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Efficacy of Minimally Invasive Non-Surgical Therapy (MINST) in Managing Stage III/IV Periodontitis: A Systematic Review of Randomized Controlled Trials

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Keywords

Minimally invasive surgical procedure, non-surgical therapy, periodontal pocket, periodontitis, root planning

Abstract

Introduction: Minimally invasive non-surgical therapy (MINST) was introduced as an alternative approach in the management of periodontitis. This technique uses a combination of mini/micro instruments with magnification loupes or microscopes for optimal root debridement without flap elevation. This systematic review of randomized controlled trials (RCTs) evaluates the efficacy of MINST in managing Stage III/IV periodontitis. Methods: A review protocol was created according to Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines. Although the PRISMA guideline was followed, this review protocol was not registered in PROSPERO. Online search was conducted on three databases, PubMed, EMBASE, and Google Scholar to find articles published in English from 2013 up to June 2023. Only RCTs using MINST as an intervention were included. Results: Out of 129 studies, 6 RCTs involving a total of 223 patients met the criteria. The included studies then divided into 3 groups based on intervention comparisons; MINST vs minimally invasive surgical treatment (MIST), MINST with/without adjunct material, and MINST vs conventional non-surgical periodontal therapy (CNST). Minimally invasive non-surgical therapy (MINST) showed comparable efficacy to MIST in the treatment of single intrabony defects with significant probing depth (PD) reduction and clinical attachment level (CAL) gain. After one session of full-mouth MINST, a minimal residual pocket was achieved, and the use of adjunct materials effectively enhanced the treatment outcome. Conclusion: Moderate evidence supports MINST as an effective and minimally traumatic approach for managing advanced periodontitis, offering comparable clinical outcomes to surgical therapy. Further high-quality trials with long-term follow-up are recommended.

Introduction

Periodontitis is a multifactorial chronic inflammatory disease caused by plaque biofilm dysbiosis and characterized by the progressive destruction of tooth-supporting tissues (1–3). It is classified into four different stages (I–IV) based on disease severity and into three grades (A–C) based on its progressivity (2,3) The 2023 EFP S3 guideline has been incorporated to support this classification and provide evidence-based recommendations for treatment planning.

The main goal of periodontitis treatment is to achieve adequate infection control by lowering the bacterial load below the inflammatory/disease threshold level (3). This can be achieved by oral hygiene instruction and non-surgical periodontal therapy as well as surgical therapy, especially in advanced cases. However, synthesis of evidence from randomized controlled trials remains limited in guiding optimal non-surgical approaches, particularly for advanced cases (4) non-surgical periodontal therapy aims to eliminate periodontal inflammation, reduce pocket depth through mechanical disruption, and remove subgingival biofilm using hand instruments and/or ultrasonic or sonic instruments (3,5) This approach reduces the risk of further disease progression. However, in some cases with deep periodontal pockets or furcation involvement, mechanical elimination of subgingival biofilm is difficult and often incomplete (5). Particularly for advanced cases such as stage III and IV an adjunctive therapy might be needed. Recent studies have explored the effectiveness of systemic antibiotics and regenerative techniques in conjunction with non-surgical periodontal therapy to achieve better outcomes. A case report by Rafiei, et al. (6) showed the successful application of regenerative procedures in managing advanced periodontitis, underlining the importance of early diagnosis and long-term maintenance in preventing more damage. Another emerging adjunct in periodontal therapy is the use of probiotics. Tricoly, et al. (7), conclude a systematic review on the use of Lactobacillus reuteri as an adjuvant to non-surgical periodontal treatment, conducted that probiotics could enhance the reduction of bleeding on probing and probing depth.

Minimally Invasive Non-Surgical Therapy (MINST) has emerged as an effective treatment approach that focuses on the thorough mechanical debridement of subgingival biofilm with minimal tissue trauma. This technique uses a combination of mini- and micro-instruments with magnification loupes or microscopes to eliminate subgingival biofilm (8,9). Multiple studies have shown that MINST can be a viable treatment option for deep periodontal pockets, based on clinical, microbiological, and histological evidence (8,10). Minimally invasive non-surgical therapy (MINST), compared to conventional non-surgical treatment, has shown better treatment outcomes for intrabony defects, notably a reduction in probing depth (PD), clinical attachment level (CAL) gain, and greater radiographic bone fill (11,12). In addition, MINST is effective in reducing post- operative morbidity and discomfort, achieving minimal recession, and improving patient-reported outcomes (13).

