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Clinical comparison of instrumentation systems for periodontal debridement: A randomized clinical trial

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Abstract

Objective: To compare clinical efficacy, chairside time and post-treatment hypersensitivity of four instruments used for subgingival periodontal debridement.

Materials & Methods: Seventeen patients with stage II and III periodontitis were enrolled in this randomized clinical trial using a split-mouth design. Quadrants were randomly divided into four treatment groups: Group A: Gracey curettes-Hu-Friedy®; Group B: piezoelectric ultrasonic (Satelec®) with No.1S insert; Group C: diamond burs 40 µm (Intensiv Perioset®); and Group D: piezosurgery ultrasonic (Mectron®) with PP1 insert. Clinical outcomes, chairside time and hypersensitivity were assessed at 1, 2, 4 and 8 weeks after treatment. The primary outcome variable was improvement in clinical attachment level.

Results: At 8 weeks post-treatment, Gracey curettes, piezoelectric ultrasonic (Satelec®) and piezosurgery ultrasonic (Mectron®) were statistically more effective than diamond burs in increasing attachment level and reducing probing pocket depth. Comparison of piezoelectric ultrasonic (Satelec®) and piezosurgery ultrasonic (Mectron®) with the other instruments showed a statistical difference ($p < 0.001$) in chairside time. Regarding post-treatment hypersensitivity, no statistical differences were observed in any of the groups.

Conclusions: Gracey curettes, piezoelectric ultrasonic (Satelec®) and piezosurgery ultrasonic (Mectron®) were clinically more effective than diamond burs 40 µm. The ultrasonic instruments showed a significant reduction in chairside time.

KEYWORDS
non-surgical periodontal therapy, periodontal curettes, piezosurgery, scaling and root planing, subgingival debridement, ultrasonic

1 | INTRODUCTION

Periodontitis is an inflammatory disease of the tooth-supporting tissues that leads to bone loss and possible tooth loss. This disease is triggered by a group of predominantly gram-negative bacteria from the bacterial biofilm constantly forming on the tooth surface. These periodontal pathogens and their toxins develop a host immune response promoting chronic inflammation and periodontal destruction.[1-3] Removal of pathogenic bacterial biofilms, toxins and calculus, and restoration of a cleaned root surface are critical in arresting

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the progression of periodontitis. This outcome can be achieved by non-surgical or surgical periodontal therapy.[4] Previous studies have shown that scaling and root planing (SRP) offer better clinical and microbiological results.[5-7]

Different types of instruments such as curettes, sonic or ultrasonic instruments, and rotary instruments with special burs can be used to perform SRP.[6,8] Compared with other techniques, root instrumentation with curettes is considered more challenging, time-consuming, and fatiguing.[9]

Sonic and ultrasonic devices have been developed to overcome these limitations[9,10] and have shown similar or superior results to those of manual instrumentation.[10,11] Advances in instrument design, power-driven root devices, lasers and systemic antimicrobial agents have further improved SRP outcomes. Among the power-driven instruments, ultrasonic piezosurgery (Piezosurgery® Mectron), using ultrasonic microvibrations,[12] is indicated for both bone surgery and subgingival debridement. Similarly, rotary instruments with diamond burs of different roughnesses, such as the PerioSet system (Intensive—Swiss Dental Products), can be used for cleaning and polishing root surfaces.[4,8,9]

Regardless of the instrument type, one of the most common side effects of SRP is dentin hypersensitivity, which often causes patient discomfort;[11] however, this hypersensitivity tends to decrease after a few weeks.[13-15]

To our knowledge, there are no studies comparing clinical outcomes, chairside time and post-treatment hypersensitivity in periodontal debridement when performed with either curettes, piezoelectric ultrasonic (Satelec®), piezosurgery ultrasonic (Mectron®) or rotary instruments with diamond burs.

The aim of the present study was to compare the clinical efficacy, chairside time and post-treatment hypersensitivity of these four instruments used for periodontal debridement.

2 | MATERIALS AND METHODS

2.1 | Study design

This single-blind randomized split-mouth clinical trial compared clinical efficacy, chairside time and post-treatment hypersensitivity of four different instrument systems for periodontal debridement. The instruments studied were as follows: curettes (Hu-Friedy®) (Group A); piezoelectric ultrasonic (Satelec®) (Group B); diamond burs 40 µm (Intensiv Perioset®) (Group C); and piezosurgery ultrasonic (Mectron®) (Group D). A randomized list generated by software (Random function; Microsoft Excel for MAC; version 15.13.3) linked each quadrant to a specific treatment modality group. A total of 108, 111, 102 and 110 teeth were assigned to groups A, B, C and D, respectively (Figure 1).

The study was conducted in three phases: 1. initial screening (one visit), 2. treatment (two visits), 3. reevaluation and data collection (one visit). One operator (R.P) performed the initial screening and treatments. All clinical data were collected by a previously calibrated and blinded experienced examiner (A.S.).

