DentalView DV2 Perioscopy System™: an Endoscopic Method for Exploration and Visualization of Subgingival Deposits

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The DentalView DV2 Perioscopy System™ (DentalView Inc., Lake Forest, CA, USA) was designed to visualize the subgingival environment for diagnosis and to aid the treatment of periodontitis.

This instrument consists of a 0.5 mm diameter fiber-optic strand. This strand is inserted into a sheath, which provides a sterile barrier between the patient's tissue and the perioscope. The sheath is connected to a peristaltic pump, which conducts a flow of water around the strand to the strand's end to irrigate the working field. The end of the sheath has a sapphire lens that focuses on the tooth's surface and sends the image back through the fiber-optic strand to a video sensing chip camera (CCD). The image is then displayed on an active matrix LCD-TFT monitor. Using the perioscope, clinicians are able to visually explore the gingival pocket, finding the precise location of the biofilm, root deposits, granulation tissue, caries and root fractures.

Key words: perioscopy, dental endoscopy, scaling and root planing

INTRODUCTION

Traditionally, anti-infective periodontal therapy has been performed by effective plaque control and mechanical therapy by scaling and root planing. The efficacy of this treatment depends on different factors, like the anatomy of the subgingival area and the presence of furcation defects, but also on the therapist's skills. Normally, the examination of the treated sites is accomplished by manual and tactile exploration. However, the inability to detect some root deposits that have not been eliminated, has been repeatedly demonstrated by different investigators (Brayer et al, 1989; Rabbani et al, 1981; Sherman et al, 1990). Visualization of the root surface during subgingival debridement may improve the clinical results of the treated teeth.
Recently, a non-invasive method for the examination of the hard and soft tissues of the subgingival sulcus has been developed with the purpose to allow the clinician a direct view of the subgingival area. This has been made possible, as a result of the improvement in fiber-optic devices.

The Perioscope

This endoscope for dental purposes is manufactured by DentalView Inc., Lake Forest, CA, USA (Fig.1). The endoscope has a flexible design that can be combined with other dental instruments. The use of this technology has been previously described in a few case reports and clinical studies (Avradopoulos et al, 2004; Stambaugh, 2002). The equipment contains a gradient index lens that is mounted on the end of a 2 m 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 resulting in a diameter of 0.85mm at the distal end. A springactivated connector is located 1 m from the distal end to connect to a window sheath. This connector assures that the distal lens remains in contact with the distal window of the sheath. On the other end of the endoscope there are optical connectors for the illuminating light and the camera.

Endoscope Sheath

Sterilization is mandatory if the distal tip of the Perioscope comes in direct contact with the patient's tissues. However, sterilization is time consuming and reduces the lifetime of the endoscope (usually, the instrument must be replaced after 12 autoclave cycles). Thus, a sterile disposable sheath was developed, which provides a barrier against pathogens and can be removed after use (Fig. 2). The sheath is equipped with a sapphire window, allowing a clear view through the endoscope.

Furthermore, because subgingival bleeding may obscure the vision through the endoscope, a separate water channel connected to a peristaltic pump provides a water spray, which keeps the working field clear. Finally, a small plastic connector at the distal end of the sheath that fits on a stainless steel receptacle built into each instrument (curette, explorer and ultrasonic adapter) allows a precise positioning of the endoscope while working with the instrument.

Visualization

The endoscope is delivered with a medical grade CCD video camera connected with a camera coupler. This coupler magnifies and focuses the transmitted image onto the CCD sensor. The electrical signals from the sensor are digitized by the camera's control unit resulting in a standard S-video signal (Y/C) output to an attached monitor. The endoscope is delivered with a 12.1" diagonal active matrix backlit LCD Display (Fig. 3), and the monitor has a resolution of 800 x 600 pixels. The objective lens has a nominal 70° field view in air. Under water this field is decreased due to the refraction index of water: 70°/1.33 =53°. The image of the root and sulcus projected on the monitor is magnified from 22x to 48x. The clinician can therefore indirectly observe the contents of the sulcus and subgingival root surface with a highly magnified, illuminated view.

Adapted Instruments

A new set of instruments has been developed for the use with the endoscope, i.e. curettes, explorer, ultrasonic scaler. 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 (Fig. 4). It is a stainless steel tube welded to a handle that accepts the window sheath of the endoscope. 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 view of the scaler tip. This tube also directs irrigation fluid.

