

Validity and Reliability of Periodontal Parameters Measurements

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ABSTRACT

Objective: The purpose of this study was to evaluate the validity and reliability of periodontal parameters measurements.

Study Design: Cross-sectional Study

Place and Duration of Study: This study was conducted at the periodontology Khyber college of Dentistry Peshawar Pakistan from January 2020 to March 2020 for a period of 03 months.

Materials and Methods: A total of 10 patients with 288 variables for five different periodontal parameters were examined. The study inclusion and exclusion criteria were followed. Two investigators (A and B) carried out the whole process. 'A' was the principal investigator/ intra examiner who measured the periodontal parameters and 'B' Co-investigator recorded all the readings. Five periodontal parameters including Pocket depth (PD), gingival recession (GR), bleeding on probing (BOP), plaque and calculus were measured.

Results: Pocket depth and gingival recession were recorded as numeric data so ICC (Intra class correlation coefficient) was carried out for these variables whereas Kappa score was carried out for categorical data (BOP, plaque and calculus). The ICC and Kappa values were statistically significant and were in the range of strong correlation for intra examiner.

Conclusion: The reproducibility recorded for calculus score and gingival recessions was 100%, 97% for plaque score, 95% for pocket depth measurement, and 91% for bleeding on probing and were statistically significant but it requires training and calibration with inter examiner.

Key Words: Periodontal parameters, Validity, Reliability

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INTRODUCTION

Calibration process is purely a comparison of measurement values. Calibration of a process gives consistency in readings by reducing the chances of errors and thus increases its validity⁽¹⁾.

Intra examiner calibration or intra rater reliability is the degree of agreement among repeated administrations of

a diagnostic test performed by a single rater/ examiner⁽²⁾. The term reliability in research is defined as "the degree at which the measurements should be consistent at different times and with different examiners"⁽³⁾.

Productive treatment planning in periodontology needs detailed investigative evidence and a comprehensive periodontal examination. In periodontics, comprehensive periodontal examination is an essential part of investigation⁽⁴⁾. Measurements of periodontal parameters can be analyzed more effectively and precisely in the patient's mouth^(5,6). Periodontal parameters are regularly measured in periodontal treatment process for the evaluation of presence or absence of disease, diseases severity, and disease progression, prognosis of the disease and construction of a treatment plan^(7,8). Comprehensive periodontal examination has been the standard for years in periodontal treatment plan⁽⁹⁾. However the dexterity of an operator may vary from operator to operator and may result in shortcoming during the measurement of periodontal parameters⁽¹⁰⁾. To restrain from these shortcomings validity and reliability should be practice to reduce the chances of errors. Assessment of patients for various periodontal parameters showed good agreement and validity^(11,12).

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Therefore, the purpose of this study is to evaluate the reproducibility and validity of an intra-examiner for different periodontal parameters. These periodontal parameters include; Pocket depth, gingival recession, bleeding on probing, plaque and calculus.

MATERIALS AND METHODS

The data source was patients randomly visiting to the department of periodontology Khyber college of Dentistry Peshawar Pakistan. A total of 10 patients with 288 variables for five different periodontal parameters (Pocket depth (PD), gingival recession (GR), bleeding on probing (BOP), plaque and calculus) were examined. Patients with periodontal disease were included if they were presented with teeth 16, 11, 26, 36, 41 and 46. Patients who were systemically compromised and not willing to participate in the study were excluded. The study was allowed by the institution. Basic aim was to validate and reproduce the calibration process of a single examiner i-e intra examiner. The examiner was trained with another expert examiner prior to conduct the calibration process. This was in order to reduce the chances of error and differences in measurement levels of an individual. All the 10 patients were briefed about the procedure before examination. Each patient was examined for all periodontal parameters twice in a single day with a break of 20 to 30 minutes. The readings were recorded by co-investigator. The co-investigator explained all the procedure, nature of the examination and purpose of the examination to the patient. After the willingness of the patient the procedure was started.

