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Use of the Vector™ scaling unit in supportive periodontal therapy: a subjective patient evaluation

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Abstract

Background: Patient discomfort is one reason for poor compliance with supportive periodontal therapy (SPT). The aim of this study was to compare the levels of discomfort during SPT, using the Vector™ system and treatment with a conventional ultrasonic scaler.

Methods: Forty-six patients with an SPT programme were debrided using both the Vector™ system and a conventional piezo-electric scaler (Sirona™) in a split mouth design. A visual analogue scale was used to evaluate of pain scores upon completion of treatment. A verbal response scale(VRS) was used to assess discomfort, vibration and noise associated with the scaling system, as well as the volume and taste of the coolant used by these systems.

Results: Patients instrumented with the Vector™ system experienced approximately half the amount of pain compared with the conventional ultrasonic scaling system. The VRS showed that the Vector™ system caused less discomfort than the conventional ultrasonic scaling system when assessed for pain, vibration, noise and volume of coolant. These findings were all statistically significant. There was, however, no statistically significant difference between the two systems when assessed for taste.

Conclusion: During SPT the Vector™ system caused reduced discomforting sensations compared with conventional methods and may be useful in improving compliance with SPT programmes.

Key words: patient comfort; supportive periodontal therapy; ultrasonic scaler

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Compliance with supportive periodontal therapy (SPT) is generally poor (Kerry 1995) with rates approximating 30%. The reasons for this are multifactorial and remain largely speculative, but experience or fear of discomforting stimuli during SPT appointments may be a significant factor. This notion is supported by pre-treatment interviews of 20 patients, where two-thirds indicated that some degree of pain and unpleasantness was associated with periodontal debridement (Svensson et al. 1994).

Ultrasonic and sonic instruments are routinely used to mechanize subgingival debridement. The discomforting stimuli elicited from their use may include pain, vibration, excessive noise, bad taste and a high volume of water coolant. Very little patient evaluation has been reported regarding these potentially distressing stimuli, although pain and noise accounted for a high incidence of anxiety during hygienist appointments in 78% and 36% patients, respectively (de Jongh & Stouthard 1993).

Recently, a new ultrasonic (magnetostrictive) scaling unit, the Vector™ (Dürr Dental, Bietighiem-Bissingen, Germany), has been developed which utilizes a resonant ring to deflect the 25 Hz frequency vibrations down the longitudinal axis of the scaler tip. As a result, the instrument tip moves parallel to the tooth surface when located within a periodontal pocket in contrast to the laterally directed vibrations that occur with a standard ultrasonic or sonic scaler. The Vector™ coolant is applied by intermittent pulsation at a flow rate of 6 ml/min. This is considerably less than the minimal flow rate of 20 ml/min. recommended for conventional systems (Trenter & Walmsley 2003). The liquid directed to the Vector™ scaler tip establishes indirect connection of ultrasonic energy to the periodontal tissues. The principle of generating an adhering film of water or hydroxyapatite particle suspension around the tip is comparable with the lithotripsy systems used to remove urinary tract calculi (Tolley & Downey 1999).

By minimizing vibrations applied directly to the root surface, the Vector™ system may provide significant advantages to the patient over conventional

systems. Firstly, it should make treatment less painful than that afforded by conventional systems. Secondly, it should prevent inadvertent gouging of the root surface. Thirdly, it should cause a reduction in the high-frequency noise; and finally, through its unique cooling system it should prevent excessive heat build-up from occurring at the root surface.

All of these proposed advantages (less pain, less vibration, less noise and less volume of coolant required) should contribute to a more comfortable patient experience. A less discomforting treatment might increase patient compliance and hence give a better prognosis for periodontal therapy.

The present study was undertaken to determine if the Vector™ system provided a more comfortable patient experience as compared with a standard ultrasonic scaler during SPT.

