REVIEW ARTICLE

Perio-Scopy: A New Paradigm in Periodontal Therapy

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ABSTRACT

The recent introduction of the Perioscope has dramatically improved the removal of subgingval calculus during periodontal therapy. The Perioscopy system was initially designed to visualize the subgingival region for diagnosis but has been subsequently adapted to aid the treatment of periodontitis. The Perioscope consists of a miniature camera placed inside a sleeve and inserted under the gingival sulcus or pocket for visualization and instrumentation subgingivally. The subgingval images from the Perioscope is immediately displayed as real-time videos with a magnification ranging from 24-X to 48-X times on a chair side monitor or video screen disclosing even minute details of the pathologies of the root surface which might be missed under conventional visualization. As this microscopic endoscope provides excellent magnified visualization of the root surface and assures the complete or near complete removal of the bacterial infection, this technology provides the best conservative approach to non-surgical and surgical periodontal care.

KEYWORDS: Perioscopy, Periodontal Endoscopy, Micro-dentistry, Regenerative Periodontal Endoscopy, Perio-scope

INTRODUCTION

Traditional Periodontal Therapy was based on the concept of debridement of the tooth and root surfaces by removing the plaque bio-films and calculus deposits by manual and powered scalers and root planing instruments. This procedure to reduce the bacterial load of the sub gingival environment was done by either using tactile sensation in closed pockets or under direct visualization of the root surfaces by flap surgery. The efficacy of this treatment was subject to various factors like the subgingval access, root morphology, defect extent and the tactile skills of the periodontist. Brayer etal and Sherman etal have demonstrated that manual mechanical debridement is not a fool proof method and some residual root deposits remain even after periodontal treatment.[1,2]Hence visualization of the root surface under magnification was thought of to improve the quality of care of periodontal treatment.

Every patient deserves to have the best quality of care based on the latest evidence based treatment protocol that results in the most predictable outcome. The outcome includes the concept that every treatment plan is an opportunity to be less invasive and most effective treatment as possible. And sometimes the technological advances can be used to enhance the possible outcomes with introduction of instruments and materials to help the periodontist to both diagnose and manage pathologies at the earliest. The idea of having fibre-optic devices at the end of diagnostic and therapeutic instruments is not new to the field of medicine as medical specialties for the past twenty years have extensively used these kind of fibre-optics to reach inaccessible anatomic locations and do non-invasive surgery. But the adaptation of these kind of fibre-optics to dentistry is relatively new. Especially in the field of periodontics where the inherent limitations like the visual and physical access to the disease involved site of the periodontal pocket may be solved by the introduction of such fibre-optic technologies to the periodontal instruments small enough to enter even into the deepest, most inaccessible pocket in a less invasive way.

This recent concept of using magnification under direct visualization and instrumentation with miniaturized armamentarium is now known as micro-dentistry.[3]The basic treatment paradigm of micro-dentistry is to diagnose early, treat less and thus preserve more of the original healthy oral tissues. The latest concept of micro dentistry as applied to periodontics is the use of a miniaturized dental endoscope called the Perioscope for both diagnosis and treatment of periodontal conditions. Perioscopy, previously called as periodontal endoscopy, is a procedure that pairs a miniature dental endoscope with advanced video, lighting and magnification technology for easy visualization sub-gingivally and hence enables us to diagnose and treat the subgingival region as conservatively as possible.[4] The device used, called a perio-scope uses this fibre-optic technology to illuminate the periodontal pocket offering a clear and magnified view of the root surface and inaccessible areas such as trifurcations and bi-furcations. The Perioscope can also be used to detect sub gingival calculus remnants, ulcerated sulcular epithelium, cemental perforations and the tortuous pathways of draining sinuses.

