Peri-implant inflammation and marginal bone level changes around dental implants in relation to proximity with and bone level of adjacent teeth.

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Abstract

Purpose: The purpose of this retrospective study was to investigate the radiographic bone changes and prevalence of peri-implant tissue inflammation around teeth and neighboring implants in relation to implants' positioning and characteristics. Furthermore, the study aimed to assess success and survival rates of the implants when different sets of criteria were utilized.

Material and Methods: Patients with an implant supported Fixed Dental Prosthesis in function for at least one year were recruited for this study. The radiographic horizontal and vertical position of the dental implants was identified in relation to anatomic landmarks around teeth. Pprobing depth (PD), bleeding on probing (BOP) and radiographic bone level around dental implants and adjacent teeth at the time of implant placement, prosthesis delivery and the most recent review were assessed.

Results: 98 patients with 195 implants provided complete radiographic sets for bone measurements. Mean observation period was 37.8 months. Survival rate was 99.6%, success rate ranged from 83.6% to 91.3% when different success criteria were utilized. Significantly greater interproximal bone loss occurred around teeth when the horizontal distance of Bone level implants was <1mm, (mesial side :0.87±0.38 mm and distal side:1.09±0.94mm), the same however was not observed with Tissue level implants. There eas no significant impact of the coronoapical positioning of the implants to the marginal bone loss. No correlation was found between the proximity of implant and teeth and prevalence of peri–implant inflammation.

Conclusion: Significant interproximal bone resorption occurs when horizontal distance between implants and adjacent teeth <1 mm. The prevalence of peri-implant inflammation did not correlate with the proximity of the implant and neighboring teeth.

(264 words)

Introduction

Dental implant treatment has achieved a highly predictable outcome, with reported survival rates of 95.4% survival after 5 year of function[1] (Pjetursson et al. 2012). Despite the high survival rates, peri implant inflammation is reported to arise frequently in the forms of peri-implant mucocitis and peri-implantitis, ultimately resulting in loss of marginal bone.

Bone undergoes constant remineralization and resorption, a process called bone remodeling. At the early stages sfter implant placement and/or occlusal loading, peri-implant marginal bone loss is often observed radiographically, typically attributed to bone remodeling. The early marginal bone loss due to remodeling has been attributed to healing response to the surgical trauma and /or physiological adaptation to function and the respective mechanical forces ().

Further to physiological bone remodeling, marginal bone resorbtion will occur as a result of peri-implant inflammation, which constitutes one of the major current threats for long term success of the implant treatment.

Vertical and horizontal positioning of an implant in relation to the neighboring teeth, could have the potential to influence long term peri-implant bone levels, affecting both the remodeling process, as well as the ability to practice effective oral hygiene and thus the risk for plaque induced peri-implant inflammation.

With regards to coronoapical positioning, Mailoa J et al found increased peri-implant bone loss if the implant platform is placed more than 3mm apical to CEJ of the adjacent tooth[3]. When it comes to the bone level of teeth adjacent to implants, the literature includes often contradicting findings. Esposito et al reported a correlation between the horizontal tooth-implant distance and bone level at adjacent teeth[4], where the periodontal bone loss increased with decreasing tooth-implant distance. In contrast, other studies reported that the placement of implant in close proximity to an adjacent tooth, even though tooth-implant distance was less than 1mm, did not result in decrease in bone level around these teeth[6]. Rasperini G. et al. showed that vertical bone loss around implants failed to affect the bone level of their neighboring teeth[7]

The purpose of this retrospective clinical study was to assess the prevalence of inflammation and measure the marginal bone level changes around dental implants and neighboring teeth in relation to the horizontal and vertical implant position.

Material and Methods

a) Patient Selection

This retrospective study was conducted at the Prince Philip Dental Hospital, Faculty of Dentistry of The University of Hong Kong and obtained approval from the Institutional Board of The University of Hong Kong/Hospital Authority Hong Kong West Cluster (UW 15-609).

