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RESEARCH ARTICLE

THE INFLUENCE OF CALCULUS ON INITIAL PROBING DEPTH

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ABSTRACT

Objective: To evaluate probing depth (PD) measurements, using a conventional probe, before and after calculus removal in individuals attending a dental school in Makkah city.

Materials and methods: In total, 82 individuals, aged 17 years and older, non-smokers, with no known history of systemic disease and exhibiting at least 20 remaining teeth, were included. The presence of calculus deposits during the periodontal examination was a prerequisite for enrollment in the study. PD measurements were recorded prior to and immediately after scaling by a single examiner.

Results: The mean and standard deviation (SD) values of PD prior to and after scaling were 2.19±0.94 mm and 2.78±0.98 mm, respectively, and the difference was statistically significant ($P < 0.001$). Only 7% of the examined sites showed PD ≥ 4 mm prior to scaling compared with 18% after scaling, and the difference was statistically significant ($P < 0.001$). There was no statistically significant difference in PD values before and after scaling when the results were stratified by gender.

Conclusion: A significant increase in the number of sites with a PD ≥ 4 mm was observed following scaling treatment. Calculus deposits could contribute to reading errors in the assessment of initial probing depth

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INTRODUCTION

Probing depth (PD) assessment is a commonly used clinical measure for detecting the loss of periodontal support (Wolf, 2011). It is measured from the free gingival margin to the depth of the probable crevice, which ranges from 1mm to 3mm in a healthy gingival sulcus (Wolf, 2011). Accurate periodontal probing is essential for proper periodontal diagnosis and therefore the establishment of an effective treatment plan (Drucker, 2012). Misinterpretation of the true periodontal condition may result in a lack or an excess of treatment; hence, the need for accurate measuring tools is essential if more precise data are to be obtained for the diagnosis and early detection of the disease (Andrade *et al*., 2012). In the literature, the use of conventional probes has been acknowledged as suffering from some drawbacks. Probing force, errors in visual assessment, degree of inflammation in the periodontal tissues, probe angulation, probe design, and root anatomy are some variables that influence the practitioner's ability to measure probing depth accurately (Osborn *et al*., 1990; Mayfield, 1996; Listgarten, 1980; Garnick, 2000). Different modified probes have been invented to minimize the errors associated with conventional probes. These modified probes are combined with controlled force application, automated measurement, and computerized data collection and provide a means of recording attachment changes over time (Osborn *et al*., 1990; Alves Rde *et al*., 2005; Gupta *et al*., 2015). Although electronic probes were developed to overcome some of the technical difficulties associated with conventional probing (Osborn *et al*., 1990; Alves Rde *et al*., 2005; Gupta *et al*., 2015), manual probes are considered acceptable for routine periodontal examination and produce results comparable with those obtained with modified electronic probes (Niederman, 2009). The presence of calculus is another source of error that may interfere with the accurate reading of PD during periodontal probing (Oringer *et al*., 1997). Supragingival calculus has been found to be a hindrance to the correct positioning of the probe (Listgarten, 1980), whereas subgingival calculus may act as a barrier to full probe penetration, leading to a possible underestimation of

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measurements (Clerehugh *et al*., 1996). However, there is lack of clinical studies examining the effect of calculus on the initial values of probing depth. The main objective of the present study, therefore, was to investigate the influence of calculus removal on the reproducibility of initial PD measurements, by means of a conventional probe, before and immediately after scaling in individuals attending a dental school.

MATERIALS AND METHODS

This study was carried out in the dental clinics at the Faculty of Dentistry in Umm Al-Qura University (UQU), Makkah city, Saudi Arabia, and was approved by the Ethics Committee of that institution. Included in the study were individuals of both genders, aged 17 years and older, who had been referred for periodontal scaling. Those recruited were non-smokers with no known history of systemic disease and who had not received any periodontal treatment in the six months preceding the start of the study. Those with fewer than 20 remaining teeth and declining to provide consent were excluded. The presence of calculus deposits during the periodontal examination was a prerequisite to inclusion in the study and was recorded according to the Calculus Surface Index (CSI), which was introduced by Ennever *et al*. in 1961 (Ennever *et al*., 1961). The detection of supra- and subgingival calculus deposits was made with the use of a mouth mirror and a dental explorer through visual and tactile examination. A single calibrated examiner conducted the recording of PD at baseline and immediately after scaling using a UNC-15 periodontal probe (Hu-Friedy, Chicago, IL, USA).PD was evaluated for each tooth at six sites: mesiobuccal, midbuccal, distobuccal, and three corresponding lingual/palatal sites. All sites of third molars were disregarded. Each study participant received a single full-mouth scaling completed within the same visit by means of a sonic scaler (Sonicflex 2003 L, KaVo). The same power and frequency settings as well as the scaler tip design were utilized for all participants.

