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Periodontics

Accuracy of Modified Parallel Profile Radiography for measurements of Biologic Width: A Comparative Clinical Study

Aashutosh Karnik[1] Mala Dixit Baburaj[2]

Abstract

Objectives

This study was aimed at assessing the accuracy of modified parallel profile radiography (MPPRx) for measuring biologic width when compared to trans-sulcular probing and measurements made after surgical entry.

Materials and Methods

10 patients with periodontitis in maxillary anterior teeth were enrolled in the study after their informed consent. After taking a profile radiograph using MPPRx, trans-sulcular probing and surgical entry were used to measure distance between two fixed points. The mean measurements obtained using all three techniques were compared using One Way ANOVA. Bartlett's test was used for determination of variation among the standard deviations.

Results

The mean values in millimetres for the measurements obtained using MPPRx, trans-sulcular probing and surgical entry were 4.412 ± 0.5998, 4.6 ± 0.5164 and 4.6 ± 0.5164 respectively. Variation between the means was not significant (p=0.6770). Differences among the standard deviations were also not found to be significant (p=0.8762).

Conclusion

Our study concludes that MPPRx is comparably accurate to more invasive techniques like trans-sulcular probing and may be routinely employed as a non-invasive method to measure biologic width prior to restorations in the maxillary anterior teeth.

Key Words

Dental Radiology, Periodontics, Crown Lengthening.

1. Assistant Professor
   Department of Periodontics
   Bharati Vidyapeeth Deemed University Dental College and Hospital
   Navi Mumbai, Maharashtra, India
2. Professor and Head,
   Department of Periodontics
   Nair Hospital Dental College
   Mumbai, Maharashtra, India

Introduction

The epithelial and connective tissue attachment to the tooth was termed as "physiologic dentogingival unit" by Gargiuolo et al while the term "biologic width" was coined by Cohen.[1,2] The average measurements for the epithelial and connective tissue attachment in humans are 0.97 mm and 1.07 mm respectively[1]. In the teeth that are in need of restorations, biologic width plays an important role in maintaining the integrity of periodontal tissues, as evidenced by the persistent inflammation or bone loss that result from its violation[3,4,5]. However, there exists a wide inter and intra-individual variation in the values of biologic width[6]. Considering the importance of biologic width, it is essential that an effort be made to determine the values of biologic width.

Various methods have been suggested to measure the biologic width and trans-sulcular probing is one of the commonest methods employed in routine dentistry.[7] Trans-sulcular probing, however, requires administration of local anaesthesia and is hence an invasive technique. Soft tissue cone beam tomography represents a non-invasive but expensive alternative to trans-sulcular probing.[8] As an affordable non-invasive alternative, Parallel Profile Radiography (PPRx) was suggested by Alpiste-Illueca in 2004, which makes use of conventional radiography equipment to take various measurements of the dentogingival unit.[6] With some modifications, it is possible to apply PPRx in regular clinical use. The present study was designed with the following aims:

- To develop a modification in the PPRx protocol to make it clinically applicable,
- To compare the accuracy of the modified PPRx protocol with trans-sulcular probing and surgical measurements.

Materials and Methods

This comparative study was carried out in accordance with the Declaration of Helsinki, 2000 at Nair Hospital Dental College, Mumbai, India, from October 2008 to January 2009 after obtaining approval from the institutional ethics committee. Ten patients with periodontitis in maxillary anterior teeth requiring flap surgical debridement were selected and their informed consent was taken. A point was marked on hard tooth substance along the mid-facial free gingival margin from where all measurements were made. Modified PPRx (MPPRx) radiograph was taken before surgery. The distance between bone crest and gingival margin was measured on the radiograph using a calibrated scale after scanning the radiograph and importing the image in Adobe Photoshop CS5 (Adobe, San Jose, USA). Trans-sulcular probing was carried out at the marked location after administration of local anaesthesia (lignocaine 2% with 1: 200,000 epinephrine) and the distance between bone crest and gingival margin was noted. Surgical flap debridement was carried out and the distance between bone crest and the marking on the tooth measured. The measurements were tabulated prior to analysis in a Microsoft Excel 2007 (Microsoft, Redmond, US) spreadsheet and checked for data entry errors. All analysis was done using PC based software (GraphPadInStat, GraphPad, La Jolla, USA). One Way ANOVA was used for analysing the variation among the means of all three measurements. Bartlett's test was used for determination of variation among the standard deviations.

