Utilization of a periodontal endoscope in nonsurgical periodontal therapy: A randomized, split-mouth clinical trial

Article *in* The Journal of Periodontology · March 2023

DOI: 10.1002/JPER.22-0081

Pooja Maney
University of Texas Health Science Center at Houston

Received: 4 November 2022 | Revised: 25 January 2023 | Accepted: 20 February 2023

DOI: 10.1002/JPER.22-0081

JOURNAL OF Periodontology

HUMAN RANDOMIZED CONTROLLED TRIAL

Utilization of a periodontal endoscope in nonsurgical periodontal therapy: A randomized, split-mouth clinical trial

Hillary N. Wright[1] | **Elizabeth T. Mayer**[1] | **Thomas E. Lallier**[2] | **Pooja Maney**[3]

[1]Department of Periodontics, Louisiana State University Health New Orleans School of Dentistry, New Orleans, Louisiana, USA

[2]Department of Cell Biology and Anatomy, Louisiana State University Health New Orleans School of Medicine, New Orleans, Louisiana, USA

[3]Department of Periodontics and Dental Hygiene, University of Texas Health, Science Center at Houston School of Dentistry, Houston, Texas, USA

Correspondence
Pooja Maney, Department of Periodontics and Dental Hygiene, University of Texas Health Science Center at Houston School of Dentistry, 7500, Cambridge Street, Houston, TX 77054, USA.
Email: Pooja.Maney@uth.tmc.edu

Abstract

Background: The removal of subgingival calculus to obtain gingival health is an integral part of nonsurgical periodontal therapy. The periodontal endoscope is used by some clinicians to help enhance access to effectively remove subgingival calculus; however, longer-term studies on this subject are still lacking. The purpose of this randomized, controlled clinical trial was to compare the clinical outcomes of scaling and root planing (SRP) using a periodontal endoscope versus conventional SRP using loupes for up to 12 months, utilizing a split-mouth design.

Methods: Twenty-five patients were recruited who exhibited generalized stage II or stage III periodontitis. SRP was rendered by the same experienced hygienist using either a periodontal endoscope or conventional SRP using loupes, following random assignment of the left and right halves of the mouth. All periodontal evaluations were done by the same periodontal resident at baseline, and at 1, 3, 6, and 12 months after therapy.

Results: Single-rooted teeth interproximal sites displayed a significantly lower percentage of improved sites ($P < 0.05$) than multirooted teeth for probing depth and clinical attachment level (CAL). Maxillary multirooted interproximal sites favored the use of the periodontal endoscope at the 3- and 6-month time periods ($P = 0.017$ and 0.019, respectively) in terms of the percentage of sites with improved CAL. Mandibular multirooted interproximal sites showed more sites with improved CAL using conventional SRP than with the periodontal endoscope ($P < 0.05$).

Conclusion: Overall, the use of a periodontal endoscope was more beneficial in multirooted sites compared to single-rooted sites, specifically in maxillary multirooted sites.

KEYWORDS
nonsurgical periodontal therapy, periodontitis, scaling, subgingival

1 | INTRODUCTION

The primary etiologic factor for periodontal disease are bacterial biofilm (plaque) and dysbiosis. Calculus is considered a secondary etiologic factor, as it does not cause periodontal disease by itself, but rather harbors disease-causing bacteria.[1] Calculus formation is the result of calcification of dental plaque biofilm, with mineral ions provided by saliva or gingival crevicular fluid. There are four means of attachment of calculus to a root surface: acquired pellicle attachment, penetration of the calculus into the root surface cementum, mechanical interlocking into the calculus and/or tooth surface irregularities, and attachment to unaltered cementum.[2] Supragingival calculus perpetuates inflammation of the adjacent tissues resulting in gingivitis and subgingival calculus that is close to the periodontal pocket lining epithelium, promoting periodontitis.[3]

Calculus deposits are challenging to remove due to the mechanical interlocking on root surfaces as well as calculus embedding into root cementum. Subgingival scaling and root planing (SRP) is an integral part of nonsurgical periodontal therapy in order to remove bacterial plaque and calculus from diseased root surfaces. Removal of calculus is important in order to achieve a "biologically acceptable" tooth surface in the treatment of periodontitis.[1] Although complete calculus removal is not possible, especially in areas of anatomical complexity, a state of gingival health can still be achieved.[4] Conventional SRP is a closed approach, performed either with or without the use of loupe magnification. Removal techniques consist of conventional nonsurgical methods using curettes and/or different types of powered scalers. Nonsurgical therapy has its limitations with regard to the amount of calculus that clinicians are able to remove within a certain level of probing pocket depth. It has been demonstrated that both experienced and inexperienced operators leave calculus behind, especially in periodontal pockets of ≥4 mm.[1] Surgical intervention is the next step to gain better visibility and access. Residual calculus has been shown to be the greatest following SRP using a closed approach with no access flap and at the cementoenamel junction or in association with grooves, fossae, or furcations.[1] This study also showed that only 32% of calculus-free surfaces were obtained on teeth with pocket depths of >6 mm without access flap surgery and 50% calculus-free surfaces were obtained even with access flap surgery. Premolars and molars are more difficult to debride nonsurgically and more than 60% of molar sites can present with residual calculus.[5] Another study reported that more than 90% of cases had deposits of plaque and calculus remaining in sites with pocket depths greater than 5 mm after SRP.[6] These findings have led to the development of methods to enhance calculus visualization and removal. Being able to better visualize calculus in deeper pockets could potentially enhance the outcomes of nonsurgical periodontal therapy and reduce the need for surgical therapy. The use of a periodontal endoscope is one such approach that has been utilized by clinicians to enhance visibility.[7–11] Visibility with this technique is similar to surgical therapy but without the need for an access flap. The procedure involves the use of an endoscope that allows root magnification of 24× to 48× by a 0.99 mm fiber optic bundle that is a combination of a 10,000 pixel capture bundle surrounded by multiple illumination fibers.[7] The fiber is attached into the "explorer" that is placed into the gingival sulcus. The image is relayed to a screen that the user views as the explorer moves around the tooth while simultaneously conducting SRP with an ultrasonic scaler, thereby enhancing the ability to visualize pockets nonsurgically.

