



Minimally Invasive Procedures in Periodontology: An Overview

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Abstract

Minimally invasive dentistry has been defined as a concept that preserves both the hard tissues (dentition) and the supporting soft tissue structures (gingiva and periodontal tissues) and includes both non-surgical and surgical techniques and procedures. The implementation of minimally invasive procedures such as Minimally Invasive Surgery (MIS), Minimally Invasive Periodontal Surgery (MIPS), Minimally Invasive Surgical Techniques (MIST), Modified Minimally Invasive Surgical Techniques (M-MIST) have also been developed to minimise the surgical trauma experienced by the patient and to reduce the duration of the surgical procedure. These procedures included minimal incisions and flap reflection and careful handling of the hard and soft tissues as well as the use of instruments such as operating microscopes, magnifying lenses, microsurgical instruments, and materials. The aim of this paper is to provide an overview of the current use of minimally invasive techniques and procedures in the non-surgical and surgical management of periodontal disease(s).

Keywords: Minimally invasive procedures; Non-surgical; Review; Surgical procedures

Introduction

The traditional understanding of how to treat both dental caries and periodontal disease has been challenged over the last 30 years and there has undoubtedly been a seismic shift in how to treat both conditions. For example, in the treatment of

dental caries there has been a greater emphasis in early detection and prevention (involving both the clinician and patient) and a move away from the 'extension for prevention' philosophy to a more conservative approach (minimally invasive dentistry). The treatment of periodontal disease has also seen a paradigm shift in how to treat periodontal disease and rather than intentionally removing hard tissue (for example: cementum) to remove calculus and render the root surface hard and smooth and as such a simple disruption of the biofilm covering the hard tissues of the teeth may be suffice for clinical improvements [1]. According to Ower [1], the successful management of periodontal disease, by both non-surgical and surgical procedures is the establishment of optimal self-performed biofilm control by the patient prior to treatment. In other words, it is the disruption of the plaque biofilm by the patient and clinician that is clearly essential for the successful treatment and management of periodontal disease. The implementation of minimally invasive procedures such as Minimally Invasive Surgery (MIS), Minimally Invasive Periodontal surgery (MIPS), Minimally Invasive Surgical Techniques (MIST), Modified Minimally Invasive Surgical Techniques (M-MIST) have also been developed to minimise the surgical trauma experienced by the patient and to reduce the duration of the surgical procedures. These procedures included minimal incisions and flap reflection and careful handling of the hard and soft tissues as well as the use of instruments such as operating microscopes, magnifying lenses, microsurgical instruments, and materials [2-6]. Although minimally invasive therapeutic approaches have become the standard of care for numerous medical procedures, the use of minimally invasive

techniques in both non-surgical and surgical periodontal therapy has not progressed at the same rate [6]. The aim of this paper is to provide an overview of the current use of minimally invasive techniques and procedures in both non-surgical and surgical management of periodontal disease(s).

Non-Surgical and Surgical Procedures in Periodontology

There are several techniques and procedures that are available to treat periodontal disease successfully ranging from non-surgical to surgical procedures which may be supplemented by adjunctive anti-microbial therapy, surgical material etc. to either maintain or enhance both hard (bone) and soft (gingivae, connective) tissue. Using minimally invasive procedures to fulfill these aims has increased in popularity over the last two decades due in part to an improvement in dental material, equipment e.g., improvement in ultrasonic scaling tips) and improvement in surgical techniques designed to minimise the trauma to both hard and soft tissues. An important aspect that is often overlooked when treating patients with periodontal disease is the impact of providing oral hygiene instructions before the treatment phase [7-9]. The importance of teaching aids in the form of video, charts and oral instruction in tooth brushing studies have also been shown to be beneficial in reducing plaque levels [10-11].

Non-surgical procedures

According to Ower [1] a very persuasive case can be proposed for non-surgical disease management, in terms of better treatment outcomes, compared to surgical procedures particularly in pockets up to 6mm in depth. Although studies have shown that surgical procedures may be of short-term benefit in pockets ≥ 6 mm, Ower [1] argues that the evidence from long-term studies suggests that non-surgical treatment may be as effective as surgical treatment in the deeper pocket.

