Correlation between Tooth Mobility Measured by Periotest and Radiographic Alveolar Bone Loss in Chronic Periodontitis

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***Abstract* - The aim of this study was to determine the correlation between tooth mobility and radiographic alveolar bone loss in Ramfjord teeth of chronic periodontitis patients. The results of Ramfjord teeth procedure supported conserving time, limiting cost, and reducing patient and examiner fatigue while providing maximal clinical information. Clinical attachment level, periodontal disease index, tooth mobility and radiographic alveolar bone loss were measured in Ramfjord teeth and/ or substitutable teeth with chronic periodontitis of both genders of subjects (age of 35-59 years). A total of 65 subjects (34 males and 31 females) were selected and descriptive cross-sectional study design was used. Correlation between Periotest Value score (PTV) and alveolar bone loss was higher in central incisors (in mandibular central incisors, r=0.526 and $p<0.001$) and (in maxillary central incisors, r=0.455 and $p<0.001$) than premolars and molars. It was the highest correlation in mandibular central incisors. This explained the fact that the alveolar bone and connective tissue attachment play an important role in maintaining tooth equilibrium. It can also be useful in predicting the amount of bone loss for the determination of diagnosis, prognosis and treatment outcomes of the periodontal diseases by using Periotest instead of taking radiographs that is limited in some patients and used as an adjunct in diagnosing periodontal diseases.**

Keywords; tooth mobility, Periotest, alveolar bone loss, Ramfjord teeth, periodontitis

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Introduction

Periodontal disease is one of the two major dental diseases that affect human populations worldwide at high prevalence rates. Chronic periodontitis is usually a progressively destructive change leading to loss of bone and periodontal ligament due to the extension of inflammation from gingiva into the adjacent bone and ligament (Page & Korman, 1997).

Generally, the diagnosis of periodontal disease is based on the presence and extent of gingival inflammation, frequently measured as bleeding on probing, probing pocket depth, clinical attachment level, and the pattern and extent of alveolar bone loss assessed radiographically. In addition, consideration may be given to age, gingival recession, tooth mobility, medical and dental histories, previous treatment, and signs and symptoms, including pain, ulceration, and microbial deposits (AAP, 2003).

Increased tooth mobility is both an indicator and outcome of detrimental changes in the periodontium. Clinical and experimental observations have revealed hypermobility as a collective outcome of both loss of alveolar bone and associated qualitative and quantitative alterations in the periodontal ligament and supra-alveolar soft tissue (Persson & Svensson,

1980). An evaluation of patients' tooth mobility is a prerequisite for diagnostic assessments and treatment strategies. Subjective methods where the tooth is deflected between two instrument handles are widely accepted in the clinical routine, but are operator-dependent and non-reproducible (Laser *et al*., 1975).

Objective measurement techniques often require complex experimental setups; however, quantitative information about tooth mobility is feasible. A cost-efficient and time-saving alternative to obtain objective information about tooth mobility is the Periotest method, an accepted technique for diagnostic findings in different dental fields such as Periodontology, Traumatology, Implantology, Oral Surgery or Orthodontics (Goellner *et al*., 2010).The Periotest method (Siemens Dental Division) for determining periodontal function was developed between 1972 and 1984 by an interdisciplinary group of researchers (Schulte *et al*., 1990).

Diagnosis of periodontitis is based on measuring either the loss of connective tissue attachment to the root surface or the loss of alveolar bone crest. The radiograph can be a valuable aid in diagnosis of periodontitis and determining its prognosis and evaluation of its treatment outcome. Bitewing, periapical and panoramic are three radiographic techniques used for the evaluation of the periodontium. Different opinions exist about the best radiographic technique for diagnosis and evaluation of periodontal bone loss (Moradi *et al*., 2010).