A few previous clinical studies have compared SRP with the adjunctive use of a periodontal endoscope to conventional SRP. A pilot study showed that use of a periodontal endoscope resulted in less bleeding on probing (BOP) and gingival inflammation (GI), but no difference was reported for other clinical parameters.[8] Better visualization of calculus on tooth surfaces has been reported with the use a periodontal endoscope when compared to a tactile explorer used traditionally to detect calculus.[9] Additionally, a higher percentage of residual calculus was found remaining on root surfaces following traditional SRP when compared to the use of a periodontal endoscope, when teeth extracted after treatment were analyzed.[10] Michaud et al. also reported less residual calculus using an endoscope in multirooted teeth extracted and analyzed immediately after treatment. However, these findings were significant only for interproximal pockets with <6 mm depth.[11] A split-mouth controlled clinical study evaluating SRP using a periodontal endoscope reported that sites with ≥6 mm probing depth (PD) in anterior teeth presented with significantly improved PD and clinical attachment levels (CAL) at the end of 3 months compared to the control group.[12] A systematic review included eight randomized controlled trials, four of which compared the ability to remove subgingival calculus by using a periodontal endoscope or traditional SRP on hopeless teeth.[13] The other four studies compared clinical outcomes of patients with periodontal disease treated by means of periodontal endoscopy or conventional SRP. The findings verified the additional benefit of using periodontal endoscopy for calculus removal, although the use of the periodontal endoscope was more time-consuming than conventional SRP. Comparison of clinical parameters, however, revealed no significant difference between using a periodontal endoscope and traditional SRP.[13] A more recent study, however, reported a slight clinical and radiographic benefit to the use of a periodontal endoscope in deeper pockets.[14] Although studies have demonstrated certain advantages with the use of a periodontal endoscope for SRP, there is still a further need for well-designed longer-term controlled clinical studies to establish these findings. Therefore, the aim of this study was to compare the longer-term (up to 12 months) clinical outcomes of SRP using a periodontal endoscope versus conventional SRP using loupes, utilizing a split-mouth design. Data analysis for this study was done utilizing a unique approach, using a number of sites in several categories including maxilla versus mandible, single-rooted versus multirooted, and facial/lingual versus interproximal.

2 | MATERIALS AND METHODS

2.1 | Study design

In this clinical study we utilized a prospective randomized single-blinded split-mouth design, in order to compare the results of SRP using a periodontal endoscope* versus conventional SRP using loupe magnification. Approval was obtained from the Louisiana State University Health New Orleans Institutional Review Board (IRB#9587, ClinicalTrials.gov Identifier: NCT05293301), which was secured in accordance with the Declaration of Helsinki of 1975, as revised in 2013. A total of twenty-five subjects were recruited in the study, between August 2018 and October 2019, from the Louisiana State University Health School of Dentistry postgraduate periodontics clinic. IRB-approved written informed consent was obtained from each participant by the provider (L.T.M.) prior to enrollment in the study.

2.2 | Periodontal Parameters

Study subjects underwent an initial comprehensive periodontal exam at baseline, performed by a single blinded examiner (H.N.W.). PD, free gingival margin (FGM), CAL, and BOP were recorded using a UNC 15 periodontal probe.

All measurements at post-SRP follow-up visits were made by the same blinded examiner (H.N.W.) as at baseline, at ~1, 3, 6 months, and 1 year. Primary outcome measures were the percentage of periodontal sites that improved for PD, CAL, and BOP following SRP, with the use of either conventional loupe magnification or a periodontal endoscope. Secondary outcome measures were the comparison of clinical measures of periodontal status of teeth (PD, CAL, and BOP) following SRP with the use of either conventional loupe magnification or using a periodontal endoscope. Following the first ~1 month recall appointment, patients were placed on regular 3 month recall periodontal maintenance.

2.3 | Participants

2.3.1 | Power and sample size calculation

The power for this split-mouth study was set at 0.90, with a significance of 0.05 to detect improvement in CAL of 1 mm or greater with a standard deviation of 15% between the groups (σ), using the Wilcoxon rank sum test. Based on these calculations, we required 2928 sites for analysis. With six sites per tooth, and 90% of expected 28 teeth per subject, this indicated that we required 20 subjects for the analysis. An increased sample size of 25 was used to compensate for dropouts.

2.3.2 | Inclusion and exclusion criteria

Subjects included were 18 years of age or older, in good general health, with a diagnosis of generalized stage II or stage III periodontitis as per the 2017 World Workshop classification,[15] required whole mouth SRP, with a maximum of 6 mm PD at any site and with at least one molar in each arch, excluding third molars.

Exclusion criteria included any requirement for antibiotic premedication prior to dental treatment, uncontrolled hypertension, uncontrolled diabetes, unwillingness to sign the informed consent, or the need for any antibiotic intervention for unrelated conditions.

2.4 | Randomization and allocation concealment

All subjects were de-identified and numbered from 001 to 025. After subject consent, each subject's right and left sides of the mouth were randomly assigned by a coin toss to receive one of the two treatment modalities: SRP using conventional loupe magnification or SRP using a periodontal endoscope (see Figure S1 in the online *Journal of Periodontology*). Treatment allocations were concealed, documented electronically, and were accessible only to the treatment therapist (L.T.M.).