In keeping with the change in the philosophical approach to periodontal treatment the question may be raised as to what measures would be required to disrupt the dental biofilm objective without initiating any damaging changes to either the soft or hard tissues. Several suggestions have been made that may minimise these effects such as the use of a diode laser [12], full mouth disinfectant procedures [13], and sub gingival air polishing [14]. A review by Nibali et al. [15] assessed the efficacy of minimally invasive non-surgical therapy (MINST) in the treatment of periodontal infrabony defects based on a retrospective analysis of 35 infrabony defects in 23 subjects and concluded that MINST procedures led to both clinical and radiographic improvements in the infrabony defects.

Surgical Procedures in Minimally Invasive Periodontal Surgery (MIPS/MIST)

The application of microsurgical concepts recognised in Medicine would therefore appear to be very appealing in periodontal surgery and it is evident from reviewing the periodontal literature that these concepts have gradually been

implemented in Dentistry with a view to minimise the surgical trauma experienced by the patient and to reduce the duration of the various surgical procedures used in periodontal therapy. These procedures include minimal incisions and flap reflection and careful handling of the hard and soft tissues as well as the use of innovative instruments, such as operating microscopes, magnifying lenses, microsurgical instruments and materials [16-17].

Furthermore, the development and modification of various techniques and procedures such as Minimally Invasive Surgery (MIS), Minimally Invasive Periodontal Surgery (MIPS), Minimally Invasive Surgical Techniques (MIST), Modified Minimally Invasive Surgical Techniques (M-MIST) and Video scope MIS (VMIS). These techniques have also been used in conjunction with regenerative materials in Guided Tissue Regeneration (GTR), augmentation procedures, marginal gingival recession defects using restorable barrier membranes, connective tissue grafts, flapless surgical techniques with or without enamel matrix derivatives (EMD) etc., [18-28].

There are several disadvantages following conventional surgical procedures which include post-operative healing complications, such as pain and swelling which may be related to flap design, duration of the procedures, extent of visualisation of the defect depth and the materials used during the procedure. For example, the wide extensive nature of the incisions within the flap design to visualise the extent of the periodontal problem may have an impact on post-operative healing. Several investigators have modified surgical periodontal procedures to preserve the periodontal tissues wherever possible for example in the papilla preservation technique and its subsequent modifications (modified and simplified papilla preservation techniques) [29-30].

According to Dannan [23], the main objectives of MIPS/MIST procedures are as follows:

- (1) Reduce surgical trauma,
- (2) Increase flap/wound stability,
- (3) Allow stable primary closure of the wound,
- (4) Reduce surgical chair time, and
- (5) minimize patient discomfort and side effects.

Advantages of Minimally Invasive Periodontal surgery (MIPS)

The concept of MIPS/MIST procedures would suggest that it is a method of gaining surgical access without the disadvantages associated with more traditional surgical procedures, such as minimizing the flap design and tissue trauma, smaller incisions etc. There are several relevant outcomes arising from this type of less invasive procedure, such as the maintenance of the blood supply to the surgical area and the stabilisation of the blood clot during the initial stages of the wound healing process. It has also been reported that there is less post-operative recession with MIPS/MIST procedures [5, 23].

Disadvantages of Minimally Invasive Periodontal surgery (MIPS).

One of the problems in using these minimally invasive techniques is that by minimising the extent of flap design, this may in turn restrict the field of vision for the operator. Another problem may relate to the development of MIPS/MIST procedures as clinicians have continually modified the original technique to improve the procedure, for example, using elements of a papilla preservation techniques with less invasive incision designs [25]. According to Jaffray [31] cited by Dannan [23] there are, disadvantages associated with these procedures such as:

- Requires specialist training in MIPS/MIST procedures
- Specialist equipment may be required (e.g., microscopic visualisation [surgical microscopes and video scopes], magnification loupes, fiber optics)
- Additional equipment may add considerable expense to the practice
- Some procedures may take longer compared to conventional procedures
- Precision and accuracy of microscopic visualisation may be limited in terms of the depth of field/access in periodontal defects, e.g., limitations within the fibre system (Jaffray [31] cited by Dannan[modified]) [23].

