

A novel sub-junctional pinhole technique (S-PHT) in treating intrabony defects of stage III periodontitis – Case Series

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Research Article

Keywords: Intrabony defects, minimally invasive periodontal therapy, periodontal regeneration, periodontal therapy

Posted Date: October 11th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-10557391/v1>

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Additional Declarations: No competing interests reported.

Abstract

Background

Sub-junctional pinhole technique (S-PHT) is a minimally invasive approach in which graft material is introduced into the intrabony defect through a pinhole made on the facial surface opposite to the intrabony defect alveolar crest and apical to the junctional epithelium 4 weeks following minimally invasive non-surgical therapy. This strategy is intended to keep the long junctional epithelium as a biologic seal over the grafted material, while providing maximum soft tissue support around the grafted material.

Methods

This case series presents the short-term outcome of ten patients diagnosed with stage III grade A periodontitis with interproximal intrabony defects of at least 3 mm, treated with S-PHT. Xenogenic graft material was introduced into the defect through a facial pinhole opposite to the alveolar crest following defect degranulation using minimally invasive hand and ultrasonic instrumentation. Clinical and radiographic parameters were recorded at baseline (4 weeks after non-surgical therapy) and at 9 months following S-PHT.

Results

Nine months following S-PHT, all sites measured ≤ 4 mm probing pocket depth (PPD). The number of sites with clinical attachment level (CAL) gain ≥ 3 mm was 6 out of the 10 reported cases. Six sites out of the 10 cases fulfilled a composite outcome of pocket closure of ≤ 4 mm with ≥ 3 mm attachment gain and no bleeding on probing. Significant improvement in intrabony defect fill reported after 9 months with a mean defect fill of 3.1 mm (< 0.001).

Conclusions

This case series demonstrates that S-PHT, as a minimally invasive approach, could be a reliable patient friendly option for treating intrabony defects in stage III periodontitis.

Trial Registration:

ClinicalTrials.gov. identifiers NCT07763223 PRT-RCT-2026-001 (05-08-2026 and retrospectively registered 19-08-2026)

1. Background

The goal of periodontal therapy is to stop the progression of periodontal destruction by controlling infection and inflammation caused by periodontal dysbiotic biofilm, and ideally to regenerate the lost periodontal structures.[1] Successful treatment is evidenced clinically by achieving the clinical endpoint of probing pocket depth reduction (PPD) into ≤ 3 mm or ≤ 4 mm with no bleeding on probing associated with clinical attachment gain of ≥ 3 mm and radiographic defect fill. [2, 3] Many flap techniques associated with or without graft materials and or biologic mediators have been proposed to achieve this goal. However, in order to degranulate the defects and to introduce the grafting materials extensive tissue reflection following conventional surgeries could result in loss of soft tissue support, clot instability, attachment loss, and can lead to morbidities such as thermal sensitivity, food impaction, and compromised esthetics.[4] Extracellular matrix macro-movements associated with surgical injury or aggressive non-surgical therapy may result in altered cell behavior and cellular necrosis.[5] For optimal maintenance of soft tissue support and subsequent clot stability, which could maximize the clinical outcomes and patients' satisfaction, most of the treatment directions are currently moving toward minimally invasive

approaches. [6–9]. However, in most of the currently used minimally invasive approaches we still reflect certain level of the mucoperiosteum and incise the junctional epithelium.

Junctional epithelium is a distinct phenotype firmly attached to the tooth and thus forms an epithelial barrier against the plaque bacteria. It allows the access of GCF, inflammatory cells and components of the immunological host defense to the gingival margin, Epithelial cells activated by microbial substances secrete chemokines, and cytokines, that attract and activate professional defense cells, such as lymphocytes and polymorphonuclear leukocytes. [10] In healthy tissue, the cell turnover rate is remarkably fast, requiring only 4 to 6 days to completely renew itself compared to 6–12 days for standard oral epithelium and up to 30 days for normal skin. [11] In order to get an access into periodontal defect most of the current flap techniques incise the junctional epithelium and reflect partial or full thickness flap which actually compromise both of the soft tissue support around the defect and the junctional epithelial seal on top of the defect. It was reported that, in spite of the rapid junctional epithelium renewal rate, it needs about one month following surgery for the gingival sulcus to fully epithelialized, and developed a well-defined junctional epithelial attachment. [12]