Statistical analysis

In total, 820 teeth and 4914 sites were examined. Statistical analysis was conducted with SPSS statistical software for Windows (version 21, SPSS Inc., Chicago, IL, USA).The data were analyzed by the paired t-test. The chi-square test was performed to view the significance of the grouped PD (classified into ≤ 3mm and ≥ 4 mm). A P value of 0.05 or less was considered statistically significant.

RESULTS

In total, 82 individuals (36 males, 46 females), with a mean age of44.3 years, were included. The mean and the standard deviation (SD) values of PD taken pre- and post-scaling were 2.19±0.94 mm and 2.78±0.98 mm, respectively, and the difference was statistically significant (P< 0.001). Table 1 shows the frequency of PD measurement prior to and after scaling in the entire sample. When PD was classified as ≤ 3mm and ≥ 4mm, only 7% of the examined sites were ≥ 4 mm prior to scaling compared with 18% after scaling, and the difference was statistically significant(P< 0.001) (Table 2). The mean and the SD values of probing depth before scaling for males and females were 2.2 ±0.94 mm and 2.2 ±0.98 mm, respectively, and the difference between genders was not statistically significant (P=0.95). The mean and the SD values of PD after scaling for males and females were 2.78 ±0.91mm and 2.78 ±0.96 mm, respectively, and the difference between genders was not statistically significant (P=0.97). Table 3 shows the frequency of various PD measurements prior to and after scaling, stratified by gender. PD classified as ≤ 3mm and ≥ 4 mm in males and females is shown in Table 4.

Table 1. Frequency (n) and percentage (%) of various PD measurements taken prior to and after scaling in the total sample

PD values (mm)	Pre-scaling n (%)	Post-scaling n (%)
1	1219 (24.8)	367 (7.5)
2	1999(40.7)	1438 (29.3)
3	1344 (27.4)	2240 (45.6)
4	235 (4.8)	679 (13.8)
5	97 (2.0)	160 (3.3)
6	14 (0.3)	24 (0.5)
7	6 (0.1)	6 (0.1)
Total	4914 (100)	4914 (100)

Table 2. PD classified as ≤ 3 mm and ≥ 4 mm prior to and after scaling in the total sample

PD values (mm)	Pre-scaling n (%)	Post-scaling n (%)	P-value
≤3	4562 (92.8)	4045(82.3)	<0.001
≥ 4	352 (7.2)	869(17.7)	
Total	4914(100)	4914 (100)	

Table 3. Frequency and percentage of various PD measurements taken prior to and after scaling and stratified by gender

PD values (mm)	Pre-scaling n (%)		Post-scaling n (%)	
	Males	Females	Males	Females
1	681 (24.7)	538 (24.9)	206 (7.5)	161 (7.5)
2	1156 (41.9)	843 (39)	833(30.2)	605 (28)
3	717 (26)	627 (29)	1230 (44.6)	1010 (46.8)
4	126 (4.6)	109 (5)	368 (13.3)	311 (14.4)
5	65 (2.4)	32 (1.5)	103 (3.7)	57(2.6)
6	10 (0.4)	4 (0.2)	15 (0.5)	9 (0.4)
7	5 (0.2)	1 (0)	5 (0.2)	1 (0)
Total	2760 (100)	2160 (100)	2760 (100)	2160 (100)

Table 4. PD classified as ≤ 3 mm and ≥ 4 mm taken prior to and after scaling and stratified by gender