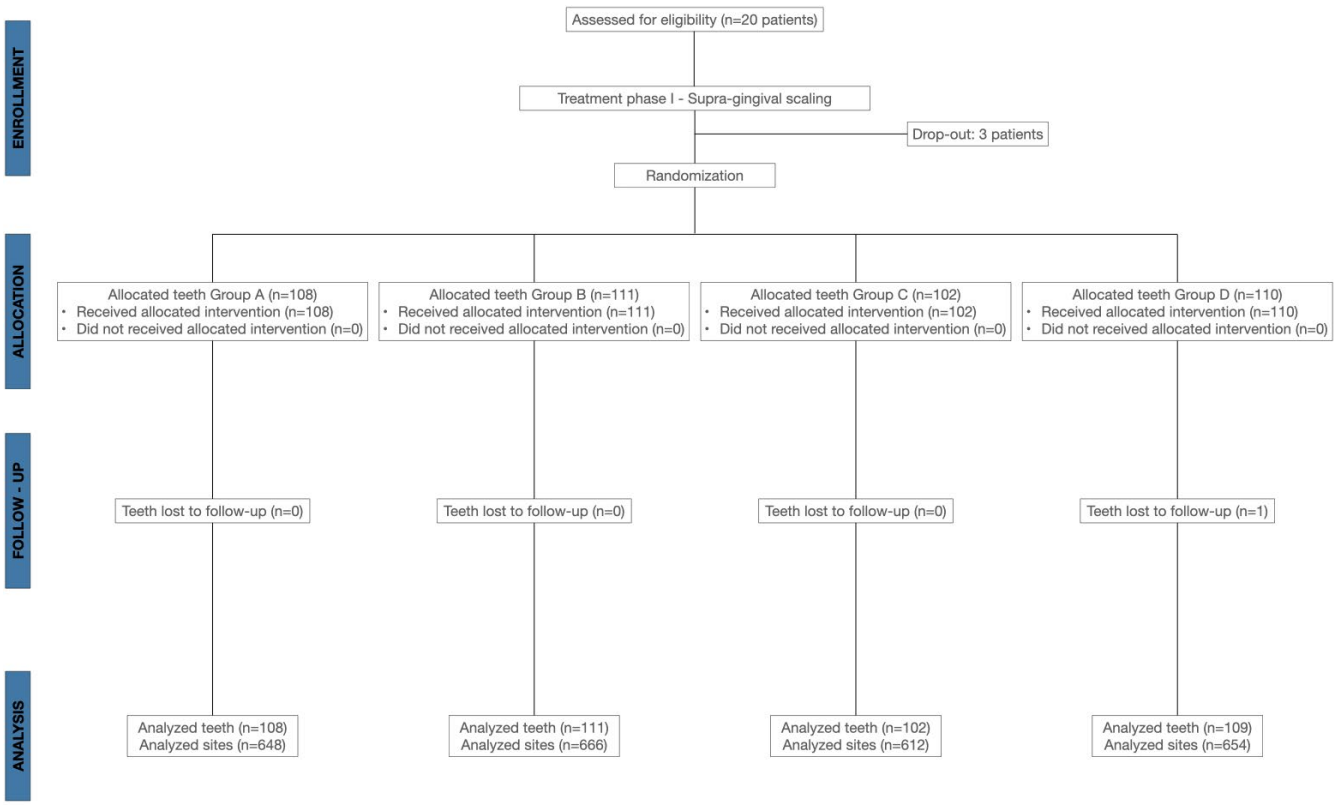

FIGURE 1 The CONSORT flow chart.

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2.2 | Participants

Twenty patients were selected from the postgraduate clinic of the Department of Periodontology at Universitat Internacional de Catalunya (UIC), Barcelona, Spain. The patients received a complete periodontal and periapical radiographic examination and a complete medical and dental history.

This study was approved by the local ethics committee (registration number: PER -ECL-2011–11-NF). Before enrolment, each patient received and signed an informed consent form.

All patients met the following inclusion criteria: ≥18 years old, periodontitis diagnosis at stage II and III (≥3 teeth per quadrant with ≥4 mm PPD), and ≥20 teeth in the remaining dentition.[16] Exclusion criteria were uncontrolled systemic diseases affecting healing, and pregnancy, lactation, smokers, diagnosis of grade C periodontitis (rapid rate), presence of acute periodontal or endodontic infection, recent periodontal treatment and antibiotic therapy in the last 3 months or during the study, and allergies to infiltrating local anaesthetics.

2.3 | Interventions

2.3.1 | *Examiner calibration*

A single clinician (RP) with extensive professional experience recorded all clinical variables, and reliability and degree of agreement in measurement were assessed before the study. The clinical variables of 10 patients were recorded and repeated at 24 hours. Significant agreement was obtained with a value of 0.80 Cohen's kappa coefficient.[16]

2.3.2 | *Clinical measurements and course of treatment*

Clinical measurements were recorded at baseline, 4 weeks and 8 weeks after periodontal debridement of each quadrant.

Parameters recorded included the following: Silness and Löe plaque index (PI),[17] gingival index (GI),[18,19] evaluated in all teeth after application of 0.5% erythrosine solution (Plac-Control®, Dentaid SA, Parc Tecnologic del Vallés) probing pocket depth (PPD), clinical attachment level (CAL) and gingival recession (REC), recorded at six sites per tooth using a PSP11 periodontal probe (Hu-Friedy®), bleeding on probing (BOP),[19] mobility (MOB) (Miller 1950), furcation involvement (FI) with a PQ2N Nabers probe (Hu-Friedy®, Leimen)[20] and dental hypersensitivity.

Dental hypersensitivity was tested with a stimulus produced by blowing air perpendicular to the root surface for 1 second. Responses were recorded on a questionnaire with a numerical scale (from 0 to 10, where 0 represents absence and 10 represents the maximum value).[13,15] Unlike the visual analog scale (VAS), this scale allows objective numerical values.