The preset case series introduced a new minimally invasive approach of S-PHT in which defect degranulation and graft material introduced into the infrabony defect through a tiny, gingival pinhole entry point made on the facial surface opposite to the defect alveolar crest and apical to the junctional epithelium four weeks following minimally invasive non-surgical therapy. Maximizing soft tissue support through flapless pinhole approaches and natural graft protection through keeping the junctional epithelium could have an impact on the clinical outcomes of periodontal therapies.

2. Methods

2.1. Participants enrollment.

This case series includes ten non-smoking patients (five males and five females, aged 39–61 years) who received treatment in periodontology department of the faculty of dentistry Al Azhar University, Cairo, Egypt between November 2024 and December 2025. All patients were systemically healthy and diagnosed with stage III periodontitis [13] with pocket depth of ≥ 6 mm, clinical attachment loss of ≥ 4 mm and at least one intrabony defect 3 or 2 walled, of at least 3 mm in depth, and ≥ 45 -degree angulation width. Each patient contributed to the study with a single maxillary or mandibular single or multirooted interproximal defect. Patients with any systemic condition that contraindicates any surgical intervention, pregnant or lactating females, smokers or alcoholic patients, patients with a history of periodontal therapy and antibiotic administration in the last 6 months, patients with unacceptable oral hygiene after the re-evaluation of step 1,2 therapy, and teeth with any level of mobility were excluded from the study. The Preferred Reporting Of Case Series in Surgery (PROCESS) guideline was adopted for reporting findings. [14] All patients were thoroughly informed of the nature, potential risks, and benefits of their participation in the study, and they signed informed consent documents that included details of the clinical procedures. The study protocol was approved by the Ethics Committee of Al Azhar University dental school (EC Ref No. 1437/2757) and informed consent of AL Azhar University Dental School standard operating procedures was obtained by staff trained in taking consent.

2.2. Clinical periodontal assessment

The present case series primary outcome was a composite outcome of pocket closure < 4 mm, CAL gain of ≥ 3 mm with no bleeding on probing 9 months following therapy. Secondary outcomes were radiographic defect fill, improvement in PPD, gain in CAL and patients' satisfaction. Periodontal measurements were taken by a calibrated examiner (MT) at the deepest point of the selected sites using a manual University of North Carolina (UNC-15) periodontal probe (Hu-Friedy, Chicago, IL, USA) and a personalized acrylic stent. Initial measurements before therapy and baseline measurements 4 weeks following minimally invasive non-surgical therapy (MINST) included, bleeding on probing, probing pocket depth (PPD) recorded as the distance from the free gingival margin to the base of the periodontal pocket, clinical attachment level (CAL) as the distance

from the cemento-enamel junction to the base of the pocket. Standardized Periapical radiographs of selected study sites were taken at baseline and at the 9-month follow-up visit using the parallel technique with a Rinn holder and an occlusal platform. Periapical radiographs included in the study were transferred into a dedicated software measurement system (Blue Sky Bio-USA). The linear measurement was carried out after identifying in periapical radiographs CEJ on the tooth with the intrabony defect the most coronal part of the alveolar bone crest and the most apical part of the alveolar bone defect where the periodontal ligament space was identified to retain its normal width. Intrabony defect depth (IBD) is the distance from an imaginary line between the alveolar crest and the root surface to the defect base. Postoperative pain experience was evaluated using a standardized 10-cm horizontal Visual Analog Scale (VAS), where 0 indicated "no pain" and 10 indicated "the worst pain imaginable." Patients were thoroughly instructed on how to use the scale prior to surgical discharge. Pain levels were recorded at four distinct time points: immediately postoperative (within 30 minutes of S-PHT completion), and subsequently at 24 hours (Day 1), 48 hours (Day 2) and 72 hours (Day 3). Patients recorded their daily pain scores at approximately the same time each evening