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ARMAMENTARIUM – THE PERIODONTAL ENDOSCOPE

The first introduction of micro-dentistry to periodontics was in the advent of magnification loupes which were worn over the years or mounted on a head band with magnifications ranging from 2x- to 8-x. The disadvantage of using loupes was the heaviness of the instrument and the glare from the lenses. The next instrument to be introduced for periodontal micro therapy was the microscope – either floor mounted or wall mounted with a magnification ranging from 4-X to 22-X. But the floor mounted surgical microscope had the disadvantage of limited accessibility of tortuous pockets and 3-wall bony defects. Also at the highest magnification the smallest movement can affect the image because of the objective lens of the microscope and the actual site in the mouth.

But recently a non-invasive method for the examination of the hard and soft tissues of the sub gingival sulcus has been developed with the purpose to magnify the hard to visualize subgingival area and also to allow a direct view of the sub gingival area. This has been made possible, as a result of the improvement in fiber-optic devices. This device as pertaining to periodontal treatment is called a Perio-Scope.[4] The advantage of the Perioscope over other magnifications devices like the loupes and microscope is that it is intimately in connection with the root surface and so the image easily stays within the focal depth of the field with no distortion or even during disturbances of movement. Hence the Perioscope is the only minimally invasive real-time video technology based treatment option available for periodontal disease treatment.[5,6]

The basic component of a Perioscope is of a 0.5 mm diameter fiber-optic strand which is inserted into a sheath to provide a sterile barrier between the patient's tissue and the Perioscope. The other parts are:

The Fiber-Optic Strand: The equipment contains a gradient index lens that is mounted on the end of a 2m long fused fiber-optic bundle containing 10,000 individual light guiding fibers pixels). Surrounding the fused bundle and lens are 15 large core plastic fiber-optic strands for carrying illumination light from a remote lamp to the operative site. This assembly is encased in a flexible plastic tube with a connector activated by a spring and a sheath at a distance of 1m from the distal end. On the other end of the endoscope there are optical connectors for the illuminating light and the camera.

The Sterile Sheath: Because the sub gingival region of a periodontitis patient is a highly infectious region sterilization of the tip becomes mandatory if the distal tip of the fiber-optic strand (of the Perioscope) comes in direct contact with any of the sub gingival tissues. But as frequent sterilization cycles reduces the lifetime of the endoscopic fibre-optic strands (12 autoclave cycles for every tip) and is also time consuming and impractical for a whole mouth examination with multiple pockets a sterile disposable sheath was developed to encase the fibre-optic strand and which can be discarded after every use and which provides an efficient barrier against subgingval contamination. The sheath is equipped with a sapphire window enabling a clear see through for the fibre-optic strand.

The Peristaltic Pump: As the subgingval region of a periodontal pocket is a highly inflamed area the chances of bleeding inside the gingival pocket is very high. This bleeding will obscure the view from the Perioscope by filling up the pocket area beneath the fibre-optic strand hence an effective irrigation device connected to the Perioscope become necessary. This has been achieved by the addition of a pulsatile peristaltic pump to the Perioscope which keeps up a constant water spray under the fibre-optic strand keeping the working field free of blood and debris. The sheath is connected to a peristaltic pump, through a separate water channel which in turn conducts a flow of water around the strand to the strand's end to irrigate the working field.

The CCD Camera: The sapphire lens at the end of the sheath focuses on the tooth's surface and sends the image back through the fiber-optic strand to a video sensing chip camera (CCD). This CCD is a medical grade video camera connected to a camera coupler which magnifies and focuses the image onto the CCD sensor. The electric signals from the CCD are digitized and converted by the cameras control unit into a normal S-video output which is then displayed on an active matrix LCD-TFT monitor. The objective lens has an effective 70* view under air but reduced to 53* view under water and suboptimal conditions. The image of the root and pocket as displayed onto the backlit LCD monitor is an enhanced image of 22 x- to 48-X magnifications. Hence using the Perioscope, the periodontist is able to visually explore the gingival pocket, finding the precise location of the biofilm, root deposits, granulation tissue, caries and root fractures in a highly magnified and illuminated view.

