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RELIABILITY AND ACCURACY OF GOLD STANDARD DIAGNOSTIC AID FOR PERIODONTAL DISEASE: AN OBSERVATIONAL STUDY

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ABSTRACT:
The aim of this study was to assess the reliability and accuracy of commonly used periodontal probes manufactured by different companies. 50 UNC-15 & 50 Williams periodontal probes of different companies (GDC, SSWhite& Hu-friedy) were measured in length and diameter at 1mm and 15 & 10 mm respectively. A vernier scale is a device that indicates where the measurement lies in between two of the marks on the main scale. TOLEXO™ 150mm verniercaliper (error±0.02mm) was used. Distribution of range of markings on William's and UNC-15 varied between different sets of probe. One way analysis of variance indicated highly significant differences ($p < 0.0001$) in tine diameter and length at 1 mm and 15 mm for UNC-15 and tine diameter and length at 1 mm for William's probe. No significant difference was found in length at 10 mm for different sets of William's periodontal probe. This considerable variety in tine diameter for periodontal probes may influence pocket depth and attachment level measurements. The discrepancy seen in the dimensions reduces the reliability and accuracy of the periodontal probe. Thus, probe diameter and calibration should be considered in addition to other variables of periodontal probing.

Keywords: Tine diameter, calibration, probing errors, accuracy

INTRODUCTION:

Periodontal probing is the most useful diagnostic parameter to determine the presence and severity of periodontal lesions, and in the assessment of periodontal treatment. The probe enables the clinician to determine pocket depths and attachment levels, presence of inflammation (bleeding on probing and suppuration), presence of plaque and calculus, and irregularities in root configuration.[1]

Obtaining reliable measurements of pocket depth and attachment level is obviously critical to both longitudinal clinical studies and routine clinical assessment of periodontal therapy. Current probing methods are subject to various errors. Variations in probing force are evident between different examiners and in different sites for a single examiner.[1-3] The degree of penetration of the probe tip is also influenced by the presence of

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inflammation and when inflamed the probe stops at the level of intact connective tissue fibers 0.3 to 0.5 mm apical to the termination of the junctional epithelium. Probe angulation, probe tip dimension, and pocket depth will also affect reproducibility.[4] Errors in visual assessment, rounding off to the nearest mm, recording errors, variations in probe markings, and patient cooperation must also be considered. Finally, even the use of a stent to guide angulation of the probe does not significantly affect reproducibility.[5]

There are variations in methodologies which limits the opportunity for comparison of epidemiological studies and it is also important to standardize periodontal probing to determine true pocket depth (Magnusson et al 1988).[6] Errors are inherent to the use of periodontal probes, apart from this there is very less literature concerned about the errors or accuracy of the instrument includes instrument dimensions (L&D) and graduation markings. Thus the aim of this study was to assess the reliability and accuracy of commonly used periodontal probes manufactured by different companies.

The most commonly used probes are Williams graduated probe and University of North Carolina (UNC-15) probe.

The periodontal probe developed by William CHM has been one of the most popular instruments for the examination of pockets. William was a periodontist who specialized in the study of the relationship between pocket formation and focal infection.[7-9] During the late 1950s, few other authors like Goldman et al,[10]Orban et al,[11] Glickman [12] published their text on importance of periodontal probe in diagnosis, prognosis, and treatment. All authors agreed and supported use of the William's probe which was rod shaped with 1, 2, 3, 5, 7, 8 and 9 mm markings, and a 1.0 mm diameter at the tip. Goldman et al [10] stated that 'Clinical probing with suitable periodontal instruments, such as William's calibrated probe is a prime necessity in delineating the depth, topography and character of the periodontal pocket'. Modifications of William's probe were described by many authors. The best-known examples are probably the probes of Goldman and Fox, Nabers, Drellich, Cross and Gilmore. Today, the University of North Carolina probe (PCP-UNC 15, Hu-Friedy Manufacturing Co., Chicago, IL, USA), with color coding of every millimeter demarcation, is probably the preferred instrument in clinical research if conventional probes are required.[9]

MATERIALS AND METHODS:

The material for this study comprised of two types of periodontal probes that are commonly used (UNC-15 and Williams graduated probe) (Fig. 1) manufactured by three different companies (GDC, SS white and Hu friedy). Markings were in the form of engraved grooves or bands. 50 UNC-15 and 50 William's probes of each company were measured.

Width of markings was measured as the distance from the probe tip to the most proximal and distal limits of first millimetre and last millimetre marking. So for UNC-15 probe, probe length was measured from probe tip to 1mm marking and 15mm marking and for William's probe, it was measured from probe tip to 1mm marking and 10mm marking. Accuracy of calibration was assessed from the mean of each measured marking to the tip of the tine, and compared with the expected distance as designated by the manufacturer.