After the initial examination and data collection, each participant received individual oral hygiene instructions to brush twice daily for two and a half minutes with the Bass technique,[21] using a medium bristle manual toothbrush (Vitis Access® medio, Dentaid SA, Parc Tecnologic del Vallés), a fluoride toothpaste (Vitis® Encias, Dentaid SA, Parc Tecnologic del Vallés) and interdental brushing once daily with interproximal brushes according to the width of each patient's interproximal spaces (Interprox®, Dentaid SA, Parc Tecnologic del Vallés). Supragingival debridement was performed at all patients using a piezoelectric ultrasonic (Satelec®) device and insert N°1 (Satelec® F00246). The surface of each tooth was then polished with a rubber cup. One week later, patients were recalled for periodontal subgingival debridement under local anaesthesia (Articaine solutions - 1:200,000), and scaling was performed from the most posterior tooth of the quadrant to the most anterior.[22] Two quadrants were treated at each visit (2 visits in total): the first and fourth quadrants were treated at the first visit, and the second and third quadrants were treated at the second visit.

Group A treatment consisted of Gracey curettes 5/6, 11/12 and 13/14, which were used with vertical scaling movements from the most apical point of the pocket to the cementoenamel junction, and short horizontal movements in the most coronal areas. When necessary, the curettes were sharpened with an Arkansas stone during the procedure.

Group B treatment consisted of using a piezoelectric ultrasonic (Satelec®), set at 11–12, with a universal tip (Satelec® F02170), performing horizontal and vertical movements under water irrigation. According to the manufacturer's instructions, the ultrasonic tip was replaced when blunt. Group C was treated with 40 µm diamond burs (Intensiv Perioset®) with a rotating contra-angle handpiece at 6.000 rpm under water irrigation, performing movements parallel to the axis and around each tooth. A new bur was used for each quadrant. In group D, a piezosurgery ultrasonic (Mectron®) was used in periodontal mode (ROOT) with a PP1 insert set at 2–3 and under water irrigation, performing horizontal and vertical movements.

All groups were instrumented until a smooth and well-debrided root surface could be felt with the tip of a dental explorer. A digital timer was used to record the time in seconds from start to completion of treatment of each quadrant.

The operator worked individually in all clinical procedures. A second operator assisted only in recording the variables.

2.4 | Statistical analysis

Intra- and inter-group analyses were performed for each clinical parameter. Descriptive analysis was calculated with frequency and percentage for the qualitative variables, while mean and standard deviation were calculated for the quantitative variables. For the evaluation of hypersensitivity and chairside time, each treated tooth was considered as the unit of analysis. For the remaining variables, the site was considered the unit of analysis. The primary outcome was CAL gain expressed in mm, and the value of PPD at baseline

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TABLE 1 Baseline measurements - site level.

	PPD		REC		CAL		Sensitivity		Plaque index	
Group / Treatment	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
A	3.30	0.07	1.11	1.34	4.41	1.84	3.08	3.06	1.40	0.50
B	3.28	0.06	1.35*	1.47	4.63	2.01	2.96	2.20	1.35	0.56
C	3.56*	0.07	1.05	1.25	4.59	2.47	2.57	2.44	1.46	0.54
D	3.36	0.07	1.18	1.46	4.54	2.13	3.27	2.25	1.21	0.46
Overall	3.37	1.63	1.18	1.39	4.54	2.12	2.99	2.49	1.35	0.52

PPD, probing pocket depth; REC, recession; CAL, probing attachment level; SD, standard deviation; * =$p < 0.05$; **=$p < 0.001$; - =$p > 0.05$.

TABLE 2 Baseline measurements - Patient level.

		CAL		PPD		REC	
Group / Treatment	No of patients	Mean	SD	Mean	SD	Mean	SD
A	17	4.54	1.09	3.38	0.78	1.16	0.72
B	17	4.62	1.42	3.28	0.78	1.33	0.79
C	17	4.74	0.86	3.59	0.47	1.15	0.81
D	17	4.79	1.47	3.49	0.72	1.30	0.99
Overall	68	4.67	1.21	3.44	0.69	1.23	0.82

PPD, probing pocket depth; REC, recession; CAL, probing attachment level; SD, standard deviation; * =$p < 0.05$; **=$p < 0.001$; - =$p > 0.05$; Group A: curettes (standard Gracey Hu-Friedy®), Group B: piezoelectric ultrasonic (Satelec®), Group C: 40-µm diamond burs (Intensiv Perio Set®), and Group D: piezosurgery ultrasonic Mectron®.

was used as a covariate in the analysis. Other variables were analysed using ANOVA test blocked. Student t test was used to test the significance (95%) of the difference between groups for PPD, CAL, BOP, REC and PI and to test the improvement between baseline and reevaluation. The normal distribution of the data was tested using the Shapiro-Wilks test, and the homogeneity of variances was assessed. All tests were performed with Bonferroni corrections. Data were analysed using Statgraphic (Statgraphic Statistical Software: version 4.1 for Windows).

3 | RESULTS

3.1 | Experimental population

Considering a mean CAL difference of ≥1 mm (SD = 0.93),[23] accepting an alpha risk of 5% and a beta risk of 20% and anticipating a dropout rate of 20%, a sample of 17 subjects were necessary.

Initially, 20 patients were included in the study, and 17 of them completed the final evaluation, including 5 women and 12 men, with a mean age of 53 years (SD = 7.43).