2.3. Periodontal intervention

Initial parameters before therapy were recorded for all patients. Following the S3 clinical practice guidelines protocol [13] all patients received their first step 1 therapy, which included patient education for the nature of the disease and its effect on periodontal and systemic health, motivation for oral hygienic measures of teeth brushing and flossing and assessment and control of any susceptibility factor that could affect the treatment outcomes. Following control of all risk factors and checking patient compliance, step 1 and step 2 therapy of full mouth supra and sub-gingival professional mechanical plaque removal (PMPR) were performed in a single visit using conventional manual and ultrasonic instruments (Sickle scaler, jacket scaler (NORDENT), 13/14 Gracey Curette, 15/16 Gracey Curette, Harmony™ Handle). Selected defects received subgingival professional mechanical plaque removal using the MINST protocol by careful insertion of thin ultrasonic tips (NSK type-PD1) extending to the most apical part of the pocket. Additional subgingival instrumentation using manual 13/14 Mini Five™ Gracey Curettes, 15/16 After Five™, Harmony™ Hand Gracey mini-curettes (Hu -Friedy) to achieve biofilm removal in areas with difficult accessibility. Care was taken to preserve the stability of the defect-associated soft tissues. Intentional vigorous smoothing of the root surfaces, root planning, and gingival curettage were avoided. Subgingival rinses were not performed to achieve blood clot stabilization following subgingival instrumentation. [15] All procedure was performed using 4x magnification loupes (Bryant Dental loupe-UK). Recoding operation time of defect degranulation and graft filling was not restricted; the end point was when the clinician satisfied with the work. Baseline clinical parameters of the selected defects were recorded 4 weeks following PMPR session.

Four weeks following completion of MINST, the point of entry for interproximal defect degranulation and grafting was determined by measuring the distance between the interdental gingival margin to the intrabony defect base with bone sounding using periodontal probe to be subtracted from the distance between the alveolar crest and the intrabody defect base measured in radiographic photo while the probe in place during bone sounding to avoid radiographic shape distortion. (Fig. 1b) With the tip of prob type ultrasonic insert a pinhole was created on the facial surface at the estimated entry point and ultrasonic degranulation performed which was followed by manual debridement using minimally invasive curettes. (Fig. 1c, d) Xenogenic graft material (Geistlich Bio-Oss small particle size of 0.25–1 mm) hydrated and introduced through the same entry point opposite to the alveolar crest using mini sized amalgam carrier of 1.5 mm diameter (Fig. 1c). Single interrupted suture was used to close the point of entry if the point of entry exceeds 1mm. Intraoperative radiograph was taken to ensure complete defect fill. In addition, in order to ensure complete defect fill, the graft material safely confined within the defect, and detect any internal voids or gaps against the root surface periapical and CBCT three-dimensional, cross-sectional views were taken (Sirona - Ortho Phos xl line, Germany)

2.4. Post-Operative Follow-Up

For the first one week following therapy, all patients were instructed to refrain from the mechanical tooth brushing and flossing at the test site. Chlorhexidine mouth wash 0.12 (Hexitol - Arab Drug Company, Egypt) was prescribed two times daily for one week following therapy. All patients were recalled every month for supragingival professional mechanical plaque removal and oral hygiene reinforcement. No additional subgingival professional mechanical plaque removal or graft injection was performed. Clinical and radiographic parameters were recorded by the same calibrated examiner at 9 months. No antiseptic mouthwashes or antibiotics were prescribed.