An electronic search of dental implant treatments provided by students and staff of Implant Dentistry department was performed using the computer system of Prince Philip Dental Hospital (SALUD, Two Ten, Dublin) which has been in use since 2009. All patients having received a single implant supporting a single crown (FDP) with a minimum of twelve months after loading were eligible to enroll in the study and were invited for a clinical examination. At the review appointment, written informed consent was obtained prior to examination. The patients were under maintenance scheme with regular appointments conducted at various intervals between 4-12 months, as based on individual risk assessment. Clinical examinations were carried out by five calibrated examiners who were either staff or qualified dentists, postgraduate students of the clinic of implant dentistry.

b) Clinical Examination

Clinical measurements included pocket probing depth (PPD) and bleeding on probing (BOP) at four sides (buccal, lingual, mesial and distal) around the implants. Probing measurements were made using a graded perio-probe with light touching force and periapical radiographs of the implants were taken with the parallel cone technique.

c) Peri – Implant Inflammation

The presence of peri-implant mucocitis and peri-implantitis was assessed.

Peri-implant mucocitis was defined as the presence of the clinical signs of inflammation of the peri-implant mucosa, that is bleeding on probing upon probing with gentle force [8] at the time of review examination.

Peri-implantitis was defined as the presence of bleeding on probing in addition to loss of supporting bone [8]. Peri-apical radiographs taken at time of loading and at review visit were used for bone loss calculation.

d) Survival and success

Survival of implant was defined as an implant remained *in situ* and had no history of replacement. Determining success however, 3 different sets of criteria were used as below:

1. Albrektsson et al criteria[9];

2. Less than 1mm of marginal bone loss measured from time of loading, as suggested by French et al (2016) and Sanz and Chapple[11] (ref)

3. Less than 1mm of marginal bone loss measured from time of loading, and no presence of BOP.

e) Radiographic Measurements

The periapical radiographs taken immediately after implant placement were used as a baseline. Radiographs taken after crown insertion and at the most recent follow up visit were used to assess the marginal bone level change (Figure 1). The radiographs were scanned with Epson Perfection V700 Photo Dual lenses scanner with 24 bit color and digitized at a resolution of 400 dpi. After digitalization, images were inserted to Image J software (Wayne Rasband National Institutes of Health USA). The contrast of the images was adjusted and the images were magnified in computer screen for better visualization and easier measurement. To account for possible distortion of the radiographs, the linear dimensions of the digitized images were calibrated. The known distances between the implant threads as well as implant diameter were used for calibration. A built-in digital caliber in the software was used to calibrate all measurements. Radiographic landmarks were measured to assess changes in the bone level around the implants and their adjacent teeth. Several landmarks (Figure 2) were identified: The Cementoenamel Junction (CEJ, blue points) of the adjacent teeth, the most coronal bone contact (tBC, green points) of the adjacent teeth, the implant shoulder (BL, bone level implant) , the implant platform (PL, tissue level implant , red points) as well as the most coronal bone contact of the implant (iBC, yellow points).

A horizontal line parallel to the implant platform was drawn (Green line, Figure 3). Other lines (White lines) parallel to this and the other respective reference points were also drawn. The vertical distances between the lines and the horizontal distance between the implant and the adjacent teeth were measured. The radiographic measurements were performed by three calibrated examiners and expressed in millimetres. Calibration was conducted with a set of trial measurements on periapical radiographs from 6 randomly selected patients.

The following parameters were measured (Figure 4):

mTI: The horizontal distance between the implant and the mesial adjacent tooth.(Red line at mesial side, 1)

dTI: The horizontal distance between the implant and the distal adjacent tooth.(Red line at distal side, 2)

mCEJ-PL The vertical distance between the CEJ of mesial tooth and the shoulder of bone level implant or the platform of tissue level implant. (Blue line at mesial side,3)

dCEJ-PL The vertical distance between the CEJ of distal tooth and the shoulder of bone level implant or the platform of tissue level Implant (Blue line at distal side,4).

mPL-BC The distance between platform of tissue level implant or shoulder of bone level implant and the most coronal bone contact at mesial side of implant.(Yellow line at mesial side, 5)

dPL-BC The distance between platform of tissue level implant or shoulder of bone level implant and the most coronal bone contact at distal side of implant (Yellow line at distal side, 6)

mCEJ-BC The distance between CEJ or crown margin and the most coronal bone contact of the mesial tooth.(Pink line at mesial side,7)

dCEJ-BC The distance between CEJ or crown margin and the most coronal bone contact of the distal tooth. (Pink line at distal side,8)

The radiographic bone change was calculated by subtracting the bone level at baseline from bone level at crown insertion or from at most recent follow up.