2.5 | Interventions

SRP for each patient was completed in two sessions by a single experienced dental hygienist (L.T.M.) who was trained in the use of a periodontal endoscope. Training was conducted by a consultant hygienist contracted by

* Perioscopy®, Zest Dental Solutions®, Carlsbad, CA

the manufacturer. This was accomplished by live patient demonstrations as well as hands-on training. Since the use of a periodontal endoscope is associated with a learning curve, the study hygienist (L.T.M.) practiced on typodonts and then utilized the periodontal endoscope for SRP on 10 live patients, prior to beginning the study. All patients received local anesthesia prior to treatment (appropriate local infiltrations and/or nerve block injections were given using 2% lidocaine with 1:1,00,000 epinephrine).

2.5.1 | Conventional SRP using loupes magnification

SRP was performed on the randomly selected sides using an ultrasonic scaler[†] and Gracey curettes[‡] 1/2, 11/12, 13/14, 15/16, 17/18 for supra- and sub-gingival debridement, using enhanced visualization by conventional loupes with 2.5 magnification and a headlamp. Calculus removal and smooth surfaces were checked for by the provider (L.T.M.) using a 11/12 explorer. Oral hygiene instructions for continuing homecare were also provided.

2.5.2 | SRP using a periodontal endoscope

SRP was done on the randomly selected sides using only ultrasonic instruments (per recommended protocol during use of the periodontal endoscope) for supra- and sub-gingival debridement, using enhanced visualization via a periodontal endoscope (see Figure S1 in the online *Journal of Periodontology*). Calculus removal and smooth surfaces were checked for by the provider (L.T.M.) using an 11/12 explorer. Oral hygiene instructions for continuing homecare were also provided.

Oral hygiene instructions were specific to each patient. In general, patients were instructed to use the modified Bass technique for brushing twice daily and interproximal cleaning aids once daily (floss with or without the use of interproximal brushes).

2.6 | Data analysis

We analyzed our data on the basis of the number of sites, rather than on individual patients or average clinical parameters measured. Since each tooth could have six possible sites, and patients varied in their number of missing teeth (i.e., with no sites), this was the most appropriate approach for analysis of our data. For each site, at each time point, the improvements of specific clinical parameters (PD, CAL, FGM, and BOP) were evaluated. Due to the prevalence of missing teeth, all sites on those teeth were omitted from further analysis. Sites were divided into several categories including maxilla versus mandible, single-rooted versus multirooted, facial/lingual versus interproximal. All anterior teeth and premolars were categorized as single-rooted teeth. Sites were evaluated for the presence/absence of improvements and compared statistically using the Wilcoxon rank sum test and Student's *t*-test, with a P value of < 0.05 being considered as statistically significant. The Shapiro–Wilk test was initially used to evaluate the normal distribution of data.

3 | RESULTS

Twenty-five subjects were initially recruited (36% male, 64% female) with a mean age of 42.7 years (see Table S1 in the online *Journal of Periodontology*). Twenty-three subjects completed the 1 and 3 month follow-ups, while 19 and 11 subjects completed the 6 and 12 month follow-ups, respectively (Figure 1, Table S2 in the online *Journal of Periodontology*). Of a possible 3864 sites, we examined 3573 sites at the 3 month follow-up appointment, 2912 sites at the 6 month follow-up, and 1794 sites at the 12 month follow-up (see Table S2 in the online *Journal of Periodontology*). Since patients were randomly assigned to study groups for periodontal endoscope-aided SRP on either the right or left sides of their mouths, this could have resulted in an imbalance of sites examined in one group or another. However, 14% of the sites were examined on multirooted teeth for both study groups, while 36% of the sites were examined on single-rooted teeth for both study groups, resulting in no statistical bias in either group (see Table S3 in the online *Journal of Periodontology*).

For this study, we mainly focused on periodontally involved teeth (defined as having PDs of greater than 3 mm on their initial visit with corresponding bone loss). All further analysis was performed only on these 1267 periodontally involved sites, which were evenly distributed between the conventional SRP and periodontal endoscope-aided SRP study groups (Table 1). This analysis also revealed that ∼25% of single-rooted teeth sites were periodontally involved, while ∼62% of multirooted teeth sites were periodontally involved. Furthermore, ∼80% of the sites were periodontally involved for interproximal regions of multirooted teeth, while facial/lingual sites on these teeth or any sites on single-rooted teeth were significantly less likely to be periodontally involved (15% to 32%, Table 1). Despite the smaller numbers of teeth involved when comparing maxillary and mandibular teeth, all groups had over 100 periodontally involved sites and displayed

[†] Cavitron Plus with FSI 1000 Insert, Dentsply Sirona, Charlotte, NC
[‡] Hu-Friedy, Chicago, IL