The sample included 431 teeth and a total of 2586 sites (6 sites per tooth). One tooth in group D had to be extracted during treatment, resulting in 2580 sites for statistical analysis. The sites were used to measure the efficacy of treatment for the parameters PPD, REC, CAL, PI.

The variables PPD, REC, CAL, PI and BOP were also analysed at patient level.

TABLE 3 CAL increase at 8 weeks post-treatment by subgroup PPD: 1-3 mm; 4-6 mm; ≥7 mm (95% confidence interval).

Baseline PPD	Number of sites	CAL gain at 8 weeks	SD
1-3 mm	1522	−0.09*	1.07
4-6 mm	972	0.95*	1.40
≥7 mm	86	2.19*	2.11

PPD, probing pocket depth; CAL, clinical attachment level; SD, standard deviation; * =$p < 0.001$.

3.2 | Clinical attachment level

Table 1 shows the baseline analysis at the site level. Mean values from CAL showed no statistically significant difference ($p > 0.05$) among treatment groups. Table 2 shows the means for the baseline analysis at patient level.

Table 3 shows the group comparisons after treatment. Statistically significant differences were observed when group A was compared to group D ($p < 0.05$); when group B was compared to group D ($p < 0.05$); and when group C was compared to groups B and D ($p < 0.05$ and $p < 0.05$, respectively).

After 8 weeks, no statistically significant differences were observed when group A was compared with groups B and D ($p < 0.05$ and $p < 0.05$, respectively). Nevertheless, group D showed the largest difference: 4.04 (SD = 1.86 mm).

Groups were subdivided according to levels of initial PPD: 1-3 mm; 4-6 mm; ≥7 mm. Forty-one per cent of sites had ≥4 mm, and

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TABLE 4 Comparison of CAL mean measurements at baseline and 8 weeks after treatment. (95% confidence interval).

Group	No of patients	CAL mean T0	SD	CAL mean T8	SD	*p*-value
A	17	4.54	1.09	4.18	0.84	-
B	17	4.62	1.42	4.25	1.15	-
C	17	4.74	0.86	4.47	1.02	-
D	17	4.79	1.47	4.21	1.13	-
		-		-		
Overall	68	4.67	1.21	4.28	1.02	-

CAL, probing attachment level; SD, standard deviation; * =$p < 0.05$; ** =$p < 0.001$; - =$p > 0.05$; Group A: curettes (standard Gracey Hu-Friedy®), Group B: piezoelectric ultrasonic (Satelec®), Group C: 40-µm diamond burs (Intensiv Perio Set®), and Group D: piezosurgery ultrasonic (Mectron®).

TABLE 5 Distribution of PPD measurements at baseline and 8 weeks post-treatment (95% confidence interval).

Distribution of PPD in %			
Overall data	**Baseline**	**8 weeks**	***p*-value**
1-3 mm	59.05%	82.79%	**
4-6 mm	37.59%	16.47%	**
>7 mm	3.36%	0.73%	*
Group A			
1-3 mm	14.54%	21.04%	*
4-6 mm	9.94%	4.14%	*
>7 mm	0.81%	0.12%	-
Group B			
1-3 mm	16.24%	21.04%	*
4-6 mm	8.58%	4.41%	*
>7 mm	0.70%	0.08%	-
Group C			
1-3 mm	13.15%	19.80%	-
4-6 mm	10.05%	4.22%	*
>7 mm	0.93%	0.12%	-
Group D			
1-3 mm	15.12%	20.92%	*
4-6 mm	9.01%	3.71%	*
>7 mm	0.93%	0.43%	-

PPD, probing pocket depth; * =$p < 0.05$; ** =$p < 0.001$; - =$p > 0.05$; Group A: curettes (standard Gracey Hu-Friedy®), Group B: piezoelectric ultrasonic (Satelec®), Group C: 40-µm diamond burs (Intensiv Perio Set®), and Group D: ultrasonic Piezosurgery (Mectron®).

59% ≤3 mm. Analysis of CAL gain after treatment showed statistical significance for all subgroups (Table 4).

Table 5 shows CAL gain at patient level analysis. No significant differences ($p>0.05$) were found among all groups at baseline or at reevaluation after 8 weeks.

3.3 | Probing pocket depth

Table 2 shows the site-level analysis at baseline. Compared to the other groups, the mean PPD (3.56 mm SD 0.07) in group C showed a statistically significant difference ($p = 0.0126$). Post-treatment comparison of all groups showed no statistical differences (Table 3).

Patient level analysis showed no statistically significant differences, either at baseline (Table 6) or after treatment (Table 5).

Table 7 shows the subgroup baseline PPD analysis. Sites with initial PPD of 1-3 mm showed a statistically significant difference in the reduction of PPD between groups A and C ($p = 0.0175$), with remaining deeper pockets in group C, and no statistical difference between the other comparisons. Initial PPD of 4-6 mm or ≥7 mm showed no statistically significant differences in PPD among groups, either at baseline or post-treatment ($p > 0.05$).

Table 8 shows the patient level analysis with no significant differences ($p > 0.05$) among groups at either baseline or reevaluation.

Intragroup analysis found statistically significant reduction for each group; groups A, C and D with *p*- value <0.001 and group B with *p*-value <0.05.

