



## CLINICAL EFFICACY AND SUBJECTIVE PAIN EVALUATION OF TWO ULTRASONIC SYSTEMS IN NON-SURGICAL PERIODONTAL TREATMENT OF MODERATELY ADVANCED CHRONIC PERIODONTITIS

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### ABSTRACT

**Objective:** To compare the clinical efficacy and perception of pain between Vector<sup>TM</sup>-system and a conventional P5 ultrasonic system in the non-surgical treatment of chronic periodontitis.

**Materials and methods:** 45 patients with moderate periodontitis were treated by

Vector<sup>TM</sup>-system and a conventional P5 ultrasonic device in a split-mouth design clinical trial. At baseline and 6 weeks after non-surgical phase of treatment was completed, plaque index, bleeding on probing, pocket probing depth and clinical attachment levels were measured and recorded. A visual analogue scale was used to evaluate the patients' perceived pain immediately after scaling and root planning.

**Results:** At 6 weeks of evaluation, all sites showed an improvement in clinical parameters. No statistically significant differences in pocket probing depth and bleeding on probing was observed between the groups. However the Vector<sup>TM</sup>-system – treated group showed a greater improvement in reduction of pocket depth than P5 device. Patients treated with Vector<sup>TM</sup>-system (mean=22.5 mm, SD=7.53 mm) experienced almost 80% less pain compared with the pain, experienced by the other conventional ultrasonic device (mean=37.16 mm, SD=11.30 mm).

**Conclusion:** During initial periodontal treatment for the patients with moderate periodontitis, Vector<sup>TM</sup>-system could achieve a comparable clinical efficacy in means of reduction of major clinical parameters and reduced pain sensation compared to the conventional ultrasonic device instrumentation.

**Keywords:** Vector<sup>TM</sup>-system, P5 ultrasonic device, pain, non-surgical periodontal treatment

### INTRODUCTION

Chronic periodontitis is a multifactorial immune-inflammatory destructive disease, affecting the support-

ing tissues of teeth. The disease is associated with loss of clinical attachment, destruction of the alveolar bone and periodontal ligament, leading to eventual tooth loss. Non-surgical periodontal therapy is an effective approach for the patients. Mechanical root debridement is the cornerstone of cause-related periodontal therapy, aimed at removal of subgingival biofilm and calculus, which combined with effective oral hygiene procedures prevent bacterial recolonization and formation of supragingival biofilm [1]. The debridement is usually performed by hand instruments and/or power-driven devices. Ultrasonic systems offer some advantages for both patient and clinician, but some questions remain to be solved. Such is the discomforting stimuli like pain, vibration, excessive noise, bad taste and high volume of water coolant. It has been shown that periodontal treatment is a distressing event for many patients, with actual pain and expected pain being the major anxiety-provoking factors [2]. Application of conventional ultrasonic devices has other hazards, such as overheating of the pulp during scaling, the release of aerosols with potentially dangerous bacteria, possible platelet damage caused by the cavitation effect [3]. A novel ultrasonic device was introduced to overcome some of the problems - Vector<sup>TM</sup>-system (Durr Dental, Bietigheim-Bissingen, Germany). The unique characteristics of this system include a resonating ring, which converts the horizontal oscillation (frequency 25 KHz) into pure vertical movements. As a result, the instrument tip moves parallel along the root surface. The coolant of the system is an aqueous suspension of hydroxyapatite-containing polishing fluid, which is applied by intermittent pulsation at a flow rate of 6 ml/min. Because of the linear ultrasonic movement of the working tip, the suspension is kept around the instrument by hydrodynamic forces and the formation of an aerosol is avoided. The coolant establishes an indirect coupling of ultrasonic energy to the root surface so that the root surface is supposed to be cleaned by hydrodynamic forces such as cavitation or

acoustic microstreaming rather than by the chipping action of the instrument tip [4]. By avoiding oscillations applied vertically on the root surface, treatment with Vector-system is less aggressive to root surface, proved by a scanning electron microscopic study [5].

Since less painful treatment may increase patient compliance and may give a better prognosis for long-term clinical outcomes, the subjective perception of pain, experienced during a clinical treatment session is, therefore, an important aspect in the patient-dentist relationship.

Slot et al. [6] demonstrated that Vector-system showed comparable clinical and microbiological results when compared to SRP either with hand instruments or with power-driven devices in moderately deep periodontal pockets. Guentsch and Preshaw reported Vector-system was less efficient when removing big calculus deposits [7]. A recently published study by Arpag et al. [8] demonstrated significant improvement for the clinical attachment level and the pocket probing depths as well as tumor necrosis factor alpha levels as a potent inflammatory mediator in gingival crevicular fluid after Vector – debridement.