Statistical Analysis

Statistical analysis was performed by using software Statistical Package for Social Sciences (SPSS) version 23 (SPSS Inc., Chicago, IL, USA). Correlation between parametric measurements (implant vertical and horizontal positioning in mm) and non-parametric data (BOP) was tested by Pearson correlation. Changes in parametric measurements (bone level changes at different time points) were analysed for statistical significance with one way Anova and Mann-Whitney test. The level of significance was set at 5% (p=0.05).

Results

a) patient sample

A total of 119 patients with 243 implants were available for clinical and radiological examinations. The patients consisted of 38 (32%) males and 81 (68%) females with a mean age of 53.6 years and a follow up period from 12-75 months after loading, with mean follow up of 37.8 months. A total of 243 implants were present *in situ* at the review appointment. One of the patients had a history of previous implant lost due to advance peri-implantits yielding an overall survival rate of 99.6%.

b) Probing pocket depth, Bleeding on probing (BOP) and Peri-implant mucocitis

Probing pocket depth and bleeding on probing were assessed at 4 sites of each implant. Of the total 243 implants, a total of 972 probing measurements were obtained. At site level, the average probing depth was 2.66mm, at implant and patient level, the average probing depth were 2.67mm and 2.70mm respectively. There were 153 implants (63%) with at least one site with bleeding on probing. Consequently, when peri-implant mucositis was defined as one or more sites with bleeding on probing, the prevalence at implant level (out of 243 studied implants) was 63%, while at patient level, 83 out of total 119 patients have at least one implant site with bleeding on probing, giving a prevalence of peri-implant mucocitis at of 69.7%.

d) Radiographic bone loss measurements and Peri-implantitis

Of the total 243 implants, radiographs of 48 implants were either not available or not proper for measurements. The radiographic bone loss was calculated on the remaining 195 implants. There were 163 implants (83.6%) with bone loss < 1mm , 32(16.4%) implants with bone loss ≥ 1mm and 6 (3.1%) implants with bone loss ≥ 2mm. The maximum amount of bone loss was 2.48mm. Although there were 6 implants with bone loss more than 2mm, only 3 of them presented with bleeding on probing. Consequently, when peri-implantitis was defined as bone loss of more than 2mm and positive BOP, the prevalence of peri-implantitis was 1.5% at implant level and 3% at subject level. When the bone loss threshold was set at 1mm level, there were 22 implants with bleeding of probing in 19 subjects yielding the prevalence of 11.3% at implant level and 19.2% at subject level out of 98 patients.

e) Biological Success rate

Depending on the three sets of criteria, success rates varied as below:

1) Criteria set by Albrektsson et al.

The number of implant which satisfied the above criteria was 178 out of 195 implants, giving a success rate of 91.3%.

2) Bone loss less than 1mm

The number of implants with less than 1mm bone loss at review as compared to time of loading was 163, yielding as success rate of 83.6% out of 195 implants.

3) No Bone loss more than 1mm and no bleeding on probing

The number of implants with bone loss more than 1mm combined with bleeding on probing was 21, yielding as success rate of 89.2% out of 195 implants.

f) Bone changes around teeth and horizontal tooth-implant distance

134 mesial teeth and 106 distal teeth had adequate X-rays to calculate bone level change in relation to different horizontal tooth-implant distance.

The horizontal tooth-implant distance was classified into three groups: Group 1:

TI<1mm; Group 2; TI1-1.5mm; Group 3>1.5mm. The mean value of bone loss surrounding mesial teeth after implant placement at Group 1, 2 and 3 were 0.87±0.38 mm; 0.59±0.45 mm and 0.36±0.48mm respectively (Table 1). The mean value of bone loss surrounding distal teeth after implant placement at Group 1, 2 and 3 were 1.09±0.94 mm; 0.44±0.41 mm and 0.36±0.53 mm respectively (Table 2)

g) Bone changes around implants and horizontal tooth-implant distance

Tissue level implants and bone level implants were analyzed separately. The bone loss around teeth at mesial and distal side of implants is shown in figures 9 and 10 (tissue level) and figures 11 and 12 (bone level). Only bone loss surrounding the adjacent teeth of bone level implants was significantly different between Group 1(TI <1mm) and Group 3 (TI> 1.5mm).

h) Bone changes around teeth and coronoapical implant position

106 mesial and distal teeth had adequate X-rays to calculate bone level change in relation to vertical distance between CEJ and platform of the implant.

