ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)

IJDSIR : Dental Publication Service

Available Online at:www.ijdsir.com

Volume – 8, Issue – 2, March – 2025, Page No. : 54 - 64

Minimally Invasive Therapies in Periodontitis - A Literature Review

[1]Dr. G. Shivani, PG Student, Department of Periodontics, Panineeya Institute of Dental Sciences, Hyderabad.

[2]Dr. K. Rekha Rani, Professor & HOD, Department of Periodontics, Panineeya Institute of Dental Sciences, Hyderabad.

[3]Dr. Vidya Pranathi, PG Student, Department of Periodontics, Panineeya Institute of Dental Sciences and Research Centre, Hyderabad.

[4]Dr Suhailuddin Mir, PG Student, Department of Periodontics, Panineeya Institute of Dental Sciences, Hyderabad.

[5]Dr. P. Greeshma, PG Student, Panineeya Institute of Dental Sciences, Hyderabad.

[6]Dr. R. Gahana, PG Student, Panineeya Institute of Dental Sciences, Hyderabad.

[7]Dr. SNS. Bhavana, PG Student, Panineeya Institute of Dental Sciences, Hyderabad.

Corresponding Author: Dr. K. Rekha Rani, Professor & HOD, Department of Periodontics, Panineeya Institute of Dental Sciences, Hyderabad.

Citation of this Article: Dr. G. Shivani, Dr. K. Rekha Rani, Dr. Vidya Pranathi, Dr Suhailuddin Mir, Dr. P. Greeshma, Dr. R. Gahana, Dr. SNS. Bhavana, "Minimally Invasive Therapies in Periodontitis- A Literature Review", IJDSIR- March – 2025, Volume – 8, Issue – 2, P. No. 54 – 64.

Type of Publication: Review Article

Conflicts of Interest: Nil

Abstract

Minimally invasive surgical techniques (MIST) in periodontics have emerged as a transformative approach to managing periodontal diseases, prioritizing the preservation of soft tissue and enhancing patient comfort. This review article discusses key minimally invasive procedures including the Modified Papilla Preservation Technique (MPPT), Simplified Papilla Preservation Flap (SPPF), Tunnel Technique, Entire Papilla Preservation Technique (EPP) and Non incised Papillae Surgical Approach (NIPSA). Each technique is elaborated upon with recent studies that validate their effectiveness in improving clinical outcomes, reducing postoperative pain, and enhancing aesthetic results. The review highlights the advantages of MIST, such as faster healing rates and higher patient satisfaction, while also acknowledging the limitations regarding their applicability in complex cases. Overall, this article underscores the significance of MIST in contemporary periodontal therapy and suggests that ongoing research will further solidify their role as standard practices in periodontal treatment protocols.

Keywords: Blood Clot Protection, Flapless Surgery, Periodontal Diseases, Swelling

Introduction and Background

Periodontal diseases, including gingivitis and periodontitis, are among the most common oral health conditions globally, with nearly 50% of adults affected

by some form of periodontal disease.[1] Traditional periodontal surgeries are effective but typically require large incisions, significant tissue manipulation, and lengthy recovery, leading to discomfort, scarring, and extended healing.[2] In response to these challenges, MIST has emerged as a promising alternative in periodontal therapy. These procedures emphasize small incisions, precise tissue handling, and reduced trauma, which significantly minimizes pain, swelling, and recovery time for patients.[3] Key techniques, including laser-assisted surgery, flapless surgery, and minimally invasive regenerative procedures, focus on preserving as much healthy tissue as possible while achieving effective clinical outcomes.[4] These approaches not only improve functional outcomes but also enhance aesthetic results, which is particularly important in aesthetic sensitive areas such as the anterior maxilla.[5] Despite the clear advantages of MIST, its widespread adoption in clinical practice is yet to occur. The mandatory utilization of specialized equipment, advanced training, and appropriate patient selection remains a barrier to the widespread implementation of these techniques.[6] Additionally, while early studies show promising results, many more studies are needed to substantiate the long-term clinical effectiveness and safety of MIST in periodontal care.[7] This article, examines the current landscape of minimally invasive surgical techniques (MIST) in periodontics, highlighting their potential to enhance treatment outcomes and improve patient care. It reviews key techniques, their benefits and limitations, and the technological advancements in shaping this innovative field.