Materials and Methods

Patient selection

The study was approved by University of Queensland Dental Research Ethics Committee. Forty-six patients (age range 27–71 years) were recruited from those attending for SPT at the post-graduate Periodontics clinic at the University of Queensland. This clinic receives referrals from undergraduate student clinics, private practice, and self-referred patients who are unable or unwilling to attend private dental practice. Participants had previously been diagnosed with chronic periodontitis and had completed initial periodontal debridement and were considered periodontally stable prior to entering the SPT programme (mean deepest pocket depth 4.8 mm, SD 1.2 mm). All participants were provided with detailed information regarding the study, and signed an informed consent form.

Inclusion criteria

To be included in this study subjects had to be greater than 18 years of age, have an adequate level of English language comprehension and have a minimum of two teeth in each quadrant.

Exclusion criteria

Exclusion criteria for this study included: patients who did not give informed consent, patients with concurrent root hypersensitivity, pulpitis, abscesses and other acute infections of the mouth requiring immediate treatment. In addition patients with significant systemic disease that may preclude normal scaling procedures (neurological, cardiovascular, haematological, psychiatric and malignant disorders) were also excluded.

Study design

The study was a randomized, split mouth comparison clinical trial. Forty-six patients with stabilized chronic periodontitis were debrided using two different methods: a conventional ultrasonic scaler Siroson L (Sirona™, Sirona Dental Systems GmbH, Bensheim, Germany) using the universal 4L tip with a maximum power setting of 40% and the Vector™ system (Dürr Dental) using the metal straight Paro Probe tip with a power setting of 25–30 μm (6–7 LED lights on control panel). The choice of scaling unit for the first half of debridement (quadrants 1 and 4) was randomized by coin toss. Upon completion of this first half of debridement, patients were immediately instructed to complete a questionnaire about their experiences. After completion of this task, the second half of the debridement (quadrants 2 and 3) was performed using the alternate scaling unit. The patient then immediately completed another copy of the same questionnaire.

Both supra and subgingival instrumentation was undertaken as required to achieve a clinically smooth root surface, free of deposits. Up to 10 min./quadrant were allowed for this procedure. Interruption of the scaling procedure because of excessive pain was recorded for each tooth. Once an interruption occurred, the scaling procedure was discontinued on that tooth in question.

Questionnaires

The visual analogue scale (VAS)

The VAS was used to retrospectively measure the intensity of pain experienced during treatment. Pain was assessed on a 100 mm horizontal, continuous interval scale where the left end point was marked ''no pain'' and the right end point marked ''worst pain imaginable''. The patient did not assign a number to the pain but simply placed a mark to coincide with the level of pain experienced.

The verbal response scale (VRS)

Patients were also asked to rate the degree of discomfort because of various facets of the scaling procedure using a five-point VRS. The facets included and responses requested are shown in Table 1.

Statistical analysis

Scores of the VAS were analysed using the parametric paired Student's *t*-test. Differences were considered to be statistically significant at $p < 0.05$. The

Table 1. Questionnaire presented to patients for product evaluation

Question	Possible answers
How much pain did you feel during the scaling procedure? Choose the alternative that best describes this sensation	No pain, mild pain, moderate pain, severe pain, very severe pain
How did you find the noise of the scaling unit?	Soothing and pleasant, unaware or not bothered, mildly annoying, moderately annoying, severely annoying
How much were you bothered by the amount of water used by the scaling unit?	No discomfort, very mild discomfort, mild discomfort, moderate discomfort, severe discomfort
How much were you bothered by the taste or texture from the scaling unit water?	Not at all, very mildly unpleasant, mildly unpleasant, moderately unpleasant, severely unpleasant
How much were you bothered by the vibration or buzzing of the scaler?	No discomfort at all, very mild discomfort, mild discomfort, moderate discomfort, severe discomfort
Would you be happy to be treated with this scaling unit at your next appointment?	Yes, no
Any comments you would like to make?	

VAS is a simple, robust, sensitive and reproducible means of expressing pain numerically (Maxwell 1978), which can be analysed by parametric statistics (Philip 1990, Hartmannsgruber & Silverman 2000).