Vertical distance between CEJ of the adjacent teeth to platform or shoulder of the implant was classified into three groups: Group 1 CEJ-PL < 3 mm; Group 2 CEJ-PL 3-6 mm and Group 3 > 6 mm. The mean value of bone loss surrounding mesial adjacent teeth after implant placement at Group 1, 2 and 3 were 0.49±0.49 mm , 0.32±0.50 mm and 0.26±0.35 respectively (Table 3). The mean value of bone loss surrounding distal adjacent teeth after implant placement at Group 1, 2 and 3 were 0.40±0.52 mm, 0.52±0.76 mm and 0.40±0.65 mm respectively (Table 4).

i) Bone changes around implants and coronoapical implant position

190 and 193 implants had adequate X-rays and clear image to calculate peri-implant bone loss after loading at mesial and distal side of the implants respectively. Peri-implant bone loss after loading was classified into three groups: Group 1: < 1mm; Group 2: 1-2mm; Group 3 >2mm. At mesial side of implant there were 170, 17 and 3 implants belonging to Group 1,2 and 3 respectively (Table 5). At distal side of implant there were 165, 25 and 3 implants belonging to Group 1, 2 and 3 respectively (Table 6). The correlation between peri-implant bone resorption and bone level of its adjacent tooth was studied, no correlation was found at both mesial and distal sides, the Pearson

correlation was 0.36 (Figure 13) and 0.07 respectively.

j) Bleeding on probing and implant positioning

No correlation was found between the proximity of implant to adjacent teeth (horizontal positioning of >1, 1.5 or >1.5 mm) and the presence of BOP. The same was true for the coronoapical positioning and BOP.

Discussion

This retrospective study examined the survival and success parameters as well as the types and prevalence of biological complication of the implant treatments provided by the implant dentistry department of The University of Hong Kong. In the literature, there appears significant variations and ambiguity with regards to the definition of success, which lead to the use of multiple sets of criteria in the present study.

The survival rate observed of 99.6% was comparable to other studies conducted in university teaching environments [12,13,14].

Report of success of implant treatment is lower and more scarce than report of survival in the literature. Among the studies that report success rate, criteria for success vary significantly and depend on the purpose of the studies. The criteria can be biological, e.g. based on bleeding on probing, pocket depth and annual bone loss[15] or based on bone loss measurement alone [10]. However, the different biological criteria for success vary significantly in the literature and might render it difficult to be compared. On top of that, report at either site, implant or patient level might further obscure the prevalence of complications. Due to the different success criteria used in the literature, different thresholds were applied in this study to define the success rate of the implant treatment.

Using three different sets of criteria based on marginal bone loss (Albrektsson [9]; Criteria French[10] and Sanz11) The success rates were found to be 91.3%, 83.6% and 89.2% respectively.

From the criteria chosen, marginal bone loss is an important criterion for implant success, albeit it has limited value when not correlated with clinical observations such as presence of inflammation or deepening peri-implant pockets. In the literature, the main theories for marginal bone loss after loading include peri-implant tissue inflammation, remodeling and overloading[16].

Plaque induced peri-implant inflammation has been shown to cause marginal bone loss around implants[17,18] with bacterial plaque being the true risk factor.

The causal relation of marginal bone loss with "overloading" remains controversial [19], but possibly, loading patterns might have a modifying effect in marginal bone loss in the presence of inflammation[20].

Inflammatory peri-implant disease consists of two disease entities, Peri-implant Mucocitis and Peri-implantitis. Peri-implant mucositis is defined as plaque induced inflammation limited at the peri-implant mucosa. The clinical diagnosis however is often ambiguous, as bleeding upon gentle probing at 0.25N at the absence of other clear clinical signs of inflammation is reported to have low predictive value for further loss of bone (ref). Peri-implantitis on the other hand is charactrised in addition to bleeding by loss of supporting bone, which is clinicaly diagnosed by increasing probing pocket depth and confirmed by periapical radiographs[8].