Tine diameter was measured at the 1 mm and 15 mm for UNC-15 probe and 1mm and 10mm for William's probe from the tip to standardize the area of measurement for all the probes. All measurements were made by using a digital vernier scale: a device that indicates where the measurement lies in between two of the marks on the main scale. A digital vernier calliper of 150 mm (manufactured by TOLEXO™) calibrated with a 0.01 mm scale (error±0.02mm) was used (Fig. 2). Blind duplicate measurements were made. The data were used to compare differences within and between different probe sets and calibration system

RESULT:

Only in very few cases was a marking exactly coincident with the manufacturer's designated calibration to within 0.01 mm.

William's probe: (Table 1, Graph 1A,B,C and D)

The range of variation and mean of diameter at 1 mm and 10 mm for William's probe are represented (Table 1). One way analysis of variance indicated highly significant differences ($p < 0.0001$) in tine diameter at 1 mm and 10 mm and in length at 1 mm between different sets of probes. No significant difference in length at 10 mm was found in all the sets of probe. There was wide variation seen among all parameters (length and diameter) when the three different manufacturing companies were compared with least variation seen among probes of Hu friedy William's probe.

UNC-15 Probe:(Graph 2A,B,C and D)

The range of variation and mean of diameter at 1 mm and 15 mm for UNC-15 probe are represented (Table 2). One way analysis of variance indicated highly significant differences ($p < 0.0001$) in tine diameter and length at 1 mm and 15 mm between different sets of probes. There was wide variation seen among all parameters (length and diameter) when the three different manufacturing companies were compared with least variation seen among probes of Hu friedy William's probe.

The variations in the width markings seen reduces the accuracy of the instrument and it also concludes from this part of the study that there is considerable variety in tine diameter for a range of currently available periodontal probes, which may influence pocket depth and attachment level measurements.

DISCUSSION:

In the present study, 50 probes of each manufacturing companies were measured and assessed, which showed that the discrepancies does exist within the manufacturing company and also when compared to other companies. So when the parameters (i.e, diameter and length) were measured the minimum variation was seen with the Hu friedy probes (UNC-15 and William's probe).

The increasing variation in the probe diameter and width markings along the length of the probe leads to the decrease in the accuracy of the probes and thus reduces the reliability of the instruments.

On examination of the ranges, it became apparent that difference in accuracy of the same marking distance between the different samples of the same set could be considerable, implying that if the same pocket is measured with different samples of the same probe design produced by the same manufacturer in the same production line, a difference of 0.5 mm or more could result due to probe calibration inaccuracy, even in an ideal theoretical situation where all other variables would have been excluded. When measured in mm according to the nearest calibration, this may result in differences of 1 mm due to inaccuracy in probe tine calibration alone.

As for tine diameter, there are few reports concerning accuracy of probe calibration and marking width. Winter (1979)[13] collected 129 periodontal probes in use (121 Williams and Goldman-Fox and 8 Michigan) from periodontal practices and measured at the 5, 7, and 10 mm markings (3, 6, and 8 mm for Michigan probes) to the nearest 0.1 mm. He concluded that most markings were not precise. Of a total of 387 measurements, 130 were accurate to the nearest 0.1 mm; the range was usually between 0.2 and 0.4 mm. However, in the case of old (unspecified) probes, ranges of 1 mm occurred. Also accumulation of periodontal probes with inconsistent markings may occur in practice, and that this may affect treatment planning. The findings of the present study, although more comprehensive, are in agreement in this respect.

As it is important to standardise periodontal probing *''as much as possible''* in order to determine "true pocket depth", one may wonder why the tine of the instrument of measurement itself still presents variability, to the degree determined in this study.[6]

Such factors may not seem very relevant for clinical practice, although tine diameter would seem relevant in relation to the tendency to overestimate pocketdepth with thin probes in the presence of inflammation at initial examination, and to underestimate using thick probes when initial treatment and improved oral hygiene have resulted in readaption of the soft tissues to the tooth. For clinical research purposes, however, where mean changes in probing attachment level of tenths of a milimeter may be important, this study has demonstrated that, unless the same accurate and consistent probe is used for allmeasurements, which is unlikely in studies of adequate population size, such levels of change could result, at least partly, from inaccurate probe tine characteristics.

So we conclude that the tine diameter and marking characteristics, as well as accuracy of calibration from the tip, should be considered in addition to other variables in relation to periodontal probing, particularly for clinical research. Standardisation of tine characteristics and avoidance of the use of different types or batches in a single study should enhance the accuracy and reproducibility of periodontal probe-dependent measurements.