The ordinal scores of the five-point VRS were analysed by a non-parametric version of the repeated measures of analysis of variance (Friedman test). This test is based on the ranks within each case. The scores for each variable are ranked and the mean ranks for the variables are then compared.

The ''yes/no'' data regarding whether patients would be ''happy'' to continue using either scaling unit was analysed using the Pearson χ^2 test. As the number of subjects was relatively low the Fisher's exact test was also applied.

Results

The treatment with the Vector™ system was never assessed to be as painful as the treatment with the conventional ultrasonic scaling system during SPT. As shown in Fig. 1, the results of the VAS comparison during SPT showed that the patients instrumented with the Vector™ system (mean 15.34 mm, SEM = 2.11) experienced about half the amount of pain as compared with when instrumented with the conventional ultrasonic scaling system (mean 29.35 mm, SEM = 3.11), and was highly significant ($p < 0.01$).

When a regression analysis was performed on these data ($R^2 = 0.453$) and graphically displayed (Fig. 2) the slope of the ''line of best fit'' supports a trend that the Vector™ system causes about half the amount of pain as compared with the conventional ultrasonic scaling system (Pearson's correlation = 0.673, $p < 0.01$)

The results of the five-point VRS comparison also showed that the Vector™ system caused less discomfort than the conventional ultrasonic scaling system when assessed for pain, noise, volume of water and vibration (Figs 3–6). These findings were all highly statistically significant ($p < 0.01$). There was, however, no statistically significant difference ($p = 0.503$) between the two systems when assessed for taste (Fig. 7).

The results from the yes/no question regarding whether patients would be happy to be treated with the ultrasonic system again showed no statistically significant difference (Pearson's $\chi^2 = 0.509$ and Fisher's exact test = 0.949 is $p = 1.0$) between the Vector™ and the conventional ultrasonic scaling system (see Table 2).

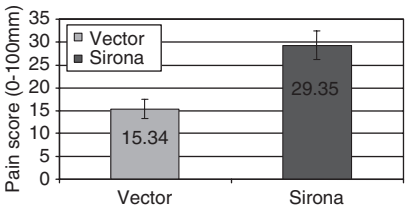

Fig. 1. Mean visual analogue scale values and standard error (SE) of the pain scores after treatment with the Vector™ and Sirona™. Pain scores were analysed by the paired Student's *t*-test ($p < 0.001$).

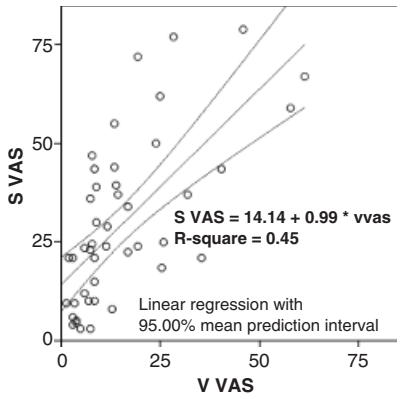

Fig. 2. Regression analysis of pain scores correlated with Vector™ and Sirona™ systems.

Discussion

In this study, treatment with the Vector™ system was approximately half as painful as treatment with a conventional ultrasonic instrument when assessed by the VAS. This finding is supported by a recent study that compared the subjective intensity of pain during treatment of three teeth with matching periodontal lesions, using either the Vector™, a sonic scaler or hand instruments (Braun et al. 2003). The correlation between the VAS scores for the two different approaches (Pearson's correlation = 0.673, $p < 0.01$) accounts for varying pain thresholds between patients, such that while some patients rate either procedure as quite painful the conventional ultrasonic instrument was almost always rated as more painful.