In this study, the prevalence of peri-implant mucocitis was found to be 63% at implant level and 69.7% at subject level when the most sensitive threshold was used (one or more sites with BOP). When the threshold was set at two or more BOP sites, the prevalence decreased to 42.8% at implant level and 52.9% at subject level. Although the definition of Peri-implant mucositis and Peri-implantitis appears to reach a wider consensus, the clinical diagnosis of inflammation at early stages remains elusive and thus the report of multiple thresholds might be essential for the correct interpretation of the findings. Similarly, Peri-implantitis was diagnosed as 1.5% at implant level and 3.1% at patient level when defined as bone loss of more than 2mm combined with bleeding on probing. When the threshold was decreased to 1mm, the prevalence increased to 11.3% at implant level and 19.2% at patient level. However, bone loss of 1mm is dangerously close to the margins of measurement error, while it is believed to often reflect physiological remodeling rather than pathological bone loss. Results with regards to prevalence may not be directly comparable to those of studies which used different definitions for peri-implant diseases and with different mean observation time. A published review of the literature[8] which included implants in function for more than 5 years, reported the prevalence of peri-implant mucocitis at approximately 50% at implant level and 80% at subject level, while the prevalence of peri-implantitis was found at 12% and 43% of implant sites and 28% and more than 56% of subjects. In a later review article[22], the prevalence of peri-implantitis after 5 to 10 years was found to be 10% at implant level and 20% at subject level. Yet another recent meta-analysis [23] with implant mean functional time from 3.4 to 11 years estimated peri-implant mucocitis and peri-implantitis with on average to be 43% and 22 % at subject level respectively.

Previous research reported that horizontal tooth-implant distance might influence the marginal bone level adjacent to teeth[4]. In the present study, the results indicated that if the horizontal distance between implant and the adjacent tooth decreased, the mean value of approximal bone loss increased. The results concurred with previous studies, pointing that the closer the distance between implant and tooth the greater the approximal bone crest reduction at teeth[4,24]. Nevertheless, the results of this study suggested that the peri-implant marginal bone loss was significantly higher only when the horizontal distance was less than < 1mm, as compared with distance greater than 1.5 mm. When it comes to Bone level implants, significantly higher periodontal marginal bone loss was additionally found when the horizontal distance between implants and the adjacent teeth was less than 1mm. This was not observed with tissue level implant. The variation of bone level implants and tissue level implants also reflects a discrepancy between the diameter of platform and the diameter of the implant, the diameter of platform is wider. As a result, the distance between platform of tissue level implants and the adjacent teeth surface is shorter than the distance between rough surface of the implants and the adjacent teeth. It remains to be investigated if the presence of the tissue collar has a direct impact or if operators tend to assess the horizontal distance to adjacent teeth differently when placing tissue or bone level implants.

The findings of the present study showed no significant difference in bone resorption when the horizontal distance was 1mm-1.5mm, or greater than1.5mm. This finding might be challenging previous recommendations that implant should be placed at least 1.5mm from the adjacent tooth[25].

Nevertheless, distance to adjacent teeth is primarily prosthetically driven and even if the distance of 1mm does not result in increased marginal bone loss it can often pose restorative and aesthetic challenges.

The coronoapical position of implants did not appear to affect the bone level of neighboring teeth. These findings were in line with the study done by Chang and Wennstrom in 2010[27], where the height of bone crest at proximal area between tooth and implant was maintained when implants were placed at different coronoapical levels. Also, the same result was documented with histomorphometry in a study investigating changes around dental implants inserted in different vertical levels[28]. On the other side, Malioa et al reported that implants placed at a vertical distance greater than 3mm from the CEJ of the adjacent teeth showed more interproximal bone loss[3]. Others reported that implants positioned 6mm apical to the CEJ of the adjacent teeth showed more mean marginal bone loss[29].

The difference in the outcome of mesial and distal sides could be attributed to uneven alveolar ridge, where for example the most coronal bone contact of mesial side might be different to that of the distal side. Furthermore, one could hypothesise that the view of the operator might favor the mesial to the distal side of the implant, depending on the position of the implant in the mouth and accessibility for direct visual inspection while preparing the osteotomy. This could result in underestimating the optimal position. In the present study the distance between the CEJ and the bone crest prior to implant placement was not measured. Moreover, the implants with horizontal proximity less than 1 mm or coronoapical position of 6 mm or more was small. Consequently, the results should be received in the light of such limitation. Finally, as the bone resorption is assessed at different time intervals, possible impact of factors such as tooth eruption or movement, is difficult to account for and could affect some measurements.