2.5. Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistics for Windows, Version 27.0 (IBM Corp., Armonk, NY, USA). Continuous variables were summarized as mean $\pm$ standard deviation (SD), while non-normally distributed variables were additionally presented as median and interquartile range (IQR). Categorical variables were expressed as frequencies and percentages. The normality of continuous variables was assessed using the Shapiro–Wilk test because of the small sample size. Since the repeated clinical outcome variables (PD, CAL, IBC, and VAS pain scores) were not normally distributed, non-parametric statistical tests were applied. Changes in PD, CAL, and IBC across the three assessment time points (initial, baseline, and 9-month follow-up) were evaluated using the Friedman test. When a statistically significant overall difference was detected, post-hoc pairwise comparisons were performed using the Wilcoxon signed-rank test with Bonferroni correction to adjust for multiple comparisons. Similarly, changes in postoperative pain (VAS scores) recorded on the day of surgery and on postoperative days 1, 2, and 3 were analyzed using the Friedman test, followed by Wilcoxon signed-rank tests for pairwise comparisons when appropriate. Bonferroni correction was applied to control for type I error resulting from multiple testing. For all statistical analyses, a two-tailed p-value < 0.05 was considered statistically significant. For post-hoc pairwise comparisons, Bonferroni-adjusted p-values were used to determine statistical significance.

3. Results

The study sample comprises a cohort of ten middle-aged to older adult patients, a demographic that is highly representative of advanced periodontal clinical investigations. The mean age of the participants is 49 years, with a standard deviation of 6.66 years, spanning a minimal age of 39 years to a maximum of 61 years. Patients underwent S-PHT for 5 intrabony defects of 2 walls and 5 sites of 3 walls 4 weeks following MINST (baseline) (Table 1). All subjects reported mild discomfort with no need for systemic analgesics. No adverse signs reported, such as oedema, abscess, suppuration or bone graft exposure following defect degranulation and graft injection. Table 2,3 shows clinical Parameters before therapy, at baseline and 9 months after treatment.

Table 1
demographic and VAS score individual data

1	Age (years)	Tooth/defect site	Gender	Number of walls	Operation time (min)	VAS same day	VAS Day 1	VAS day 2	VAS day 3
	45	U4/M	M	2	20	3	1	0	0
2	48	U5/D	F	2	15	2	1	0	0
3	61	L2/M	F	3	25	2	1	0	0
4	55	L6/M	M	2	15	3	1	1	0
5	49	L6/M	M	3	20	1	2	1	0
6	56	U4/D	F	3	25	2	1	0	0
7	41	U5/M	M	2	15	2	0	1	1
8	52	L4/D	M	2	30	2	0	1	0
9	39	L6/M	F	2	25	3	1	0	1
10	44	L6/M	F	3	30	3	0	0	0
Mean ± SD	49 ± 6.66				21.5 ± 5.26	2.3 ± 0.67	0.8 ± 0.53	0.4 ± 0.51	0.2 ± 0.42
VAS: Visual Analog Scale (0–10); F: female; M (Gender column): male; U: upper; L: lower; M (Tooth/defect site column): mesial; D: distal.									

Table 2
individual clinical characteristics at initial, baseline and 9 months following therapy

1	PD initial	PD baseline	PD at 9 M	CAL initial	CAL baseline	CAL at 9 M	IBC initial	IBC baseline	IBC at 9 M	BOP initial	BOP baseline	BOP at 9 M
	9	6	3	7	4	3	5	5	1	1	0	0
2	8	5	3	6	3	3	3	3	1	1	0	0
3	7	5	3	6	3	3	4	4	0	1	0	0
4	6	4	3	4	3	2	3	3	0	1	0	0
5	6	4	2	5	3	3	3	3	0	1	0	0
6	7	5	3	5	3	3	4	4	1	1	0	0
7	9	7	4	7	4	3	4	4	0	1	0	0
8	7	5	3	5	3	2	3	3	1	0	0	0
9	6	4	3	4	2	2	3	3	0	1	0	0
10	7	5	4	5	3	2	4	4	1	1	0	0
Mean ± SD	7.2 ± 1.14	5.0 ± 0.94	3.1 ± 0.56	5.4 ± 1.07	3.1 ± 0.53	2.8 ± 0.51	3.6 ± 0.69	3.6 ± 0.69	0.5 ± 0.52	0.9 ± 0.31	0	0

All values in millimeters unless stated otherwise. PD: probing pocket depth; CAL: clinical attachment level; IBC: intrabony component; BOP: bleeding on probing (0 = absent, 1 = present); M: at 9 months.