Historical Evolution MIST

MIST has undergone significant evolution since its inception, transforming the landscape of surgical practices, particularly in periodontics. This overview highlights key milestones in the development of MIST, tracing its origins and advancements. The term "minimally invasive surgery" (MIS) was first coined by Fitzpatrick and Wickham in 1990. MIS as stated by them is the ability to perform traditional surgical procedures through smaller incisions, resulting in less trauma and faster recovery times. Researchers introduced MIST in periodontics in 1995. The introduction of specific minimally invasive techniques such as the Tunnel Technique and the Modified Papilla Preservation Technique (MPPT) allowed for targeted treatment of periodontal defects with minimal disruption to surrounding tissues. MIST was proposed later as a formalized approach that emphasized wound stability and primary closure for blood clot protection. This technique has been further refined into M-MIST, which incorporates space provision for regeneration, enhancing clinical outcomes while minimizing patient discomfort.

Discussion

Principles of Minimally Invasive Surgery

It highlights a major shift in surgical techniques aimed at minimizing discomfort to the patient while maintaining effective surgical outcomes. The principles of MIST encompass various strategies and methodologies that prioritize smaller incisions, reduced tissue manipulation, and enhanced recovery times.

Conservative Incision Techniques: The intra-sulcular incisions are typically limited in extent, avoiding vertical cuts and preserving interdental papillae. The tunnel technique involves creating a supra periosteal tunnel at the recipient site, which is particularly useful for managing gingival recession. It allows for graft placement with minimal flap elevation, thereby reducing trauma.[8]

Tissue Preservation: The soft tissue involvement in the surgical procedure is minimized to the extent possible

enhancing blood supply, aiding in faster recovery, and minimizing postoperative discomfort.

Use of Advanced Visualization: High-power magnification tools, such as operating microscopes, are employed to enhance the surgeon's ability to visualize the surgical field. This facilitates more precise tissue manipulation and improves surgical outcomes by ensuring better wound stability.

Minimized Trauma and Morbidity: MIPS aims to achieve the same therapeutic results as traditional techniques but with less trauma, leading to reduced pain, swelling, and recovery time for patients. Studies have shown that patients experience less postoperative discomfort and quicker healing times with minimally invasive techniques.[9]

Classification of MIST

They can be broadly classified into non-surgical and surgical approaches, each offering unique benefits for various periodontal conditions. A detailed overview of these classifications, along with their relevant techniques is presented. (Figure 1)

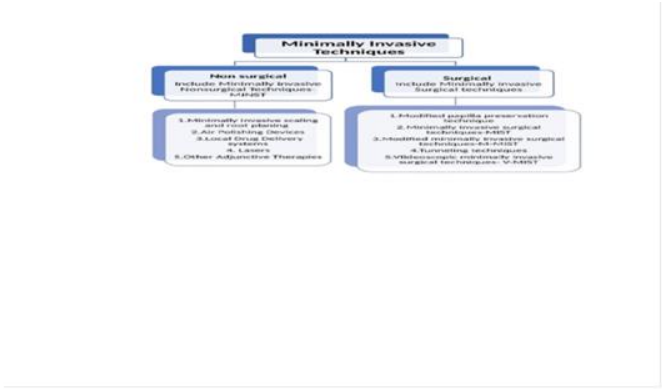

Figure 1: Classification of MIST

Minimally invasive nonsurgical therapy (MINST)

MINST is an innovative approach in periodontal treatment aimed at managing conditions such as periodontitis with reduced tissue trauma. This technique emphasizes the use of advanced tools and methodologies to achieve effective periodontal debridement while minimizing discomfort and promoting faster healing.

