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 – 7, Issue – 2, March – 2024, Page No. : 142 - 148

Perioscopy: A New Perspective in Periodontal Therapy

[1]Dr. Sarmistha Sritam, Department of Periodontology and Implantology, Sri Siddhartha Dental College and Hospital, Tumkur, Karnataka

Corresponding Author: Dr. Sarmistha Sritam, Department of Periodontology and Implantology, Sri Siddhartha Dental College and Hospital, Tumkur, Karnataka.

Citation of this Article: Dr. Sarmistha Sritam, "Perioscopy: A New Perspective in Periodontal Therapy", IJDSIR- March – 2024, Volume –7, Issue - 2, P. No. 142 – 148.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Seeking professional care early on gum disease can reduce risk of tooth loss and other concerning effects. If one has bleeding gums, bad breath, or other signs of gum disease, he or she may be a person for periodontal treatment with perioscopy. Perioscopy is a procedure that uses a miniature camera with advanced lighting and magnification, to visualize and treat areas below the gum line non-surgically. This miniature camera and fibre optic light source is called an endoscope. This technology allows seeing, diagnosing, and treating periodontal disease below the gum line. It allows completely visualize the root and remove bacteria from the root of the teeth. The recent introduction of the Perioscope has dramatically improved the removal of subgingival calculus during periodontal therapy. The Perioscopy system has been designed to visualize the subgingival region for diagnosis and also adapted to aid the treatment of periodontitis. The subgingival 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 root surface which might be missed under conventional visualization. As this microscopic endoscope provides excellent magnification of the root surface and aid to remove the bacterial infection, this technology provides the best conservative approach to non-surgical and surgical periodontal care at present.

Keywords: Perioscopy, Periodontal Endoscopy, Perioscope, Periodontitis.

Introduction

Conventional periodontal treatment is based on the removal of plaque, biofilm and calculus deposits from the tooth and root surfaces using manual and powered scalars and root planning devices [1,2]. Brayer et al and Sherman et al have demonstrated that manual mechanical debridement is not a fool proof method and some residual root deposits remain even after periodontal treatment [1,2].During this gum disease

treatment, the periodontists place scaling instruments beneath the gum line to detect and remove tartar and plaque deposits from the tooth roots. The success of this treatment is determined by a number of parameters; subgingival access, root morphology, defect magnitude, and tactile skills of periodontists. Therefore, visualisation under magnification of the root surface was thought to increase the value of periodontal treatment [1,2]. Every patient is entitled to the highest level of treatment. The introduction of devices and materials to assist the periodontists in both diagnosing and managing treatment at the earliest possible stage can sometimes be employed to improve the achievable outcomes [3].The World Health Organization indicated that tooth loss caused by severe periodontitis occurs in 15%–20% on middle-aged adults (35–44 years old) in most populations worldwide [4]. Advanced periodontitis remains to be one of the primary causes of tooth loss [5]. Nonsurgical periodontal therapy (NSPT) relies primarily on mechanical biofilm and calcified hard deposit (HD) removal [6]. Although its therapeutic effect seems predictable [7], the presence of deep periodontal pockets with limited accessibility [8, 9] may negatively affect the outcome of NSPT, requiring additional flap surgery [10]. It was hypothesized that when flap surgery is contraindicated, periodontal endoscopy (PE) could provide a good sulcus visualization tool, improving the efficacy of nonsurgical subgingival periodontal instrumentation [11, 12].

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]. Micro-dentistry is a new idea that involves employing magnification under direct observation and instrumentation with a reduced armamentarium [3]. Micro-dentistry treatment paradigm is to detect early, treat less, and thereby, maintain more of the original healthy oral tissues. 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 [13]. Perioscopy, also known as periodontal endoscopy, is a treatment that combines a small dental endoscope with advanced video, illumination, and magnification technologies for subgingivally imaging, allowing us to detect and treat the subgingival region as conservatively as possible [4]. The use of a Perioscope or a miniature dental endoscope, for both detection and treatment of periodontal disorders is the most current advancement in Periodontics micro-dentistry [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. Subgingival calculus remains, ulcerated sulcular epithelium, and cemental perforations can all be detected using the Perioscope [4].

Perioscopy

Perioscopy is a procedure that utilizes a dental endoscope, or small fibre-optic camera that lights up and magnifies the treatment area. The Perioscope is attached to an instrument that is gently placed beneath the gum line, or in the spaces between the teeth and gums, called periodontal pockets. Once in place, the periscope gives the periodontists a 48X magnified and illuminated view of the root surfaces and gum tissues, which can be viewed on a large computer screen. The periodontists also use Perioscopy in conjunction with scaling routine periodontal maintenance cleanings, and treating other periodontal problems including dental implants.

Parts of Perioscope

Following are the parts of Perioscope:

Fibre-optic Strand

A Perioscope includes a sheath and a 0.5 mm fibre-optic strand. A gradient index lens is installed at the end of a two meters long fused fibre-optic bundle with 10,000 individual light-directing fibre pixels. Huge core plastic fibre-optic strands surround the fused bundle and lens, providing light to the operating site from distance bulb.

Sterile Sheath

The fibre-optic strand's distal tip must be sterilised with sterile disposable sheath as it comes in direct contact with any of the subgingival tissues to act barrier to infection. 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 wire can be clearly seen through the sapphire glass in the sheath.

Peristaltic Pump

There is a risk of bleeding within the gingival pocket during Perioscopy. The inflammatory subgingival region and bleeding will hinder vision from the Perioscope. Hence there is a provision of a pulsatile peristaltic pump in the Perioscope which keeps continuous water spray and maintain the working field free of blood and debris. There is a separate water tube connects the sheath to a peristaltic pump which drives water from the strand to the strand's end for irrigating the working field.

