DOI: 10.7860/JCDR/2022/56120.16795

Review Article

Dentistry Section

Enhanced Periodontal Debridement with Periodontal Endoscopy (Perioscopy) for Diagnosis and Treatment in Periodontal Therapy

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ABSTRACT

The perioscope, which was only recently introduced, has greatly improved the removal of subgingval calculus during periodontal therapy. A fibre-optic periodontal endoscope was created to aid in the imaging of subgingival tissues and to improve periodontal disease diagnosis and treatment. Scaling and root planing have the goal of completely removing plaque and calculus from root surfaces. While this is unachievable, the agreed end-point during periodontal instrumentation is a smooth, glassy root surface. This has frequently led in over instrumentation and excessive cementum removal. Cement removal has been judged unnecessary in most cases. The removal of plaque, calculus, and endotoxin adhered to the root surface is critical. The easiest way to clean root surfaces is to use powered instruments sparingly. Due to a lack of visibility, excessive cementum removal occurs during hand instrumentation. The ability to visibly debride roots using endoscopic technology can improve success rates in a more conservative and minimally invasive manner. The perioscopy device was created to visualise the subgingival region for diagnosis, but it has since been altered to help with periodontitis therapy. The perioscope is a small camera that is encased in a sleeve and inserted under the gingival sulcus or pocket for subgingivally visualisation and instrumentation. This technique gives the greatest conservative approach to non surgical and surgical periodontal care because it enables superb magnified visualisation of the root surface and ensures the total or near complete elimination of the bacterial infection. The aim of this brief review was to provide knowledge about periodontal endoscopy, its implementation in day today practice.

Keywords: Armamentarium, Charge-coupled device camera, Fibre-optic, Magnification microdentistry, Scaling and root planning

INTRODUCTION

Traditional periodontal therapy was based on the removal of plaque biofilms and calculus deposits from the tooth and root surfaces using manual and powered scalers and root planing devices [1,2]. The success of this treatment is determined by a number of parameters, including subgingival access, root morphology, defect magnitude, and the periodontist's tactile skills. Therefore, visualisation of the root surface under magnification was thought to increase the value of periodontal treatment [1,2].

Every patient is entitled to the highest level of treatment. Every treatment plan is a chance to be as minimally intrusive and as effective as feasible [3]. The introduction of devices and materials to assist the periodontist in both diagnosing and managing treatment at the earliest possible stage can sometimes be employed to improve the achievable outcomes [3]. Fibre-optics have only recently been applied to dentistry. Particularly in the branch of periodontics, intrinsic restrictions such as visual and physical access to the disease-affected location of the periodontal pocket may be overcome through the use of fibre-optic technology [3].

Microdentistry is a new idea that involves employing magnification under direct observation and instrumentation with a reduced armamentarium [3]. Microdentistry treatment paradigm is to detect early, treat less, and thereby, maintain more of the original healthy oral tissues. The use of a perioscope, a miniature dental endoscope, for both detection and treatment of periodontal disorders is the most current advancement in periodontics micro-dentistry [4].

Perioscopy, also known as periodontal endoscopy, is a treatment that combines a small dental endoscope with advanced video, illumination, and magnification technologies for subgingivaly imaging, allowing us to detect and treat the subgingival region as conservatively as possible [4]. This fibre-optic technology is employed by the perioscope to make better visualisation of periodontal pocket and a clear and enlarged view of the root surface and unapproachable locations [4]. Subgingival calculus remains, ulcerated sulcular epithelium, and cemental perforations can all be detected using the perioscope [4].

PARTS OF PERIOSCOPE

Following are the parts of perioscope [5,6]:

Fibre-optic Strand

A perioscope is made up of a sheath and a 0.5 mm fibre-optic strand. At the end of a two meters long fused fibre-optic bundle with 10,000 individual light-directing fibre pixels, a gradient index lens is installed. Fifteen huge core plastic fibre-optic strands surround the fused bundle and lens, providing light to the operating site from distance bulb [5,6].

Sterile Sheath

The subgingival region is the seat of infection in a periodontitis patient, the fibre-optic strand's distal tip must be sterilised with sterile disposable sheathif it comes into direct contact with any of the subgingival tissues. The endoscopic fibre-optic strand's lifetime is limited by repeated sterilising cycles (12 autoclave cycles for each tip), they are time taking and unfeasible for a full mouth screening with several pockets. The fibre-optic strand is enclosed in a sterile disposable sheath that may be discarded after each use and acts as a barrier against subgingval infection. The fibre-optic wire can be clearly seen through the sapphire glass in the sheath [5,6].