The most commonly used approach to diagnose bone behavior around teeth is radiographic bone examination. However, the weakness of both digital periapical radiographs and conventional radiographs are inability to provide early detection of periodontal disease activity and also technique sensitive, high cost, need equipment and private place or room for imaging and also limited in some people like pregnant women. So, to reduce the radiation hazards in such persons, the present study can provide the fact for the estimation of bone loss without taking radiographs for the diagnosis and prognosis determination, and treatment planning of periodontal diseases by using Periotest value or mobility grading and measuring clinical attachment level.

Materials and Methods

Both genders of subjects (age of 35-59 years) with chronic periodontitis attending at the Department of Periodontology, University of Dental Medicine, Yangon was selected. Total number of subjects is 65 and study duration is 1 year.

Subjects aged between 35-59 years old, having Ramfjord teeth and/or substitutable teeth with chronic periodontitis were included in the study. Subjects who had systemic diseases (such as Diabetes Mellitus, Osteoporosis, Paget diseases etc.), osteomyelitis of jaws, pregnancy, hormonal replacement therapy, any malignancy, and teeth of those with periapical lesion, traumatic root fracture and alveolus fracture are excluded in the study.

Miller Relation between Miller's mobility index and Periotest value (PTV) score

- The amount of tooth mobility is displayed by a value called Periotest value (PTV) ranging from –8 to +50, which can be correlated to 4° of tooth mobility reported by the Miller.
- No distinguishable movement is Grade-0 ranging from 8.0 to 9.9 Periotest value.
- First distinguishable sign of movement is Grade-1 ranging from 10.0 to 19.9 Periotest value.

- Crown deviation within 1 mm of the normal position is Grade-2 ranging from 20.0 to 29.9 Periotest value.
- Easily noticeable Mobility and the tooth movement more than 1 mm in any direction or rotation in its socket is Grade 3 ranging 30.0 to 50.0 Periotest value (Chakrapani *et al*., 2015).

After the selection of subjects, the nature and design of the clinical trial was explained to the participants and consent was taken. Then, thorough history taking and clinical examination were done with the measurements of CAL and PDI by using Michigan probe with William's markings, the three measurements from the lingual aspect (mesio-lingual, mid-lingual, disto-lingual) and buccal aspect (disto-buccal, mid-buccal, mesio-buccal) were done on Ramfjord teeth and data were recorded. Measurements of tooth mobility by using Periotest were also done and resulted PTVs results were recorded. Amount of bone loss was measured by taking digital periapical X-rays with Standard parallel technique using Carestream Dental Imaging Software 6.13.0 version or Image J Software 1.37 V on computer and values were recorded. After collecting the data, the results were tabulated and subjected to statistical analysis. Means and standard deviations of data were calculated for each of the Ramfjord teeth with chronic periodontitis. Then, analysis with Pearson correlation-regression test was carried out to correlate the data.

Bone loss can be defined as the difference between the present septal bone height and the assumed normal bone height for any particular patient, bearing in mind that the normal bone height varies with age.

Amount of bone loss can be measured by substracting the septal bone height from normal bone height, whereas, septal bone height is distance between CEJ and crest of alveolar bone. Normal bone height of young adults is 0.96-1.22 mm (Average 1 mm) and normal bone height of old adults is 1.88-2.8 mm (Average 2 mm) (Carranza, 2002).

Amount of bone loss can be measured in percentage by following formula (Schulte *et al*., 1992)

Bone loss = (1 – hi/hg) 100%

Whereas, 'hi' is intra-alveolar root length (for horizontal type of bone loss - from the most coronal portion of interproximal bone to apex of root, for vertical type of bone loss- from base of intra-bony pocket to apex of root, parallel to long axis of tooth). 'hg' is total root length (from CEJ to apex of root, parallel to long axis of tooth) (Whaites, 1992). This study was approved by Research and Ethical Committee of University of Dental Medicine, Yangon.

Figure 1. Measurement of Clinical Attachment Level at 31 with Michigan Probe with William's Markings

Figure 2. Detection of Tooth Mobility with Periotest at 24

Statistical Analysis

After data collection, data entry was done by using statistical package for social science (SPSS-16). The data was expressed as the minimal, maximal, mean and standard deviation (SD). Pearson correlation regression test was used to analyze the data.