Table 3
Clinical data analysis at the three evaluation periods

	Time point	median (IQR),	Mean $\pm$ SD,	P value	Pairwise comparison	adjusted p-value
PD	Initial	7.0 (2.25)	7.20 $\pm$ 1.14	< 0.001	Initial vs. Baseline	0.076
	Baseline	5.0 (1.25)	5.00 $\pm$ 0.94		Initial vs. 9 months	< 0.001
	9months	3.0 (0.25)	3.10 $\pm$ 0.57		Baseline vs. 9 months	0.076
CAL	Initial	5.0 (1.50)	5.40 $\pm$ 1.07	< 0.001	Initial vs. Baseline	0.016
	Baseline	3.0 (0.25)	3.10 $\pm$ 0.57		Initial vs. 9 months	< 0.001
	9months	3.0 (1.00)	2.60 $\pm$ 0.52		Baseline vs. 9 months	0.791
IBC	Initial	3.5 (1.00)	3.60 $\pm$ 0.70	< 0.001	Initial vs. Baseline	1.000
	Baseline	3.5 (1.00)	3.60 $\pm$ 0.70		Initial vs. 9 months	0.002
	9months	0.5 (1.00)	0.50 $\pm$ 0.53		Baseline vs. 9 months	0.002

Pocket depth demonstrated a progressive reduction across the three assessment time points, decreasing from a median of 7.0 mm at the initial assessment to 5.0 mm at baseline and 3.0 mm at 9 months. The Friedman test demonstrated a statistically significant overall difference in probing depth across the three time points ($p < 0.001$). Post-hoc pairwise comparisons using the Wilcoxon signed-rank test with Bonferroni adjustment revealed a statistically significant difference only between the initial and 9-month measurements (adjusted $p < 0.001$). Although the unadjusted comparisons between the initial and baseline measurements and between baseline and 9 months were statistically significant ($p = 0.025$ for both), neither remained statistically significant after Bonferroni adjustment (adjusted $p = 0.076$ for both). These findings indicate a significant overall reduction in probing depth over time, with the most pronounced statistically significant difference observed between the initial assessment and the 9-month follow-up. Clinical attachment levels demonstrated a progressive improvement across the three assessment time points, with the median CAL decreasing from 5.0 mm (IQR: 1.50) at the initial assessment to 3.0 mm (IQR: 0.25) at baseline and remaining at 3.0 mm (IQR: 1.00) at 9 months. The Friedman test demonstrated a statistically significant difference in CAL across the three time points ($p < 0.001$). Post-hoc pairwise comparisons using the Wilcoxon signed-rank test with Bonferroni adjustment demonstrated statistically significant differences between the initial and baseline measurements (adjusted $p = 0.016$) and between the initial and 9-month measurements (adjusted $p < 0.001$). In contrast, no statistically significant difference was observed between baseline and 9 months (adjusted $p = 0.791$), indicating that the improvement in CAL occurred primarily between the initial assessment and baseline (4 weeks following MINST) and was subsequently maintained at 9 months.

Intrabony component fill (IBC) demonstrated a marked reduction over the assessment period. The median IBC decreased from 3.5 mm (IQR: 1.00) at the initial assessment and baseline to 0.5 mm (IQR: 1.00) at 9 months. The Friedman test demonstrated a statistically significant difference in IBC across the three assessment time points ($p < 0.001$). Post-hoc pairwise comparisons using the Wilcoxon signed-rank test with Bonferroni adjustment demonstrated statistically significant differences between the initial and 9-month measurements (adjusted $p = 0.002$) and between baseline and 9 months (adjusted $p = 0.002$). In contrast, no difference was observed between the initial and baseline measurements (adjusted $p = 1.000$), indicating that the significant reduction in the intra-bony component occurred primarily during the follow-up period between baseline and 9 months.

