervention was performed in the form of open flap surgery and harvesting autogenous bone graft from mental symphysis or Resective osseous surgery in their respective groups.

Comparator (C): A comparison was made with open flap debridement.

Outcome (O): the outcome was assessed using clinical and radiographic parameters to evaluate soft and hard tissue response in all three groups.

Study Design (S): Randomised controlled clinical trials (RCT) and case reports

2.2 **Search methods**

Three databases (Pubmed, Embase, and Scopus) were searched to find relevant papers. The search was conducted using a systematic search approach that included medical subject headings and synonyms for the following terms: "open flap surgery" OR "autogenous bone graft" OR "resective osseous surgery" AND "chronic periodontitis". The search strategy was developed and modified depending on the database's search specifications. Supplementary Table 1 contains a complete list of search strategies. The search was not limited in terms of time or language. The most recent search was conducted in October 2024.

2.3 Inclusion/exclusion criteria

Studies included a comparison of open flap surgery and harvesting autogenous bone graft from mental symphysis or ROS against open flap debridement. Patients with a definitive diagnosis of Chronic periodontitis with hemi septal periodontal osseous defects. Studies which used randomized controlled design or case report method to report outcome. Studies that focused solely on medical, pharmacological, or topical treatments for periodontitis were omitted.

2.4 Selection process

All search results were screened for inclusion in two stages. The first stage consisted of reading the title and abstract. Two authors independently assessed the titles and abstracts, and papers that did not meet the inclusion criteria were removed. The remaining articles were searched for full-text retrieval. Articles whose entire text was not openly available were contacted by email and requested to provide the full text. If the authors did not respond to at least three emails over the course of three weeks, the studies were excluded. The same two reviewers independently reviewed the remaining studies in full to evaluate the publications for inclusion. Finally, articles that met the requirements were added. At every stage of the selection process, disagreements over decisions were settled by consensus or with the assistance of a senior reviewer.

2.5 Data collection and analysis

Two reviewers gathered data from the included studies using a customized extraction template, and one senior reviewer double-checked the data. Name of author, year of publication, study design, sample characteristics (sample size, sampling techniques,

number of cases/controls, age/gender of participants), intervention, comparator, data analysis method, and study key findings were all extracted from the papers individually. All the extracted information was synthesized and summarised in a narrative format and presented in tabular form.

2.6 Quality assessment

All studies were evaluated for methodological quality using the Joanna Briggs Institute (JBI) criteria for randomized controlled trials and case studies. Two reviewers evaluated the studies' quality, with a third reviewer resolving any disagreements. There was no minimum quality requirement for inclusion in this evaluation.

RESULTS:

Search results

The search strategy synthesize a total of 652 studies out of which 237 were eliminated for being duplicates and 359 were found ineligible based on title and abstracts screening. Remaining 56 studies were sought for full text assessment. Amongst these, 51 studies were further eliminated due to following non-eligibility factors: three wall defects, incomplete data on one wall defects. Thus, a total of 5 studies were included and synthesised narratively.

Study Characteristics

Out of 5 studies, 2 were clinical trials and remaining 3 were case reports. The included studies were published between the period of 1998 to 2015. The studies were carried out in India, Pennsylvania, Sweden, Israel and Nepal. All participants were middle age adults with age ranging from 30-58 and mean age of 43.90.