3.4 | Recession

At site level, group B had the greater mean REC at baseline and showed a statistically significant difference ($p < 0.05$) compared to the other groups (Table 2). When comparing group D to group B and group C ($p < 0.001$) post-treatment, statistically significant differences were observed, with shallower recessions using the piezosurgery ultrasonic (Mectron®) device. In addition, comparison of group C with groups A and B showed statistically significant differences ($p < 0.001$), with deeper recession in the diamond bur group. Comparisons between group A and groups B and D showed no statistically significant differences ($p > 0.05$). Groups A and C yielded statistically significant differences between the two-time intervals ($p < 0.05$ and $p < 0.001$, respectively).

The overall REC was also evaluated by subgroups according to the initial PPD value. The subgroup with a baseline PPD of 1–3 mm showed a statistically significant difference between groups D and C and between groups B and D ($p = 0.0175$), resulting in deeper recessions when using the piezoelectric ultrasonic device (Satelec®). The 8 week reevaluation showed shallower recessions when using the piezosurgery ultrasonic (Mectron®) device. Statistically significant differences were found when comparing the values obtained with the other treatment modalities.

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TABLE 6 Comparison of baseline and 8 weeks post-treatment measurements. (95% confidence interval).

	PPD					REC					CAL				
	Baseline		8 weeks			Baseline		8 weeks			Baseline		8 weeks		
Group	Mean	SD	Mean	SD	*p*-value	Mean	SD	Mean	SD	*p*-value	Mean	SD	Mean	SD	*p*-value
A	3.30	0.07	2.81	0.04	**	1.11	1.34	1.35	1.33	*	4.41	1.84	4.16	1.71	*
B	3.28	0.06	2.81	0.04	**	1.35	1.47	1.45	1.47	-	4.63	2.01	4.26	1.72	-
C	3.56*	0.07	2.84	0.05	**	1.05	1.25	1.63	1.23	**	4.59	2.47	4.41	1.78	-
D	3.36	0.07	2.82	0.04	**	1.18	1.46	1.23	1.45	-	4.54	2.13	4.04	1.86	-
Total	3.37	1.63	2.82	1.09	**	1.18	1.39	1.41	1.38	**	4.54	2.12	4.22	1.77	-

PPD, probing pocket depth; REC, recession; CAL, probing attachment level; SD, standard deviation; * =$p < 0.05$; ** =$p < 0.001$; - =$p > 0.05$.

The subgroup with an initial PPD of 4–6 mm showed a statistically significant difference at baseline when comparing group A with groups B and D. And also, when comparing group C with groups B and D ($p < 0.001$). Reevaluation at 8 weeks showed a statistically significant difference when comparing groups A and C.

Analysis of the subgroup with an initial PPD of ≥7 mm showed no statistically significant differences between the groups at baseline (p 0.05). However, at 8 weeks reevaluation, groups A and C showed shallower recessions with statistically significant difference compared to groups B and C. Group C showed deeper recession with statistically significant difference ($p < 0.001$) compared to groups A, B and D.

Table 9 presents the individual level analysis and shows no significant differences ($p > 0.05$) among groups, either at baseline or at the 8 weeks reevaluation.

3.5 | Dental Hypersensitivity

The mean baseline value was 2.99 (SD = 2.49). One week after treatment, the mean score increased to 4.24 (SD = 2.91) and a slight downward trend was observed at the 4-week reevaluation with a mean score of 4.14 (SD = 3.07). After 8 weeks of treatment, the downward trend continued with a mean of (SD = 2.98) (Tables 2 and 9). Comparison between baseline and 8 week reevaluation showed no statistically significant differences between time intervals ($p > 0.05$). However, when the results were assessed together, statistically significant differences were observed between baseline and weeks 1 and 4, between weeks 1 and 8 and between weeks 4 and 8.

Reevaluation scores at 8 weeks showed better results in the group using the piezoelectric ultrasonic (Satelec®) device: 3.04 (SD = 2.39). However, no statistically significant differences ($p > 0.05$) were found compared to the other groups.

3.6 | Plaque scores

The mean baseline PI score was 1.35 (SD = 0.52), with no statistically significant differences ($p > 0.05$) observed among treatment groups. (Table 2 and 10). A significant reduction was observed in all groups after four weeks. Analysis of the groups at different time points showed statistical differences between the evaluations at baseline and subsequent time intervals ($p < 0.001$). Group A showed the best reduction PI: 0.48 (SD = 0.58) at the 8 week reevaluation. Figure 2 show the PI improvement changes for each treatment group in relation to the time variations.

3.7 | Bleeding on probing

The average baseline value of BOP was 48.57%. After 8 weeks, this value was significantly reduced to 26.54% ($p < 0.05$). The results in Figure 3 show the decrease in bleeding on probing 4 and 8 weeks after treatment.

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TABLE 7 Comparison of mean PPD measurements at baseline and 8 weeks post-treatment (95% confidence interval).

Group	No of patients	PPD mean T0	SD	PPD mean T8	SD	*p*-value
A	17	3.38	0.78	2.80	0.35	**
B	17	3.28	0.78	2.82	0.39	*
C	17	3.59	0.47	2.84	0.25	**
D	17	3.49	0.72	2.84	0.29	**
Overall	68	3.44	0.69	2.82	0.32	**

The PPD mean, studied at patient level, showing the change during time for each group. PPD, probing pocket depth; SD, Standard Deviation; * =$p < 0.05$; ** =$p < 0.001$; - =$p > 0.05$; Group A: curettes (standard Gracey Hu-Friedy®), Group B: piezoelectric ultrasonic (Satelec®), Group C: 40-µm diamond burs (Intensiv Perio Set®) and Group D: piezosurgery ultrasonic (Mectron®).