The aim of this systematic review was to evaluate the effectiveness of MINST in the treatment of periodontitis especially stage III/IV based on data from existing randomized controlled trials (RCTs).

Materials and methods

This systematic review was reported based on the PRISMA statement (Preferred Reporting Items for Systematic Reviews and Meta-Analysis). Although the PRISMA guideline was followed, this review protocol was not registered in PROSPERO.

Focused Question

The research questions for the literature search are based on the PICOS methods: population (P), intervention (I), compare (C), and outcome (O), which are explained as follows:

P	:	Healthy adult patients have been diagnosed with either stage III/IV periodontitis, according to the AAP/EFP 2017 classification, or chronic periodontitis with a PD of less than 5 mm (with or without an intrabony defect).
I	:	Minimally invasive non-surgical therapy (MINST), either with or without the combination of other adjunct materials.
C	:	All types of intervention comparisons suggested in the included randomized controlled trials (RCTs)
O	:	Probing depth (PD), clinical attachment level (CAL), gingival recession (REC), and radiographic bone fill

Therefore, the focus question for this systematic review was "In healthy adult patients with stage III/IV periodontitis or chronic periodontitis with PD ≥ 5 mm, what is the effectiveness of minimally invasive non-surgical therapy (MINST) on periodontal parameters such as probing depth (PPD), clinical attachment level (CAL), gingival recession (REC), and radiographic bone fill?"

Selection Criteria

Eligible studies were included if they met the following criteria:

- Randomized controlled clinical trials (RCTs)
- Patients with stage III/IV periodontitis or chronic periodontitis with PD ≥ 5 mm (with or without intrabony defect) who will be treated with MINST and compared with other types of intervention
- At least 1-month follow-up after the procedure
- PD, CAL, REC, and radiographic bone fill data were available
- Published in English language within the past 10 years

Studies that did not meet the inclusion criteria were excluded along with other exclusion criteria:

- Animal studies
- in vitro and in vivo studies
- studies with irrelevant data results

Search Strategies

Electronic searches were conducted on three databases: Google Scholar, PubMed, and EMBASE using a structured Boolean strategy. Full search strings for each database are presented in Table 1 to ensure transparency and reproducibility. Only peer-reviewed, English-language RCTs published between 2013 and June 2023 were included, and grey literature was excluded.

Table 1. Search Strategies.

Google Scholar	("Minimally invasive non surgical therapy" OR "MINST") AND ("periodontitis" OR "deep periodontal pocket" OR "intrabony defects") AND ("periodontal regeneration" OR "clinical outcomes" OR "radiograph")
PubMed	("Minimally invasive non surgical therapy" OR "MINST" OR "flapless approach") AND ("periodontitis" OR "deep periodontal pocket" OR "intrabony defects") AND ("periodontal regeneration" OR "clinical outcomes" OR "radiograph")
EMBASE	('minimally invasive non surgical therapy' OR 'minst' OR 'flapless approach') AND ('periodontitis'/exp OR 'periodontitis' OR 'deep periodontal pocket' OR 'intrabony defects') AND ('periodontal regeneration'/exp OR 'periodontal regeneration' OR 'clinical outcomes' OR 'radiograph'/exp OR 'radiograph')

Study selection and data collection process

After duplicate' removal, the authors performed manual and independent screening of titles and abstracts. Eligibility process was then conducted on the full text articles to make a selection of studies that met the inclusion criteria. Disagreements between reviewers were resolved through discussion until consensus was reached. Reasons for excluding studies were recorded.

Data were extracted from full-text articles including author name, year of publication, study design, number of patients, diagnosis/defect type, interventions performed, instruments used, and all clinical outcomes. Where available, patient-level outcome data were prioritized over site-level data to ensure uniformity across studies.

Risk of Bias Assessment

Risk of bias analysis of each selected study was performed by the authors independently. The risk-of-bias was assessed using the RoB-2 tool and categorized into "low risk," "some concern," and "high risk" as per Cochrane definitions. Heterogeneity between studies was qualitatively considered (14). No meta-analysis was performed due to clinical heterogeneity; instead, we provide a qualitative synthesis.

Results

Characteristics of included Articles

A total of 129 titles were identified through electronic searches: 111 from Google Scholar, 8 from PubMed, and 10 from EMBASE. After duplicate removal, 113 articles underwent title and abstract screening. Of these, 105 were excluded, and 8 full-text articles were further evaluated for eligibility. Two articles were excluded because one lacked outcome data and the other had inaccessible full text. Thus, six RCTs were included for final analysis.