All sites measured ≤ 4 mm PPD 9 months after therapy. The number of sites with CAL gain ≥ 3 mm was 6 sites out of the 10 cases reported. Six sites out of the 10 cases fulfill a composite outcome of pocket closure of 4 mm or less with 3 mm attachment gain and no bleeding on probing. All 10 examined sites showed significant filling of the intrabony defect.

Postoperative pain scores demonstrated a progressive reduction over the three-day follow-up period. The median VAS score decreased from 2.0 (IQR: 1.00) on the day of surgery to 1.0 (IQR: 1.00) on postoperative day 1, and further to 0.0 on

postoperative days 2 and 3. The overall comparison using the Friedman test demonstrated a statistically significant difference in VAS scores across the four assessment time points ($p < 0.001$). Pairwise comparisons using the Wilcoxon signed-rank test demonstrated a statistically significant reduction in pain between the day of surgery and postoperative day 3 ($p = 0.004$), which remained statistically significant after Bonferroni correction. The difference between the day of surgery and postoperative day 1 was statistically significant before adjustment ($p = 0.009$) but did not reach the Bonferroni-adjusted significance threshold of $p < 0.0083$. No statistically significant differences were observed between postoperative days 1 and 2 ($p = 0.157$), days 1 and 3 ($p = 0.058$), or days 2 and 3 ($p = 0.317$). Overall, these findings indicate a significant reduction in postoperative pain over time, with the most pronounced statistically significant difference occurring between the day of surgery and postoperative day 3. (Table 4)

Table 4 VAS score analysis at different evaluation points:					
Comparison time	IQR	Mean $\pm$ SD	P value	Pairwise comparison	p-value
Same day	2.0 (1.00)	2.30 $\pm$ 0.67	< 0.001	Same day vs. Day 1	0.009
Day 1	1.0 (1.00)	0.80 $\pm$ 0.63		Same day vs. Day 2	0.011
Day 2	0.0 (1.00)	0.40 $\pm$ 0.52		Same day vs. Day 3	0.004
Day 3	0.0 (0.25)	0.20 $\pm$ 0.42		Day 1 vs. Day 2	0.157
				Day 1 vs. Day 3	0.058
				Day 2 vs. Day 3	0.317

4. Discussion

Sub-junctional pinhole technique combined with minimally invasive non-surgical therapy (S-PHT) for the treatment of intrabony defects in patients with stage III periodontitis. The results demonstrated that minimally invasive defect degranulation and graft injection through a buccal pinhole and keeping the long junctional epithelium physiologic seal, significantly enhanced intrabony defect fill, probing pocket depth (PPD) reduction, clinical attachment level (CAL) gain, and composite outcome measures with enhanced patients’ satisfaction.

Minimally invasive approaches have gained increasing attention in periodontal therapy due to their ability to preserve soft tissue architecture, maintain clot stability, and reduce patient morbidity. [16,17] Both minimally invasive non-surgical and surgical techniques are currently recommended by the EFP S3 clinical practice guidelines for the management of intrabony defects, given their favorable outcomes compared with conventional approaches.[13] However, complete periodontal regeneration is not consistently achieved, particularly in defects with unfavorable morphology or limited intrinsic space maintenance. This limitation has been attributed partially to clot retraction and the absence of a stable scaffold within the intrabony component of the defect.[18] Incised junctional epithelium and detached mucoperiosteum following flap reflection is supposed to provide inadequate protection and stability for the grafted materials.

