The Vector™ System: an Ultrasonic Device for Periodontal Treatment

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Three years ago the Vector™-system was introduced to the European market for ultrasonic periodontal treatment. The manufacturer claimed that the system removed root cementum and periodontal soft tissues less aggressively than hand instruments. Furthermore, the treatment with the Vector™-system was claimed to be less painful than treatment with conventional systems, as vibrations applied horizontally to the root surface were avoided by a specific oscillation pattern. In addition, by changing the different insert tips of the handpiece, it is possible to use the device not only for periodontal treatment but also in restorative dentistry (i.e. minimal invasive preparation). Several studies assessed the properties of the device, and evaluated its possible benefits especially for periodontal debridement and supportive periodontal care. This survey reviews the current use of the Vector™-system for periodontal therapy.

Key words: Vector™-system, ultrasonic device, periodontal debridement

The Vector™ System

The device (Fig. 1) generates ultrasonic vibrations which are converted by a resonating ring, so that a horizontal oscillation is deflected vertically (Fig. 2). As a result the instrument tip moves parallel to the root surface (Fig. 3) and is recommended for use in conjunction with irrigation fluids containing hydroxyl-apatite or silicon-carbide (Hahn, 2000). The tooth surface is supposed to be cleaned due to hydrodynamic forces such as cavitation or acoustic microstreaming (Walmsley et al, 1990; Khambay and Walmsley, 1999) rather than by the chipping action of the instrument tip. The principle is comparable to ultrasonic cleaning baths or lithotriptor systems.

Efficiency

The overall capability of the Vector™ treatment to improve clinical parameters (e.g. pocket depths and bleeding on probing) in a similar way to hand instruments was demonstrated (Klinger et al, 2000; Sculean et al, 2004). Calculus can be removed completely from root surfaces. However, the efficiency depended on the fluid used. Employing an artificial periodontal pocket, the Vector™ System was observed to be least efficient when the polishing fluid and the straight metal insert tip were used (Braun et al, 2002; Krause et al, 2003). In terms of the amount of root substance removed during subgingival debridement, the system is supposed to be used with the polishing fluid. The use of the abrasive fluid generates a root substance loss comparable to hand instruments (Braun et al, 2003b). Further studies are necessary to evaluate these findings in vivo.

Patient Comfort

By avoiding vibrations applied horizontally to the root surface, treatment with the Vector™ System has been shown to be less painful than treatment with conventional systems (Braun et al, 2003c). The subjective intensities of pain during the treatment were measured by means of an intermodal inten-

Fig. 1 Base unit and handpiece of the Vector™ System.

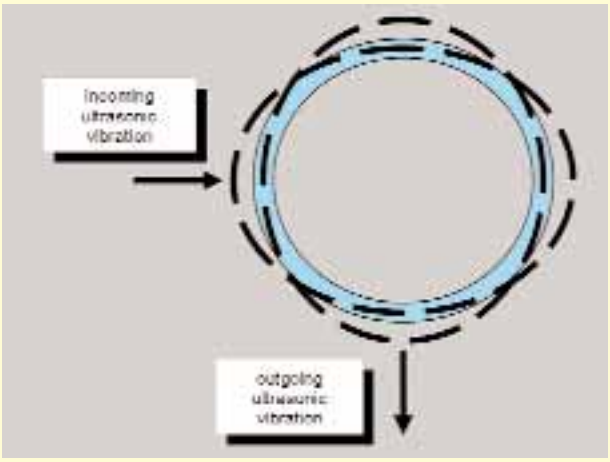

Fig. 2 90° deflection of the horizontal ultrasonic vibration by the resonating ring

Fig. 3 Due to the lack of horizontal vibrations, the irrigation fluid is forwarded vertically without spraying.

Fig. 4 Removable bags containing abrasive and polishing fluid.

sity comparison; and a visual analog scale was used for the evaluation after the treatment. The results of the intermodal intensity comparison during treatment showed that the use of the Vector™ System caused less pain than cleaning with hand instruments or conventional ultrasonic systems. These results could be confirmed on the visual analog scale. Additionally, the polishing fluid may reduce hypersensitivity after ultrasonic subgingival scaling. SEM investigations showed the formation of a granular smear layer covering the dentinal tubules (Braun et al, 2003a).

Handling

The device is a portable system consisting of a base unit, a handpiece, a foot pedal two irrigation fluid reservoirs and different insert tips. The base unit contains two devices for removable fluid bags (Fig. 4), covered by a protective hood. The polishing fluid contains ultrafine dispersed hydroxyl-apatite particles and is recommended for standard periodontal debridement and for removal of adherent subgingival biofilm. The abrasive fluid contains silicon-carbide particles and is supposed

Fig. 5 Color-coded tool kits.

Fig. 6 Tool kit for periodontal treatment.

Fig. 7 Demounted handpiece ready for autoclaving.

to be used for recontouring and fining of tooth restorations and for cavity preparation according to minimal invasive criteria. There is a liquid reservoir behind another protective hood that needs to be filled with dental quality standard water for dilution of the polishing or abrasive fluid prior to treatment. By pressing the service pushbuttons on the base unit, the appropriate fluid can be chosen or the system can be rinsed with water. The system is activated by a foot pedal control. A light pressure on the pedal switch activates a pulsating fluid flow; and preset intensity of the ultrasonic vibration is regulated with the pushbuttons on the base unit. Generally, the system should be operated with an amplitude of 30 µm for all applications, with the first seven LEDs lighting up on the intensity display. Maximum amplitude of 35 µm can be activated by pressing down on the foot pedal switch to the maximum extent.