Results

Table 1. Mean and Standard Deviation of CAL, PDI, Tooth Mobility and Alveolar Bone Loss in Ramfjord Teeth

Tooth number (Ramfjord Teeth)	CAL (mm)	PDI (score)	Tooth mobility (grade)	Bone Loss (mm)	Bone loss (%)
16	3.17± 1.05	4.57± 1.53	0.37± 0.70	1.38± 1.1	27.49± 9.76
21	1.65± 1.09	4.14± 0.35	0.40± 0.72	1.84± 1.29	23.97± 8.79
24	2.01± 1.19	4.2± 0.44	0.45± 0.71	1.33± 1.01	22.6± 7.39
36	2.76 ±1.35	4.34± 0.54	0.26± 0.59	0.94± 1.25	20.82± 10.55
41	3.10 ±1.48	4.58± 0.68	0.88± 0.91	3.10± 1.67	36.78± 11.29
44	2.13 ±1.17	4.25± 0.50	0.26± 0.57	0.95± 0.95	19.83± 7.77

Table 2. Correlation between Tooth Mobility (PTV) and Alveolar Bone Loss (mm) in Ramfjord Teeth of Chronic Periodontitis Patients

Tooth number (Ramfjord Teeth)	r	r^2	*p* value
16	0.253	0.064	0.041*
21	0.455	0.207	<0.001***
24	0.279	0.078	0.024*
36	0.410	0.168	0.001**
41	0.526	0.277	<0.001***
44	0.427	0.183	0.003**

Pearson correlation test

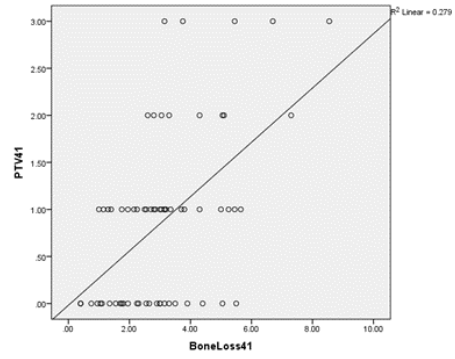

Figure 3. Correlation between PTV and Bone Loss (mm) at 41

Table 3. Correlation between Tooth Mobility (PTV) and Alveolar Bone Loss (%) in Ramfjord Teeth of Chronic Periodontitis Patients

Tooth number	r	r^2	*p* value
16	0.302	0.091	0.015*
21	0.477	0.227	<0.001***
24	0.326	0.106	0.008**
36	0.434	0.188	<0.001***
41	0.560	0.314	<0.001***
44	0.511	0.261	<0.001***

Pearson correlation test

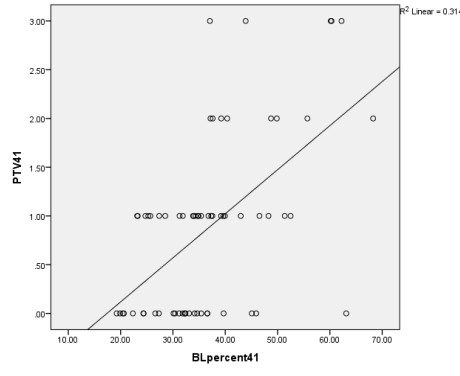

Figure 4. Correlation between PTV and Bone Loss (%) at 41

Discussion

In daily dental practice, dental professionals use both radiographic and clinical parameters measurements to obtain information about the extent of bone loss and for determining the diagnosis and severity of periodontal diseases. Partial mouth examination with appropriate adjustment of Ramfjord index teeth data is useful for assessing periodontal disease progression in longitudinal population studies of human periodontitis (Rams *et al*., 1993). In this study, the results of Ramfjord teeth procedure strongly support conserving time, limiting cost, and reducing patient and examiner fatigue while providing maximal clinical information. However, the Ramfjord teeth assessment was not as suitable for evaluation of either disease extent or prevalence (Dowsett *et al*., 2002).