The data found no correlation between peri-implant bone resorption and the bone level changes of the adjacent teeth. This is in accordance with a previous report[7] which demonstrated that radiographic bone level changes around teeth seemed not to be influenced by the bone loss at the adjacent implants. The tissue structure around dental implant is different to those around natural tooth[5]. Moreover, factors such as surgical procedure, establishment of biological width, loading patterns, roughness of implant surface, might affect peri-implant differently than periodontal tissues. Again, the relatively minimal bone loss that was observed in this study might have limited the ability to discover any such correlation.

Bone resorption around both implant and tooth can be induced by plaque induced inflammation. It is believed that the infection between implant and their adjacent teeth is inter-related[32] and lack of access for oral hygiene is frequently shown to be a major risk factor for peri-implant and periodontal inflammation (34 Serino & Strom) . In that sense, it appears surprising that implant proximity to adjacent teeth did not correlate with increasing of BOP. Nevertheless, one should note that this study did not actually assess clinical access to oral hygiene and proximity in itself might not be always excluding the practice of oral hygiene with media such as dental floss or interdental brushes.

The relatively small observation period when it comes to plaque induced inflammation could be an inherent limitation of this retrospective study, where maintenance scheme was also offered to the patients. Consequently, the follow up period might not be long enough to fully assess the possible long term influence of implant positioning. The radiographs were taken by different operators, even if the parallel cone technique was utilized at all times. Without the use of a customised radiographic film holder, small differences in the cone angle might affect the accuracy of measurement. Measures were taken to reduce potential measurement errors and unclear and severely distorted radiographs were excluded, calibration was done before each measurement to minimize the possible effect of distortion.

Conclusion

Survival rate was high at 99.6% at average observation time of 3 years, which is comparable standard international best practices. Success rate ranged from 83.6% to 91.3% when different sets of criteria were used. Marginal bone loss at adjacent teeth was only significantly increased when the horizontal distance between bone level implants and the neighbouring teeth was less than 1mm. No significant association was found between apicocoronal implant position and radiographic bone change at the adjacent teeth. The bone loss surrounding dental implants did not appear to correlate with bone level changes of the adjacent teeth and there was no correlation between implant proximity to natural teeth and bleeding on probing.

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List of figures:

Figure 1: Peri-apical Radiographs at a) Implant placement b) Loading C) Most recent review appointment