TABLE 8 Comparison of REC mean measurements at baseline and 8 weeks post-treatment (95% confidence interval).

Group	No of patients	PPD mean T0	SD	PPD mean T8	SD	*p*-value
A	17	1.16	0.72	1.38	0.71	-
B	17	1.33	0.79	1.44	0.80	-
C	17	1.15	0.81	1.66	0.83	-
D	17	1.30	0.99	1.37	0.98	-
Overall	68	1.23	0.82	1.46	0.83	-

REC, recession; SD, standard deviation; * =$p < 0.05$; ** =$p < 0.001$; - =$p > 0.05$; Group A: curettes (standard Gracey Hu-Friedy®), Group B: piezoelectric ultrasonic (Satelec®), Group C: 40-µm diamond burs (Intensiv Perio Set®), and Group D: piezosurgery ultrasonic (Mectron®).

TABLE 9 Comparison of hypersensitivity and plaque index measurements at baseline and 8 weeks after treatment (95% confidence interval).

	Hypersensitivity					Plaque index				
	Baseline		8 weeks			Baseline		8 weeks		
Group	Mean	SD	Mean	SD	*p*-value	Mean	SD	Mean	SD	*p*-value
A	3.08	3.06	3.68	3.56	-	1.40	0.50	0.48	0.58	**
B	2.96	2.20	3.04	2.39	-	1.35	0.56	0.56	0.54	**
C	2.57	2.44	3.05	3.31	-	1.46	0.54	0.52	0.55	**
D	3.27	2.25	3.04	2.73	-	1.21	0.46	0.69	0.73	**
Total	2.99	2.49	3.21	2.98	-	1.35	0.52	0.57	0.61	**

Group A: curettes (standard Gracey Hu-Friedy®), Group B: piezoelectric ultrasonic (Satelec®), Group C: 40-µm diamond burs (Intensiv Perio Set®), and Group D: piezosurgery ultrasonic(Mectron®); SD, standard deviation; ** =$p < 0.001$; - =$p > 0.05$.

3.8 | Chairside time

The mean chairside time for all treatment modalities was: 356" (SD = 44 SD). The differences among the groups are shown in Figure 4.

Statistically significant differences were observed among groups ($p < 0.005$), except between groups B and D ($p > 0.05$). However, statistically significant differences were observed when comparing group B with groups A and C and also when comparing group D with groups A and C ($p < 0.05$) (Figure 4).

Chairside time was also evaluated by tooth group: Molars, Premolars and Anterior teeth. (Figure 5).

The molar group showed the best results, 289" (SD = 23") when the piezosurgery ultrasonic (Mectron®) device was used. The comparison among all treatment groups showed statistically significant differences ($p < 0.001$).

The piezosurgery ultrasonic (Mectron®) also showed the best results in the premolar group: 285" (SD = 25). There were no statistical differences between groups A and D ($p > 0.05$) and groups B and D ($p > 0.05$). Statistical differences were found when comparing group C with the other groups ($p < 0.001$). The best results were also obtained in the anterior region: 268" (SD = 35) when the piezosurgery ultrasonic device was used. No statistical differences ($p > 0.05$) were found when groups B and D were compared. However, statistical

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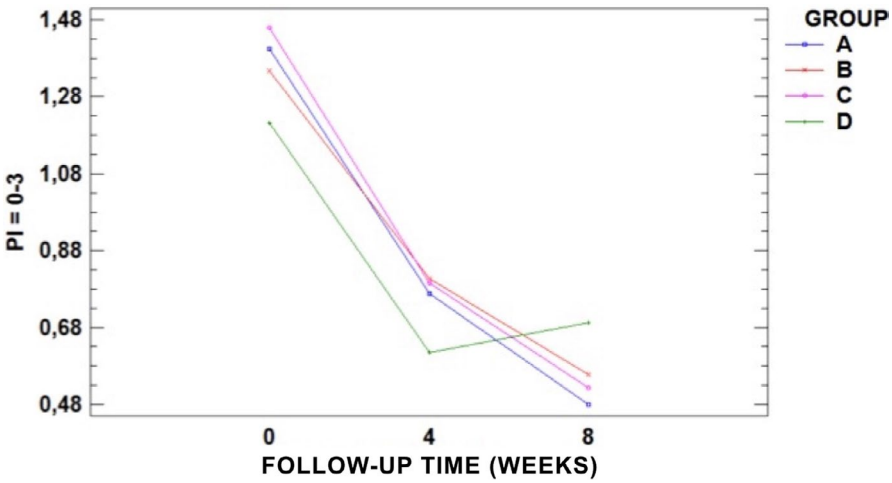

FIGURE 2 Description of plaque index in relation to change over time. (95% confidence interval).

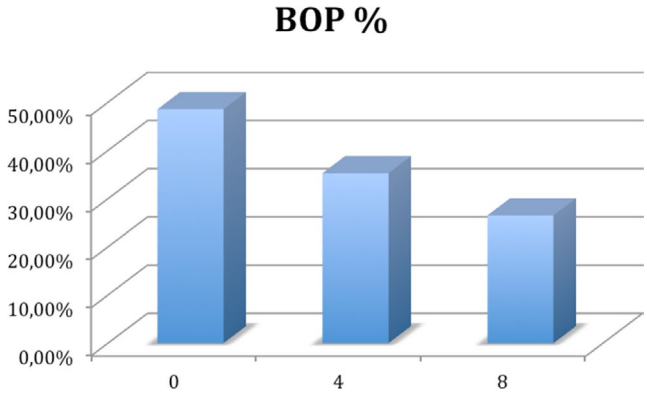

FIGURE 3 Total sample bleeding on probing percentage at baseline and at 4 and 8 week reevaluation.

differences ($p < 0.001$) were also found when groups B and D were compared to groups A and C.