Peristaltic Pump

There is a risk of bleeding within the gingival pocket because the subgingival region of a pocket is inflammatory and bleeding will hinder vision from the perioscope. The perioscope contains a pulsatile peristaltic pump that keeps continuous water spray maintaining the working field free of blood and debris. A separate water tube connects the sheath to a peristaltic pump, which drives water from the strand to the strand's end, irrigating the working field [5,6].

Charge Coupled Device Camera

The sheath's sapphire lens focuses on the tooth's surface and sends the image to a video sensor chip camera through a fibre-optic thread [5]. This CCD is a video camera that uses a camera coupler to magnify and focus the image onto the CCD sensor. The camera's control unit digitises and converts the CCD's electric impulses into a standard S-video output, which is presented on an active matrix Liquid Crystal Display-Thin Film Transistor (LCD-TFT) monitor. The objective lens has a field of view of 70° in air, but it is reduced to 53° in water and other less-than-ideal environments [5]. The image of the root and pocket on the LCD panel is improved with magnifications ranging from 22 to 48 [5,6].

Microsurgical Instruments

Curettes, explorers, and ultrasonic scalers are some of the latest endoscopic tools available. A gingival retractor (soft tissue shield) is now linked to the curette blade [5]. The gingival tissue is kept away from the endoscope's tip using this retractor, to see the curette blade and tooth surface visibly. The distal tip features a gingival retractor fashioned into it. The ultrasonic adapter is made up of a collar, a strut, and a tube, all of which are stainless steel [5]. To keep the collar in place, it is screwed into the end of a standard ultrasonic scaler. The scaler tip as well as surrounding tooth surface are viewed through the endoscope window sheath. The distal tip of the tube is also fixed upfor irrigating fluid, while gingival tissue retraction ensures an unobstructed view of the active tip [5,6].

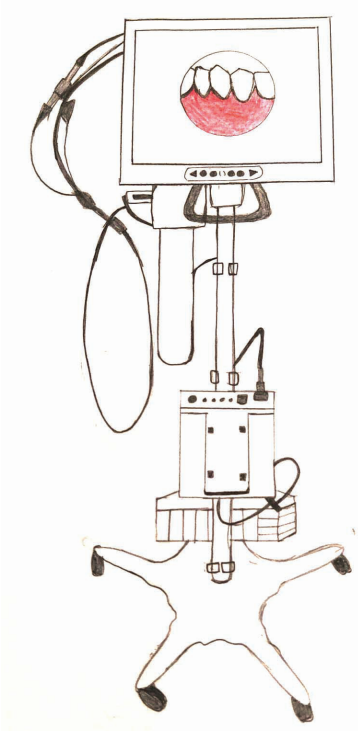
PERIOSCOPY

Indications of Perioscopy Procedure

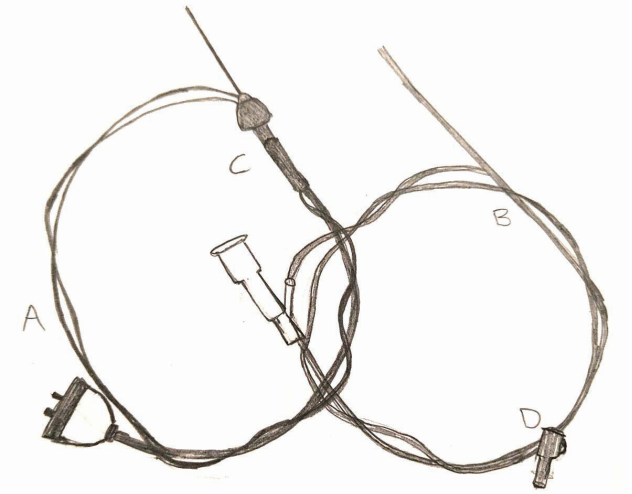
1. Endoscopic visualisation and treatment will assist any periodontal problem with a probing pocket depth of greater than 4 mm [5].
2. Abnormal root deformities and anatomical changes can be detected, followed, and repaired without recurrence [5].
3. The adjunctive use of perioscope provides some benefit to the treatment outcomes of non surgical periodontal therapy, especially, at deeper probing depths [7].
4. Periodontal microsurgery allows in cases of teeth with a poor prognosis and limited access to abnormalities to be repaired with less invasive equipment and improved treatment outcomes [8].

Perioscopy Procedure

While most people can be treated without anaesthetic during a perioscopy appointment, there is typically little discomfort. For mild to advanced periodontitis, full mouth treatment takes an average of 90-120 minutes, however these time-frames are predicated on a dental expert, who is very efficient with a perioscope. On the LCD screen, the periodontist can see the magnified root surface at a magnification of 24X to 48X and around 3 mm of the root is checked at a time [5]. The perioscope is held with left hand by the clinician and debridement instrument is held in the right. Periodontal Endoscopy (PE) is a minimally invasive method that improves dental practitioners' ability to detect and remove calculus by allowing them to see the periodontal area more clearly [9]. [Table/Fig-1,2] provide a diagrammatic representation of the perioscopy system and its components.