A study published in 2023 evaluated the effectiveness of MINST compared to traditional non-surgical therapy for patients with stage III periodontitis characterized by predominantly supra bony defects. This split-mouth randomized controlled trial involving 20 patients, indicated that MINST performed similarly to classical non-surgical treatment in terms of healing sites with probing depth (PD) ≥ 5 mm and bleeding on probing (BOP). However, it was observed that there was minimal gingival recession around the molars ($p = 0.037$). These findings suggest that while MINST does not outperform traditional methods in overall efficacy, it offers benefits in specific clinical scenarios, particularly regarding aesthetic outcomes related to gingival recession.[10]

A recent study from King's College London published in the Journal of Clinical Periodontology stated that MINST can effectively resolve intra bony defects without the need for surgical intervention. The study reported positive outcomes, showing that half of the intra bony defects treated with MINST resolved, highlighting its potential as a non-invasive alternative to more invasive surgical procedures.[11]

Adjunctive Therapies: Adjunctive therapies, such as local drug delivery systems and laser therapies, are used alongside SRP to improve treatment outcomes. Local delivery of antibiotics (e.g., doxycycline or minocycline) can help target specific periodontal pathogens, reducing the bacterial load and promoting healing of inflamed tissues.[12] Additionally, lasers, including diode lasers and Er: YAG lasers, are used to sterilize periodontal pockets, reduce bacterial contamination, and aid in soft tissue healing.[13] These therapies, when integrated with SRP, enhance the overall healing process and improve the outcomes.

Applications of MIST in periodontics: These procedures have revolutionized periodontal therapy by reducing surgical trauma and enhancing healing outcomes. This approach is particularly beneficial in various applications, including regenerative procedures, aesthetic surgeries, and soft tissue augmentation.

Regenerative Procedures

Treatment of Intrabony Defects: MIST is preferable in the treatment of proximal intra bony defects due to minimal surgical trauma, which is crucial for successful tissue regeneration. The technique allows for small incisions and limited flap reflection, promoting better wound stability and reducing patient morbidity.

Studies indicate that MIST combined with bioactive materials like Bio-Oss Collagen can lead to significant clinical attachment gain and improved radiographical outcomes in isolated interdental intrabony defects.

Furcation Management: The integration of minimally invasive techniques with regenerative materials has shown good outcomes in managing furcation defects. By preserving surrounding tissues and minimizing trauma, MIST enhances the regenerative potential in these challenging areas.

Aesthetic Periodontal Surgeries

Root Coverage Procedures: MIST techniques are particularly advantageous for root coverage procedures as they maintain the tissue architecture while achieving aesthetically pleasing results. These procedures play a vital role in the anterior region, where cosmetic outcomes are paramount. The preservation of gingival tissue during these procedures contributes to faster healing and reduced discomfort for patients.

Crown Lengthening: MIST facilitates crown lengthening with minimal manipulation, thereby improving both functional and aesthetic outcomes. The technique allows for precise adjustments while ensuring quicker recovery times, making it a preferred choice among clinicians.

Soft Tissue Augmentation

Mucogingival Surgeries: MIST is beneficial for mucogingival surgeries aimed at enhancing the width of attached gingiva and correcting mucogingival defects. The less invasive nature of these techniques leads to improved functional and aesthetic outcomes while minimizing postoperative complications.[14]

Advantages of minimally invasive procedures include less postoperative pain, improved rate of healing, enhanced aesthetic outcomes, and better acceptance by the patient.

Modified Papilla Preservation Technique (MPPT): The MPPT minimizes trauma to the interdental papilla during periodontal surgery by sparing the papilla. This approach helps maintain vascular supply, promoting better healing and aesthetic outcomes. A recent study demonstrated that MPPT led to minimal postoperative recession and significant bone fill at 18-month follow-up. The research highlighted the technique's versatility in addressing aesthetic and functional concerns across various cases, confirming its long-term effectiveness in periodontal regeneration.[15] Another study involving 15 patients with deep intrabony defects concluded that there was a reduction in probing depth (4.4 mm) and clinical attachment gain (3.35mm) after MPPT application. The results indicated a high success rate for primary closure over barrier membranes, reinforcing the technique's efficacy in regenerative procedures.[16]

Simplified Papilla Preservation Flap (SPPF): An oblique initial incision across the base of the papilla is made, preserving supra-crestal fibers while minimizing tissue detachment. This technique is particularly advantageous for narrow interdental spaces. A study was conducted using SPPF to achieve primary closure of the

interproximal tissue over barrier membranes placed coronal to the alveolar crest. Fifteen patients with deep intra-bony defects were treated using this technique with the placement of titanium-prepared membranes as barriers to cover the defects. A primary closure of the interproximal portion of the membrane was achieved in 93% of the cases indicating that this technique could be employed successfully in cases treated with membranes in the interproximal regions.[17]

Tunnel Technique: The tunnel technique, developed by Raetzke, creates a tunnel through the gingival tissue without detaching the papilla from its base. This technique is particularly effective for root coverage procedures and has gained popularity due to its ability to preserve the papillae, often facilitating the placement of grafts.