Plaque assessment: At first, the plaque score was recorded both visually and with the help of '15 UNC (University of North Carolina) color-coded probe on all the four surfaces of the included teeth i-e Mesial, Buccal, Distal and Lingual. The patient was given a disclosing agent in the form of a chewing tablet and was asked to chew

it for a minute and then rub his tongue all over the teeth. The stained plaque was visually recorded on all the four surfaces of the teeth. The patient was asked to rinse his/her mouth and after 10 minutes break the plaque was again recorded with the help of a dental explorer on all the four surfaces of the teeth.

Calculus assessment: After plaque score, calculus score was recorded on all the four surfaces of the teeth including Mesial, Buccal, Distal and Lingual. Calculus was 1st recorded visually and then after a 10 minutes break it was recorded with the help of a dental explorer.

Pocket depth measurement: Pocket depth was recorded after the detection of plaque and calculus on six sites of each included tooth i-e Distobuccal, Midbuccal, Mesiobuccal, Distopalatal/Lingual, Midpalatal/Lingual and Mesiopalatal/Mesiolingual using 15 UNC color-coded probe. The probe was gently

inserted into the gingival crevice or pocket along the long axis of the tooth until resistance felt. The pocket depth is the distance from gingival crevice up to the base of the pocket where resistance is felt.

Table No.1: Validity of Pocket Depth Measurement for Intra examiner

Variables (Pocket Depth)*	ICC	Variables (Pocket Depth)*	ICC
PDMB16R1 / PDMB16R2	0.967	PDMB11R1 / PDMB11R2	0.893
PDMIB16R1 / PDMIB16R2	0.814	PDMIB11R1 / PDMIB11R2	0.753
PDDB16 R1 / PDDB16R2	0.955	PDDB11 R1 / PDDB11R2	0.955
PDMP16R1 / PDMP16R2	0.957	PDMP11R1 / PDMP11R2	0.957
PDMP16R1 / PDMP16R2	0.911	PDMP11R1 / PDMP11R2	0.911
PDDP16R1 / PDP16R2	1.000	PDDP11R1 / PDP11R2	1.000
PDMB26R1 / PDMB26R2	0.945	PDMB36R1 / PDMB36R2	0.953
PDMIB26R1 / PDMIB26R2	0.980	PDMIB36R1 / PDMIB36R2	0.980
PDDB26 R1 / PDDB26R2	0.964	PDDB36 R1 / PDDB36R2	0.918
PDMP26R1 / PDMP26R2	1.000	PDML36R1 / PDML36R2	0.984
PDMP26R1 / PDMP26R2	0.719	PDML36R1 / PDML36R2	0.959
PDDP26R1 / PDDP26R2	0.904	PDDL36R1 / PDDL36R2	0.973
PDMB41R1 / PDMB41R2	0.800	PDMB46R1 / PDMB46R2	0.824
PDMIB41R1 / PDMIB41R2	0.690	PDMIB46R1 / PDMIB46R2	0.757
PDDB41R1 / PDDB41R2	0.822	PDDB46R1 / PDDB46R2	0.971
PDML41R1 / PDML41R2	1.000	PDML46R1 / PDML46R2	0.975
PDML41R1 / PDML41R2	1.000	PDML46R1 / PDML46R2	0.800
PDDL41R1 / PDDL41R2	1.000	PDDL46R1 / PDDL46R2	1.000

ICC coefficients (P- value <0.001)

* PD= Pocket Depth, MB= Mesiobuccal, MIB=Midbuccal, DB=Distobuccal, MP=Mesiopalatal, MIP=Midpalatal, DP=Distopalatal, ML=Mesiolingual, MIL=Midlingual, DL=Distolingual, R1=Rater 1, R2=Rater 2, Teeth number 16,11,26,36, 41, 46 (FDI dental numbering system)

Bleeding on probing was recorded while recording the pocket depth. Bleeding on probing was observed for four main sites i-e; Mesial papilla, Distal papilla, buccal surface and palatal/lingual surface. Bleeding on probing was recorded after 10 seconds of the probe insertion. Sometimes in disease severity the bleeding occurs as we insert the probe while in some cases where the disease was in passive state we have to wait for 10

seconds after the probe insertion to see the signs of bleeding.