MPPRx is an application of long cone radiography that provides radiographic images of the vestibular profile of periodontal tissues of anterior teeth. It starts with placement of a gutta percha cone (No. 40, Malifer) in the gingival sulcus at the mid-facial free gingival margin till it reaches the base of the sulcus. The cone is then sheared with Blade No. 15 at the margin of the free gingiva. A lead foil measuring 5.0 mm × 1.0 mm× 0.1 mm is then positioned on the surface of the gingiva, aligned with the long axis of the tooth starting from the free marginal gingiva, with the help of sticking plaster (Fig. 1). The gutta percha cone and the lead foil serve as the radiographic

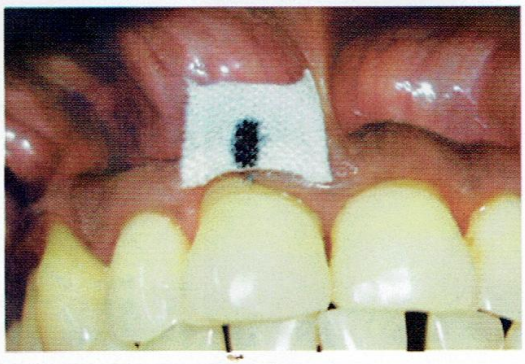

Fig.1: Gutta percha cone inserted in the sulcus and lead foil positioned with the help of sticking plaster

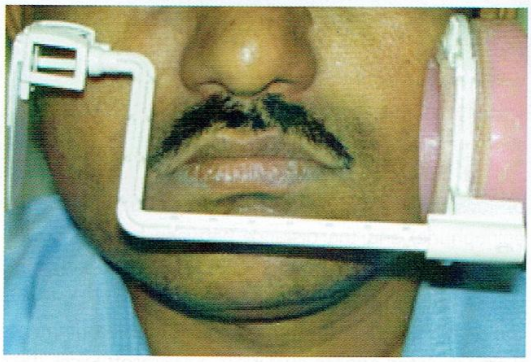

Fig.2: Placement of radiographic film with the help of paralleling device

markers necessary for measurements in MPPRx. A radiographic film (No. 2, Kodak Ultra Speed) is attached to a paralleling assembly and placed extraorally in such a way that the x-ray beam would travel tangential to the teeth (Fig. 2). The radiograph was then developed using standard x-ray developing techniques. MPPRx differs from the original PPRx technique in the following ways:

1. Use of sticking plaster to stick lead foil instead of a self-sticking lead foil,
2. Extraoral film placement instead of intraoral vestibular film placement,
3. No frontal projection radiograph that is included in the original PPRx technique.

After scanning and importing the radiograph in an image editing software, landmarks need to be identified (Fig. 3),