Of the various measurement tools that are available for evaluation of patient perceptions, the VAS is a simple, robust, sensitive and reproducible means of expressing pain numerically (Huskisson 1982), and it has been used to effectively evaluate dental pain (Matthews & McCulloch 1993, Seymour et al. 1983). The VAS provides a retrospective

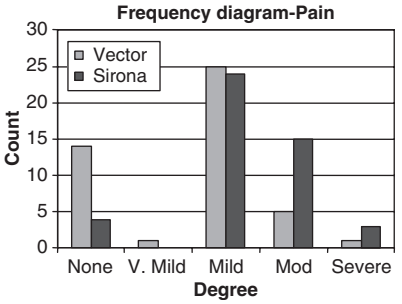

Fig. 3. Frequency histogram of pain scores as assessed by verbal response scale after treatment with the Vector™ and Sirona™ systems. Pain scores were not normally distributed and hence analysed by non-parametric test (Friedman test, $p < 0.001$).

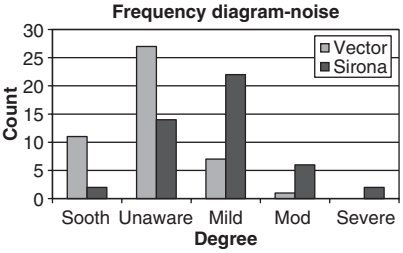

Fig. 4. Frequency histogram of verbal response scale scores of noise levels after treatment with the Vector™ and Sirona™ systems. These scores were not normally distributed and hence analysed by non-parametric test (Friedman test, $p < 0.001$).

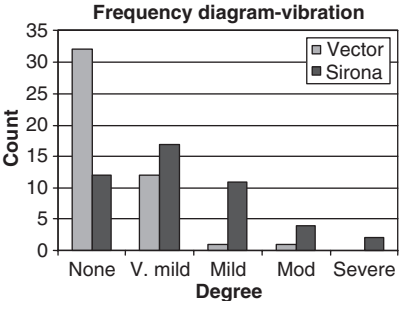

Fig. 5. Frequency histogram of verbal response scale scores assessing vibration levels after treatment with the Vector™ and Sirona™ systems. These scores were not normally distributed and hence analysed by non-parametric test (Friedman test, $p < 0.001$).

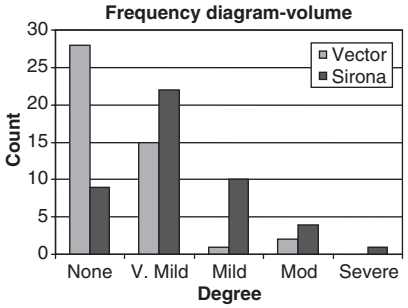

Fig. 6. Frequency histogram of verbal response scale scores assessing discomfort from the volume of scaler coolant after treatment with the Vector™ and Sirona™ systems. These scores were not normally distributed and hence analysed by non-parametric test (Friedman test, $p < 0.001$).

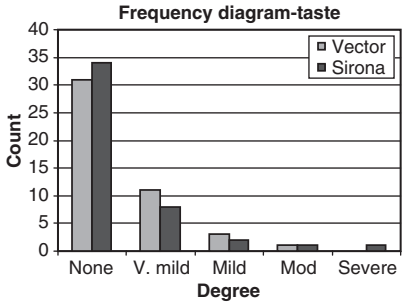

Fig. 7. Frequency histogram of verbal response scale scores assessing discomfort from the taste of scaler coolant after treatment with the Vector™ and Sirona™ systems. These scores were not normally distributed and hence analysed by non-parametric test (Friedman test, $p = 0.983$).

Table 2. Patient acceptance of mode of therapy as measured by their happiness to be treated by the same scaling unit at their next appointment

	S-Happy		Total
	no	yes	
V-Happy, no	0	1	1
V-Happy, yes	9	36	45
Total count	9	37	46

Pearson's $\chi^2 = 0.249$, $p = 1.00$ (Fisher's exact); V, Vector™; S, Sirona™.

assessment of previous painful sensations. Because of this, it was very important to explain the VAS very precisely to the patient before treatment so there was no delay in completing it after treatment. In view of this, the present study required the patient to complete the VAS and VRS immediately after each mode of treatment was completed. The use of a continuous VAS recording instead of discrete categorical choices has been shown in other studies to reduce the tendency of patients to choose mid-range numerical values that can cause clustering of values near to a central tendency (Scott & Huskisson 1976).