[Table/Fig-1]: Diagrammatic representation of the perioscopy system and its components (Image hand drawn by authors).



[Table/Fig-2]: Components of a perioscope. A) Fibre-optic bundle; B) Sterile disposable sheath; C) Spring tension connection; D) Connection to the water supply.

Role of Periodontal Endoscopy in Diagnosis

The periodontist with the use of perioscope can visually evaluate the gingival pocket in a magnified and lighted view, looking for biofilm, root deposits, granulation tissue, caries, and root fractures. Periodontist can rule out the confirm diagnosis and treatment plan with the help of periodontal endoscope [5].

Advantages of Perioscopy

1. A perioscope allows the periodontist to observe the subgingival morphology in the least invasive method possible, for diagnosis and improved management strategies for root and soft tissue debridement. In traditional method the effectiveness of calculus removal decreases substantially with increasing pocket depth anatomy can inhibit calculus removal with an increased prevalence of residual deposits being associated with the cementoenamel junction, line angles and furcations [10].
2. Accurate visualisation of the root surface under magnification allows the most effective instrumentation possible. It is important to ensure that the root surface is not over-instrumented, which could result in loss of unaffected cementum or post-treatment sensitivity.

3. The main advantage of perioscope is the enlarged visualisation of subgingival calculus adhering to the root surfaces.
4. The perioscope allows us to accurately see and demarcate any root surface anatomical aberrations or anomalies such as line angles and furcations, dilacerations that may compromise periodontal health maintenance after treatment [10].
5. Finally, the adoption of the least invasive methods improves long-term treatment outcomes by reducing harm to healthy surrounding tissues while efficiently treating the disease [5].
6. The level of perceived pain or discomfort with the periodontal endoscope was significantly less than that experienced during periodontal probing [7].

Disadvantages of Perioscopy

1. The time element is perioscope's first and greatest disadvantage. Despite being a game-changing tool in several aspects [5].
2. Second, while the majority of patients can be treated deprived of anaesthetia, a small percentage of patients feel discomfort without anaesthesia and hence, require the same level of anaesthesia as traditional periodontal surgical treatments [5].
3. Finally, when compared to traditional periodontal care, the use of a perioscope necessitates distinct clinical abilities, and achieving expertise requires training and time to become accustomed to the device [5].

Limitations of Perioscopy

It is a technique-dependent procedures so requires skilled dentist, necessitates a longer treatment period. It is expensive in comparison with traditional periodontal treatment. In condition such as constricted arch or broad arch, rotated, crowded teeth, anterior or posterior likely to have impact on outcomes [11].

DISCUSSION

A periodontal endoscope is a costly purchase in and of itself; a whole mobile equipment must be calculated at roughly 30,000 Euro. A sterile replacement sheath, costing roughly 80 Euro, is necessary for each patient [11].

In a 2007 study, Geisinger ML et al., compared the efficacy of periodontal endoscope assisted Scaling and Root Planing (SRP) to SRP alone, finding that the periodontal endoscope resulted in a statistically significant overall improvement in calculus removal during SRP, there was 2.14% (p-value <0.001) more residual calculus at control versus test sites. At buccal/lingual and interproximal surfaces, mean differences in residual calculus were 1.30% (p-value <0.015) and 2.93% (p-value <0.001), respectively [12].

Blue CM et al., investigated whether the adjunctive use of a periodontal endoscope enriched periodontal outcomes when compared to scaling/root planing alone in a randomised split mouth study in 2013. The authors found that the perioscope improved gingival inflammation and bleeding upon probing but was not superior to traditional SRP in terms of pocket depth reduction and clinical outcomes. There was no discernible difference between the two groups [13].

In a randomised controlled clinical trial by Wu J et al., evaluated the efficacy of PE during SRP of residual pockets in chronic periodontitis patients after initial periodontal treatment, and found that SRP+PE resulted in significant reductions in Pocket Depth (PD) was 3.12±0.63 mm and Plaque Index (PLI) 0.49±0.21 compared to SRP alone in residual pockets less than 5 mm where p-value=0.001 for PD and p-value=0.021 for PLI [14].

The therapeutic benefits of periodontal endoscope-assisted and traditional subgingival scaling on residual pockets were compared by Xu YJ et al., in 2021. The authors determined that subgingival scaling with a periodontal endoscope produced superior results than traditional subgingival scaling [15].