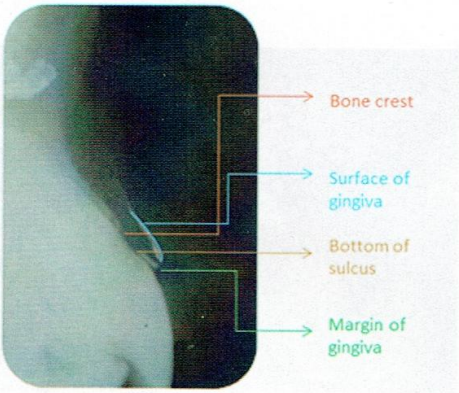

Fig.3: Identification of landmarks on MPPRx radiograph

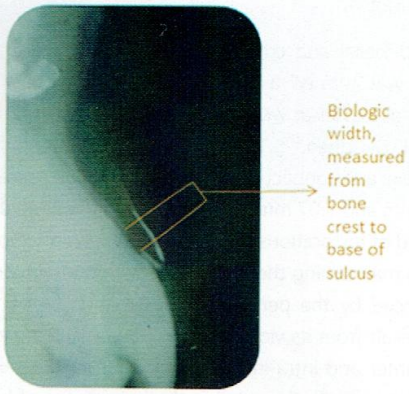

Fig.4: Measurement of biologic width on MPPRx radiograph

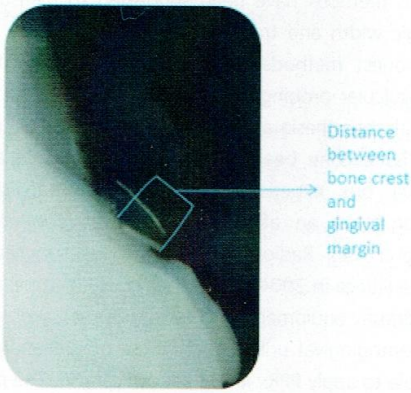

Fig.5: Distance from the bone crest to gingival margin on MPPRx radiograph, used for comparison in this study

Fig.6: Trans-Sulcular Probing

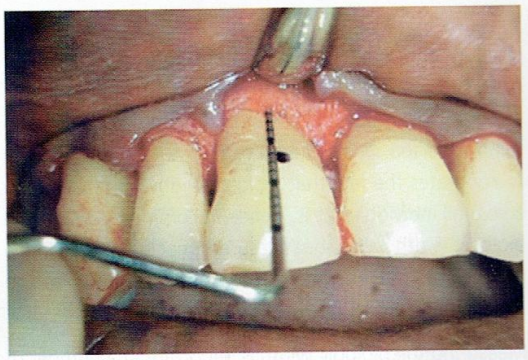

Fig.7: Measurements after surgical entry

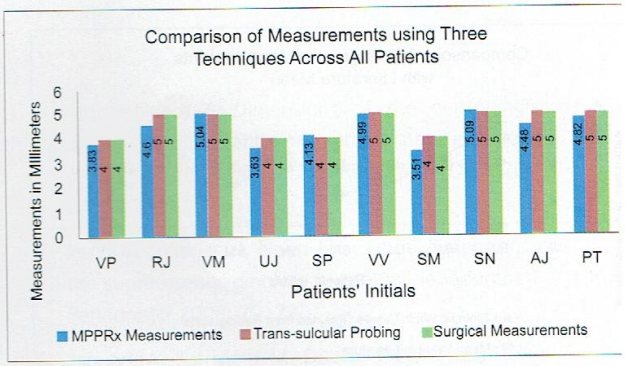

Fig.8: Comparison of measurements using three techniques across all patients

Table 1: Initial Radiographic Data

Initials of the patient	Radiographic length of lead foil	Actual length of lead foil	Radiographic length of gutta percha point	Actual length of gutta percha	Radiographic distance between bone crest and gingival margin	Calculated actual distance between bone crest and gingival margin
VP	7.51	5	4.52	3.0	5.76	3.83
RJ	6.05	5	2.75	2.1	5.57	4.60
VM	8.26	5	4.19	2.5	8.32	5.04
UJ	6.06	5	2.80	2.3	4.40	3.63
SP	7.49	5	4.21	2.8	6.18	4.13
VV	6.84	5	3.54	2.6	6.83	4.99
SM	6.29	5	2.64	2.1	4.42	3.51
SN	7.24	5	3.92	2.7	7.38	5.09
AJ	7.69	5	4.74	3.1	6.89	4.48

Table 2: Comparison of measurements obtained using three methods

Initials of the patient	Calculated actual distance between bone crest and gingival margin on radiographs	Distance between bone crest and gingival margin using trans-sulcular probing	Distance between bone crest and gingival margin after surgical entry
VP	3.83	4	4
RJ	4.60	5	5
VM	5.04	5	5
UJ	3.63	4	4
SP	4.13	4	4
VV	4.99	5	5
SM	3.51	4	4
SN	5.09	5	5
AJ	4.48	5	5
PT	4.82	5	5
Mean Values ± Standard Deviation	4.412 ± 0.5998	4.6 ± 5164	4.6 ± 5164