Discussion and Conclusions

Although there have been developments in MIPS/MIST procedures over the last twenty-five years, it is important to acknowledge the role of non-surgical procedures (including patient education) in minimally invasive procedures in periodontal therapy and not solely focus on surgical procedures and new materials. For example, Ower [1], argued passionately that to successfully manage periodontal disease, it is essential for the patient to take ownership of their oral care by establishing optimal self-performed biofilm control through effective oral hygiene procedures (tooth brushing, mouth rinsing, interdental cleaning etc.) prior to any treatment and in any subsequent maintenance following treatment. Other investigators such as Zingale et al. [12] used a diode laser to compare several closed and open procedures and reported that the selected closed approach therapies such as SRP, laser-curettage/SRP, and laser-curettage/SRP/laser-sealing resulted in less marginal gingival recession than the open approach (papilla reflection/flap closure). One advantage of the closed approach using a diode laser compared to the open approach therefore may be where patients are concerned about aesthetics. According to Mizutani et al. [32] despite the somewhat limited positive gains from the adjunctive use of lasers in periodontology, there does not appear to be any statistically significant differences in clinical parameters such as pocket reduction and clinical attachment gain compared with mechanical debridement procedures. Other investigators such as Grazani et al. [28] have utilised a flapless technique with or without EMD and reported that there was a higher degree of periodontal healing in sites with PPDs (deep

periodontal pockets) ≥ 6 mm at 3 months. According to these investigators using this technique with EMD may constitute a viable option in improving the periodontal status of the deeper periodontal pocket (following treatment) as well as reducing the need for any additional surgical intervention. Other non-invasive options may also be relevant in the treatment of exposed root surfaces and sub gingival debridement, for example, air polishing procedures, adjunctive local/systemic antimicrobials, and the use of desensitizing toothpastes, mouth rinses, varnishes, or sealants in marginal gingival recession defects rather than involving surgical procedures to cover the root surface [12, 14, 33-35].

Despite the tremendous progress over the last two-three decades nevertheless there appears to be limited data (in terms of evidence from randomised clinical trials and systematic reviews comparing both conventional and innovative minimally invasive procedures. Although the introduction of minimally invasive procedures into periodontal practice has made an impact on both clinical parameters and patient outcomes it was evident that most of the published studies were provided by clinicians in specialist and hospital practices with experience in MIPS/MIST procedures. These procedures are very technique sensitive and require considerable expenditure for the clinician in terms of specialized equipment and surgical instruments and this perhaps may be a barrier for the techniques to be transferred into clinical practices outside the specialist or hospital environment. A comprehensive systematic review by Reddy et al. [26] outlined the advantages of MIPS/MIST procedures compared to the more traditional surgical approach suggesting that these procedures can provide an additional tool to treating periodontal disease(s) more effectively. Currently there is emphasis on observing patient outcomes in clinical research rather than just focusing on collecting clinical data looking at relatively small gains in pocket depth and attachment levels. Perhaps in future, focusing on the outcomes of the clinical procedures from the patient's point of view in terms of their Quality of Life such as reduced trauma, less stress and operating time during the surgery, the resultant aesthetics, minimizing post-operative pain as well as patient acceptance may be more relevant when evaluating the benefit of these procedures [18].

In conclusion it is important to recognise the importance of non-surgical procedures in the treatment of periodontal disease not simply as a precursor to subsequent surgical intervention but as an alternative treatment within the minimally invasive philosophy. MIPS/MIST procedures may therefore provide the clinician with more options in the treatment of periodontal disease(s) although there is a requirement to undertake specialist training in the use of the instruments, procedures, and materials. There is also a requirement for future studies to compare the effectiveness of the various minimally invasive techniques with traditional techniques together with patient-centered outcomes in randomized clinical studies.

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Recommended reading

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