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A thin or thick probe handle: does it make a difference?

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Abstract: *Objectives:* The aim of the present study was to assess the probing force exerted when using two manual periodontal probes with different handle diameters in hands of different dental professionals. *Methods:* For this study two periodontal probes with handle diameters of 54 and 92 mm were used. The 11 subjects responsible for the measurements were periodontists, postgraduate periodontal students and dental hygienists. Per measurement session, 20 measurements were performed by each subject. Each probe was used 10 times. After the first baseline measurement session, a second session was performed 1 week later and a last third session another 3 weeks later. Orders for using each probe were randomized for each subject and each session. *Results:* The mean overall force with the thin probe was 55.2 g and with the thick probe 59.4 g. The difference of 4.2 g between the two probe types was found to be statistically significant ($P = 0.041$). *Conclusion:* The present study showed that the diameter of the probe handle also had an effect on the force exerted with a periodontal probe. However, the clinical relevance of this difference may be minor, when considering the interindividual variance of forces exerted when probing.

Key words: diameter probe handle; periodontal probe; probe handle

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Introduction

In diagnosing and evaluating treatment of periodontal diseases, the presence of inflammation and subsequent pathological changes of the periodontium are evaluated by various means, including inflammation, presence of bacteria, gingival crevicular fluid flow and periodontal probing. Currently, periodontal probing depth, loss of connective tissue attachment

and bleeding on probing are generally used to estimate severity of inflammation and response to treatment. Evaluation of these parameters depends on the use of the periodontal probe (1).

Current probing methods are subject to various errors, e.g. measurement outcomes are strongly dependent on probing force (2–4). Therefore, variations in probing force are of importance and appear to be evident between different examiners and at different sites for a single examiner (5).

The degree of probe tip penetration when measuring a pocket is also influenced by the presence of inflammation. With increasing probing forces, the location of the tips of the probes changed from a position occlusal to the most coronal connective tissue fibres to a position apical to the most coronal connective tissue fibres (6). It must be realized that even though forces used are low, pressures exerted by the probe may be high, because thin probes are used and penetration of tissues is deep (1). In addition to the probing force, the shape of the probe tine and probing direction are factors that influence the recorded probing depth (7).

During the last decades various pressure-sensitive automated probes have been developed to reduce the factor of variability of probing force (8, 9). Some authors have reported an improved reproducibility of probing measurements (10–13), whereas others found no improvement of the reproducibility when using constant force probes (14–17). The automated Florida Probe® introduced by Gibbs *et al*. (18) has shown to be more reproducible than manual probing in a number of studies (18–20). A recent study has shown that compared to automated probes the manual probe still remains a reliable tool in daily periodontal practice (21).

As probing force is of great importance for periodontal probing, manual probing might be influenced through neuromuscular stress in the hand musculature. Especially for the size of the handle, Schneevoigt and Reitemeier (22) demonstrated a design-related influence on these intrinsic muscles. With increasing diameter of the handle, less stress was observed in the hand musculature. They suggested that through lesser fatigue of hand muscles, the coordination of the use of dental hand instruments with a diameter ≥7.5 mm is more precise. Possible influence of the size of the probe handle on the probing force of the subject with a manual probe may therefore be expected. With increasing muscle tension and fatigue feeling, the accuracy of the strength advancement and the movement development decreased (22).

This raises the question whether there is a difference in probing force between a periodontal probe with a thick or a thin handle?

Therefore, the aim of the study was to assess the exerted probing force using two manual periodontal probes with different handle diameters by a number of dental professionals.

Methods

Probes

For this study two periodontal probes with different handles were used. All subjects used these same two probes (Fig. 1). One probe had a handle diameter of 92 mm (Hu-Friedy® PQW6-Y1; Hu-Friedy Mfg. Co., Inc., Leimen, Germany)*. The other probe had a handle diameter of 54 mm (Hu-Friedy® PQW-P2; Hu-Friedy Mfg. Co., Inc., Leimen, Germany)*. The tips of both probes were identical both in diameter as well as for angle of the tip. The weight of the Hu-Friedy® PQW6-Y1 is 20 g and the weight of the Hu-Friedy® PQW-P2 is 16 g. Both probes had Williams markings at 1, 2, 3, 5, 7, 8, 9 and 10 mm, with a 'round' tip which has a diameter of 0.5 mm.

Subjects

The subjects responsible for the measurements were periodontists, postgraduate periodontal students and experienced dental hygienists. In total 12 subjects participated in this study.

Measurements

For each of the two probes that had been used for this study, the probing force was assessed using a custom-made electronic precision balance. The subject set each probe perpendicularly onto the balance and was asked to invoke pressure to the level

Fig 1. Hu-Friedy® PQW-P2 (bottom) and Hu-Friedy® PQW6-Y1 (top).

for their habitually excerted probing force. At the moment this was reached, the subject gave a sign to the examiner who subsequently recorded the weight from the scale of the precision balance. During each measurement session, 20 measurements were performed by each subject. Each probe was used 10 times. The order of use of the thin and the thick handles was fully randomized for each subject and session.