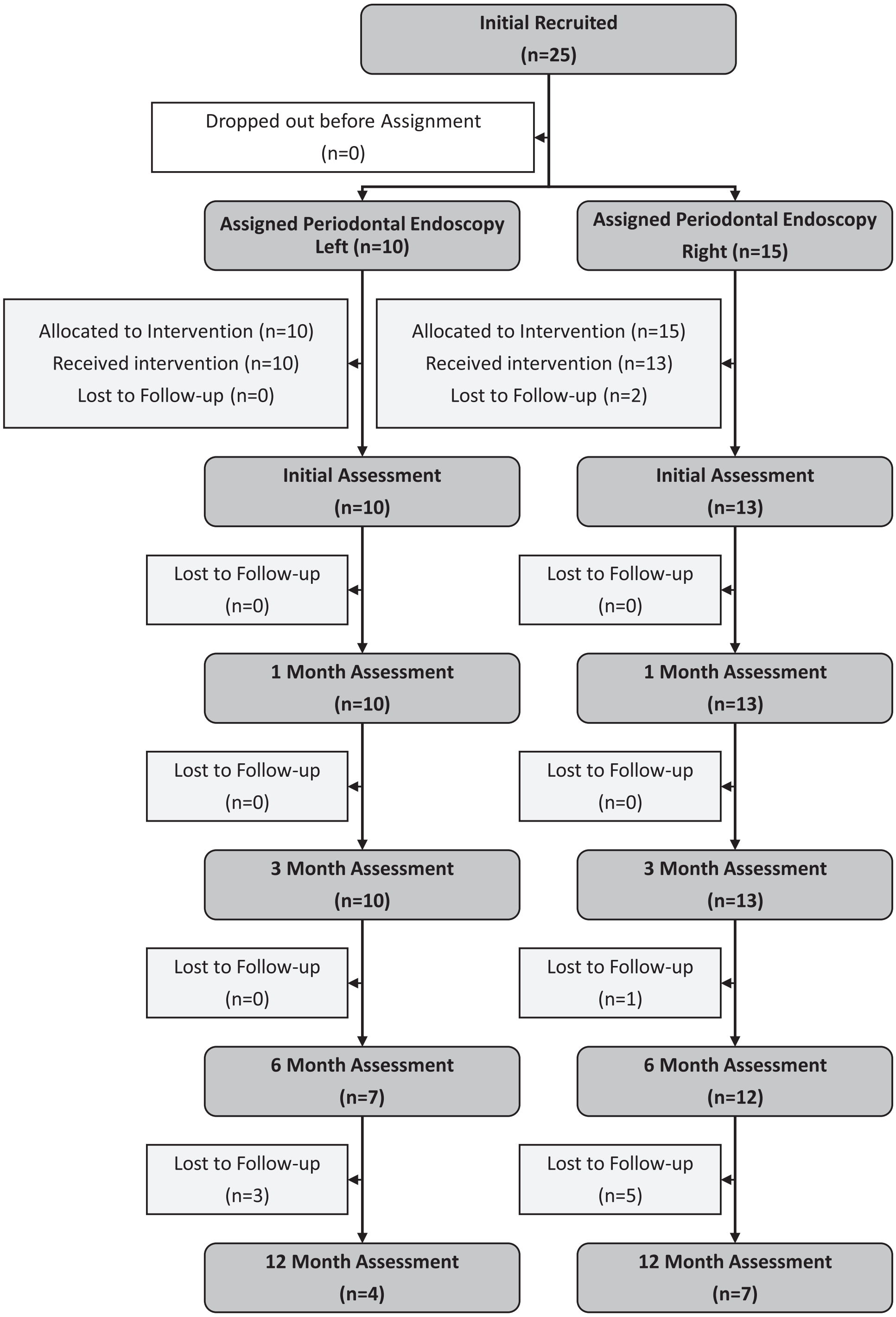

FIGURE 1 Study intervention flowchart.

similar percentages of interproximal involved sites (77% to 81%, Table 1).

3.1 | All sites

Overall, when clinical parameters from all teeth were considered, the percentage of sites that displayed improvement were very similar between those treated with conventional SRP and those treated using a periodontal endoscope (Figure 2). Single-rooted teeth displayed a significantly lower percentage of improved sites ($P < 0.05$, see Table S4 in the online *Journal of Periodontology*) than multi-rooted teeth for PD (Figure 2A), CAL (Figure 2B), and BOP (Figure 2D). However, there was no significant difference for improved sites between those teeth treated

TABLE 1 Periodontally involved sites (> 3 mm PD).

	CON	PE	Total	CON%	PE%
MR sites	308	296		62%	61%
1R sites	325	338		25%	26%
Total	**633**	**634**	**1267**		
MR-IP	259	257		78%	80%
MR-F/L	49	39		30%	24%
1R-IP	244	272		28%	32%
1R-F/L	81	66		19%	15%
Total	**633**	**634**	**1267**		
MaxMR-IP	119	132		79%	77%
MandMR-IP	140	125		81%	78%
1R-IP	244	272		29%	32%
Total	**503**	**529**	**1032**		

Abbreviations: 1R, single-rooted; CON, conventional scaling and root planing; F/L, facial/lingual; IP, interproximal; Mand, mandibular; Max, maxillary; MR, multirooted; PE, periodontal endoscopy-assisted scaling and root planing.

with conventional SRP or those treated using a periodontal endoscope ($P > 0.05$, see Table S4 in the online *Journal of Periodontology*). Measurements of the FGM displayed no significant differences between any of the groups examined (Figure 2C).

3.2 | All facial and lingual sites

When clinical parameters from the facial/lingual surfaces of all teeth were considered, the percentage of sites that displayed improvement were very similar between those treated with traditional SRP and those treated using a periodontal endoscope (Figure 3). Single-rooted teeth displayed a significantly lower percentage of improved sites ($P < 0.05$, see Table S4 in the online *Journal of Periodontology*) than multirooted teeth for PD (Figure 3A) and CAL (Figure 3C), but not for FGM (Figure 3E) or BOP (Figure 3G). There was no significant difference between sites treated with conventional SRP and those treated using a periodontal endoscope ($P > 0.05$, see Table S4 in the online *Journal of Periodontology*). In general, the difference observed between single-rooted teeth and multirooted teeth was less for the facial/lingual surface sites.

3.3 | All interproximal sites

When interproximal sites of all teeth were considered, the percentage of sites that displayed improvement were very similar between those treated with traditional SRP and those treated using a periodontal endoscope (Figure 3).