Figure 5 shows chairside time in relation to the type of tooth and treatment modality. For the treatment of molars, a longer working time is observed for all treatment groups, except for the use of the piezosurgery ultrasonic (Mectron®) device, which showed similar values to the other tooth groups.

4 | DISCUSSION

Subgingival debridement therapy has long been studied. Recently, the European Federation of Periodontology presented a clinical practice guideline for the treatment of stage II and III periodontitis.[24] It demonstrates a high degree of recommendation in performing subgingival debridement for the treatment of periodontitis, in order to reduce probing depth, gingival inflammation and the number of locations with pathology, as well as the use of manual instruments and sonic and ultrasonic, individually or in combination.

The purpose of this study was to compare clinical effectiveness, chairside time and hypersensitivity after treatment with four instruments commonly used for periodontal debridement, following a previously validated methodology.[11,25-28]

The CAL and REC scores showed no statistical differences between baseline and after treatment for all treatment groups. However, the CAL values after treatment showed a tendency to decrease in all groups. Our results on CAL showed a mean loss of attachment of 0.09 mm for sulcus of 1–3 mm, an attachment gain of 0.95 mm for the pockets of 4–6 mm, and 2.19 mm for pockets deeper than 7 mm. These findings are slightly better than to those reported by Cobb et al.[27] showing a mean loss of attachment of 0.34 mm in sulcus, with an initial depth of 1–3 mm, a mean attachment gain of 0.55 mm for the 4–6 mm pockets, and the mean attachment gain for the pockets deeper than 7 mm was 1.19 mm. Likewise, Obeid et al.[28] demonstrated major attachment level gains ($p > 0.01$) with no significant inter-group differences between baseline and post-treatment for manual instrumentation, ultrasonic insert together with the Periopolisher system, the Periopolisher system alone and the ultrasonic insert alone, showing a mean CAL gain of 1.5, 1.2, 1.5 and 1.6 mm, respectively.

The results of the present study on Gracey curettes and conventional ultrasonics were similar to those reported in the literature.[11,25] The best results for clinical attachment gain were obtained with piezosurgery ultrasonic. However, our findings appear to show that diamond burs were the least effective treatment modality, with a decrease in CAL values. The results of an in vitro study by Solis-Moreno et al. (2012),[29] analysing surface roughness after using the same four instrumentation methods as in our study, showed that piezosurgery ultrasonic (Mectron®) produced a smoother surface roughness than either the piezoelectric ultrasonic (Satelec®) or the Gracey curettes did. Conversely, the diamond burs increased root surface roughness after treatment. Although the clinical relevance of post-treatment roughness remains controversial in the literature, the results of the present study indicate that the best clinical outcome in terms of CAL gain was achieved with the piezosurgery ultrasonic (Mectron®) device, consistent with the results obtained by Solis-Moreno et al. Other studies evaluating piezoelectric devices in non-surgical periodontal therapy reveal better clinical results in

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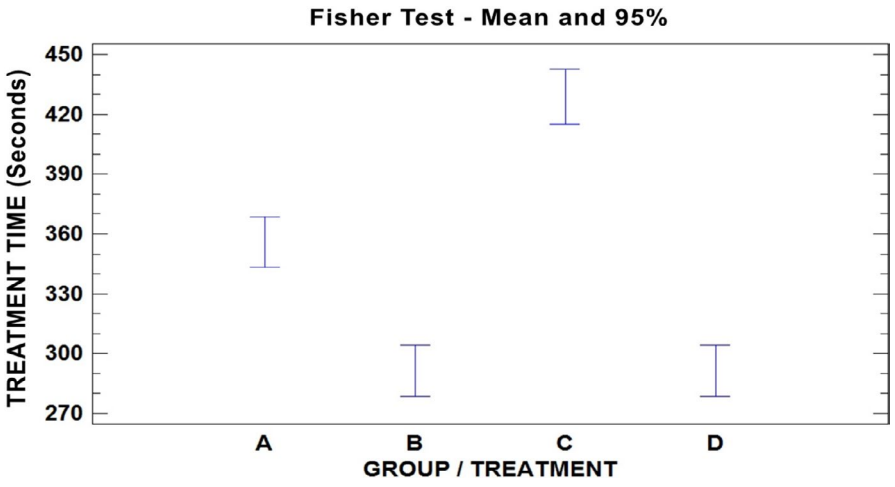

FIGURE 4 Chairside time (expressed in seconds) related to the four instrument systems.