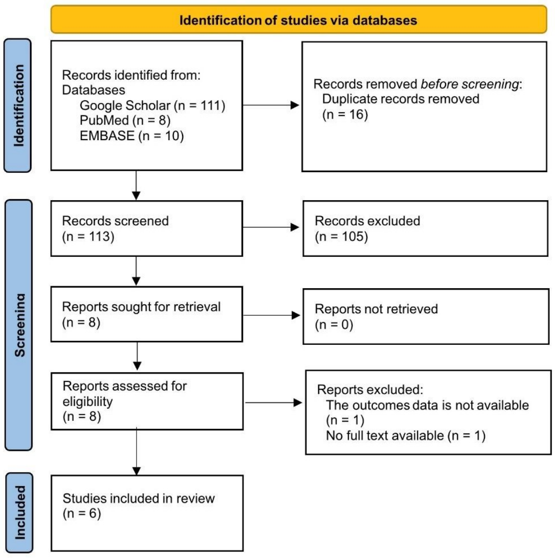

Figure 1. Selection process PRISMA flowchart.

The PRISMA flow diagram is shown in Figure 1. A total of 129 titles were identified; after screening and eligibility checks, six RCTs (n=223 patients) were included. After removing duplicates, 113 articles underwent title and abstract screening. At this stage, 105 articles were excluded and 8 full text articles were further evaluated to assess their eligibility based on predetermined criteria. Two articles were excluded after evaluation of full-text articles, respectively because outcome data were not available (Nibali et al. (4)) and full-text articles were inaccessible (Anoixiadou et al. (15)). Six RCTs were selected for final analysis (Ribeiro et al. (8), Aimetti et al. (16), Iorio-Siciliano et al. (5), Chung et al. (17), Alkimavičienė et al. (18), and Kučič et al. (13)).

Electronic searches were conducted on three databases: Google Scholar, PubMed, and Embase to find articles published in English from 2013 to June 2023. The search strategy used a combination of multiple keywords with Boolean (AND/OR) operators.

Description of Selected Studies

The main characteristics and results of the selected studies are summarized in Table 2 and Table 3. The included studies were divided into 3 groups based on the comparison of interventions, namely the MINST intervention group compared with minimally invasive surgical therapy (MIST) intervention (Table 2A), the MINST intervention group with or without adjunct material (Table 2B), and the MINST intervention group was compared with conventional non-surgical periodontal therapy (CNST) (Table 2C).

Table 2. Characteristic of the included studies.

Author, Year	Study type	N patients	Age (mean±SD) (years)	Diagnose/defect type	Intervention	Instruments (MINST)	Measured parameters	Follow- up
(A) MINST vs MIST								
Ribeiro et al., 2013 (6)	RCT, parallel group	T: 13 C: 14	T: 45.31±7.57 C: 45.43±6.79	Chronic periodontitis, At one single-rooted tooth: PD ≥ 5 mm + BOP, CAL ≥ 5 mm, IBD ≥ 4 mm	Intrabony defect T: MINST C: MIST	minicurettes, ultrasonic device with specific tips, operating microscope	FMBS, FMPS, PD, CAL, REC, IBD, microbiology evaluation (Aa, Pg, Tf)	12 months
Aimetti et al., 2017 (14)	RCT, single center, parallel group	T: 15 C: 15	T: 44.3±8.1 C: 42.2±8.1	Generalized chronic periodontitis, PD ≥ 6mm and IBD ≥ 3 mm after phase I (non-surgery)	Intrabony defect T: MINST+EMD C: MIST (SFA/M-MIST+EMD)	minicurets, ultrasonic device with thin and delicate tips, 12.5x magnification operating	FMBS, FMPS, PD, CAL, REC, IBD, patient-reported outcomes	12, 24 months
(B) MINST with or without adjunct material								
Iorio-Siciliano et al., 2021 (5)	RCT, double arm	T: 18 C: 19	T: 53.3±9.8 C: 48.5±6.5	Periodontis stage III/IV grade A/B, PD ≥5 mm without furcation involvement	full-mouth T: MINST+NaOCl gel C: MINST	Gracey micro-curettes, ultrasonic scalers with specific thin tips, 4.0x magnification loupes	FMBS, FMPS, PD, CAL, REC, %sites PD ≥5 + BOP	6 months
Alkimavičienė et al., 2023 (16)	RCT	T: 23 C: 23	T: 51.2±1.5 C: 46.3±9.5	Periodontitis stage III/IV grade A/B, PD ≥ 6 mm, horizontal and vertical bone loss (≥ 3 mm)	full-mouth T: MINST+ PACNs C: MINST	Gracey micro-curettes, mini curettes, ultrasonic scalers with thin & delicate tips, 4.5x magnification loupes	BOP, PI, PD, CAL, immunology evaluation (MMP-3, TIMP-1)	8 weeks
(C) MINST vs. CNST								
Chung et al., 2022 (15)	RCT, pilot study, split-mouth, single blind	9	47.3 (33-62)	Periodontitis stage III grade B	T: MINST C: CNST	Gracey mini curettes, piezo-electric scaler with specific thin & delicate tips, 4.0x magnification loupes	FMBS, FMPS, PD, CAL, REC, patient's comfort feedback (VAS score)	3 months
Kučič et al., 2023 (11)	RCT, single-center, split-mouth	20	43.15±8.80	Periodontitis stage III grade B/C, PD ≥ 5 mm, supra-bony defect (horizontal bone loss)	T: MINST C: CNST	Gracey mini-curettes, piezo- electric device with specific thin & delicate tips, 3.5x magnification loupes	FMBS, FMPS, PD, CAL, REC, %sites PD ≥5 + BOP, patient-reported outcomes	3, 6 months