S-PHT was designed to address these limitations by combining the biological advantages of MINST with minimally invasive defect degranulation and the injection of space-maintaining graft material without flap reflection. This could provide maximum protection of the grafted material within the intrabony defect by both of the coronal intact long junctional epithelium and flapless manipulation of the defect. The JE is designed to provide a seal around the teeth to defend the internal environment against bacterial infection from dental plaques and periodontal disease. [19, 20] For that reason, minimally invasive graft insertion in this study was introduced 4 weeks following MINST in order to insure complete regain of any injured epithelial cells during manipulation and establishment of a long junctional epithelium. Long junctional epithelium was reported to completely formed within 2 weeks following non-surgical therapy. [21, 22]

Following periodontal flap reflection, the connective tissue was reported to have time to form some attachment to the root surface coronal to the level of the alveolar bone before the junctional epithelium has grown down. One month following surgery, the gingival sulcus is reported to be fully epithelialized, and a well-defined junctional epithelial attachment is present. [23] That is why complete protection of the grafted material following surgeries is not guaranteed and this could be one of the main factors that limit the treatment outcomes and the present suggested S-PHT intended to tackle.

Defect degranulation remains a controversial aspect of minimally invasive periodontal therapy. While MINST aims to preserve granulation tissue to enhance wound stability, chronic inflammatory granulation tissue has been associated with persistent bacterial load and impaired tissue maturation [24]. The expected incomplete removal of granulation tissue from the full depth of the intrabony defect due to the limited access using minimally invasive approaches could be a positive factor enhancing reduction of bacterial load within the remaining granulation tissue, giving a space for graft material to fill the defect and could be also a possible source of more stem cells. Previous studies have reported no significant differences in clinical and radiographic outcomes between complete and partial removal of granulation tissue in minimally invasive surgical approaches, supporting the clinical rationale of the present protocol [25, 26]. The present study intrabony defects were selected to be contained deep, wide 2 or 3 walled in order to ensure its suitability for grafting 4 weeks following non-surgical therapy. Evidence supports that all bone graft types can enhance the regenerative potential of intra-bony defects, primarily by improving defect stability and soft tissue architecture. [27]

Soft tissue improvements of PD reduction and CAL gain at 4 weeks baseline and at 9 months following S-PHT could be attributed mainly to the effect of MINST. Similar to the outcomes of the present study, recent systematic reviews and meta-analysis evaluated changes in clinical parameters following full mouth subgingival instrumentation. They reported that the greatest proportion of probing depth reduction and clinical attachment gain occurs within the first 1–2 months, with additional but smaller improvements up to 3–4 and 5–6 months. [28, 29]. Randomized Controlled Trials (RCTs) confirm that Minimally Invasive Periodontal Surgery (MIPS) and techniques like the Modified Minimally Invasive Surgical Technique (M-MIST) yield significant probing depth reductions and attachment gains for intrabony defects. [31, 32] The present case series outcomes align with that reported by Sanz et al case series where they use a minimally invasive entire papillae preservation technique which is very close to the current suggested technique of S-PHT in keeping the papillae over the defect un-reflected. They reported 4.00 ± 0.63 mm pocket reduction, 3.67 ± 1.03 mm CAL gain and a mean radiographic intrabony filling of 2.41 ± 2.03 mm. 6 months following therapy. The present suggested technique of S-PHT more conservative way could explain the slightly higher level of improvement compared to Sanz et al study. [33]

The reported significant amount of graft retention over 9 months wither it is remodeled or not could be a factor in maintaining stability of the non-surgical therapy. In addition, flapless graft material retention below intact long junctional epithelium could hinder its apical proliferation giving more chance for regenerating tissues to replace the grafted material. Another finding that needs further investigations is the non-significant differences in the number of cases with complete defect fill with two or three osseous walls. This could raise a question if the intact soft tissue walls around the defect provided by flapless graft insertion could compensate for the lost bony walls? Composite outcome defined with pocket closure, CAL gain ≥ 3 mm in the absence of bleeding on probing was achieved in 6 sites out of the 10 cases evaluated. Composite outcome measures have been shown to be more predictive of long-term tooth stability and treatment success than individual clinical parameters. [30] These significant improvements in all parameters could through light on the synergistic effect of the 3 directions employed in S-PHT namely, MINST, flapless insertion of the graft material providing more defect stability and isolating the defect with a coronal long junctional epithelial seal with its mechanical and biological potentials.