Digital periapical X-rays are useful for periodontal registration and have a great advantage in giving a precise reading with a lower ionization compared to the conventional intraoral x-rays. Because of that, digital periapical radiographic method was selected in this study. With regard to methodology, digital radiography with paralleling technique was used in the present study for the evaluation of bone loss, whereas earlier studies used conventional intraoral periapical radiographs and bitewing radiographs for the analysis of bone loss.

Increased tooth mobility is a common symptom of advanced form of plaque associated periodontal disease as proved by (Persson & Svensson, 1980).

In the present study, all of the Ramfjord teeth showed significant and positively strong correlation between tooth mobility and alveolar bone loss (mm and %) except 24 and 16 in which there were weak correlations in this study whereas correlation was stronger in 21, 41, 44 and 36 than in 24 and 16. This may be due to greater root surface area and larger connective tissue attachment area in 24 and 16 made those tooth less mobile when compared to the other teeth.

It was more correlated in anterior teeth and in teeth with lesser root surface area than posterior teeth and teeth with greater root surface area. The correlation between the tooth mobility and bone loss was stronger in the mandible than in the maxilla. This difference could be due to the fact that the anterior teeth had a conical single root and less root surface area compared to that of the molars and premolars, which had multiple and curved roots in both arches. Also the root length of the mandibular anterior teeth was less than that of the maxillary anterior teeth, indicating that they had less root surface area compared to the upper anterior teeth. So, the teeth with greater root surface area showed lesser mobility than those with lesser root surface area although there were equal amount of bone loss in such teeth. This meant that the greater the alveolar bone height, the lower the tooth mobility and the greater the alveolar bone loss, the higher the tooth mobility. This explains the fact that the alveolar bone and connective tissue attachment play an important role in maintaining tooth equilibrium.

The present study was consistent with the study of Schulte *et al*., (1990) who showed that the percentage of bone loss was the parameter that was most highly correlated to the Periotest value score.

Although tooth mobility related to clinical attachment loss and bone loss was more significant and correlation was higher in anterior than posterior teeth, mandible than maxilla, the study can provide the fact that amount of bone loss

can be estimated by using Periotest value (PTV) or tooth mobility grading and by measuring clinical attachment level, for the determination of diagnosis, prognosis, treatment planning and outcomes of the periodontal diseases instead of taking radiographs that are also limited in some people due to its unwanted effects.

Conclusion

The efficiency of Periotest as a device to measure tooth mobility is reliable and very well acceptable to the patients, due to its non-invasive and simple design and procedure. Significant correlation between tooth mobility and alveolar bone loss (mm and %) was found in all teeth except 24 and 16 in which weak correlation was occurred. This meant that the greater the alveolar bone height, the lower the tooth mobility and the greater the alveolar bone loss, the higher the tooth mobility.

It was more correlated in anterior teeth than posterior teeth, teeth with lesser root surface area than those with greater root surface area and in the mandible than in the maxilla.

This explains the fact that the alveolar bone and connective tissue attachment play an important role in maintaining tooth equilibrium. The PTV was higher in the incisors when compared with the premolars and molars. Percentage of bone loss was the parameter that was most highly correlated to the Periotest score.

The most commonly used approach to diagnose bone behavior around teeth is radiographic bone examination. However, the weakness of both digital periapical radiographs and conventional radiographs are inability to provide early detection of periodontal disease activity and also technique sensitive, high cost, need equipment and private place or room for imaging and also limited in some people like pregnant women. So, to reduce the radiation hazards in such persons, the present study can provide the fact for the estimation of bone loss without taking radiographs for the diagnosis and prognosis determination, and treatment planning of periodontal diseases by using Periotest value or mobility grading and measuring clinical attachment level.

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The authors declare there is no potential conflict of interest.

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