Note. *T: test group, C: control/comparison group, RCT: randomized controlled trial, MINST: minimally invasive non-surgical therapy, MIST: minimally invasive surgical therapy, SFA: single flap approach, M-MINST: modified MIST, EMD: enamel matrix derivative, FMBS: full mouth bleeding score, FMPS: full mouth plaque score, PD: probing depth, CAL: clinical attachment level, REC: gingival recession, IBD: intrabony defect depth, BOP: bleeding on probing, PCANs: proanthocyanidins, CNST: conventional non-surgical therapy.*

Four studies had an RCT-parallel group design (5,8,16,18), while two studies from Chung et al. (17), and Kučič et al. (13), used a split-mouth design. Studies from Ribeiro et al. (8), and Aimetti et al. (16), performed the MINST procedure to treat intrabony defects non-surgically after the periodontal phase I was completed, while the study from Iorio-Siciliano et al. (5), and Alkima-vičienė et al. (18) performed full-mouth MINST during phase I.

Risk of Bias Assessment of Selected Studies

The results of the risk of bias assessment of selected RCT studies using the RoB-2 tool 12 are shown in Figure 2. Five studies (Ribeiro et al., Aimetti et al., Iorio-Siciliano et al., Alkimavičienė et al., and Kučič et al.) have a low risk of bias (low risk), while one study from Chung et al., has a high risk of bias (high risk).

	D1	D2	D3	D4	D5	Overall
Ribeiro dkk., 2013	+	+	+	+	+	+
Aimetti dkk., 2017	+	+	+	+	+	+
Iorio-Siciliano dkk., 2021	+	+	+	+	+	+
Alkimavičienė dkk., 2023	+	+	+	+	+	+
Chung dkk., 2022	+	+	+	-	+	-
Kučič dkk., 2023	+	+	+	+	+	+

Figure 2. Risk of bias assessment. **D1**: Randomisation process. **D2**: Deviations from the intended interventions. **D3**: Missing outcome data. **D4**: Measurement of the outcome. **D5**: Selection of the reported result.

MINST Group Compared with MIST

Two randomized controlled trials (Ribeiro et al. and Aimetti et al.) compared the effectiveness of MINST and MIST in the treatment of intrabony defects. Both treatments showed similar improvements in probing depth (PD) reduction and clinical attachment level (CAL) gain. Although radiographic bone fill was slightly higher in the MIST group, differences were not clinically significant. Both groups demonstrated minimal gingival recession and high patient satisfaction.

The study by Aimetti et al. also assessed the effect of adjunctive enamel matrix derivative (EMD) on both treatment interventions (Table 3A). When compared to baseline, both MINST and MIST demonstrated positive treatment outcomes, marked by significant reductions in probing depth (PD) and gains in clinical attachment level (CAL). However, there were no significant differences between the two treatment groups (Table 3A).

Table 3. Characteristic of the included studies (primary and secondary outcomes).