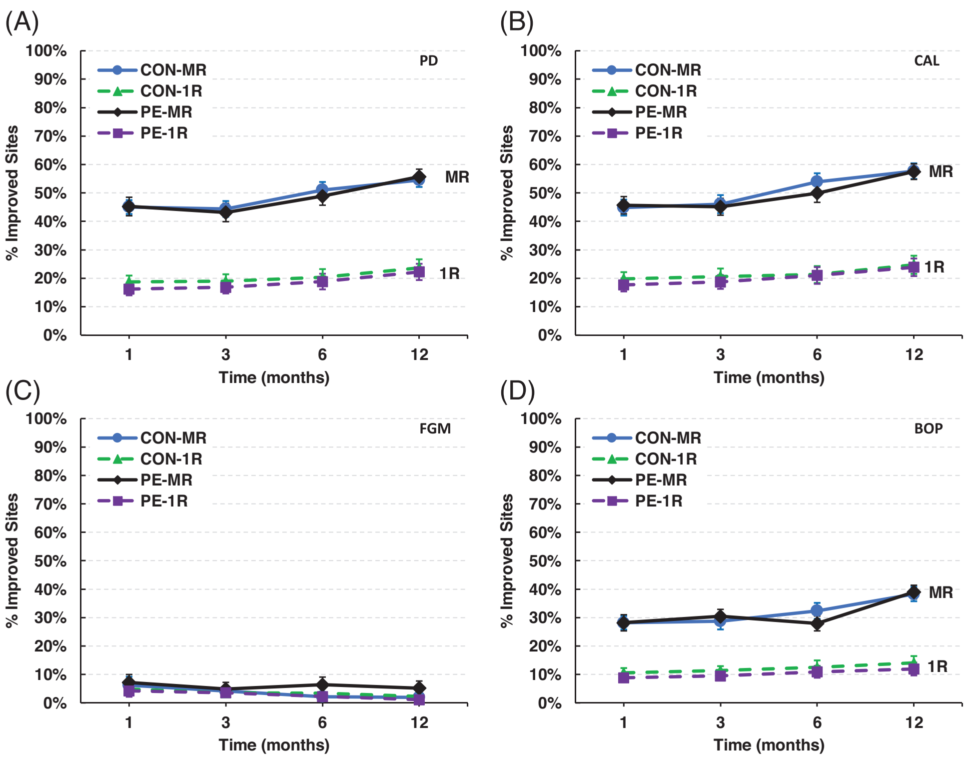

FIGURE 2 Comparison of single-rooted (1R) versus multirooted (MR) teeth at all sites following conventional (CON) scaling and root planing (SRP) and SRP using periodontal endoscopy (PE). Points represent the mean and standard deviation of measurements from subjects at 1, 3, 6, and 12 months posttreatment. (A) Probing depth (PD). (B) Clinical attachment level (CAL). (C) Free gingival margin (FGM). (D) Bleeding on probing (BOP).

JOURNAL OF Periodontology

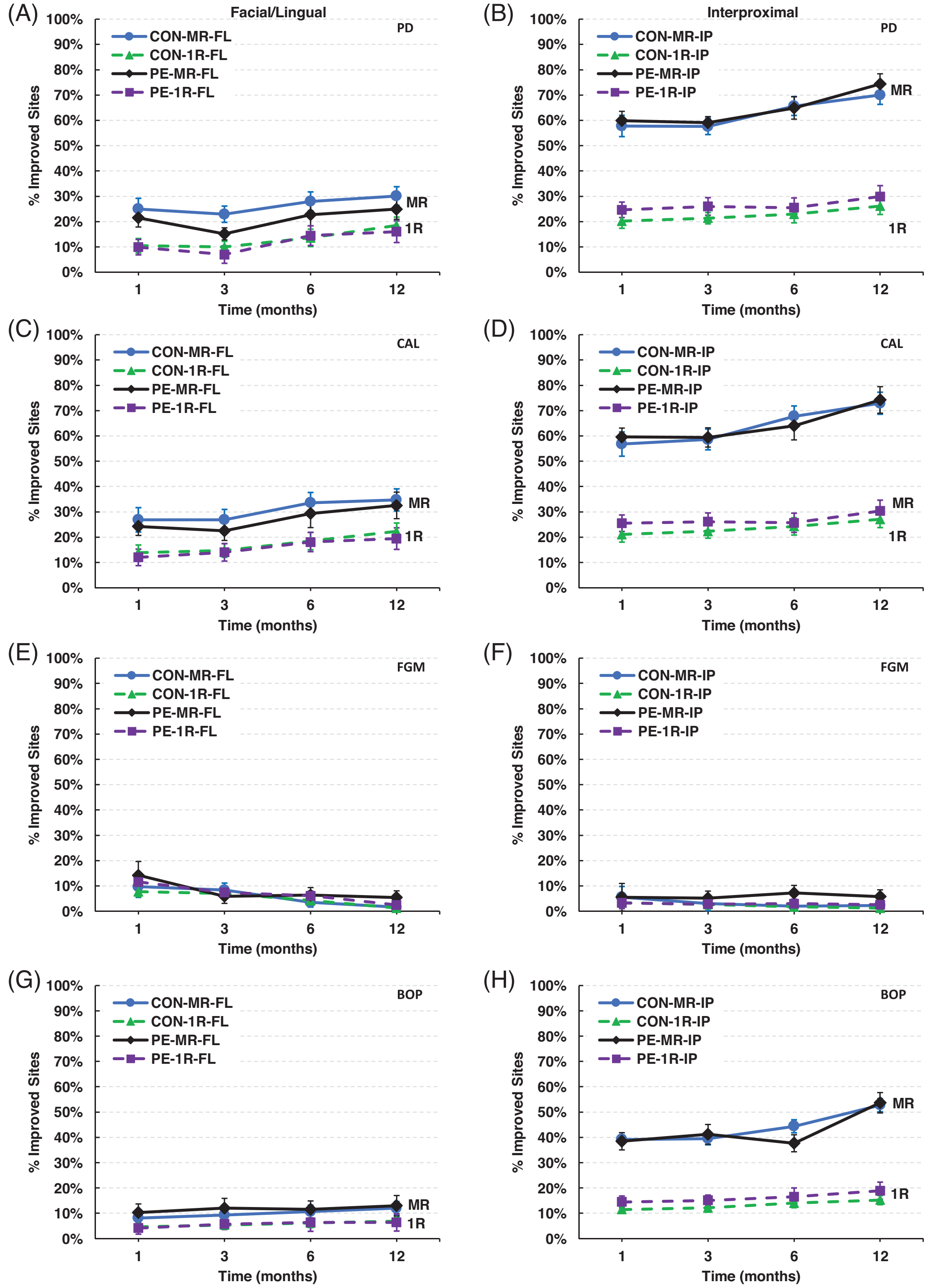

FIGURE 3 Comparison of facial/lingual (FL) and interproximal (IP) sites of single-rooted (1R) versus multirooted (MR) teeth following conventional (CON) scaling and root planing (SRP) and SRP using periodontal endoscopy (PE). Points represent the mean and standard deviation of measurements from subjects at 1, 3, 6, and 12 months posttreatment. (A,B) Probing depth (PD). (C,D) Clinical attachment level (CAL). (E,F) Free gingival margin (FGM). (G,H) Bleeding on probing (BOP).