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. 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 degree in air, but it is reduced to 53 degree in water and other less-than-ideal environments. The image of the root and pocket on the LCD panel is improved with magnifications ranging from 24X to 48X.

Microsurgical Instruments

Some of the latest endoscopic tools available are curettes, explorers, and ultrasonic scalars. A gingival retractor (soft tissue shield) is now linked to the curette blade. The gingival tissue is kept away from the endoscope's tip using this retractor, to see the curette blade and tooth surface visible clearly. 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 are of stainless steel. The scalar tip as well as surrounding tooth surface are viewed through the endoscope window sheath. The distal tip of the tube is also fixed up for irrigating fluid for a clear and unobstructed view of the active tip.

Indications for Perioscopy

Any periodontal condition with a probing pocket depth (PPD >4) of more than 4mm will be benefitted from endoscopic visualization and treatment.

1. 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.
2. Abnormal root deformities and anatomical changes can be detected, followed, and repaired without recurrence.
3. Indications for major periodontal surgery by open access flaps with all its resultant sequel of recession and root exposure is avoided by microsurgery.

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.

5. 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.

6. 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.

7. 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.

8. Patients where periodontal surgery is contraindicated due to their medically compromised health status benefit from Perioscopy.

9. 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.

Use of Perioscope in Periodontal Disease

Different uses of Perioscope are:

Detection and removal of subgingival calculus

Perioscope can be used in detecting and removing dental calculus, which are primarily consists of inorganic contents covered by an unmineralized bacterial layer. The porous structure of calculus largely resembles that of dentin [14]. Kurihara et al, showed that the fluorescence intensity can also be used to distinguish dental calculus from sound enamel with high reproducibility [15].

Video scope assisted minimally invasive periodontal surgery

Stephen K Harrel et al, reported the outcomes from video scope assisted minimally invasive periodontal surgery. Patients having a residual pocket probing depth atleast 5mm and 2mm of clinical attachment loss following initial non surgical therapy, were treated with V-MIS. There was significant improvement ($p \geq 0.001$) in mean PPD (4.11± 0.98 mm) and CAL (4.58±1.19 mm) in surgical site. A mean improvement in the soft tissue also noted (0.48±0.65mm $p \geq 0.006$). The improvement associated with V-MIS appears to be favourable when compare to previous reported result of periodontal regenerative surgery [16].

Use in Dental implant

The cause of bone loss around implants is unknown. It may be because the implant interface with the bone is completely different from a natural tooth. It is unlikely that peri-implant bone loss is the same process that occurs in periodontal bone loss around natural teeth. Thus a Perioscope may be used for the post care of a dental implant [17].

Treatment Process

1. Local anaesthesia will be administered prior to procedure if required.

2. A small tip (endoscope) is placed beneath the gingiva.

3. The endoscope is carefully swept along the tooth root surface removing plaque with water flushing out the pocket.

4. Fine instruments will be used to remove plaque below the gum line.

5. Once thorough debridement has been achieved, the healing process commences with preventing further gingival damage and tooth loss.

6. Perioscopy will take a bit longer time than the standard appointment due to the intricate nature of the procedure.

Advantages of Perioscopy

- 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.
- Perioscopy is a minimally invasive, non–surgical approach to gum care.
- There is less tissue trauma to surrounding areas resulting in faster healing with little post treatment time.
- Reduces the need for gum surgery
- Does not involve incisions or sutures
- We are able to detect unseen calculus that causes bleeding and inflammation.
- Not only is the treatment process comfortable, there is also less gum recession occurring post-operatively which results in less sensitivity and a better cosmetic outcome.
- The endoscope also allows early detection of undiagnosed dental problems such as decay, cracks, failing restorations and root fractures.
- The long term results of perioscopy are monitored with regular maintenance appointments.
- Can be a cost-effective alternative to surgical care
- It may be possible for some to have all treatment in one appointment making it convenient for busy or out of town patients

Disadvantages of Perioscopy

- The first disadvantage of Perioscope is the time factor. Although Perioscope is revolutionary product, it still has a longer treatment time comparable to the conventional periodontal therapy.
- Second disadvantage is the pain factor. Although the majority of patients can undergo treatment without any anaesthesia, but many patients experience discomfort in the absence of anaesthesia. Thus require the same quantum of anaesthesia like conventional periodontal surgical procedures.
- Finally, to operate a Perioscope require specific clinical skill compared to conventional periodontal therapy. Achieving expertise requires training and time to become accustomed to the device and used to the technology.

Limitations of Perioscopy

There are few limitations of Perioscopy which includes;

- It requires skilled dentist as a technique-dependent procedure
- It requires 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 [18].

Conclusion

Surgery is the traditional treatment option for people diagnosed with advanced stages of periodontal disease. Now with introduction of Perioscopy, periodontal surgery may not be not necessary for many patients. With extensive training periodontists can use this technology for successful treatment of patients with periodontal diseases.

In Perioscope assisted periodontal debridement, the root surface area is remarkably cleaned and devoid of debris and calculus. Due to the magnification, the Periodontist may diagnose and rectify abnormalities better and earlier than traditional treatment approaches. Early management of periodontal diseases, reduces treatment times so also slows disease progression and avoiding the need for

complicated periodontal surgery. Perioscope has a definite advantage over blind instruments without magnification. For beneficial to the tissues in local area, Perioscope can be used to improve treatment outcomes by minimizing the probing pocket depth. Baring the few disadvantages, for all these advantages, the Perioscope is a game changer in the periodontal treatment and will be becoming the default standard of care for future periodontal procedures.

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