Author, Year		PD reduction (mm)	CAL gain (mm)	REC increase (mm)	IBD reduction (mm)
(A) MINST vs. MIST					
Ribeiro et al., 2013 (6)	Δ 0 – 12 months	T: 3.50±0.87[a] C: 3.19±0.71[a] NS[b]	T: 2.80±1.14[a] C: 2.58±1.13[a] NS[b]	T: 0.59±0.60 C: 0.58±0.83 NS[b]	N/A
Aimetti et al., 2017 (14)	Δ 0 – 12 months	T: 3.4±1.2[a] C: 3.6±0,8[a] NS[b]	T: 3.1±1.2[a] C: 3.5±1.0[a] NS[b]	T: 0.3±0.6 C: 0.1±0.3 NS[b]	T: 2.1±1.5[a] C: 3.4±1.4[a] sig[b]
	Δ 0 – 24 months	T: 3.6±1,0[a] C: 3.7±0.6[a] NS[b]	T: 3.2±1.1[a] C: 3.6±0.9[a] NS[b]	T: 0.4±0.7 C: 0.1±0.5 NS[b]	T: 2.6±1.6[a] C: 3.8±1.3[a] sig[b]
(B) MINST with or without adjunct material					
Iorio-Siciliano et al., 2021 (5)	Δ 0 – 6 months	T: 2.49±0.76[a] C: 1.98±0.80[a] sig[b]	T: 2.84±2.09[a] C: 2.01±1.83[a] sig[b]	T: 0.30±1.16 C: 0.26±0.97 NS[b]	N/A
Alkimavičienė et al., 2023 (16)	Δ 0 – 8 weeks Moderate pockets (4 – 6 mm)	T: 3.4±0.6[a] C: 2.9±0.6[a] sig[b]	T: 3.1±0.6[a] C: 2.5±0.6[a] sig[b]	N/A	N/A
	Deep pockets (≥ 7 mm)	T: 5.1±1.2[a] C: 5.0±1.1[a] NS[b]	T: 3.7±1.0[a] C: 3.4±1.0[a] NS[b]		
(C) MINST vs CNST					
Chung et al., 2022 (15)	Δ 0 – 3 months	T: 0.83±0.48[a] C: 0.92±0.57[a] NS[b]	T: 0.55±0.35[a] C: 0.60±0.41[a] NS[b]	T: 0.23±0.01[a] C: 0.27±0.06[a] NS[b]	N/A
Kučič et al., 2023 (11)	Δ 0 – 3 months	T: 1.84[a] C: 2.09[a] NS[b]	T: 1.63[a] C: 1.92[a] NS[b]	T: 0.20[a] C: 0.16[a] NS[b]	N/A
	Δ 3 – 6 months	T: 0.16 C: 0.14 NS[b]	T: 0.07 C: 0.07 NS[b]	T: 0.08 C: 0.13 NS[b]	

Note*. T: test group, C: control/comparison group, PD: probing depth, CAL: clinical attachment level, REC: gingival recession, IBD: intrabony defect depth, a: statistically significant (within groups), sigb : statistically significant (between groups), NSb : not significant (between groups), N/A: not available. Where available, effect sizes and statistical significance have been reported. For example, Iorio-Siciliano et al. showed significantly greater CAL gain in the MINST + NaOCl group versus MINST alone (MD = 0.83 mm, p = 0.03). Aimetti et al. reported greater IBD reduction in MIST than MINST (MD = 1.2 mm, p < 0.05). However, most studies reported within-group improvements as statistically significant without intergroup significance.*

There was also no significant increase in gingival recession (REC) between MINST and MIST, nor between baseline and follow-up in either group. Radiographic evaluations were conducted in both studies, but only Aimetti et al. presented quantitative data on radiographic bone fill. Radiographic bone fill was assessed based on the reduction of intrabony defect (IBD) depth at 12 and 24-month follow-ups. Significant reductions in IBD were observed in both therapies compared to baseline; however, the defect fill in the MIST group was significantly higher than in the MINST group (Table 3A).

Radiographic bone fill was evaluated quantitatively in the study by Aimetti et al., where the MINST group showed a mean IBD reduction of 2.6 ± 1.6 mm compared to 3.8 ± 1.3 mm in the MIST group at 24 months ($p < 0.05$). These findings are summarized in

Table 3. No other included studies provided detailed radiographic measurements, and no figures were available for visual representation.