Conclusions

Within the limitations of the present case series, we can conclude that, S-PHT could be a reliable patient friendly option in enhancing treatment outcomes of intrabony defects by keeping soft tissue support and the natural protection provided by an intact long junctional epithelium. Future controlled randomized clinical trials with large sample sizes and long follow-up

periods are warranted to validate the present findings. Further investigations combining S-PHT with different biologics or comparing it with minimally invasive surgical regenerative approaches may help clarify its regenerative potential and long-term stability. In addition, using specially designed minimally invasive bone applicators and Perioscope through the pinhole access of S-PHT to maximize atraumatic defect exploration and to ensure complete defect fill without over or underfilling needs to be investigated.

Declarations

Ethics approval and consent to participate

This study was conducted in accordance with the Declaration of Helsinki and was approved by the Research Ethics Committee of the Faculty of Dentistry, Al-Azhar University, Cairo, Egypt. All patients provided written informed consent to participate prior to enrollment.

Consent for publication

Written informed consent for publication of clinical and radiographic images was obtained from all patients included in this case series.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Authors' contributions

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Acknowledgements

Not applicable.

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Figures

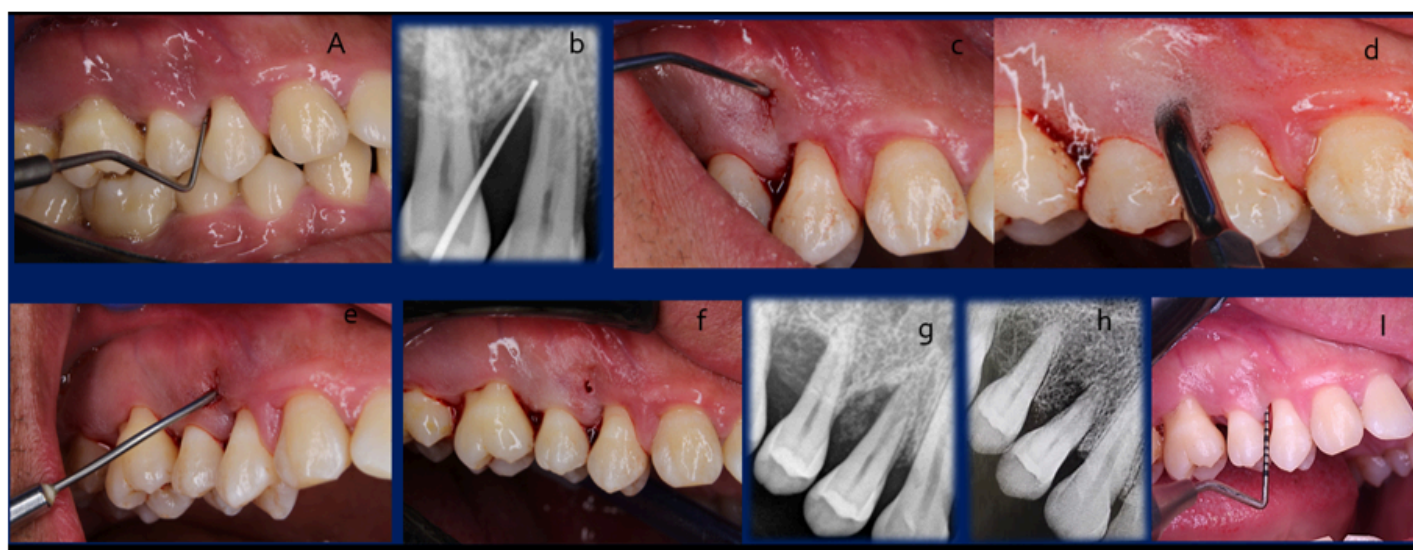


Figure 1

Bone sounding of 11 mm defect depth before therapy (a), 4 mm IBC depth (b), manual instrumentation through pinhole 7mm from the gingival margin (c), ultrasonic instrumentation (d), graft insertion through the pinhole (e), pinhole after grafting (f), radiographic photo immediately after graft insertion (g), radiographic photo 9 months after (h), probing depth 9 months after therapy (i).

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