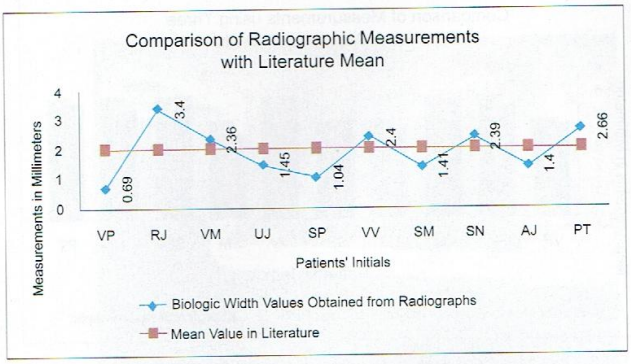

Fig.9: Comparison of radiographic values with literature mean

and subsequently, various measurements can be made (Fig. 4). For the purpose of the comparison performed in the present study, the distance between bone crest and gingival margin was measured to ensure precision (Fig. 5). The magnification factor was accounted for by using the following formula:

Actual distance between bone crest and gingival margin = Radiographic distance between bone crest and gingival margin × (Actual length of gutta percha point ÷ Radiographic length of gutta percha point). Later, trans-sulcular probing (Fig.6) and surgical entry measurements (Fig.7) were performed at the same sites.

Results

All three measurements were carried out for all the 10 enrolled patients. The initial measurements from the radiographs are presented in Table 1 and Fig. 8. The range of values for the measurements obtained using MPPRx, trans-sulcular probing and surgical entry was 3.5 mm to 5.2 mm, 4.0 mm to 5.0 mm and 4.0 mm to 5.0 mm respectively. The mean values in millimetres for the measurements obtained using MPPRx, trans-sulcular probing and surgical entry were 4.412 ± 0.5998, 4.6 ± 0.5164 and 4.6 ± 0.5164 respectively. Table 2 compares the measurements obtained using all three techniques. Variation between the means was not significant (p=0.6770). Differences among the standard deviations were also not found to be significant (p=0.8762).

Discussion

Our study found that measurements obtained using MPPRx were comparable to those using trans-sulcular probing and measurements after surgical entry. Our study also found a wide inter-personal variation in the values of biologic width when compared to the mean value reported in the literature (Fig. 9) (1). This finding corroborates the fact that biologic width is not the same across all individuals. It is, hence, recommended that the biologic width values be measured prior to all restorative procedures that encroach upon the dimensions of the dentogingival unit.

Measuring the biologic width is important in a number of procedures, including functional crown lengthening for placement of restorations and aesthetic crown lengthening to correct excessive gingival display due to altered passive eruption. MPPRx provides a simple and effective way to take various measurements at the time of treatment planning. MPPRx also enables the clinicians to locate landmarks like crest of the alveolar bone and cemento-enamel junction. Identifying these landmarks can help in the assessment of the need for osseous surgery at the time of crown lengthening. In addition, determination of biologic width in a given tooth beforehand can allow the clinician to assess tissue maturation after crown lengthening. This would eliminate the uncertainty as to the waiting period required until impressions for definitive prosthesis can be made.

Limitations for our study are as follows:

1) MPPRx can be employed only in anterior teeth, and hence the applicability of our findings for posterior teeth could not be confirmed.

2) Our study made use of conventional radiographs. Radiovisuography would reduce exposure to radiation and would allow easy measurements of radiographs.

Conclusion

Our study concludes that MPPRx is comparably accurate to more invasive techniques like trans-sulcular probing and may be routinely employed as a non-invasive method to measure biologic width prior to restorations in the maxillary anterior teeth.

Conflict of Interest: None

Source of Support: Nil

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