CLINICAL APPLICATION AND PRELIMINARY RESULTS

The DV2 Perioscopy™ system was tested by an experienced dental hygienist that had not used the system on a regular basis. Three patients were inspected for subgingival deposits. Two of them were examined during the hygienic phase after supragingival debridement. One patient was attending for supportive periodontal therapy. The DV2 Perioscopy™ system was compared with the tactile inspection with a periodontal probe (PCP-UNC 15 XP3A, Hu-Friedy Mfg. Co., Inc., Leimen, Germany). Clinical parameters registered were: probing pocket depth, tactile detectable deposits, visible deposits by perioscopy and the duration of the perioscopy procedure.

The total number of teeth inspected was 13 with a mean probing depth of 4.35 mm. Deposits were detected with the probe on 7 of 13 teeth. With the Perioscope, deposits were detected on slightly more teeth (9/13). The mean duration of the perioscopy was 15 min for each tooth. The other instruments like the ultrasonic tip were not used.

Fig. 1 Total view of the DV2 Perioscope™. (DentalView Inc., Lake Forest, CA, USA)

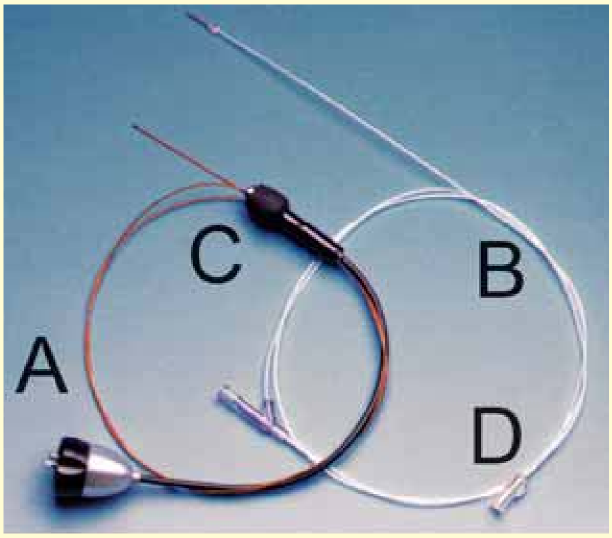

Fig. 2 View of the endoscope and its disposable sheath. (A) fiber-optic bundle, (B) sterile disposable sheath, (C) spring tension connection, (D) connector to the water supply (Luer Lock). (Image: DentalView Inc., Lake Forest, CA, USA)

Fig. 3 Detail of the LCD Monitor.

Fig. 4 Clinical application of the explorer.

DISCUSSION AND CONCLUSIONS

Endoscopic methods are widely used in medicine (Becker, 2003; Chand et al, 2003; Itzkowitz and Harpaz, 2004; Yeung and Yeung, 2003). In diseases that involve tracts, this technique is crucial for a correct diagnosis, adequate assessment of disease activity and even avoidance of surgery. Conversely, in dentistry, the use of an endoscope has traditionally had limited applications, mostly confined to surgical procedures of the temporomandibular joint or for intracanal visualization in endodontic therapy.

The use of endoscopy in periodontal diseases was not possible due to technical problems. However, recent advances in fiber-optic technology, together with modifications of the periodontal instruments, have led to the development of an instrument that allows direct inspection in the subgingival sulcus. The unit is based on a medical endoscope that was modified for application in the periodontal tissues. The device could be a valuable non-invasive method for diagnosing subgingival root deposits, caries, root fractures and soft tissues.

Clearly, the goals of periodontal treatment might be easily attainable if it were possible to visualize the root surfaces after manual or mechanical debridement, as well as detect deposits in complicated sites like furcation defects. However, image interpretation is difficult. The image, that can be seen in the monitor is not very bright and is a round image with a field about 2.4 to 6.6 cm in diameter. The magnification on the monitor can be from 46x to 15x depending on the distance between the object and the tip of the endoscope. Additionally, the clinician has to deal with the motion of the tip, and has to control the orientation of the tip. All this together with the anatomical characteristics of the sulcus environment, makes the handling of the instrument an acquired skill.

Furthermore, original articles evaluating the application of the Perioscope in patients with periodontitis are, apart from a few case reports, rather scarce (Stambaugh, 2002; Stambaugh et al, 2002). Recently, a pilot study was conducted in order to assess the clinical and inflammatory evaluation of Perioscopy on patients with chronic periodontitis (Avradopoulos et al, 2004). The purpose was to compare the changes in periodontal pocket depths and inflammatory markers (PGE_2) of sites treated by scaling and root planing, 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.

Despite the advantages of the new technology for periodontal therapy, it can be concluded that further clinical studies are necessary to determine the effectiveness of perioscopy. As of now, its regular use in daily practice cannot be recommended.

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