Key findings

The number of defects ranged from 1 to 5 defects with average number of defects being 1. 8 among the included participants. The periodontal pocket depth (PPD) was mainly 6.5-8mm, however, 2 studies reported a PPD of 1 (Langer et al). In terms of CAL, only three studies reported CAL ranging from 6.5 to 10.5 (Thakkalapati et al., Yammamiya et al., Falk et al.). Periapical or intra-oral apical radiographs were taken prior to the procedure. There was a wide variation in surgical procedure based on the location of the defect with bone grafting and surgical elevation being the most commonly used methods. Success of autogenous bone grafting was reported in 2 cases, however, one showing success, whereas the other showing mixed results with initial success but later bone loss in one case (Langer et al; Yammamiya et al). Open flap debridement in combination with PRP and DFDBA matrix was reported in one study with findings demonstrating excellent healing (Thakkalapati et al.). One study assessed the GTR therapy in periodontal defect and reported clinical bone fill and gain of attachment level. Orthodontic treatment including extrusion, uprighting, and forced eruption was reported in 2 studies (Ingber et al; Langer et al) with short term defect elimination, however the long term stability varied. The follow up period ranged from 15 days to 3 years with shortest follow up for orthodontic intervention and longer for surgical interventions. The post operative assessment indicated a significant decrease in PPD and CAL values across the studies. Similarly, the radiographic assessment indicated evidence of defect elimination, indicating that the procedures resulted in significant clinical improvement (Table 1).

Study ID	Location	Population Age	no of defects	ppd	cal	radiographic assessment	Procedure	follow up	ppd	cal	radiographic bone fill	Conclusion
Thakkalapati et al 2015	Chennai	30	1	6mm	6.5 mm	Periapical radiograph; Defect Depth - >4mm, Defect Angle - 37°	OFD with a combination of PRP and DFDBA matrix	6 months	0.5mm	Gain 6.5mm	Good Bony fill	The healing was uneventful, indicating biocompatibility of both grafting modalities. The patient showed compliance and satisfactory oral hygiene maintenance good during the course of observation period.
Yamamiya et al 2008	Niigata, Japan	55.8	4	Test: 7.7 ± 1.1 Control: 7.6 ± 1.1	Test: 8.1 ± 1.2 Control: 8.0 ± 1.3	Standardized paralleling cone technique IBD Test: 5.3 ± 1.1 IBD Control: 4.9 ± 1.4; GR Test 0.3 ± 0.6 GR Control 0.4 ± 0.5	HCP + PRP + HA and PRP + HA	1 year	Test: 2.9 ± 0.4 Control: 3.3 ± 1.0	Test: 4.1 ± 1.2 Control: 5.3 ± 1.5	IBD Test: 0.4 ± 0.9 IBD Control: 1.7 ± 1.2; GR Test 1.3 ± 1.3 GR Control 2.1 ± 1.4	A combination of HCP sheets with PRP + HA grafts or PRP + HA graft treatment led to a significant clinical improvement in the investigated clinical and radio graphic parameters. However, the added benefits of HCP sheets had statistical and clinical significance.
Falk et al 1997	Sweden	55	4	7.1 ± 2.4	10.5 ± 2.2 mm	intra-oral periapical radiographs; 6.3 ± 1.0 mm clinically; 5.7 ± 1.8	GTR Therapy	1 year	4.3 ± 1.9	5.6 ± 1.9 mm	Bone fill Mean 3.2 ± 1.8 mm	GTR-treatment of intrabony defects > 4 mm in a periodontal specialist practice will result in clinical bone fill comparable to wclinical trial has been demonstrated in case studies and controlled attachment level gain

						mm radiographically						
Langer et al.	Israel	34	1				Self-regeneration	8 months			a filling of approximately two thirds the original depth of the intraosseous defect	Defect became amenable to osseous surgery
		58	1				Autogenous bone graft	3 years			Complete repair of lesion	Remodeling of buccal crest
		42	5	7			Autogenous bone graft	3 years			almost total repair of both three- and two-wall parts of the original osseous defects, but furcation worsened at 3 years	Initial success, later Increased penetration and bone loss was noted on the first molar.
		33	1	5			Orthodontic uprighting	3.5 months	2		tooth was into final position it was splinted into place via wire and acrylic	lipping up of the crest on the mesial of the molar similar to that on the distal of the bicuspid.
		55	1	6			Orthodontic uprighting	4 months	2		evidence of crestal leveling	Residual depth of 2mm on the mesial of the tooth