MINST Group with or without Adjunct Material

Two RCTs (Iorio-Siciliano et al., dan Alkimavičienė et al.) compared the effectiveness of MINST in treating periodontal pockets, with or without the use of adjunct materials. Iorio-Siciliano et al. used an adjunct amino acid-buffered sodium hypochlorite (NaOCl) gel, whereas Alkimavičienė et al. applied collagen hydrogels with proanthocyanidins (PCANs) (Table 2B). Both studies demonstrated significant reductions in PD and gains in CAL in both groups when compared to baseline, with the mean values in the MINST + adjunct material group being significantly higher than those in the MINST-only group (Table 3B).

However, this significant difference was not observed in deep pockets (≥ 7 mm) in the study conducted by Alkimavičienė et al. The mean reductions in PD and gains in CAL were comparable between both groups. A slight increase in gingival recession (REC) was observed at the 6-month follow-up compared to baseline, but the difference was not statistically significant (Table 3B).

MINST Group Compared with CNST

Two RCTs (Chung et al., dan Kučič et al) compared the effectiveness of MINST with conventional non-surgical periodontal therapy (CNST). Both MINST and CNST resulted in reductions in PD and gains in CAL at the 6-month follow-up compared to baseline. However, there were no significant differences between the two groups (Table 3C). The study by Chung et al. reported less gingival recession in the MINST group compared to the CNST group at 1 and 3 months after treatment, but the difference was not statistically significant.

Two studies (Ribeiro et al. and Kučič et al.) also reported microbiological and patient-centered outcomes. Ribeiro et al. found significant reductions in subgingival pathogens (Aa, Pg, Tf) following both MINST and MIST treatments, with no significant intergroup difference. Kučič et al. reported that patients receiving MINST experienced higher comfort scores and less treatment-related pain, based on visual analog scale (VAS) assessments, compared to CNST. These findings highlight additional clinical benefits of MINST beyond conventional periodontal parameters.

Discussion

Minimally invasive is a medical concept that emphasizes the use of microscopic and macroscopic techniques to perform surgeries that were previously only possible through large incisions (9,19,20). This idea uses primarily techniques and instruments that cause minimal trauma to the tissue nearby, with the aim of decreasing post-operative mortality and morbidity, improving the clinical outcome, accelerating tissue healing, and shortening treatment duration.
Harrel and Rees first implement the minimally invasive concept in periodontal surgery (minimally invasive surgery) to reduce the damage to surrounding tissue caused by flap reflection. This approach helps to stabilize blood clotting and decrease the patient's morbidity (20,21). Minimally invasive surgery, is further referred as microsurgery or described as "minimally invasive surgical technique" (MIST) by Cortellini and Tonetti (21,22).

As the field of periodontology advances, non-surgical therapy also adopts a minimally invasive approach. Minimally invasive non-surgical therapy (MINST) was used first by Ribeiro et al. (12) to treat intrabony defect non-surgically after finishing phase I of periodontal treatment. This study examines and compares the outcomes of MIST and MINST at 3 and 6-month follow-up (12). Later in 2013, the exact same population was also being reevaluated in a 12 months follow-up (8). The results showed that both therapies were effective in improving clinical parameters such as PD reduction and CAL gain within 3 months after re-evaluation and remained stable until 12-month follow-up (8,12). This study discovered an increase in CAL with minimal gingival recession. This finding indicates that the gingival attachment is stable after the MINST procedure. This may be due to the minimal trauma caused by the minimally invasive approach during the procedure (8,9,12).

The earlier study is similar to the one by Aimetti et al. (16), which examines the efficacy of MINST and MIST in conjunction with the application of enamel matrix derivative (EMD) on both groups. Data from the 24-month follow-up showed there was no significant difference between the two approaches. The MINST group demonstrated a reduction in PD and gain in CAL of 3,6 mm and 3,2 mm, respectively, while the MIST group showed PD reduction of 3,7 mm and CAL gain of 3,6 mm. There was also no statistical difference in terms of minimal pain level or high level of satisfaction between the two groups (16). It can be conclude that MINST serves as a viable alternative for treating residual pockets from the invasive procedure.9 MINST also has a half-time shorter chair time than MIST (9,13,16,23).

Radiographic examination reveals a significant difference between MINST and MIST. MINST, with a flapless procedure, showed a reduction of intrabony defect depth (IBD) by 2,6 mm, while MIST by 3,8 mm (16). Moreover, a prospective study by Nibali et al. (10), showed that MINST resulted in a stable radiographic bone fill in a 5-year follow-up. The initial IBD measurement of 5.8 mm decreased to 3.5 mm after 1 year and further decreased to 3.2 mm after 5 years. The 1- and 5-year follow-up showed no statistical difference (10).