The Micro-Surgical Instruments: New set of instruments has been developed for the use with the endoscope, i.e. curettes, explorer, ultrasonic scalers. For the curette, a gingival retractor (soft tissue shield) has been added to the blade of the curette. This retractor holds the gingival tissue away from the tip of the endoscope providing a clear view of the curette blade and tooth surface. The explorer is simultaneously a periodontal probe. It is a stainless steel tube welded to a handle that accepts the window sheath of the endo-scope. The distal tip has been shaped to provide a gingival retractor. The ultrasonic adapter, also of stainless steel is a single unit comprising a collar, a strut, and a tube. The collar fits into the end of a standard ultrasonic scaler and is locked in position with a screw. Next, the tube is positioned alongside the scaler tip and the endoscope window sheath is placed on the tip of the endoscope in the correct position to view the scaler tip and adjacent tooth surface. The distal tip of the tube is also shaped to provide retraction of the gingival tissue to ensure an unobstructed vision of the active tip along with helping to direct the irrigating solution.[5]

INDICATIONS FOR PERIO-SCOPY

- Any periodontal condition with a probing pocket depth (PPD >4) of more than 4mm will benefit from endoscopic visualization and treatment.
- The primary benefit of Perioscope is the magnified visualization of the sub gingival calculus attached to the root surfaces which can be debrided with special miniaturized periodontal micro-surgical instruments.
- Aberrant root malformations and anatomical variations can be visualized and tracked along their paths and finally restored without any recurrence.
- Indications for major periodontal surgery by open access flaps with all its resultant sequelea of recession and root exposure is avoided by micro surgery.
- Teeth with a diagnosis of Refractory Periodontal disease and those with chronically inflamed pockets and increasing pocket depths are ideal candidates for periodontal endoscopy-aided therapeutic procedures.
- Teeth with poor prognosis and minimal access to defects- under furcations- can now be managed with less invasive instrumentation by using periodontal microsurgery improving their treatment outcomes.
- Avoiding second surgical procedures in implant mucositis and peri-implantitis by micro-visualization and debridement of diseased implant surfaces plays a positive role in early resolution of the peri-implant infection.
- Patients where periodontal surgery is contraindicated due to their medically compromised health status benefit from Perioscopy.[3,6]
- Finally long term treatment outcomes are improved with the use of the least invasive procedures which reduce trauma to healthy surrounding tissues while treating the disease effectively.

PERIO-SCOPY PROCEDURE

There is very little discomfort during a Perioscopy appointment so while most patients can be treated without anesthesia. Full mouth treatment averages between 90-120 minutes for moderate to advanced periodontitis but these times are based on a dental professional who is highly efficient with a Perioscope. Using the LCD screen the periodontist can see the magnified root surface at a 24x to 48x magnification and approximately 3mm of the root is viewed at one time. The Perioscope is held in the clinician's left hand (assuming he or she is right handed) while the debridement instrument is manipulated with the right hand. At the end of the Scaling and root planing procedure the results are less damaging to the root surface as the Perioscope allows the periodontist to directly view the calculus deposits instead of solely relying on tactile sensation.

ADVANTAGES OF PERIO-SCOPY

- A Perioscope enables the periodontal surgeon to see the sub gingival morphology in the most minimally invasive way possible to provide accurate diagnosis and enhanced management techniques for a thorough root and soft tissue debridement.
- Accurate visualization under magnification of the root surface enables the periodontist to conduct not only the most efficient instrumentation as possible but also to ensure that no over-instrumentation of the root surface occurs with its possible sequelea of loss of unaffected cementum or post-treatment sensitivity.
- Another primary advantage of using subgingval visualization under an endoscope is that the magnification enables us to easily spot any gingival pathologies which may affect our treatment outcomes if not addressed at the earliest.
- Finally the Perioscope also enables us to correctly visualize and demarcate any root surface anatomical aberrations and malformations which may affect the maintenance of periodontal health post treatment.