Single-rooted teeth displayed a significantly lower percentage of improved sites ($P < 0.05$, see Table S4 in the online *Journal of Periodontology*) than multirooted teeth for PD (Figure 3B) and CAL (Figure 3D), but not for FGM (Figure 3F) or BOP (Figure 3H). Again, there was no significant difference between those teeth treated with conventional SRP and those treated using a periodontal endoscope ($P > 0.05$, see Table S4 in the online *Journal of Periodontology*). In general, the difference observed between single-rooted teeth and multirooted teeth for interproximal sites was greater than that for facial/lingual surface sites.

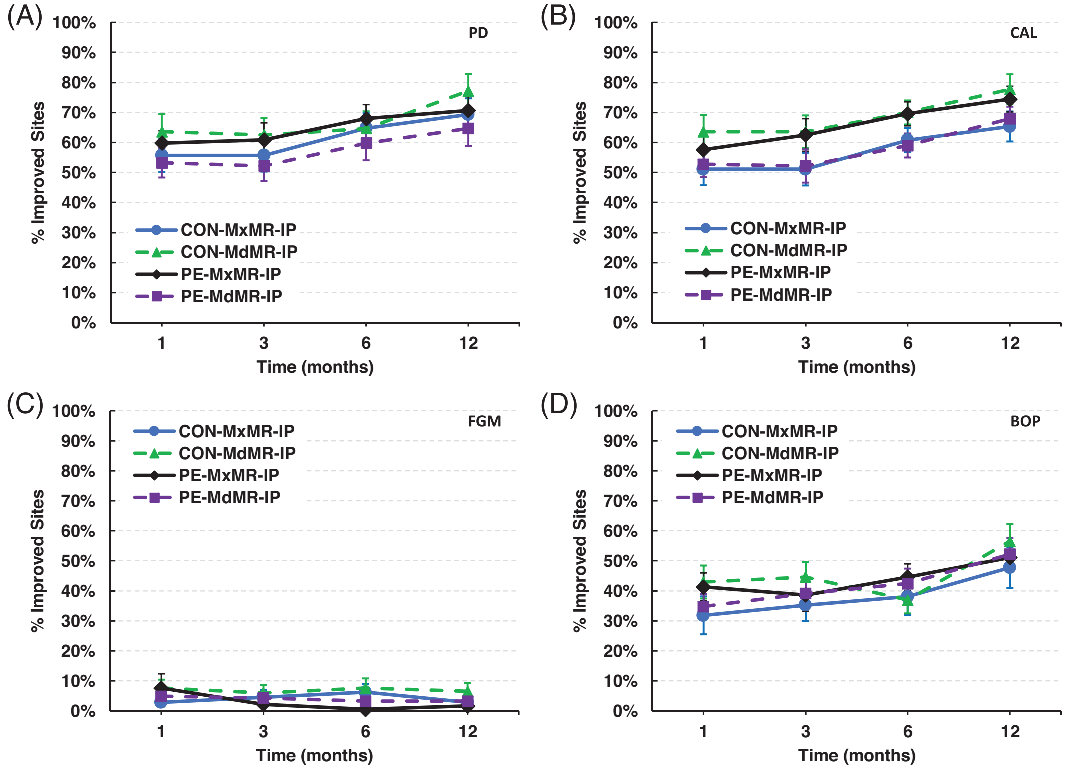

FIGURE 4 Comparison of interproximal (IP) surfaces on maxillary multirooted (MxMR) versus mandibular multirooted (MdMR) teeth following conventional (CON) scaling and root planing (SRP) and SRP using periodontal endoscopy (PE). Points represent the mean and standard deviation of measurements from subjects at 1, 3, 6, and 12 months posttreatment. (A) Probing depth (PD). (B) Clinical attachment level (CAL). (C) Free gingival margin (FGM). (D) Bleeding on probing (BOP).

3.4 | Multirooted interproximal sites

When clinical parameters from the interproximal sites were segregated into maxillary multirooted teeth and mandibular multirooted teeth, the percentage of sites that displayed improvement were very similar between those treated with conventional SRP and those treated using a periodontal endoscope (Figure 4). Interproximal sites of multirooted teeth displayed no difference in improvement between the mandible and the maxilla for PD (Figure 4A), FGM (Figure 4C), or BOP (Figure 4D). However, analysis of CAL (Figure 4B) revealed some interesting trends. When the CAL in interproximal sites of multirooted teeth were compared, significant differences were observed (Figure 5). Specifically, with the use of the periodontal endoscope on the maxilla, significantly increased numbers of sites with improved CAL at 3 and 6 months ($P < 0.05$, see Table S4 in the online *Journal of Periodontology*) were noted, with a general increase in CAL for 10% more of the sites examined (Figure 5A). In contrast, use of traditional SRP on the mandible significantly improved the percentage of sites with increased CAL at 1, 3, 6, and 12 months ($P < 0.05$, see Table S4 in the online *Journal of Periodontology*), with a general increase in CAL for 10% more of the sites examined (Figure 5B). Thus, the use of a periodontal endoscope as an aid for conventional SRP had its greatest effect on the interproximal sites of maxillary multirooted teeth.