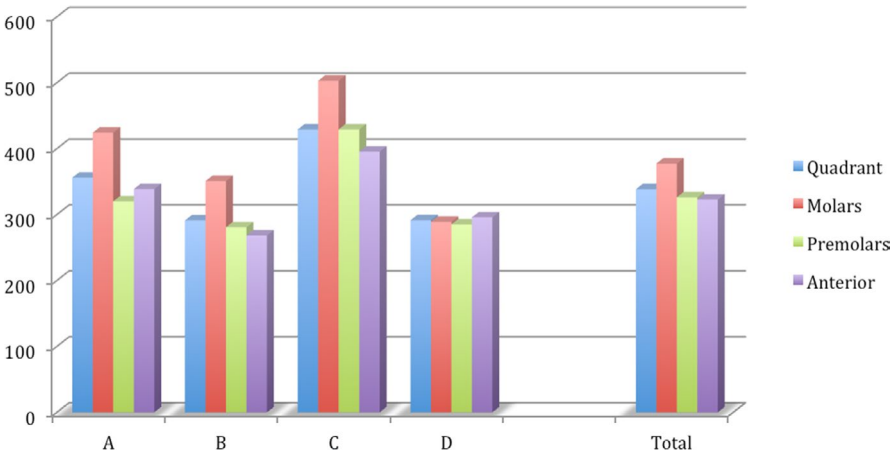

FIGURE 5 Chairside time related to tooth type for the four instrument systems.

terms of CAL gain, producing less damage to the root surface than other ultrasonic devices.[30-34]

Our findings showed a slight increase in post-treatment recession across all groups, with higher values in the diamond bur and the curette groups, respectively. These results validate those of Beuchat et al. (2001), showing that recession increased statistically in the curette group ($p < 0.01$) at two months post-treatment.[35] Additionally, rotatory instruments with diamond burs may damage the free gingiva and soft tissues, leading to greater post-treatment recession.[14]

Consistent with other studies, plaque scores were found to decrease after treatment in all groups.[24-26] In the same way, a reduction in the bleeding on probing scores was observed at 8 weeks post-treatment, showing a statistically significant difference ($p < 0.05$). A study by Cobb claims that non-surgical periodontal therapy predictably reduces inflammatory scores.[27] The initial reduction in bleeding on probing appeared to remain stable or improve with increasing post-treatment time.

Post-periodontal treatment sequelae may include patient discomfort and dental hypersensitivity.[36] Our results showed a slight increase in dental hypersensitivity in all groups at 1 week post-treatment; however, these scores returned to baseline levels at 4 weeks and showed no statistical differences across treatment modalities, these values that are in agreement with those other authors.[14,36]

New instrumentation methods have been developed to achieve optimal clinical results in the shortest possible time. According to the literature, manual instrumentation generally requires a longer chairside time to achieve the same results as sonic and/or ultrasonic scaling instruments.[7,11,25-27,37,38] The use of these can reduce the time up to 50%.[10,27,38-40] Our results are consistent with those of other studies and show that, compared with manual or rotary instruments, ultrasonic instruments statistically reduce chairside time by more than 30%.

While the efficacy of non-surgical therapy has been demonstrated in the literature, the authors of the present study are unaware of other studies comparing these four types of instrumentation systems in a human clinical trial.

One of the limitations of the present study could be the limited sample. The selection of patients included in this study was based on the criteria followed by other studies. The selection of cases with stage II and III periodontitis has resulted in a mean probing depth of 3.44 mm (SD0.69) and 41% of the pockets with ≥4 mm depth. However, it should be noted that the main limitation of the treatment of pockets ≥5 mm by subgingival debridement is the impossibility of removing 100% of the calculus.[5] Most clinical studies on this topic have used a similar inclusion criteria and sample size.[27] However, to compensate this limitation, a site-level statistical analysis was performed following the methodology used by most papers on this topic.[7,11,24-27,35,37,38]

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Another limitation was a lack of histological data. Therefore, future research should focus on root surface of hopeless teeth after extraction.

5 | CONCLUSIONS

Within the limitations of the present study, our results provide meaningful data on clinical efficacy, chairside time, and hypersensitivity after treatment using each of the four most widely used instrument systems for periodontal debridement.

The Gracey curettes, piezoelectric ultrasonics (Satelec®) and piezosurgery ultrasonic (Mectron®) provide better results in terms of CAL, PPD reduction and chairside time compared with diamond burs 40 μm. Both ultrasonic instruments showed better results in terms of chairside time. All four treatment modalities produced similar hypersensitivity.

6 | CLINICAL RELEVANCE

6.1 | Scientific rationale

Subgingival debridement and removal of bacterial biofilm represent one of the elementary steps in the treatment of periodontal disease. However, it is considered a treatment that can cause discomfort and postoperative hypersensitivity in the patient. It is also time-consuming and causes fatigue in the practitioner. The development and design of new devices and instruments that improve these limitations is constant, but there are doubts about their effectiveness.

6.2 | Principal findings

The use of ultrasonic instruments offers clinical outcomes equivalent or superior to those of manual instrumentation. They also offer advantages in reduced working time, as well as reduced postoperative hypersensitivity and patient perception.

6.3 | Practical implications

Ultrasonic instruments with less postoperative hypersensitivity, a reduction in working time and positive clinical attachment level outcomes result in a better patient and practitioner experience and would lead to improved patient compliance.

The initial probing scores of the selected sample and the reduced number of deep pockets allow an objective analysis of the use of the compared treatments. The results of this study demonstrate the efficacy of these treatments in stage II and III periodontitis.

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CONFLICT OF INTEREST

The authors reported no conflicts of interest and no economical funding related to this study.

AUTHOR CONTRIBUTIONS

Rosario Puglisi: clinical procedures, protocol design and contribution to writing. Andres Pascual: statistical analysis, protocol design and contribution to writing. Antonio Santos: clinical data collection and creator of the idea. Angels Pujol: contribution to writing. Jose Nart: contribution to writing. Marco Ferrari: contribution to writing.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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