A study highlighted the effectiveness of the tunnel technique combined with the placement of the chorion membrane in the pouch created, resulting in stable clinical outcomes over six months. The study reported significant improvement in clinical parameters, demonstrating the technique's efficacy in managing gingival recession defects. The authors noted that this approach not only preserved the papillary height but also enhanced aesthetic outcomes.[18]

Yet another study was conducted on 24 patients who were split into two groups. The patients in group I (test group) underwent a modified tunneling technique and placement of collagen matrix in the pouch with subsequent coronal advancement of the flap to cover the denuded area of the root whereas in group II patients (control group) received a modified tunneling technique with the placement of connective tissue graft in the pouch created, with coronal advancement of the flap to treat the recession. The results showed that both treatment approaches were equally effective. The researchers stated that collagen matrix can be used as an efficient alternative to connective tissue graft in the treatment of gingival recession.[19]

Entire Papilla Preservation Technique (EPP): This technique aims to preserve the entire interdental papilla during surgical procedures, minimizing trauma associated with traditional flap designs. This technique involves making a single vertical incision buccally, allowing proper management of the periodontal defect while maintaining the vascular and anatomical integrity of the papilla. By avoiding incisions directly on the papilla, EPP minimizes the occurrence of papillary atrophy and enhances healing outcomes.

In a study, six intrabony periodontal defects with defect depths ≥ 6mm were treated with EPP. The clinical and radiographic parameters were evaluated at the beginning and 6 months after surgery. There was an improvement in both the clinical and radiological parameters with an intrabone fill of 2.41 ± 2.03 mm which was appreciated at six months.[20]

Another cohort study reported promising results with EPP, showing a significant decrease in postoperative complications and improved patient satisfaction in comparison to conventional flap approaches. The study highlighted that the EPP group experienced less discomfort, reinforcing the technique's potential as a standard approach for treating specific periodontal defects.[21]

Nonincised Papillae Surgical Approach (NIPSA): It is designed to treat periodontal defects without making any incisions on the papilla itself. This approach significantly minimizes gingival trauma and preserves the papilla, which is vital for maintaining aesthetic outcomes and promoting healing during periodontal regeneration surgeries. By accessing the defect from an apical position, NIPSA allows for effective treatment,

preserving the interproximal tissue, which acts as a "dome" to support the healing process.

A systematic review highlighted that NIPSA resulted in better clinical outcomes, including probing depth reduction and clinical attachment level gain, compared to conventional methods. The need for further randomized controlled trials to validate these findings was opined, suggesting that NIPSA could be a significant advancement in minimally invasive periodontal surgery.[22]

Another study demonstrated that NIPSA effectively minimized postoperative discomfort while achieving favorable aesthetic results. This study supports its potential as a standard approach for specific periodontal defects, indicating that patients experienced less pain and quicker recovery times compared to traditional surgical techniques.[23]

Modified Vestibular Incision Subperiosteal Tunnel Access (M-VISTA): It is an innovative surgical approach that combines subperiosteal tunneling with vestibular incisions to access periodontal defects while preserving surrounding tissues. This technique is designed to minimize trauma and enhance healing by allowing access to defects without extensive flap elevation. M-VISTA is ideal for treating severe gingival recessions, where traditional methods may present challenges.