Numerous studies have shown that the combination of periodontal therapy with adjunctive material, such as locally delivered antiseptic/anti-inflammatory agents and local or systemic antibiotics improve clinical outcomes of treatment (24–27). Two RCTs on this study compared MINST effectiveness with or without adjunct material using a full-mouth approach. Iorio-Siciliano et al. (5), in their study uses an adjunct amino acid buffered sodium hypochloride (NaOCl) gel. This new formula has a detoxifying effect on the root surface, softening the calculus, and also has an antimicrobial effect especially against gram-negative species associated with periodontitis (5). While, Alkimavičienė et al. (18), utilize collagen hydrogels containing Proanthocyanidins (PCANs) as an adjunct material in their study. Proanthocyanidins are oligomers or polymers of monomeric flavan-3-ols produced as the by-product of the biosynthetic pathways of flavonoids. Proanthocyanidinsis also possess antioxidative, anticancer, antiinflammatory, and antimicrobial properties. PCANS' strong anti-inflammatory and anti-microbial effects can help reduce inflammation and accelerate the regeneration of periodontal tissue.16 The results from both studies demonstrated that the application of adjunct materials (NaOCL or PCANs) together with MINST could produce superior clinical outcomes in comparison to MINST alone. Regardless, MINST, whether or not combined with adjunct material, exhibits equivalent clinical improvement, resulting in a limited residual pocket following a single session of full-mouth treatment. This can greatly diminish the necessity for surgical intervention. Additionally, probiotics like Lactobacillus reuteri have been found to offer supplementary benefits in the treatment of periodontitis as underscored in a systematic review by Tricoly, et al. (7), where improvements in both probing depth and bleeding on probing were observed following adjunctive probiotic therapy.

Chung et al. (17) and Kučič et al. (13) conducted a comparative analysis of the effectiveness of MINST and conventional non-surgical therapy (CNST). Although both approaches yielded identical results, MINST offered superior patient comfort feedback and a reduced incidence of gingival recession compared to the conventional method (13,17) conducted a comparative analysis of the effectiveness of MINST and conventional non-surgical therapy (CNST). Although both approaches yielded identical results, MINST offered superior patient comfort feedback and a reduced incidence of gingival recession compared to the conventional method.

The observed microbiological improvements suggest that MINST is effective in disrupting key periodontal pathogens. Patient-reported outcome measures (PROMs), including perceived comfort and satisfaction, were generally more favorable in the MINST group. These qualitative benefits support the integration of MINST into patient-centered treatment planning.

The findings of this review carry practical implications for periodontal therapy in Swiss dental practice. Given Switzerland's focus on minimally invasive interventions and efficient care delivery, MINST represents a clinically viable option for managing Stage III/IV periodontitis in general dental settings. Its low surgical burden, reduced post-operative discomfort, and time-efficiency make it particularly suitable for aging populations or medically compromised patients. Additionally, if recognized within insurance frameworks, MINST could reduce treatment costs while maintaining high clinical standards.

This study's limitation is that the various approach of the MINST technique from all the chosen studies may impact the overall treatment outcomes. The findings of this review suggest that MINST could be effectively adopted in daily clinical practice, particularly in cases where surgical interventions may be contraindicated or not preferred by the patient. Given its reduced morbidity and shorter chair time, MINST may be of particular relevance for public health systems such as Switzerland's, where insurance coverage for minimally invasive interventions is increasing. However, further research is needed to support implementation guidelines.

Conclusions

Based on the results of this systematic review, there is moderate evidence supporting the shift toward minimally invasive periodontal therapy. MINST appears to be an effective non-surgical option for managing advanced periodontitis, with comparable outcomes to surgical regenerative approaches. The use of MINST may reduce the need for surgery and post-operative trauma, though further high-quality RCTs with longer follow-up are needed to confirm these results. Further research with a standardized design and long-term follow-up is necessary to generalize the effectiveness of MINST in treating Stage III/IV periodontitis...

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Zusammenfassung

Einleitung

Die minimalinvasive nicht-chirurgische Therapie (MINST) wurde als alternative Methode zur Behandlung der Parodontitis eingeführt. Dabei handelt es sich um ein Verfahren, bei dem Mini- oder Mikroinstrumente in Kombination mit Lupenbrillen oder Operationsmikroskopen verwendet werden, um eine optimale Wurzelglättung ohne Lappenhebung zu ermöglichen. Diese systematische Übersichtsarbeit randomisierter kontrollierter Studien (RCTs) bewertet die Wirksamkeit von MINST bei der Behandlung von Parodontitis im Stadium III/IV.