		35	2				Orthodontic extrusion	6 months	1	2	flattening out of the crest	Surgical intervention unnecessary
		35	1	3			Surgical elevation	1 year			1 year: 1-mm hemiseptal defect on the mesial of the bicuspid. 18 months: maintenance of the area	Residual defect reduced
		46	1	8			Surgical elevation + autogenous graft	6 months	2		a crevicular depth of 2 mm and crestal leveling	Significant reduction in defect
		42	1	3			Surgical elevation	9 weeks			crestal leveling between the bicuspids	Minimal residual defect
Ingber et al.	Pennsylvania	50	1	8			Forced eruption with orthodontic appliance	15 days	3		defect eleminated after forced eruption	the concept of forced eruption is applied to treat teeth where osseous surgery to gain sound tooth structure for restorative purposes would produce esthetic deformities or result in a sacrifice of supporting bone on adjacent teeth.

Quality assessment

The quality assessment of case reports indicate that the studies were of high quality and fulfilled majority criteria except for not explaining in detail about the patient history in the form of timeline and non- reporting of adverse event after the procedure. On the other hand, the appraisal of clinical studies indicates the poor quality of studies with randomization, blinding and group allocation not followed.

Questions (Case Reports)	Langer et al.	Ingber et al.	Thakkalapati et al 2015
1. Were patient's demographic characteristics clearly described?	Yes	Yes	Yes
2. Was the patient's history clearly described and presented as a timeline?	No	No	No
3. Was the current clinical condition of the patient on presentation clearly described?	Yes	Yes	Yes
4. Were diagnostic tests or methods and the results clearly described?	Yes	Yes	Yes
5. Was the intervention(s) or treatment procedure(s) clearly described?	Yes	Yes	Yes
6. Was the post-intervention clinical condition clearly described?	Yes	Yes	Yes
7. Were adverse events (harms) or unanticipated events identified and described?	No	Yes	No
8. Does the case report provide takeaway lessons?	Yes	Yes	Yes

Questions (RCTs)	Falk et al 1997	Yamamiya et al 2008
Was true randomization used for assignment of participants to treatment groups?	Yes	No
Was allocation to groups concealed?	No	NA
Were treatment groups similar at baseline?	Yes	NA
Were participants blind to treatment assignment?	No	NA

Were those delivering the treatment blind to treatment assignment?	No	NA
Were treatment groups treated identically other than the intervention of interest?	Yes	NA
Were outcome assessors blind to treatment assignment?	Unclear	No
Were outcomes measured in the same way for treatment groups?	Yes	Yes
Were outcomes measured in a reliable way?	Yes	Yes
Was follow-up complete, and if not, were differences between groups in follow-up adequately described and analyzed?	Yes	Yes
Were participants analyzed in the groups to which they were randomized?	Yes	NA
Was appropriate statistical analysis used?	Yes	Yes
Was the trial design appropriate, and were deviations from the standard RCT design accounted for?	Yes	NA

DISCUSSION

This systematic review highlights various procedures for treatment of hemiseptal periodontal defects. Open flap debridement with graft and mixed intervention showed promising clinical and radiographic improvements and GTR also demonstrated favourable outcomes. In contrast, autogenous bone graft and orthodontic intervention demonstrated variable results with long term challenges. However, the number of studies is too limited to reach any definitive generalized conclusion. This warrants for more evidence generation in the field to establish more conclusive recommendation for the optimal management of hemi septal periodontal defects.