The aim of this study was to compare the clinical efficacy of Vector-system and a conventional ultrasonic system in moderately advanced periodontitis patients, as well as the perception of pain, experienced during treatment.

## MATERIAL AND METHODS

Study design - randomized, split-mouth comparative clinical trial.

### Patient recruitment

45 patients, selected from the patient pool of the department of Periodontology and Oral Diseases, Faculty of Dental Medicine, Medical University – Plovdiv were included in the study. The inclusion criteria were:

- older than 18 years of age patients diagnosed with generalized chronic periodontitis;
- the percentage of sites with bleeding on probing (BOP) >80%;
- at least two teeth with pocket probing depth (PD) greater than 4 mm and less than 6 mm;
- at least 5 remaining teeth in each quadrant;
- no root hypersensitivity, pulpitis, abscesses and other acute infections of the mouth requiring immediate treatment;
- good patient compliance.

### Exclusion criteria:

- patients diagnosed with advanced chronic periodontitis or aggressive periodontitis;
- systemic diseases which may preclude periodontal debridement procedures (neurological, cardiovascular, hematological, psychiatric and malignant disorders);
- use of antibiotics for 6 months prior to treatment;

- pregnancy or lactation.

All participants were provided with detailed information regarding the study and signed an informed consent form.

Study groups were as follows:

I – periodontal debridement by a conventional ultrasonic device, randomly to the selected 2 quadrants in upper and lower jaw;

II – Vector system to the remaining 2 quadrants in the upper and lower jaw, used with the polishing suspension for irrigation.

## Clinical examination

The following parameters were assessed at baseline and 6 weeks after treatment: plaque index (Silness & Loe [9](PI), bleeding on probing (BoP), pocket probing depth (PPD), gingival recession (GR) and clinical attachment levels(CAL)at 6 sites per tooth.

The measurements were made using a computerized Florida periodontal probe (Florida Probe Corp., USA) by one experienced periodontist who was not involved in providing treatment of the patients.

## Treatment

All patients received individualized oral hygiene instructions at the beginning of the study and provided again at each visit.

Supragingival plaque and calculus were removed, and teeth were polished by air-abrasive system 1 week before starting the clinical trial.

On the 1st day of treatment, periodontal debridement was performed in the 2 quadrants mentioned above with Suprasson P5 Newtron (Satelec, Merignac Sedex, France) using H3 tip with a power setting of 27 KHz (5 on the control panel). 1 day later the remaining 2 quadrants were treated using Vector<sup>TM</sup>-system (Duerr Dental, Bietigheim-Bissingen, Germany) with Paro kit tips and power setting of 25 KHz (7 LED lights on the control panel).

Both treatments were terminated when the operator was satisfied that the root surfaces were smooth and thoroughly debrided, assessed by a universal explorer type 11/12. No antibiotics, antimicrobial drugs or mouth rinses were prescribed, since they may positively affect the healing process.

Upon completion of the first treatment, each patient was instructed to complete a questionnaire – visual analogue scale (VAS) for the pain sensation during the procedure. The patient did not receive an explanation which device was actually used during therapy. Immediately after the second procedure, the patient completed another copy with the same questionnaire.

The VAS was used to retrospectively measure the intensity of pain experienced by the patient during sub-

gingival debridement. The pain was assessed on a continuous interval scale ranging from 0 – representing a feeling of absolutely no pain, to 10, representing extreme, unbearable pain and discomfort. The patient did not assign a number for the experienced pain, but simply placed a mark to coincide with the level of experienced pain.

The healing went uneventfully in all cases. 6 weeks after completion of the initial phase, the effectiveness of two ultrasonic devices was evaluated by measuring the periodontal parameters.

### Statistical analysis

Normal distribution of the data was verified with the Kolmogorov – Smirnov test. ANOVA test was performed for pairwise comparisons. Student’s t-test was used for intergroup comparisons and Pearson test - to determine the relationship between parameters. Mann-Whitney test was used to compare the mean VAS immediately after in-

terventions. Statistical analyses were performed using SPSS v.15.0 for Windows (SPSS, Inc., Chicago, USA). The significance level was set at 0.05. Data were expressed as mean ± standart deviation (SD).

### RESULTS

45 patients diagnosed with generalized moderate periodontitis and meeting other inclusion criteria entered the study. 3 patients dropped out during the study period for different reasons, and 42 patients had a full set of clinical data, and their results were analyzed. The mean age of patients was calculated at 52.1 (range 37-69); 19 male and 23 females.