To minimize memory of muscle tension, subjects had to lay down and pick up the probe again before performing a new measurement. Throughout the study, subjects were blinded for all values of probing force to avoid bias in the measurements. One week after the first (baseline) measurement session, a second session was performed. A last and third session was completed another 3 weeks later.

Data analysis

The mean probing force for all subjects with either a thick or thin probe handle within one measurement session was calculated. In addition, the overall mean probing force for each probe was calculated. Minimum force represents the mean of all lowest probing forces of each subject. Maximum force represents the mean of all highest probing forces of each subject. Standard deviation represents the mean of the standard deviation of each session calculated for all subjects. Data were compared using descriptive statistics and tested for differences using Wilcoxon test. *P*-values ≤ 0.05 were accepted as statistically significant.

Results

Of the 12 subjects, one was not available for each of the three measurement sessions due to scheduling conflicts. Data concerning this subject were excluded from the analysis.

Table 1 shows mean probing force, as exercised with each of two probes at each of three occasions. The mean overall force with the thin probe was 55.2 g and with the thick probe 59.4 g. The difference of 4.2 g between the two probe types was found to be statistically significant ($P = 0.041$).

This table also shows the mean lowest and highest forces, measured for each subject in each session. Analysis showed that these differed between probes. The lowest measured force was lower ($P = 0.012$) with the thin-handled probe as compared to the thick-handled probe.

The mean probing force varied widely between the individual subjects. In some subjects the maximum force did not exceed 40 g while in others maximum forces up to 200 g were noted. Also the fact that probing on a precision balance is not comparable to clinical measurements, where pressure feedback is experienced by tonus of the gingiva may influence the amount of force used.

Between the two probes, the mean of the standard deviations within each individual subject showed no significant difference.

Discussion

The size and shape of the handle are important factors affecting the usability of a hand tool. For example, the diameter of the screwdriver handle determines the minimum grip force. A tactility study of commercial handles found the largest handle to give enhanced tactility, but significance was not sustained. From the purely mechanical viewpoint, a large diameter seems appropriate (*23*, *24*). As was stated in the Introduction the coordination of the use of dental hand instruments with a diameter ≥ 7.5 mm is more precise (*22*). The present study aimed to assess the exerted probing force using a manual periodontal probe with a thin handle and another with a thick handle. The results show that there was a small but significant difference between the two periodontal probes. On average 4 g more force was used with the probe with the thick handle when compared with the one with the thin handle. The range within subjects, however, was higher (SD 12.9 and 12.7, Table 1) than the difference between the two periodontal probe handles. Therefore, the clinical significance of the 4-g difference is probably negligible.

The amount of variation in the peak force between subjects was a surprising result of this study. Some subjects habitually

	Thin handle				Thick handle			
Session	Mean	Min	Max	SD	Mean	Min	Max	SD
Baseline	55.6 (39.5)	18.7	158.9	11.5	58.5 (32.2)	20.6	136.8	14.3
+1 week	54.9 (31.9)	16.9	124.3	15.0	59.5 (34.3)	19.4	128.4	13.3
+3 weeks	55.1 (32.6)	13.6	134.7	12.2	60.1 (33.5)	15.1	130.0	10.6
Overall	55.2 (32.2)	16.4	139.3	12.9	59.4 (29.8)	18.4	131.7	12.7

Table 1. **Mean (standard deviation in parenthesis), minimum and maximum probing force and mean standard deviation of the subjects using a thin or thick probe handle ($n = 11$)**

used lower forces than others (ranging from approx. 40 to 200 g). This may be related to hand position, training, experience, age, fatigue, muscle strength, body weight or other factors (25). Also the fact that probing on a precision balance is not comparable to clinical measurements, where pressure feedback is experienced by tonus of the gingiva may influence the amount of force used.

Little is known about handle size in relation to handling properties of periodontal instruments. However, the literature on endodontics provides some additional information.

As root canal preparation by hand instruments requires substantial effort, operators often suffer pain and fatigue in their arms and hands after extended treatment duration. A survey of 192 dentists described which symptoms were experienced during their dental practice (26). The results indicated that 79.2% had experienced symptoms in their hands and forearms, and the symptoms were highest during or after root canal preparation. The handle diameters of endodontic instruments on the market are currently in the 3.5–4 mm range. The influence on tactile sensitivity and efficiency of handle design or diameter is discussed in some studies (24, 27, 28). However, the optimum handle design remains ambiguous. Study results suggest that as handle diameters increase from 3.5 to 5 mm the instrumentation time becomes shorter and operators' effort reduces (29).

In summary, various studies have shown that handle diameter has an effect on grip force, fatigue and tactile precision. The present study showed that it also had an effect on the force exerted with a periodontal probe. Probing with a thick probe handle resulted on average in 4 g higher probing forces. It is concluded that although statistically significant, the clinical relevance of this small difference is probably negligible.

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