DISADVANTAGES OF PERIO-SCOPY

- The first and foremost disadvantage of Perioscope is the time factor. Although a revolutionary product in many ways, the Perioscope still has a treatment time factor comparable to conventional periodontal therapy.
- Secondly the pain factor- although the majority of patients can undergo treatment without any anaesthesia a few patients experience discomfort in the absence of anaesthesia and hence require the same quantum of anaesthesia like conventional periodontal surgical procedures.
- Finally use of a Perioscope requires different clinical skills compared to conventional periodontal therapy and to achieve proficiency takes training and time to get used to the technology.

PERIOSCOPY IN PERIODONTAL DISEASE

Armitage and Christie in a SEM study in 1973 reported that teeth involved in unresolved and aggressive forms of periodontitis exhibit cemental abnormalities particularly at the cemento-dentinal junction.[7] Yammaamato in 1999 concur with their findings and added that such periodontal diseased root surfaces have extensive resorption lacunae that characterize the entire length of the root surface.[8] These findings have implications for the refractory nature of periodontal disease and the clinical diagnosis and management of such patients may be made easier by the use of Perioscopy.[9] Mellonig and Geisinger in 2007 did a study to determine whether use of the periodontal endoscope with scaling and root planing (SRP) resulted in a decrease in residual calculus compared to SRP alone and reported that the use of the periodontal endoscope resulted in a statistically significant overall improvement in calculus removed during SRP.[10] Michaud and Mealey in 2007 did a study to determine whether endoscopy-aided scaling and root planing (SRP) resulted in a greater reduction of residual

calculus compared to SRP alone in multi-rooted teeth and reported that in shallower inter-proximal sites with probing depths ≤6 mm there was significantly less residual calculus seen in roots treated with endoscopy but overall the use of the endoscope as an adjunct to traditional SRP provided no significant improvement in calculus removal in multi-rooted molar teeth.[11]

Wilson and Carnio in 2008 did a study to evaluate the histological response in humans to removal of calculus and biofilm with the aid of the dental endoscope and concluded that histological signs of chronic inflammation were absent six months after a single course of closed sub gingival scaling and root planing using the dental endoscope and bone repair and growth of a long junctional epithelium were observed on previously diseased root surfaces.[12] Avradopoulos etal in 2004 conducted a study to assess the clinical and inflammatory evaluation of Perioscopy on patients with chronic periodontitis.[13] The purpose was to compare the changes in periodontal pocket depths and inflammatory markers (PGE2) of sites treated by scaling and root planing alone with sites treated by scaling and root planing with Perioscopy. However the results showed no statistically significant differences in clinical and inflammatory parameters between control and experimental sites. Christine M in 2013 did a randomized split mouth study to determine if the use of a periodontal endoscope improved periodontal outcomes of scaling/root planing when compared to scaling/root planing alone and reported that the adjunctive use of the perioscope improved periodontal outcomes with respect to gingival inflammation and bleeding upon probing but not found to be superior to traditional scaling and root planing with regard to pocket depth reduction and clinical attachment loss.[14]

Also Caroll J in 2006 reported a procedure called RPE - Regenerative Periodontal Endoscopy (RPE) a periodontal procedure which uses Periostat to control pre-treatment inflammation, the endoscope for effective subgingval deposit removal and Emdogain to stabilize and regenerate bone.[15] Despite the advantages of this new technology for periodontal therapy further clinical studies are necessary to determine the effectiveness of Perioscopy as a frontline periodontal therapeutic option.

CONCLUSION

The first and foremost consideration for recommending a Perioscope is improved treatment outcomes with greater reductions in probing depths and better root surface attachment gains because a periodontal debridement done under the Perioscope leaves the root surface exceptionally clean and free of infected cementum and calculus which helps the surrounding tissues – the soft tissue wall of the pocket to heal faster and better. This is a definite advantage over blind instrumentation without magnification. Also the magnification enables the periodontist to examine and treat pathologies at earlier phases than possible under routine treatment procedures which early intervention reduces the treatment times and arrests the disease process at initial levels thereby obviating the need for advanced periodontal surgeries. For all these advantages the Perioscope is a game changer in the periodontal treatment armamentarium and will revolutionize management of periodontal diseases by becoming the default standard of care for future periodontal procedures.

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