A case series conducted on ten patients with severe gingival recession assessed the outcomes of the M-VISTA technique. Thirty-eight recession defects were treated in this study. The mean baseline recession was 3.12mm, and post-intervention, a mean root coverage of 58.72% was achieved, with complete root coverage observed in 29% of the cases. The findings indicated that M-VISTA can effectively manage periodontal defects while maintaining patient comfort and achieving primary closure with minimal complications.[24]

Another investigation focused on the benefits of M-VISTA in enhancing patient comfort and reducing healing times. The study suggested that patients experienced less postoperative pain, highlighting the potential of M-VISTA as a standard approach for specific periodontal defects. Although more extensive studies are needed to confirm these results, initial findings support the technique's promise in periodontal surgery.

Pinhole Surgical Technique (PST): Developed by Dr. John Chao, is a minimally invasive method for treating gum recession. It involves creating a small pinhole in the gum tissue, through which specialized instruments are used to gently loosen and reposition the gums over the receded area. This technique eliminates the need for cutting or stitching, resulting in faster healing and less discomfort to the patient.

A study evaluated the long-term outcomes of PST for root coverage. The results indicated that PST achieve significant improvements in clinical parameters such as probing depth and clinical attachment levels, with a success rate exceeding 90%. The study emphasized the technique's advantages, including reduced postoperative pain and quicker recovery times compared to traditional grafting methods.[25]

A case series was performed in ten patients with class I and class II gingival recessions in the aesthetic zone using this technique with titanium-enriched platelet-rich fibrin (T PRF) being tucked in instead of connective tissue graft (CTG) in the tunnel created. This six-month study showed that there was a mean root coverage of 87% and a statistically significant reduction in recession width and depth from baseline values. Moreover, there was an increase in the width of keratinized gingiva,

proving that T PRF could be used as a viable alternative to CTG in the treatment of denuded roots.[26]

Single Flap Technique (SFA): This procedure involves the elevation of a flap only on one side that has deeper periodontal pockets and bone loss, whereas the other side with no clinical signs of disease was not tampered with. It was observed that the healing time and patient compliance were better.

A study was conducted on twenty patients who were divided into two groups. These patients had supra osseous pockets only related to the buccal aspects, hence they were treated by single flap approach (SFA) or SFA with placement of enamel matrix derivative (EMD). All the pockets treated closed in the SFA+EMD group, and 90% of the pockets closed in the SFA group. The other clinical parameters improved in both the groups though the gingival recession marginally increased twelve months after surgery. It was concluded that the single flap approach may be the ideal choice in pockets involving only one side.[27]

Another study was conducted comparing the singleflap approach to the doubleflap approach in twenty patients with probing pocket depths of ≥5 mm. The clinical parameters were recorded at baseline, three months, and six months, and the radiological variables were recorded at baseline and 6 months by CBCT.

The results pointed out that the SFA approach showed a significant reduction in periodontal pocket depth, gain in clinical attachment level (CAL), and gain in bone level when compared with the DFA.[28]

Modified Minimally Invasive Surgical Technique (M-MIST): This technique combines traditional regenerative approaches with minimally invasive principles to enhance healing and clinical outcomes. An RCT involving 45 patients demonstrated that M-MIST provided similar short- and long-term benefits as traditional regenerative techniques, with lower costs associated with treatment. The study reported no significant differences in clinical attachment level gains over a 10-year follow-up.[29]

Another investigation compared M-MIST with the EPP in patients with stage III periodontitis, showing that both techniques resulted in significant clinical improvements, although EPP exhibited slightly greater clinical attachment level gains at 12 months post-treatment.[30]

Another randomized clinical trial assessed M-MIST's effectiveness with or without Platelet-Rich Fibrin (PRF) for treating isolated intrabony defects. The results showed comparable improvements in probing depth and clinical attachment levels between both groups at 3, and 6 months, post-surgery, indicating that M-MIST is effective regardless of PRF use.[31]

The analysis of studies using different techniques is summarized (Table 1). The studies depicted, show satisfactory results related to minimally invasive procedures alone, however, when these techniques have been employed with regenerative materials the outcome is not very tangible. Perhaps many more studies with different materials have to be performed to ascertain their role as adjuncts.