CONCLUSION:

The conclusion from this study opens the ways to further evaluate the accuracy of diagnostic aids. Till date, the literature being scant about the observations for larger sample size, there exists a need for studies to evaluate the various diagnostic aids using sophisticated measures to confirm and help manufacturers to increase the accuracy and thus the reliability of gold standard diagnostic aids.

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TABLES:

Table 1:Range of variation in William's probe at 1mm and 10 mm diameter and 1mm and 10 mm length.

Williams		Probes	Mean ± SD	Range	p-value
Diameter	1mm	GDC	0.5 ± 0.07	0.32-0.7	<0.0001[a0]
		SS White	0.63 ± 0.06	0.55-0.8	
		Hu friedy	0.49 ± 0.02	0.44-0.54	
	10mm	GDC	0.73 ± 0.08	0.59-0.95	<0.0001 [a0]
		SS White	0.87 ± 0.04	0.8-0.96	
		Hu friedy	0.89 ± 0.02	0.84-0.94	
Length	1mm	GDC	0.83 ± 0.12	0.51-1.05	<0.0001[a0]
		SS White	0.86 ± 0.09	0.69-1.1	
		Hu friedy	0.96 ± 0.04	0.8-1.05	
	10mm	GDC	9.92 ± 0.19	9.52-10.4	0.08
		SS White	9.92 ± 0.21	9.2-10.4	
		Hu friedy	9.99 ± 0.05	9.9-10.09	

[a0] indicates P value is Significant

Table 2:Range of variation in UNC-15 probe at 1mm and 15 mm diameter and 1mm and 15 mm length.

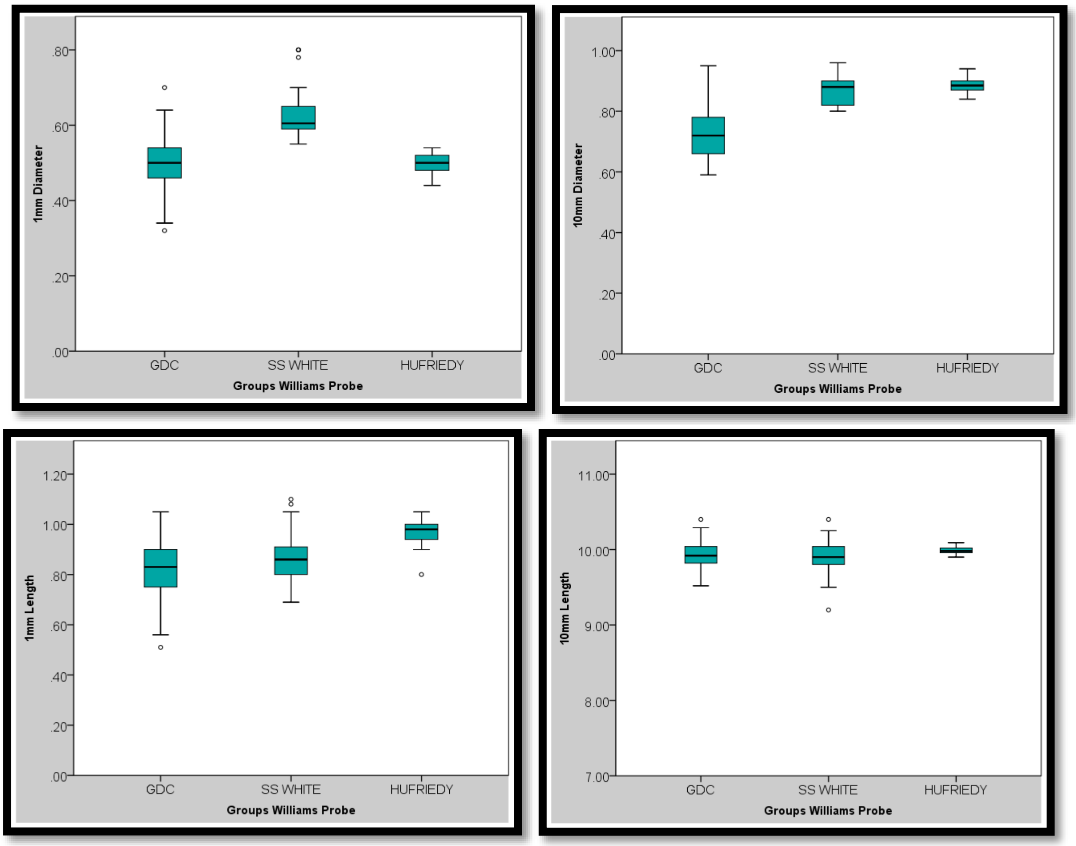
UNC 15		Probes	Mean ± SD	Range	p-value
Diameter	1mm	GDC	0.56 ± 0.08	0.4-0.75	<0.0001[a0]
		SS White	0.56 ± 0.04	0.43-0.64	
		Hu friedy	0.46 ± 0.02	0.42-0.52	
	15mm	GDC	0.93 ± 0.08	0.77-1.99	<0.0001[a0]
		SS White	1.11 ± 0.06	0.97-1.23	
		Hu friedy	0.83 ± 0.03	0.78-0.93	
Length	1mm	GDC	0.89 ± 0.15	0.6-1.31	<0.0001[a0]
		SS White	0.78 ± 0.12	0.5-0.96	
		Hu friedy	0.85 ± 0.03	0.8-0.96	
	15mm	GDC	14.98 ± 0.17	14.51-15.41	<0.0001[a0]
		SS White	14.89 ± 0.12	14.58-15.15	
		Hu friedy	14.85 ± 0.05	14.74-14.96	

