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Perioscopy in Periodontal Therapy- A Literature Review

[1] Varsha Jadhav, [2] Sonali Chaudhari, ,[3]Sayali Dethe
[1] Professor and Head of Department, [2,3] Post Graduate Student
[1,2,3]Department of Periodontology and Implantology, Yogita Dental College and Hospital, near Narangi river, Khed, District- Ratnagiri, Pin-415709 Maharashtra

***Corresponding Author:**
Sonali Chaudhari
Department of Periodontology and Implantology, Yogita Dental College and Hospital, near Narangi river, Khed, District- Ratnagiri, Pin-415709 Maharashtra

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Abstract

The Perioscope, which was recently introduced, has greatly enhanced the removal of subgingval calculus during periodontal therapy. The Perioscopy system was originally devised to visualise the subgingival region for diagnosis, but it has now been altered to help with periodontitis therapy. The Perioscope is a small camera that is placed inside a sleeve and inserted under the gingival sulcus or pocket for subgingivally visualisation and instrumentation. The subgingval pictures from the Perioscope are immediately shown on a chairside monitor or video screen as real-time movies with magnification ranging from 24-X to 48-X times, revealing even minute details of root surface diseases that could be missed under conventional visualisation. 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.

Keywords: Nil

Introduction:

Conventional periodontal therapy was based on the concept of debridement of the tooth and root surfaces by eliminating plaque biofilms and calculus deposits with manual and motorised scalers and root planing devices. This approach to minimise the bacterial load in the subgingival environment was carried out utilising either tactile feeling in closed pockets or flap surgery under direct visualisation of the root surfaces. The success of this treatment was determined by a number of parameters, including subgingval access, root morphology, defect magnitude, and the periodontist's tactile skills. Manual mechanical debridement is not a foolproof approach, as proved by Brayer et al and Sherman etal, and some residual root deposits remain even after periodontal treatment[1]. As a result, amplification of the root surface is possible.The periodontal dental explorer is the classic approach for detecting subgingival calculus, although its effectiveness is dependent on the operator's tactile sensibility. Since a smooth and clean root surface is frequently regarded the goal of scale and root planing, doctors frequently remove excessive quantities of the root structure to improve visibility[2]. Several unique approaches have recently been developed to aid in the identification of dental calculus.The use of a miniature dental endoscope called the Perioscope for both diagnosis and treatment of periodontal diseases is the most recent innovation in micro dentistry as applied to periodontics. Perioscopy, also referred as periodontal endoscopy, is a procedure that combines a miniature dental endoscope with advanced video, lighting, and magnification technology to allow for easy visualisation sub-gingivally, allowing us to diagnose and treat the subgingival region as conservatively as possible[3]. The root surface can be magnified using a fibre optic bundle with a diameter of roughly 1 mm that can be introduced into the periodontal pocket. The optical probe, which is based on light-emitting diodes, recognises the precise spectral signature created by the absorption and reflection of a specific location and uses this signal to identify subgingival dental calculus from sound enamel.[4]

The purpose of this review is to compile existing evidence on the history, components, and applications of perioscopy.

History:

Perioscopy is a microsurgical dental endoscope that allows clinicians and hygienists to examine tooth structure underneath the gum tissue with magnified details. It comprises of an outer case with mirrors positioned parallel to each other at a 45° angle. With the addition of two basic lenses, this type of periscope was used in the trenches during World War I for observation[5]

The development of magnification loupes, which were worn throughout the years or mounted on a head band with magnifications ranging from 2x to 8x, was the first introduction of micro-dentistry to periodontics. The weight of the device and the glare from the lenses were both disadvantages of utilising loupes. The microscope, either floor or wall mounted with magnification ranging from 4-X to 22-X, was the second instrument to be introduced for periodontal microtherapy. However, the floor-mounted surgical microscope had the drawback of being inaccessible to convoluted pockets and 3-wall bony deformities.[6]

The Perioscope And Its Components:

A Perioscope is a dental endoscope (endo means "within" and scope means "observe or look at"), and the procedure using this tool is known as Perioscopy. It is used to view inside the pockets between the gum and teeth at high magnifications[7]. A 0.5 mm diameter fiber-optic strand is put into a sheath to establish a sterile barrier between the patient's tissue and the Periscope which is the basic component of a Perioscope.