Table 1: Analysis of different techniques using MIST

PROCEDURE	AUTHORS	STUDY DETAILS	OUTCOME/RESULTS		
Gingival Recession Test Group CAF+MT+ CM Control Group CAF+ MT +CTG	Hamid et al 2023[19]	6month RCT wherein 24 patients with multiple gingival recessions, were treated and clinical variables were assessed	Test Group Recession (mm) -2.7 ± 0.7mm	Control Group Recession (mm) -3.1 ± 0.3	
Intra-bony Defects EPP	Sanz et al2024[20]	6month case series wherein six intra bony defects were treated with EPP. The CAL and Bone fill were assessed	Single Arm study CAL mm 3.67±1.03mm	 Bone fill% 241±2.03%	
Gingival Recession M-VISTA	Fernández-Jiménez A, et al 2021[24]	6month study wherein 10 patients with 38 gingival recessions were treated. and the clinical variables were recorded.	Single Arm Study Recession Width mm 2.26 ± 1.25mm	 Complete root coverage % 29%	
Gingival Recession Pinhole Technique With T-PRF	Agarwal M.C et al 2020[26]	10 patients with 20 class I and Class II Millers Gingival recessions were treated and assessed for Recession Depth (RD, RW, at Baseline(D0), 3 months (D3), and 6months(D6) and for PRC at 3months (D3) and 6 months (D6)	Single arm study RD mm D0 3.65±0.42 D3 0.2±0.63 D6 0.8± 1.03	 RW mm D0 2.65±0.67 D3 0.1±0.32 D6 0.35±0.47	 PRC% - D3 0.98±0.08 D6 0.87±0.18
Intra-bony Defects Control Group: M-MIST Test Groups: M-MIST + EMD M-MIST + EMD + BMDX	Cortellini et al 2022[29]	10year RCT conducted on 45 patients split equally into control & Test Groups. Clinical attachment level (CAL), was assessed	Test Groups M-MIST +EMD CAL difference: - 0.1 ± 0.8mm	 M-MIST+EMD+BMDX CAL difference: - 0.3 ± 0.6mm	Control Group M-MIST CAL difference: - 0.1 ± 0.7mm

Table 1: Analysis of different techniques using MIST

RCT – randomized clinical trial; MIST – minimally invasive surgical technique; M-MIST – modified minimally invasive surgical technique; EMD- Enamel matrix derivatives; PRF-Platelet rich fibrin; BMDX – bone mineral-derived xenograft; EPP-Entire Papilla Preservation; CAF-Coronally advanced flap; MT-Modified tunneling; CM- Collagen Matrix; CTG-Connective Tissue Graft; M-VISTA- Modified vestibular incision subperiosteal tunnel access; T- PRF – Titanium prepared platelet-rich fibrin; mm-millimeters; %-Percentage

Limitations: Despite their advantages, MIST may not be feasible for all cases, particularly those involving complex or extensive defects. Clinicians should carefully assess each case to determine the most appropriate surgical approach.

Conclusions

In conclusion, minimally invasive surgical techniques, particularly microsurgery, represent a significant advancement in periodontal therapy, offering numerous benefits over traditional surgical methods. These techniques enhance the predictability, aesthetic quality, and overall success while reducing patient discomfort

and recovery times. It has been reported that these techniques augur well in advanced cases of gingival recession. Despite the challenges related to training and skill acquisition, the growing body of evidence supporting the use of these techniques highlights their importance in modern periodontal practice. With the technological advances and the reported advantages of minimally invasive surgical methods, it is anticipated that there could be future advancements in minimally invasive surgeries. Robot-assisted minimally invasive surgery, promises to be a revolutionary step towards the same. It can be expected that such a procedure would improve the accuracy and dexterity of the surgeon with minimal trauma to the patient. The application of robotics would allow surgical procedures to be carried out automatically by the surgeon with a remote control. As these procedures continue to evolve, they will likely play a pivotal role in the management of periodontal diseases and the restoration of gingival health. Therefore, their integration into clinical practice holds great promise for improving the quality of care in periodontics.