Gingival recession: After completion of the pocket depth measurement, the included teeth were recorded for the gingival recession on all the six sites of the involved tooth. Gingival recession is the distance from the cement enamel junction to the gingival margin. The combined value of pocket depth and gingival recession is the total Clinical attachment loss (CAL).

Table No.2: Validity of Gingival Recession Measurement for Intra examiner

Variables (Gum Recession)*	ICC	Variables (Gum Recession)*	ICC
GRMB16R1 / GRMB16R2	1.000	GRMB11R1 / GRMB11R2	0.960
GRMIB16R1 / GRMIB16R2	0.943	GRMIB11R1 / GRMIB11R2	1.000
GRDB16 R1 / GRDB16R2	1.000	GRDB11 R1 / GRDB11R2	1.000
GRMP16R1 / GRMP16R2	0.962	GRMP11R1 / GRMP11R2	1.000
GRMIP16R1 / GRMIP16R2	0.987	GRMIP11R1 / GRMIP11R2	1.000
GRDP16R1 / GRP16R2	0.985	GRDP11R1 / GRP11R2	1.000
GRMB26R1 / GRMB26R2	0.911	GRMB36R1 / GRMB36R2	1.000
GRMIB26R1 / GRMIB26R2	1.000	GRMIB36R1 / GRMIB36R2	1.000
GRDB26 R1 / GRDB26R2	1.000	GRDB36 R1 / GRDB36R2	1.000
GRMP26R1 / GRMP26R2	1.000	GRML36R1 / GRML36R2	1.000
GRMIP26R1 / GRMIP26R2	0.938	GRMIL36R1 / GRMIL36R2	1.000
GRDP26R1 / GRDP26R2	1.000	GRDL36R1 / GRDL36R2	1.000
GRMB41R1 / GRMB41R2	1.000	GRMB46R1 / GRMB46R2	0.947
GRMIB41R1 / GRMIB41R2	1.000	GRMIB46R1 / GRMIB46R2	1.000
GRDB41R1 / GRDB41R2	1.000	GRDB46R1 / GRDB46R2	1.000
GRML41R1 / GRML41R2	1.000	GRML46R1 / GRML46R2	1.000
GRMIL41R1 / GRMIL41R2	1.000	GRMIL46R1 / GRMIL46R2	0.917
GRDL41R1 / GRDL41R2	1.000	GRDL46R1 / GRDL46R2	1.000

ICC coefficients (P- value <0.001)* GR= Gum Recession, MB= Mesiobuccal, MIB=Midbuccal, DB=Distobuccal, MP=Mesiopalatal, MIP=Midpalatal, DP=Distopalatal, ML=Mesiolingual, MIL=Midlingual, DL=Distolingual, R1=Rater 1, R2=Rater 2, Teeth number 16,11,26,36, 41, 46 (FDI dental numbering system).

After recording all these parameters, patient was asked to take a break for 20 to 30 minutes and then again he/she was examined for all these parameters. The plaque and calculus was recorded first because of the reason that pocket probing may alter the plaque and calculus which can mislead their presence or absence. All the data was handled very confidentially by the co-investigator during the procedure so as to avoid any biasness. The data was recorded on the periodontal charts specifically designed for periodontal patients. This data was later shifted to SPSS for kappa and Intra class correlation coefficient (ICC) measurements.

RESULTS

Pocket depth and gingival recession were recorded as numeric data so ICC (Intra class correlation coefficient) was carried out for these variables whereas Kappa score was carried out for categorical data (BOP, plaque and calculus). The ICC (p<0.001) and Kappa (>0.6) values were statistically significant and were in the range of strong correlation for intra examiner. The results were acceptable and in strong correlation of reproducibility for the intra examiner on the basis given in table-3.