3.5 | Single-rooted interproximal sites

When clinical parameters from the interproximal sites of single-rooted teeth were considered, the percentage of sites that displayed improvement were very similar between those treated with conventional SRP and those treated using a periodontal endoscope (see Figure S2 in the online *Journal of Periodontology*) for all the measurements evaluated, including PD (see Figure S2A in the online *Journal of Periodontology*), CAL (see Figure S2B in online Journal of Periodontology), FGM (see Figure S2C in online Journal of Periodontology), and BOP (see Figure S2D in the online *Journal of Periodontology*). There was no significant difference between those teeth treated with conventional SRP and those treated using a periodontal endoscope ($P > 0.05$, see Table S4 in the online *Journal of Periodontology*).

JOURNAL OF Periodontology

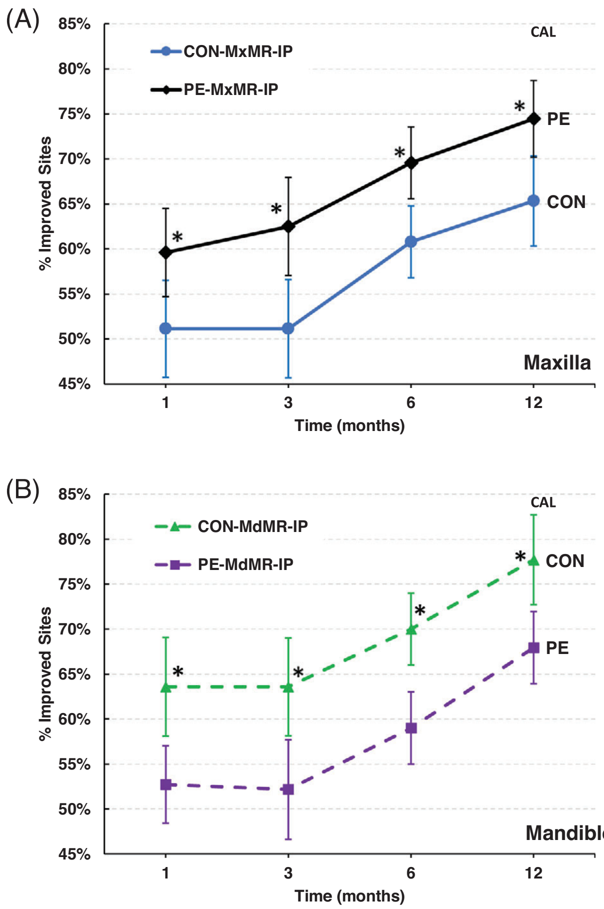

FIGURE 5 Comparison of clinical attachment level (CAL) at interproximal (IP) sites following conventional (CON) scaling and root planing (SRP) and SRP using periodontal endoscopy (PE). Points represent the mean and standard deviation of measurements from subjects at 1, 3, 6, and 12 months posttreatment. (A) Maxillary multirooted (MxMR) teeth. (B) Mandibular multirooted (MdMR) teeth. *$P < 0.05$.

4 | DISCUSSION

This study compared the use of conventional SRP using loupe magnification with periodontal endoscope-assisted SRP in generalized stage II and stage III periodontitis patients. We evaluated the percentage of improved sites, which is a different approach from previous similar studies. Moreover, we focused on the evaluation of only diseased sites and of those sites, only improved sites were evaluated. This focused analytical approach was used because, by comparing overall average values of clinical parameters, true changes may get diluted and therefore may not be accurately represented.

A systematic review evaluated eight articles that revealed no significant differences in terms of clinical parameters (PD, BOP, GI). However, less residual calculus was detected with the use of the periodontal endoscope.[13] Our overall results demonstrated that multirooted sites showed greater improvements in clinical parameters, regardless of the use of a periodontal endoscope. This finding can be attributed to multirooted sites having more sites with >3 mm PD compared to single-rooted teeth in our study population, which is usually a general finding as well. Single-rooted teeth showed little to no change in terms of all clinical parameters, which is again due to fewer single-rooted sites that had >3 mm PD in our patient population.

Periodontal endoscope-assisted SRP resulted in a significant increase in the percentage of sites with improved CAL in maxillary multirooted interproximal sites at the 3 and 6 month time periods in comparison to traditional SRP. In contrast, conventional SRP showed a significant increase in the percentage of sites with improved CAL compared to periodontal endoscope-assisted SRP in mandibular multirooted interproximal sites at the 1, 3, 6, and 12 month evaluations. This trend may be related to better accessibility conditions for maxillary posterior teeth when using a periodontal endoscope, when compared to mandibular posterior teeth. A personal observation reported by the hygienist performing all treatments was that maxillary posterior sites were easier to clean with the use of a periodontal endoscope. This observation is likely due to a lack of anatomical obstructions (mainly the tongue and increased salivary flow) in the maxilla, better facilitating the use of a periodontal endoscope, which requires more instrumentation at a given site. The periodontal endoscope method requires both the insert (shield + fiber optic bundle) and the ultrasonic tip in the gingival sulcus, as opposed to traditional SRP requiring only either the hand instrument or ultrasonic tip in the sulcus. Based on a previous study, the use of the periodontal endoscope outperformed the use of a traditional explorer for calculus detection.[9] Therefore, when the clinician is able to use it optimally, it is understandable that the use of a periodontal endoscope can improve the clinician's ability to remove calculus with better visualization and detection. However, even with the use of enhanced visualization techniques, complete calculus removal is not achievable, especially on teeth with a complex anatomy. Despite this, nonsurgical treatment can still result in a state of periodontal health. Some disadvantages of periodontal endoscopy were recently reported by Graetz et al.[16] Disadvantages include the requirement for special training and equipment, an association with a learning curve, and the requirement for additional treatment time, which could result in a higher cost to the patient.