References

1. Pihlstrom BL, Michalowicz BS, Johnson NW: Periodontal diseases. Lancet. 2005;366:1809-20. 1016:0140-673667728
2. Cortellini P: Minimally invasive surgical techniques in periodontal regeneration. J Evid Based Dent. 2012;1289:100. 10.1016/S1532-3382(12)70021-0
3. Dannan A: Minimally invasive periodontal therapy. J Indian Soc Periodontol. 2011;15:338-43. 10.4103/0972-124X.92565.
4. Steffer MR, Harrel SK, Rossmann JA, et al.: Comparison of Minimally Invasive and Conventional Flap Surgery for Treatment of Intrabony Periodontal Defects: A Pilot Case Controlled Study.J Contemp Dent. 2013;3:61-67. 10.5005/jp-journals-10031-1038
5. Aimetti M, Ferrarotti F, Mariani GM, Romano F. A.: A novel flapless approach versus minimally invasivesurgery in periodontal regeneration with enamel matrix derivative proteins: a 24-month randomized controlled clinical trial. Clin Oral Invest. 2017;21:327-337. 10.1007/s00784-016-1795-2
6. Zadeh, H. H. Minimally invasive treatment of maxillary anterior gingival recession defects by vestibular incision subperiosteal tunnel access and platelet-derived growth factor BB. Int J Periodontics Restorative Dent. 2011;31:653-660.
7. Dortaj D, Bassir SH, Hakimiha N, et al.: Efficacy of Nd:YAG laser-assisted periodontal therapy for the management of periodontitis: A double-blind split-mouth randomized controlled clinical trial. JPeriodontol.. 2022, 93:662-72. J Periodontol. 2022;93:662-72. 10.1002/JPER.21-0242.
8. Sultan N, Jafri Z, Sawai M, Bhardwaj A: Minimally invasive periodontal therapy. J Oral Biol Craniofac Res.2020;10:161-165. 10.1016/j.jobcr.2020.04.014
9. Balakrishnan A. , Arunachalam L. , & Sudhakar U: : Minimally invasive surgery in periodontics - a review. . IP. International Journal of Periodontology and Implantology. 2020;4:130-137. 10.18231/j.ijpi.2019.028.
10. Kučič AC, Gašperšič R.: Minimally invasive non-surgical therapy (MINST) in stage III periodontitis patients: 6-month results of a split-mouth, randomised controlled clinical trial. Clin Oral Investig. 2023;27:2075-2087. 10.1007/s00784-023-04994-4
11. Mehta J, Montevecchi M, Garcia-Sanchez R, et al.: Minimally invasive non-surgical periodontal therapy of intrabony defects: A prospective multi-centre