The clinical parameters, including PI, PPD, CAL and BoP significantly decreased in both groups. When the groups were compared to each other, the parameters had no statistically significant differences.

**Table 1.** Comparison of clinical parameters in both groups at baseline and 6 weeks after.

Parameters/treatment group	Baseline (mean±SD)	6weeks (mean±SD)	p-value
PI			
Vector	2.05±0.34	0.91±0.23	p<0.001
P5	1.98±0.48	0.89± 0.22	p<0.001
PPD			
Vector	4.92±0.71	2.89±0.07	p<0.001
P5	4.83±0.55	3.06±0.14	p<0.001
CAL			
Vector	5.38±0.13	4.22±0.09	p<0.001
P5	5.67±0.21	4.59±0.14	p<0.001
BoP			
Vector	0.8	0.2	p<0.001
P5	0.82	0.3	p<0.001

### Pain perception during debridement.

The average VAS value during Vector treatment was 2.16 ± 2.10, and for the control device Newtron P5, this was 6.40 ± 2.31. The median was 2 for Vector scaler and almost value for the control scaler. Placing an arbitrary threshold for significant pain experience at the VAS score of 3, 70% of the subjects experienced no significant pain (VAS 0 to 3) with Vector scaler. Further assuming another arbitrary limit at 7, 3 subjects perceived great pain (VAS 7 to 10) during treatment with the Vector scaler, and 12 patients perceived great pain during treatment with Newtron P5.

### DISCUSSION

The primary objective of cause-related periodontal therapy is the elimination of subgingival biofilm and calculus and prevention of a bacterial recolonization. New technologies were developed with the aim of better performance than conventional hand- and power-driven instrumentation systems.

Our study demonstrates that subgingival debridement with Vector-system leads to predictable significant clinical improvement in PPD and CAL gain, which are similar to those achieved with conventional P5 ultrasonic device. Our results are consistent with the results of other studies [10, 11, 12].

The reduction of bleeding on probing, however, is more pronounced in the Vector group. One of the possi-

ble explanations is that Vector is achieving smoother root surface due to the special working pattern, without scratches and grooves which could stimulate recolonization of subgingival bacteria.

Of the various measurement tools available for the evaluation of patient perceptions, VAS is a simple, sensitive and reproducible means of expressing pain numerically and has been widely used to evaluate dental pain. In order to record it precisely, we did a detailed explanation of VAS to the patients before the therapy, and it was completed immediately after each treatment session.

In the present study, root debridement with the Vector-system was approximately 50% less painful compared to the conventional P5 device. Most probably this can be explained by the strictly longitudinal movement of the instrument tip on the root surface and lack of sharp edges which could accidentally damage the gingival tissues. In addition, the periodontal lesion is only treated by cavitation or acoustic microstreaming and not by the chipping action of the tip. Our results are comparable to other studies [13,14].

Hoffman et al. reported VAS scores for the Vector™-system and a conventional ultrasonic device 15.34 mm and 29.35 mm, respectively, which were both less than that of our study [15]. The reason could be different criteria for patient selection – the measurements were performed during supportive periodontal therapy. Since their periodontal inflammation was not apparent, the reaction of the periodontal tissues would be compara-

tively weak. Moreover, all the patients in that study had undergone many times periodontaltherapy, they were, therefore, adaptive to such treatment and better mentally prepared than the subjects in the present research.

On the contrary, Kocher et al. showed that the perception of pain both during instrumentation and on the following days did not differ between the Vector-system and a conventional ultrasonic device [16]. These contradictory observations are presumably due to the fact that during the maintenance phase, the authors used the conventional ultrasonic device at the lowest power setting and with a thinner tip, which might be more suitable for removing subgingival plaque and patients actually experienced no apparent pain. But in ours and Hoffman's study, scaling systems were used at a moderate power setting, so the magnitude of the stimulation to patients was greater, and the differences between the Vector™-system and conventional ultrasonic systems became significant.

In **conclusion**, the present study indicates that non-surgical treatment of moderate periodontitis, Vector™-system could achieve a comparable clinical efficacy and reduced pain sensation, compared to a conventional ultrasonic device. Vector™ – system could be used preferably as a gentle root debridement device, as an alternative to other ultrasonic scalers. Experiencing less pain and negative emotions, the patients are more likely to cooperate in the supportive periodontal treatment, which is an essential prerequisite for the long-term stability of the periodontal complex.

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