The systematic review by Kuang et al. discusses the need for longer evaluation duration studies to explore the effects of periodontal endoscopy on clinical parameters.[13] Blue et al., from their randomized split-mouth study, reported a significant reduction in measures of periodontal inflammation associated with the use of a periodontal endoscope up to 3 months.[8] A similar randomized split-mouth study by Liao et al. reported significantly lower PD in the periodontal endoscope group in anterior teeth with a PD of ≥6 mm at 3 months, compared to the control group.[12] Graetz et al. recently reported no differences in outcomes with and without the use of the periodontal endoscope at 4 months in their split-mouth randomized controlled study.[16] We report the results of nonsurgical periodontal therapy with or without the use of a periodontal endoscope in both anterior and posterior teeth for up to 1 year, which is a longer time period than reported by the aforementioned studies. However, we were limited by the sample size in our study, especially at 12 months. Therefore, there is still a need for more randomized clinical trials with larger sample sizes and long-term follow-ups.

4.1 | Study limitations

At the 6 and 12 month time periods, we had a decline in sample size as some patients were lost to follow-up, which is a possible explanation for the significance of the 3 and 6 month results in maxillary interproximal sites not being sustained at 12 months. This sample size decline at 6 and 12 months was largely due to the COVID-19 pandemic, which made recall intervals impossible to fulfill. This unfortunately limited our overall study numbers, which can affect data interpretation and transferability of results. Additionally, compliance with periodontal maintenance recall appointments are crucial to the overall success of therapy, which was again a limitation posed by the number of subjects who failed to comply with follow-up appointments.

5 | CONCLUSION

Within the limitations of this study, greater improvement was seen with the use of a periodontal endoscope for nonsurgical periodontal therapy in multirooted interproximal maxillary sites compared to single-rooted sites. However, these results should be interpreted with caution due to the large subject drop-out rate, especially at 12 months.

AUTHOR CONTRIBUTIONS

All authors have made substantial contributions to conception and design of the study. Hillary N. Wright and Elizabeth T. Mayer were involved in recruitment and data collection. Thomas E. Lallier and Pooja Maney were involved in data analysis. Pooja Maney, Thomas E. Lallier, Hillary N. Wright, and Elizabeth T. Mayer were involved in interpretation, drafting the manuscript, and revising it critically, and have given final approval of the version to be published.

ACKNOWLEDGMENTS

The authors would like to acknowledge Dr. Angela Palaiologou-Gallis (University of Texas Health San Antonio School of Dentistry, Department of Periodontics) for her contribution and guidance towards the development of this study protocol. The periodontal endoscope unit used for this study was donated by Zest Dental Solutions, Carlsbad, CA.

CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

REFERENCES

1. Caffesse RG, Sweeney PL, Smith BA. Scaling and root planing with and without periodontal flap surgery. *J Clin Periodontol*. 1986;13(3):205-210.
2. Selvig K. Attachment of plaque and calculus to tooth surfaces. *J Periodontal Res*. 1970;5(1):8-18.
3. Friskopp J, Hammarstrom L. A comparative scanning electron microscopic study of supragingival and sub gingival calculus. *J Periodontol*. 1980;51(10):553-562.
4. Laleman I, Cortellini S, De Winter S, et al. Subgingival debridement: end point, methods and how often? *Periodontol 2000*. 2017;75(1):189-204.
5. Buchanan SA, Robertson PB. Calculus removal by scaling/root planing with or without surgical access. *J Periodontol*. 1987;58(3):159-163.
6. Waerhaug J. Healing of the dento-epithelial junction following subgingival plaque control. II: as observed on extracted teeth. *J Periodontol*. 1978;49(3):119-134.
7. Kwan JY. Micro ultrasonic periodontal endoscopy. *Contemporary Oral Hygiene*. 2006:50-58.
8. Blue CM, Lenton P, Lunos S, Poppe K, Osborn J. A pilot study comparing the outcome of scaling/root planing with and without Perioscope technology. *J Dent Hyg*. 2013;87(3):152-157.
9. Osborn JB, Lenton PA, Lunos SA, Blue CM. Endoscopic vs. tactile evaluation of subgingival calculus. *J Dent Hyg*. 2014;88(4):229-236.
10. Geisinger ML, Mealey BL, Schoolfield J, et al. The effectiveness of subgingival scaling and root planing: an evaluation of therapy with and without the use of the periodontal endoscope. *J Periodontol*. 2007;78(1):22-28.
11. Michaud RM, Schoolfield J, Mellonig JT, Mealey BL. The efficacy of subgingival calculus removal with endoscopy-aided scaling and root planing: a study on multirooted teeth. *J Periodontol*. 2007;78(12):2238-2245.
12. Liao YT, Liu Y, Jiang Y, Ouyang XY, He L, An N. A clinical evaluation of periodontal treatment effect using periodontal endoscope for patients with periodontitis: a split-mouth controlled study. *Zhonghua Kou Qiang Yi Xue Za Zhi*. 2016;51(12):722-727.

13. Kuang Y, Hu B, Chen J, et al. Effects of periodontal endoscopy on the treatment of periodontitis: a systematic review and meta-analysis. *J Am Dent Assoc*. 2017;148(10):750-759.
14. Naicker M, Ngo LH, Rosenberg AJ, Darby IB. The effectiveness of using the perioscope as an adjunct to non-surgical periodontal therapy: clinical and radiographic results. *J Periodontol*. 2022;93(1):20-30.
15. Caton JG, Armitage G, Berglundh T, et al. A new classification scheme for periodontal and peri-implant diseases and conditions – introduction and key changes from the 1999 classification. *J Periodontol*. 2018;89:S1-S8. Suppl 1.
16. Graetz C, Sentker J, Cyris M, et al. Effects of periodontal endoscopy-assisted nonsurgical treatment of periodontitis: four-month results of a randomized controlled split-mouth pilot study. *Int J Dent*. 2022;2022:9511492.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Wright HN, Mayer ET, Lallier TE, Maney P. Utilization of a periodontal endoscope in nonsurgical periodontal therapy: A randomized, split-mouth clinical trial. *J Periodontol*. 2023;1-11. https://doi.org/10.1002/JPER.22-0081