cohort study. J Clin Periodontol. 2024;51:905-914.10.1111/jcpe.13984

12. Aoki A, Mizutani K, Takasaki AA, : Current status of clinical laser applications in periodontal therapy. Gen Dent. 2009;57:94.
13. Zhang C, Zhang H, Yue Z, Miao L, Han Y, Liu K, Hou J: Modified minimally invasive surgical technique plus Bio-Oss Collagen for regenerative therapy of isolated interdental intrabony defects: study protocol for a randomised controlled trial. BMJ Open.2020;10:040046. 10.1136/bmjopen-2020-040046
14. Kaddas C, Dereka X.: Minimally invasive surgical techniques for the treatment of different types of isolated intrabony defects: A narrative review. Dent Med Probl. 2022;59:309-318. 10.17219/dmp/146540
15. Mishra, Akriti : Papillary Preservation Approach in The Treatment of Osseous Defects - A Report of 3 Cases .Journal Of Oral Medicine And Dental Research. 2024;5:1-7. 10.52793/JOMDR.2024.5(4)-71
16. Moreno-Rodríguez JA, Ortiz-Ruiz AJ: : Papilla preservation periodontal surgery in periodontal reconstruction for deep combined intra-suprabony defects. Retrospective analysis of a registry-based cohort. J Clin Exp Dent. 2021;13:769-775. 10.4317/jced.58265
17. Cortellini P, Prato GP, Tonetti MS: The modified papilla preservation technique. A new surgical approach for interproximal regenerative procedures. J Periodontol. 1995;66:261-6. 10.1902/jop.1995.66.4.261.
18. Dani S, Dhage A, Gundannavar G: The pouch and tunnel technique for management of multiple gingival recession defects. J Indian Soc Periodontol. 2014;18:776-80. 10.4103/0972-124X.147431
19. Hamid, A.M.F.A., Abou-Zeid, A.W.A. & Abdelfattah, M.Y.S: Root coverage surgeries using modified tunneling technique of xenogenic collagen matrix versus autologous connective tissue graft as a treatment of Miller class II gingival recession (RCT study).. Beni-Suef Univ J Basic Appl Sci. 2023;12:78.10.1186/s43088-023-00414-4
20. Sanz A, Anwandter A, Novoa F, Messina M, Valdés M: Entire papilla preservation technique for treatment of periodontal intrabony defects: a series of cases. Quintessence Int.. 2024;55:202-211. 10.3290/j.qi.b4920275
21. Ogawa Y, Yoshikawa K, Ishikawa T, Saito A, Imamura K: Double-sided entire papilla preservation technique in the combination periodontal regenerative therapy: A case report. Clin Adv Periodontics. 2024;14:100-107. 10.1002/cap.10258:
22. Pardo-Zamora G, Moreno-Rodríguez JA, Ortiz-Ruíz AJ. : Non-incised papilla surgical approach and leukocyte platelet-rich fibrin in periodontal reconstruction of deep intrabony defects: A case series. International Journal of Environmental Research and Public Health.. 2021;18:2465. 10.3390/ijerph18052465
23. Moreno Rodriguez JA, Caffesse RG: Nonincised Papillae Surgical Approach (NIPSA) in Periodontal Regeneration: Preliminary Results of a Case Series. . Int J Periodontics Restorative Dent. 2018;38:105-111.10.11607/prd.319
24. Fernández-Jiménez A, Estefanía-Fresco R, García-De-La-Fuente AM, Marichalar-Mendia X, Aguirre-Zorzano LA : Description of the modified vestibular incision subperiosteal tunnel access (m-VISTA)technique in the treatment of multiple Miller class III gingival recessions: a case series. BMC

Oral Health. 2021;21:142. 10.1186/s12903-021-01511-5

25. Reddy SSP. Pinhole Surgical Technique for treatment of marginal tissue recession: A case series. J Indian Soc Periodontol. 2017;21:507-511. 10.4103/jisp.jisp_138_17
26. Agarwal MC, Kumar G, Manjunath RGS, Karthikeyan SSS, Gummaluri SS: Pinhole Surgical Technique – A Novel Minimally Invasive Approach for Treatment of Multiple Gingival Recession Defects: A Case Series. Contemp Clin Dent. 2020;11:97-100. 10.4103/ccd.ccd_449_19
27. Simonelli A, Minenna L, Trombelli L, Farina R: Single flap approach with or without enamel matrix derivative in the treatment of severe supraosseous defects: a retrospective study. Clin Oral Investig. 2021;25:6385-6392. 10.1007/s00784-021-03941-5
28. Mathala VL, Konathala SV, Gottumukkala NV, Pasupuleti MK, Bypalli V, Korukonda R: Single-flap versus double-flap approach for periodontal pocket reduction in supraosseous defects: a comparative study. J Periodontal Implant Sci. 2021;51:239-253. 10.5051/jpis.2004200210
29. Cortellini P, Cortellini S, Bonaccini D, Tonetti MS: Modified minimally invasive surgical technique in human intrabony defects with or without regenerative materials-10-year follow-up of a randomized clinical trial: Tooth retention, periodontitis recurrence, and costs. J Clin Periodontol. 2022;49:528-536.10.1111/jcpe.13627
30. Mukhtar MI, Ibrahim RO, Mostafa RW, Kenawy SM: Clinical and radiographic evaluation of the entire papilla preservation (EPP) technique versus modified minimally invasive surgical technique (M-MIST) in treatment of intraosseous defects in patients with stage III periodontitis: A randomized clinical trial. International Journal of Health Sciences. 2022;6:2284-2301. 10.53730/ ijhs. v6n S6.10483
31. Ahmad N, Tewari S, Narula SC, Sharma RK, Tanwar N : Platelet-rich fibrin along with a modified minimally invasive surgical technique for the treatment of intrabony defects: a randomized clinical trial. . J Periodontal Implant Sci. 2019;49:355-365. 10.5051/jpis.2019.49.6.355