In this study, the use of the VRS showed that treatment with the Vector™ system caused less discomfort than the conventional scaler when assessed for pain, vibration, noise and volume of water, but not for taste.

Pain has been evaluated through a similar scale for sonic scalers (Jacobs & van Steenberghe 1994). This study reported that discomfort from sonic scaling is a common occurrence. These findings are consistent with the idea that discomfort from ultrasonic scaling is a significant issue in the majority of patients (de Jongh & Stouthard 1993).

The less painful sensations occurring during treatment with the Vector™ system could be the result of the longitudinal movement of the instrument tip. This action minimizes the instrument from directly chipping against the root surface. Hence the root surface is debrided by cavitation or acoustic microstreaming (AMS) and not by the chipping action of the tip (Walmsley et al. 1984, Walmsley et al. 1988).

The number of patients unaware of discomforting noise during SPT was significantly less with the Vector™ (82%) as compared with the conventional unit (34%). This is significant in view of the fact that noise from ultrasonic scaling units appears to be an anxiety producing factor in 36.4% of patients undergoing SPT (de Jongh & Stouthard 1993). Ultrasonic scalers may be a potential hazard to the auditory system of both clinicians and patients. Damage to operator hearing is possible through airborne subharmonics of the ultrasonic scaler. For the patient, damage can occur through the transmission of ultrasound through tooth contact to the inner ear via the bones of the skull. This latter hazard is a possibility during scaling of the molar teeth.

The number of patients either not bothered by, or reporting only very mild discomfort with, the volume of water used during treatment was significantly less with the Vector™ (93.5%) as compared with the conventional unit (67.4%). This result was probably because of the lower flow rate of coolant used by the Vector™ (6 ml/min.), as compared with conventional systems (minimum 20 ml/min.) (Trenter & Walmsley 2003). This may have reduced discomfort in patients particularly with gagging or mouth-breathing problems. Not surprisingly, the taste of the hydroxyapatite suspension was not found to be offensive. However, three patients did report a mild offensive taste in relation to the residual disinfectant used to clean the lines that was present at the beginning of sessions.

There was no statistical difference between the treatments with regards to a preference for re-treatment with the same instrument. However this may be because of insufficient numbers of subjects. However, Table 2 does show a trend towards preferring the Vector™ system for re-treatment compared with the convention ultrasonic (OR = 1.25, 95% CI 1.08–1.45).

A potential weakness of the study was that the patients were not blinded to the type of instrument used. As the patients had already experienced the conventional ultrasonic scaling system during previous appointments, there was potential for bias in favour of the perceived new technology. The sole operator took care in introducing the Vector™, and described it being different rather than new, and not necessarily better. As there was only one operator there were no issues of inter-clinician variability regarding their experience and perception of the equipment.

In conclusion, the results of this study show that during a typical SPT appointment, the Vector™ system resulted in about half the amount of pain as compared with a conventional ultrasonic scalers when evaluated by a VAS. The results from the VRS showed that the Vector™ system caused less discomfort than the conventional ultrasonic system when assessed for pain, noise, volume of water and vibration but not for taste. Because of this, the patients' acceptance of this new method is very good. For especially apprehensive and sensitive patients, the Vector™ system may enhance the patient's motivation and compliance for SPT.

Acknowledgements

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Clinical Relevance

Scientific rationale for study: Ultrasonic scalers can produce unpleasant sensations during their use which can impact on patient acceptance of treatment particularly in the supportive phase of periodontal treatment. In this study a new ultrasonic scaler (Vector™ scaling unit) was tested for patient comfort during SPT and was compared with a conventional ultrasonic scaling unit.

Principal findings: The Vector™ scaling unit was well accepted by patients and evoked reduced discomforting sensations when compared with the conventional ultrasonic unit.

Practical implications: These findings indicate that the Vector™ unit provides a comfortable and non-traumatic experience during SPT.