The perioscope as an adjunct to non surgical periodontal therapy was evaluated clinically and radiographically by Naicker M et al., in 2021. The authors concluded that using the perioscope as an adjunct to non surgical periodontal therapy provided a lesser advantage to the outcomes of non surgical therapy, mainly at deeper Periodontal Probing Depth (PPD) [16].

Graetz C et al., studied the effects of periodontal endoscopy-assisted nonsurgical treatment of periodontitis for four months results of a randomised controlled split mouth pilot study in which At the patient level (10/10 (male/female; age 54.3 (10.9) years), no significant differences were detected between or between the groups for Bleeding on Probing (BOP). In PE, a decreased number of surfaces with BOP (p-value=0.026) was detected at the tooth surface level. Clinical Attachment Level (CAL) and PD have both improved. Both groups showed significant PD reduction (p-value ≤0.001) and CAL gain (p-value ≤0.001) during Non Surgical Periodontal Therapy (NSPT), with PE showing stronger PD reduction (p-value <0.001) and CAL gain (p-value <0.001). There are more surfaces with subgingival Hard Deposit (HD) seen in PE at T0 (p-value=0.001) and a substantially longer treatment time per tooth (p-value <0.001). Authors concluded that subgingival HDs can be visually detected with PE during NSPT, no additional clinical benefits regarding BOP, PD, or CAL were notable compared to conventional systematic periodontal instrumentation. Additionally, PE-assisted NSPT required a longer treatment time [17].

Poppe K and Blue C, determined the amount of pain reported by subjects with periodontal disease after experiencing the use of a periodontal endoscope compared with the use of a periodontal probe during calculus detection. The results of the study showed the level of perceived pain was significantly lower with the periodontal endoscope in comparison to the use of a probe (mean visual analogue scale was 33 mm versus 60.2 mm, p-value <0.001). Subjects who presented with some sort of dental anxiety expressed increase in pain levels, but these levels were not found to be statistically significant. Authors concluded, that, subjects did not find the periodontal endoscope to elicit significant anxiety or pain during subgingival visualisation [18].

Wilson Jr TG evaluated the positive relationship between excess cement and peri-implant disease: a prospective clinical endoscopic study in which, none of the controls and all 42 test implants showed clinical symptoms of peri-implant disease. There was no excess cement in any of the controls or 34 of the test sites. Thirty days after the removal of cement, it was found that 25 of the 33 test locations did not show any clinical or endoscopic evidence of inflammation. Excess dental cement was linked to symptoms of peri-implant disease in the majority of patients (81%) according to the authors. After the extra cement was removed, 74% of the test implants showed no clinical or endoscopic symptoms of peri-implant illness [19].

Liao YT et al., compared the clinical effects of periodontal treatment using periodontal endoscope with that of conventional treatment method for patients with periodontitis. At the beginning, at the end of six weeks, and at the end of three months, there were no significant differences between the two groups. However, for sites with PD 6 mm in anterior teeth, the PD value in the test group was substantially lower than that in the control group at the end of three months, 3.20±0.9 mm vs 3.70±0.9 mm, p-value=0.05. While AL value was lower 2.9±1.2 mm vs 3.6±1.3 mm, p-value=0.061. Author concluded that, the use of an endoscope for periodontal treatment is clearly effective, especially in the medium and long term prognosis of deep pockets and single-rooted teeth [20].

Periodontal probing depth was reduced after SRP with the help of a periodontal endoscope, without vertical alveolar bone resorption or furcation involvement non surgical periodontal therapy benefits from PE [13-17]. Even with the benefits of this novel method for periodontal therapy, more clinical research is needed to confirm perioscopy's usefulness as a frontline periodontal therapeutic alternative [5].

CONCLUSION(S)

The root surface area is remarkably cleaned and devoid of debris and calculus after perioscope-assisted periodontal debridement. The most significant purpose to utilise a perioscope is to improve treatment outcomes by minimising PPD and enhancing root surface attachment gains. This is beneficial to the tissues in the local area. Because of the magnification, the periodontist may diagnose and rectify abnormalities earlier than with traditional treatment approaches. Early management reduces treatment times and slows disease progression, avoiding the need for advanced periodontal surgery.

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PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Mar 09, 2022
- Manual Googling: May 18, 2022
- iThenticate Software: Jul 29, 2022 (22%)

ETYMOLOGY: Author Origin

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was informed consent obtained from the subjects involved in the study? No
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Mar 05, 2022**
Date of Peer Review: **Apr 04, 2022**
Date of Acceptance: **Jun 04, 2022**
Date of Publishing: **Aug 01, 2022**