Table No.3: Summary of Intra Examiner Calibration Results for Periodontal parameters

	Bleeding on probing	Plaque	Calculus	Pocket depth	Gingival recession
Kappa Score	91% Excellent 8% Moderate	97% Excellent 2% Good	100% Excellent	-----	-----
ICC Score	-----	-----	-----	95% Excellent 5% Strong	100% Excellent

The results of intra examiner calibration as shown in table-3 confirmed the strong acceptable level of reproducibility. With the exception of very few variables which were also falling in the moderate to good acceptance levels, all others were in excellent acceptance level.

DISCUSSION

Periodontal parameters include clinical pocket depth (CPD), gingival recession, bleeding on probing (BOP), plaque score and calculus score. Measurement of Periodontal parameter plays an important role in identifying disease progression, severity, and effects of periodontal therapy for different clinical studies^(13,14) and are currently the most commonly used and the most revealing parameters⁽¹⁵⁾. Measurements of these parameters are very important in diagnosing periodontal diseases but subjected to the limitations of manual assessment of these parameters. Periodontal probes are used to detect these periodontal parameters. They are primarily used to detect periodontal pocket depth and

gingival recession. In addition to the measurement of these two prime parameters, periodontal probes are also used to detect or locate plaque/calculus and bleeding tendencies. Despite being the most accepted tool worldwide periodontal probing has its limitations. Errors may occur which could be patient related; calculus on the tooth/root surface, presence of overhang restorations, poorly designed crown margins, or operator related; such as incorrect angulation of the probe, the amount of pressure applied to the probe, delusion of the reading on probe and recording the data roughly^(16,17). Differences in the measurement of these periodontal parameters appear to be apparent not only between different examiners but also with a single examiner⁽¹⁸⁾. Therefore, intra examiner or inter examiner calibration should be performed to minimize the chances of errors while measuring these parameters. In our study it was observed that reproducibility recorded for calculus score and gingival recessions was 100%, 97% for plaque score, 95% for pocket depth measurement, 91% for bleeding on probing and were statistically significant. The results were due to the reason that intra examiner was trained and calibrated with an external examiner. A time interval of 20 to 30 minutes was introduced to exclude a possible bias due to examiner memory so that the second measurement could not be influenced by the first measurement and it also provided adequate rest to the patient in between different recordings. To minimize the effect of bias and for the authenticity and validity of the data, periodontal parameters were recorded for two times with an appropriate time interval. Some authors believe that calibration process is related to the operator's experience^(19,20) while other authors believe that experience is not the most important factor in measuring reproducibility⁽²¹⁾. Intra examiner agreement for calibration process permitted highly reproducible repeated measurements which states positivity of the calibration process⁽²²⁾. The results of intra examiner from present study were statistically significant when compared to other studies for pocket depth⁽²³⁾, gingival recession⁽²⁴⁾, bleeding on probing⁽²⁵⁾, plaque score and calculus score⁽²⁶⁾.

In this article, our methods pertain to calibration studies focused on reproducibility in site level periodontal parameters. We demonstrate the need to adjust variance estimates of reliability measures for the within subject of site level agreement. Failure to account for the dependence among site level agreement results in an erroneous precision in the resulting reliability estimates. In conclusion, validity and reliability of periodontal parameters measurement is important in clinical practice to for appropriate diagnosis and decision making.

CONCLUSION

The reproducibility recorded for calculus score and gingival recessions was 100%, 97% for plaque score, 95% for pocket depth measurement, and 91% for

bleeding on probing and were statistically significant but it requires training and calibration with inter examiner.

Author's Contribution:

Concept & Design of Study: Hussam
 Drafting: Muhammad Jamil, Faridullah Shah,
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 Revisiting Critically: Hussam, Muhammad Jamil
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