Material und Methoden

Das Studienprotokoll wurde gemäss den PRISMA-Richtlinien (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) erstellt. Obwohl den PRISMA-Kriterien gefolgt wurde, wurde das Protokoll nicht im PROSPERO-Register eingetragen. Eine systematische Literaturrecherche wurde in den Datenbanken PubMed, EMBASE und Google Scholar durchgeführt, um englischsprachige Artikel aus dem Zeitraum von 2013 bis Juni 2023 zu identifizieren. Es wurden ausschliesslich RCTs berücksichtigt, in denen MINST als Interventionsmethode verwendet wurde.

Resultate

Von insgesamt 129 identifizierten Studien erfüllten 6 randomisierte kontrollierte Studien mit insgesamt 223 Patienten die Einschlusskriterien. Diese Studien wurden in drei Gruppen unterteilt, je nachdem, mit welcher Intervention MINST verglichen wurde: MINST versus minimalinvasive chirurgische Therapie (MIST), MINST mit oder ohne zusätzliche Materialien sowie MINST versus konventionelle nicht-chirurgische Parodontaltherapie (CNST). Die Ergebnisse zeigten, dass MINST bei der Behandlung einzelner intraalveolärer Defekte eine vergleichbare Wirksamkeit wie MIST aufwies, mit einer signifikanten Reduktion der Sondierungstiefe (PD) und einem Gewinn an klinischem Attachment (CAL). Nach nur einer Sitzung der Full-Mouth-MINST-Therapie wurden minimale Resttaschen beobachtet, wobei der Einsatz zusätzlicher Materialien den Behandlungserfolg weiter verbessern konnte.

Diskussion

Die Ergebnisse dieser Übersichtsarbeit liefern moderate Evidenz dafür, dass MINST eine effektive und gleichzeitig gewebeschonende Methode zur Behandlung fortgeschrittener Parodontitis darstellt. Die klinischen Ergebnisse sind dabei mit denen chirurgischer Verfahren vergleichbar. Angesichts der begrenzten Zahl hochwertiger Studien sind jedoch weitere randomisierte Studien mit langfristigem Follow-up erforderlich, um die Ergebnisse zu bestätigen und die optimale Anwendungsweise von MINST zu definieren.

Résumé

Introduction

La thérapie non chirurgicale mini-invasive (MINST) a été introduite comme une approche alternative dans la prise en charge de la parodontite. Cette technique repose sur l'utilisation d'instruments miniatures ou micro-invasifs associés à des loupes grossissantes ou des microscopes, permettant un débridement radiculaire optimal sans élévation de lambeau. Cette revue systématique d'essais contrôlés randomisés (ECR) évalue l'efficacité de la MINST dans le traitement de la parodontite de stade III/IV.

Matériels et méthodes

Un protocole de revue a été établi selon les recommandations PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses). Bien que les lignes directrices PRISMA aient été suivies, le protocole n'a pas été enregistré sur PROSPERO. Une recherche électronique a été effectuée sur trois bases de données : PubMed, EMBASE et Google Scholar, afin d'identifier les articles publiés en anglais entre 2013 et juin 2023. Seuls les ECR utilisant la MINST comme intervention principale ont été inclus.

Résultats

Parmi les 129 études identifiées, 6 ECR impliquant un total de 223 patients ont été sélectionnées. Les études incluses ont été regroupées en trois catégories selon le type de comparaison : MINST versus traitement chirurgical mini-invasif (MIST), MINST avec ou sans matériau adjuvant, et MINST versus traitement parodontal non chirurgical conventionnel (CNST). La MINST a montré une efficacité comparable à celle du MIST pour le traitement des défauts intra-osseux uniques, avec une réduction significative de la profondeur de poche (PD) et un gain d'attache clinique (CAL). Après une seule séance de MINST en bouche entière, des poches résiduelles minimales ont été observées, et l'utilisation de matériaux adjuvants a permis d'améliorer davantage les résultats cliniques.

Discussion

Cette revue fournit des preuves modérées que la MINST constitue une approche efficace et peu traumatique pour la gestion de la parodontite avancée, avec des résultats cliniques similaires à ceux des traitements chirurgicaux. Toutefois, des essais cliniques de haute qualité avec un suivi à long terme sont nécessaires pour confirmer ces résultats et optimiser les protocoles d'application de cette technique.

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