The following are the remaining components:

***The Fiber-Optic Strand*:** The device consists a gradient index lens installed on the end of a 2m long fused fiber-optic bundle having 10,000 individual light directing fibre pixels). 15 big core plastic fiber-optic strands surround the fused bundle and lens, providing illumination light from a remote lamp to the operational site. This assembly is housed in a flexible plastic tube with a spring-activated connector and a sheath at the distal end.Optical connectors for the illuminating light and the camera are located on the endoscope's other end.

***The Sterile Sheath*:** Since the subgingival region of a periodontitis patient is a very infectious area, sterilisation of the tip of the fiber-optic strand (of the Perioscope) is required if the distal tip of the fiber-optic strand (of the Perioscope) comes into direct touch with any of the sub gingival tissues. However, because numerous sterilisation cycles limit the endoscopic fibre-optic strands' longevity (12 autoclave cycles for each tip), they are time demanding and impracticable for a whole mouth inspection with several pockets. To encapsulate the fibre-optic strand, a sterile disposable sheath was designed, which can be discarded after each usage and provides an effective barrier against subgingval infection. A sapphire window in the sheath allows the fiber-optic strand to be seen clearly.

***The Peristaltic Pump*:** Because the subgingval region of a periodontal pocket is a highly inflamed area, there is a considerable risk of bleeding within the gingival pocket. By filling the pocket area beneath the fibre-optic strand with blood, this bleeding will obstruct the vision from the Perioscope, necessitating the use of an irrigation device connected to the Perioscope. It's been accomplished by adding a pulsatile peristaltic pump to the Perioscope, which maintains a steady water spray beneath the fibre-optic strand, maintaining the working area clear of blood and debris. The sheath is connected to a peristaltic pump via a separate water channel, which then circulates water around the strand to the strand's end, irrigating the working field.

The CCD Camera: The sapphire lens at the end of the sheath focuses on the tooth's surface and feeds the picture back to a video sensor chip camera (CCD) through the fiber-optic thread . This CCD is a medical-grade video camera that is linked to a camera coupler that enlarges and focuses the picture onto the CCD sensor. The cameras control unit digitises and converts the electric signals from the CCD into a standard S-video output, which is then shown on an active matrix LCD-TFT monitor. The

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objective lens has an effective field of view of 70 degrees in air, but it is reduced to 53 degrees in water and other less-than-ideal conditions. The image of the root and pocket on the backlit LCD panel is an improved image with magnifications ranging from 22-x to 48-x. The periodontist can visually investigate the gingival pocket using the Perioscope, detecting the specific position of the biofilm, root deposits, granulation tissue, caries, and root fractures in a greatly enlarged and illuminated image.

Micro-Surgical Equipment: A new collection of instruments, including curettes, explorers, and ultrasonic scalers, has been designed for use with endoscopes. On the blade of the curette, a gingival retractor (soft tissue shield) has been introduced. This retractor keeps the gingival tissue away from the endoscope's tip, allowing for a clear view of the curette blade and tooth surface. At the same time, the explorer is a periodontal probe. It's a stainless steel tube with a handle that takes the endoscope's window sheath. The distal tip has been sculpted to function as a gingival retractor. A collar, a strut, and a tube make up the ultrasonic adapter, which is likewise made of stainless steel.The collar attaches to the end of a regular ultrasonic scaler and is secured with a screw. After that, the tube is positioned alongside the scaler tip, and the endoscope window sheath is placed on the endoscope's tip in the proper position to view the scaler tip and adjacent tooth surface. The tube's distal tip is also designed to retraction gingival tissue, allowing for unimpeded vision to the active tip while also assisting in the direction of the irrigating fluid.[8]

Indications:

1. Initial periodontal therapy;
2. Sites that have not responded to traditional nonsurgical debridement;
3. Maintenance patients with chronically inflamed, or increasing probing depths;
4. Residual probing depths in maintenance patients who refuse surgical therapy and/or where surgery is contraindicated for medical, or esthetic reasons;
5. Suspected subgingival pathology such as caries, root fractures, perforations, or resorption.[9]

Advantages And Uses:

1. To observe the subgingival morphology in the minimal invasive method possible, allowing for more accurate diagnosis and improved management strategies for a comprehensive root and soft tissue debridement.
2. To detect perforations and other disease entities of the root surface, as well as cracks in the tooth for endoscopic treatment options
3. Improved tactile perception of subgingival calculus.
4. Magnified root surface area for accurate visual accessibility which enables periodontist to perform the most efficient instrumentation possible, but also to ensure that the root surface is not over-instrumented, which could result in loss of unaffected cementum or post-treatment sensitivity.
5. To appropriately identify and demarcate any root surface anatomical aberrations or deformities that may impact periodontal health maintenance after treatment
6. Utilised to find and remove foreign material that could cause future harm to the implant-supporting bone or interfere with bone rebuilding surrounding the implant

Disadvantages:

1. The time element is Perioscope's first and greatest disadvantage. Despite being a groundbreaking tool in many aspects, the Perioscope still has a treatment time factor that is comparable to traditional periodontal therapy.[10]
2. Even though the majority of patients are able to get treatment without anaesthesia, a small percentage of patients suffer discomfort in the absence of anaesthesia and therefore need the same amount of anaesthesia as traditional periodontal surgical treatments.
3. When compared to traditional periodontal therapy, it necessitates new clinical abilities, and proficiency requires training and time to become accustomed to the technology.

Discussion:

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SRP has remained virtually intact as a standard therapy technique for decades. However, traditional SRP lacks visual accessibility, tactile perception, sensitivity, specificity, and reproducibility. More supplementary therapy methods, including as laser-based technology, spectro-optical technology, autofluorescence, and endoscopy, are emerging as advances in periodontology techniques. Endoscopy is a minimally invasive procedure that clinicians have successfully employed to meet their standards of care in a variety of medical disciplines. However, dental practitioners have not evolved to the same extent in their use of endoscopic procedures in periodontal care. Stambaugh and colleagues described the anatomy of periodontal endoscopy, analysed endoscopic pictures of the periodontal environment, and concluded that the periodontal endoscope allowed for direct and real-time imaging and magnification of the subgingival root surface, deposits, and soft tissue, potentially assisting practitioners in diagnosis and treatment[11,14,15].Mellonig and Geisinger conducted a study in 2007 to see if using a periodontal endoscope with scaling and root planing (SRP) resulted in a decrease in residual calculus when compared to SRP alone. They found that using a periodontal endoscope resulted in a statistically significant overall improvement in calculus removed during SRP[12]. Michaud and Mealey conducted a study in 2007 to see if endoscopy-assisted scaling and root planing (SRP) resulted in a greater reduction of residual calculus in multi-rooted teeth than SRP alone. They found that there was significantly less residual calculus seen in roots treated with endoscopy in shallower inter-proximal sites with probing depths 6 mm, but overall the use of the endoscope as an adjunct to SRP was ineffective[13]. In a systematic review and meta-analysis performed by Kuang, Yunchun and his colleagues in 2017, stated that the results of periodontal endoscopy are superior to those of regular SRP, particularly in terms of the capacity to remove calculus, despite the fact that periodontal endoscopy takes longer time. However, few researchers have examined the clinical parameters linked with periodontal endoscopy, and that there is little evidence to support the benefits of periodontal endoscopy in terms of clinical outcomes[10].Hence,To investigate the impact of periodontal endoscopy on clinical indicators, more research with longer evaluation periods is needed.

Conclusion:

The primary reason for recommending a Perioscope is to improve treatment outcomes by reducing probing depths and increasing root surface attachment gains. This is because a periodontal debridement performed under the Perioscope leaves the root surface remarkably clean and free of infected cementum and calculus, allowing the surrounding tissues – the soft tissue wall of the pocket to heal faster and better. This is a significant benefit over blind instrumentation that is not magnified. Moreover, the magnification allows the periodontist to examine and treat pathologies at an earlier stage than is possible with standard treatment procedures. This early intervention reduces treatment times and stops the disease process at an early stage, obviating the need for advanced periodontal surgeries.From all these aspects, the Perioscope can be a huge success in the periodontal treatment arsenal, and it will revolutionise periodontal disease management by becoming the standard of care for all future periodontal treatments.

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