PD values (mm)	Pre-scaling n (%)		Post-scaling n (%)	
	Males	Females	Males	Females
≤3	2554 (92.5)	2008 (93)	2269 (82.2)	1776 (82.2)
≥ 4	206 (7.5)	146 (6.8)	491 (17.8)	378 (17.5)
Total	2760 (100)	2160 (100)	2760 (100)	2160 (100)
P-value	0.355		0.826	

DISCUSSION

The aim of the present investigation was to study the changes in initial PD measurements occurring immediately after one session of scaling treatment so as to ascertain whether the presence of calculus would act as a source of error during conventional probing. The results of the current study showed that scaling yielded significant changes in the initial PD values throughout the sample. A statistically significant difference was observed when PD measured more than 4 mm after scaling in 18% of the examined sites compared with only 7% before scaling. No significant difference was found when the results were stratified by gender prior to and after scaling. Numerous studies have assessed changes in PD before and after different periodontal therapies in patients with periodontitis; however, the main aim of those studies was to determine the efficacy of a particular treatment modality through the evaluation of alterations in the clinical parameters over the healing period at different time intervals (Apatzidou, 2004; Ribeiro Edel *et al*., 2005; Westfelt *et al*., 1998; Sato *et al*., 1993; Choi *et al*., 2015; Hämmerle, 1991). One study assessed the influence of calculus on the validity of clinical PD measurements in comparison with those obtained histopathologically on extracted human teeth without any treatment provided (Clerehugh, 1996). In our study, there was no intention to track changes in the PD values during the healing process. Furthermore, the study scheme was conducted in clinical settings. Hence, there were no studies reported in the periodontal literature that could help in comparisons with the results of the present study.

To minimize the number of probe-related variables in the current study, we used a well-calibrated UNC-15 periodontal probe for all PD measurements taken at baseline and after scaling, and these measurements were taken by a single examiner. With regard to variations in probing force, which appear to be evident not only between different examiners but also within a single examiner (Gabathuler, 1971), studies demonstrated that probing force was not a primary cause for variation in PD measurements (Abbas *et al*., 1982; Hassell, 1973). All participants enrolled in this study received scaling treatment, which was conducted by one operator to eliminate inter-operator variability and to reduce variations in factors such as stroke length, force, and pressure applied during instrumentation (Marda *et al*., 2012). No differences in results were observed when the effects of a single instrumentation on the clinical periodontal parameters were compared with those from multiple instrumentations (Badersten *et al*., 1984). In the present study, PD was recorded after scaling was performed once.

In the interpretation of PD measurements made with conventional probes, it is important to consider the inflammatory condition of the periodontal tissues (Wolf, 2011). The current results showed a significant increase in the number of sites with PD measuring more than 4mm post-scaling, which can be attributed to the removal of calculus, which acted as a barrier to full probing, especially when it was subgingivally located and when PD values were underestimated before treatment. In contrast, calculus serving as a plaque-retentive factor may have been associated with increased inflammation at the pocket base, leading to deeper penetration of the probe into the connective tissue attachment due to less resistance offered by the diseased periodontium (Clerehugh, 1996). Although bleeding on probing was not considered in our study, analysis of the data showed no systematic measurement error between PD and bleeding on probing (Clerehugh, 1996). Of note, in the present study, there was a decrease in the number of sites with PD of 1-2 mm after scaling compared with those obtained before calculus was removed. This can be attributed to the presence of supragingival calculus, which was found to interfere with the correct positioning and angulation of the probe (Listgarten, 1980). Although the use of the stent method along with probing eliminated the particular issue associated with the change of probe direction (Gupta *et al*., 2015), subgingival calculus could still be an additional source of error (Clerehugh, 1996). A careful clinician should take into consideration that the initial periodontal examination is highly subject to variations, and any undetected probing errors can result in misdiagnosis, potentially exposing the patient to unnecessary harm through inappropriate treatment (Wolf, 2011). It is recommended that further clinical studies be conducted to evaluate whether calculus influences the recording of essential periodontal parameters by different probing methods.

Conclusion

Based on the results of this study, there was a significant increase in the number of sites with a PD $\geq$ 4 mm following one scaling treatment. The presence of calculus deposits could play a considerable role in producing reading errors in the initial values of PD taken by conventional probing.

Conflicts of interest

None declared.

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