[a0] indicates P value is Significant

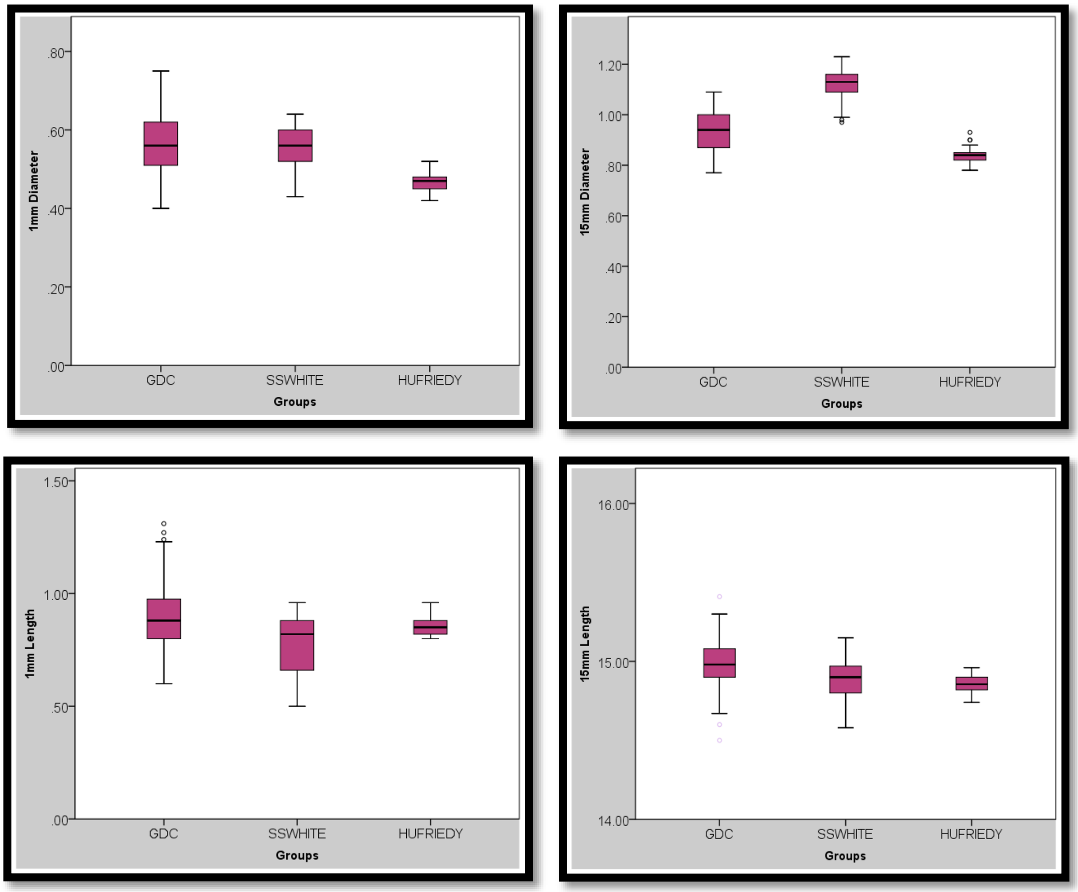
FIGURES:

Figure 1:- **Williams and UNC-15 probe**

Figure 2:Vernier Caliper of 150 mm (manufactured by TOLEXO™)



Graph 1 (A): Range of variation in tine diameter at 1 mm for Williams probe, **(B):** Range of variation in tine diameter at 10 mm for Williams probe, **(C):** Range of variation in probe length at 1 mm for Williams probe, **(D):** Range of variation in probe length at 10 mm for Williams probe



Graph 2 (A): Range of variation in tine diameter at 1 mm for UNC-15 probe, **(B):** Range of variation in tine diameter at 15 mm for UNC-15 probe, **(C):** Range of variation in probe length at 1 mm for UNC-15 probe, **(D):** Range of variation in probe length at 15 mm for UNC-15 probe