An essential distinction in the included studies is the use of mixed regeneration techniques for hemi septum periodontal defect. Regenerative techniques such as bone graft, guided tissue regeneration and platelet concentrates are usually employed to restore bone loss, periodontal ligament and connective tissue detachment by stimulation of biological healing process. Our findings indicate that mixed regenerative therapies potentially have better treatment outcome as compared to regenerative therapies. Similar findings have been reported in another systema tic review by Tavelli et al. who reported that bone grafts in combination with biologic agents (PRP, PRF, EMD) significantly improves the clinical and radiographic outcomes of periodontal infrabony defects, as compared to BG and flap procedures alone. This could be because biological agents promote cellular proliferation, angiogenesis or extracellular matrix formation in the system which accelerates the healing process associated with graft surgeries, thus improve health outcomes. While these techniques seems effective, the favorable outcomes depends on three major factors- 1.) patient factors such as compliance to oral hygiene, smoking statsu and post therapy inflammation, 2.) Surgical factors such as clinical knowledge, experience and skills of professionals, 3.) defect related factors such as its defect and

pocket depth, number of affected walls, and severity/degree of mobility (Cortellini et al.).

Another key finding of the study is varied outcome of using autogenous grafts alone with increased penetration and bone loss on the first molar as side effect after 3 years. The properties of osteoinduction, osteoconduction, and creeping substitution have been successfully depicted and can be manufactured in various sizes and shapes making it a promising graft material for smaller-sized defects in oral region, However, it comes with certain shortcomings as well which can explain the variability in results across the included studies. For instance, biological factors such as bone excessive resorption and remodelling of ABGs over time can lead to compromised stability of defect (Alalola et al). Secondly, there is a risk that underlying instability might be overlooked due to initial success of graft, leading to progressive deterioration over time (Pandit N,). Another factor could be occlusal trauma to teeth during the mastication process as a result of significant forces. Furthermore, presence of subclinical infection can result in activation of osteoclastic activity contributing to bone loss in longer terms (Timothious et al; Deandra et al.). Besides, factors such as systemic conditions, poor oral hygiene could further affect graft stability (Janjua et al). Similar side effects have been noted in a narrative review which assessed the effectiveness of ABG in treatment of maxillofacial defects. Thus, this indicates the need to consider all these factors while using Autogenous graft in treatment of hemiseptal periodontal defect.

Orthodontic intervention was the most commonly reported intervention for correcting heimseptal periodontal defects in the included studies because orthodontic interventions such as uprighting, intrusion, extrusion, and retraction allow for controlled tooth movement, which improves periodontal architecture (Ali et al). Extrusion is very effective in treating intraosseous abnormalities produced by occlusal trauma, food impaction, or uncontrolled tooth tilting. It corrects infrabony flaws, reduces periodontal pockets, and enhances periodontal stability. In contrast, intursion, when applied with minimal force, causes bone remodeling and attachment gain. Similarly, uprighting helps to redistribute occlusal stresses, decreasing damage and increasing marginal bone levels (Ali et al; Erbe et al; Ingber et al.). While these procedures have no negative impact on periodontal outcomes, stringent patient adherence to good oral hygiene practices and supporting therapy are critical for long-term success (Nambiar et al.). Erbe et al. concluded in their comprehensive review that, while orthodontic therapies are helpful, success requires a tailored multidisciplinary and comprehensive grasp on altered biomechanics.

Limitation and practical implication

Our findings are supported by a rigorous and systematic search strategy, strict protocol and standardised risk of bias assessment. However, the limited number of studies and low level of evidence make it difficult to draw a conclusion from this review. Therefore, further research using robust methodologies such as cohort studies or controlled trials are required to identify the most effective intervention for treatment of hemi septum periodontal defect.

Conclusion

Based on the findings from included studies, this systematic review has drawn following conclusions. Firstly, mixed regenerative techniques, autogenous grafts and orthodontic interventions has been reportedly applied in hemiseptal periodontal defects, however, there is no study till date that compared the efficacy across the treatment options. Secondly, while the therapies seem effective, the evidence comes from clinical case reports limiting its generalizability to wider population. Thus, future research should be focused on conducting rigorous research using controlled trials or cohort studies to test outcome of these interventions on hemiseptal periodontal defects.

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