The handpiece can be used with different insert tips allocated to color-coded tool kits (Fig. 5). These consist of instruments for subgingival periodontal treatment (silver) (Fig. 6); periodontal recall (black); removal of supragingival calculus (yellow); minimal invasive preparation and finishing (red); and microinvasive preparation (violet). All inserts are secured inside the collet of the handpiece using the torque wrench in the tool kit's top cover.

Before using the Vector™ System, the availability of an adequate amount of polishing and / or abrasive fluid and water has to be controlled. After each treatment session the system should be rinsed with water to avoid blockages by any remaining fluids. All used inserts placed inside the closed tool kit and the demounted handpiece should be autoclaved at 134°C (Fig. 7). The device's surfaces, cords, cables and connectors should be cleaned with a suitable surface disinfectant agent. When no treatment is carried out for more than 24 hours the whole system needs to be rinsed with a disinfectant solution.

Clinical Application

To effectively treat periodontal disease, the bacterial load has to be reduced to allow healing of the inflamed tissues (Schenkein, 1999). Because of

Fig. 8 Patient before (left) and after (right) periodontal therapy with the Vector™ System. Inflammation of the periodontal tissues decreased.

the working principle, the instruments of the Vector™ System have to be used with an adhering film of liquid to enable the transfer of ultrasonic energy to the tooth surface. In case of tough calculus formation it may be necessary to use additional mechanical means to loosen supragingival visible deposits. In particular, during initial periodontal treatment the Vector™ System can be used with the abrasive fluid to finish overhanging restorations. Generally, subgingival treatment should be performed with the polishing fluid and an appropriate insert tip, allowing a gradual removal of deposits. The system could be shown to generate less pain sensations during the treatment (Braun et al, 2003c), making it suitable for pain-sensitive patients or in cases of contraindications to local anesthesia. Furthermore, it might be possible to increase the patient's compliance, employing a method that causes less discomfort and pain. However, depending on the kind of insert tip used, the time taken to remove calculus may be longer than treatment with a hand instrument or a conventional ultrasonic instrument (Braun et al, 2003a). Thus, it is advisable to control the efficiency of the treatment carefully. The straight metal insert tip was detected as the least efficient of the inserts for the removal of calculus. This instrument can therefore not be recommended as a standard insert, although the operator has the advantage of reaching all areas of the root surface without changing the tip's orientation. The overall capability of the Vector™ treatment to improve clinical parameters (e.g. pocket depths and bleeding on probing) in a similar way to hand instruments was demonstrated (Klinger et al, 2000; Sculean et al, 2004). Improvements of these parameters indicate that the system allows plaque biofilm to be controlled (Fig. 8) (Haffajee et al, 2003). Further studies need to evaluate the system's capability to maintain non-inflamed periodontal tissues during supportive periodontal care.

CONCLUSIONS

The Vector™ System can be used for periodontal therapy without surgical access. Efficiency of the treatment depends on the insert tip fitted and the use of the appropriate adjunctive fluid. Treatment time might be longer compared to conventional methods for root surface instrumentation. Generally, the polishing fluid should be used to achieve a lower root substance loss than with hand instruments. It is possible to reduce pain sensations compared to conventional methods for periodontal therapy. Employing a method that causes less discomfort and pain, it might be possible to increase the patient's compliance during non-surgical periodontal therapy and recall.

REFERENCES

Braun A, Krause F, Nolden R, Frentzen M: Efficiency of the Vector™ System compared to conventional methods for periodontal debridement (abstract). Parodontologie 2002; 13: 281-282.

Braun A, Cichocka A, Semaan E, Jepsen S, Frentzen M: Root surfaces after ultrasonic instrumentation with a polishing fluid (abstract). J Periodontol 2003a; 74: 1562-1563.

Braun A, Krause F, Frentzen M, Jepsen S: Removal of root substance with the Vector System (abstract). J Clin Periodontol 2003b; 30: 55.

Braun A, Krause F, Nolden R, Frentzen M: Subjective intensity of pain during the treatment of periodontal lesions with the Vector'-system. J Periodontal Res 2003c; 38: 135-140.

Haffajee AD, Arguello EI, Ximenez-Fyvie LA, Socransky SS: Controlling the plaque biofilm. Int Dent J 2003; 53: 191-199.

Hahn R: Therapy and prevention of periodontitis using the Vector™ Method. ZWR 2000; 109: 642-645.

Khambay BS, Walmsley AD: Acoustic microstreaming: detection and measurement around ultrasonic scalers. J Periodontol 1999; 70: 626-631.

Klinger G, Klinger M, Pertsch J, Guentsch A, Boerner D: Periodontal therapy using the ultrasonic Vector™ System. Die Quintessenz 2000; 51: 813-820.

Krause F, Braun A, Frentzen M, Jepsen S: Calculus removal with the Vector™ System (abstract). J Clin Periodontol 2003: 30: 56.

Schenkein HA: The pathogenesis of periodontal diseases. AAP position paper. J Periodontol 1999; 70: 457-470.

Sculean A, Schwarz F, Berakdar M, Romanos GE, Brecx M, Willershausen B, et al: Non-surgical periodontal treatment with a new ultrasonic device (Vector™ Ultrasonic System) or hand instruments. J Clin Periodontol 2004; 31: 428-433.

Walmsley AD, Walsh TF, Laird WR, Williams AR: Effects of cavitational activity on the root surface of teeth during ultrasonic scaling. J Clin Periodontol 1990; 17: 306-312.

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