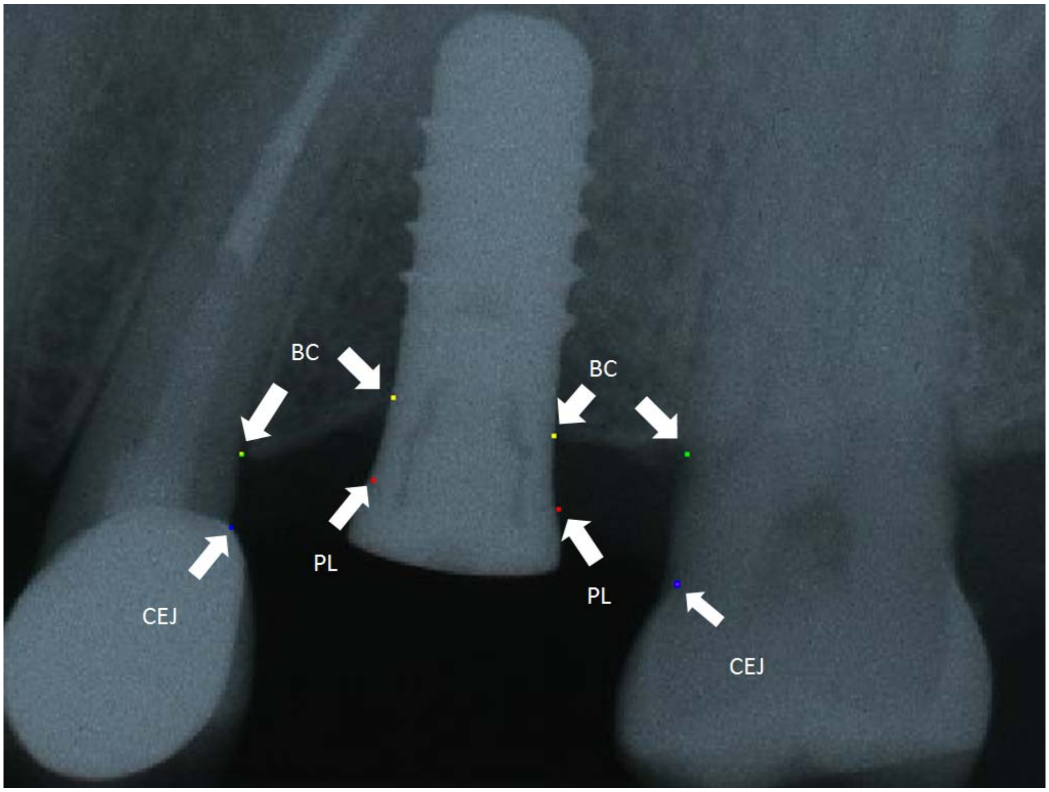

Figure 2: Radiographic reference points used for radiographic mesurements.

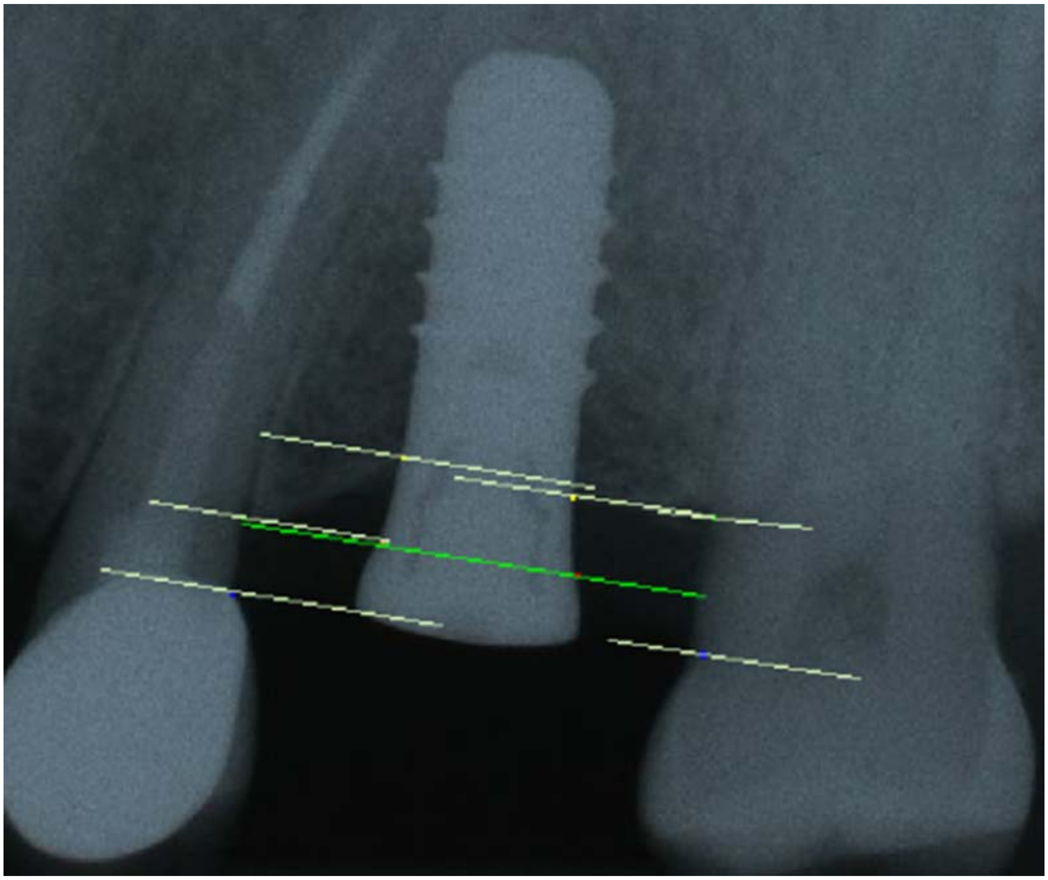

Figure 3: Lines connecting radiographic reference points, drawn parallel to implant prosthetic platform (Green line – Tissue Level implant) for measurements.

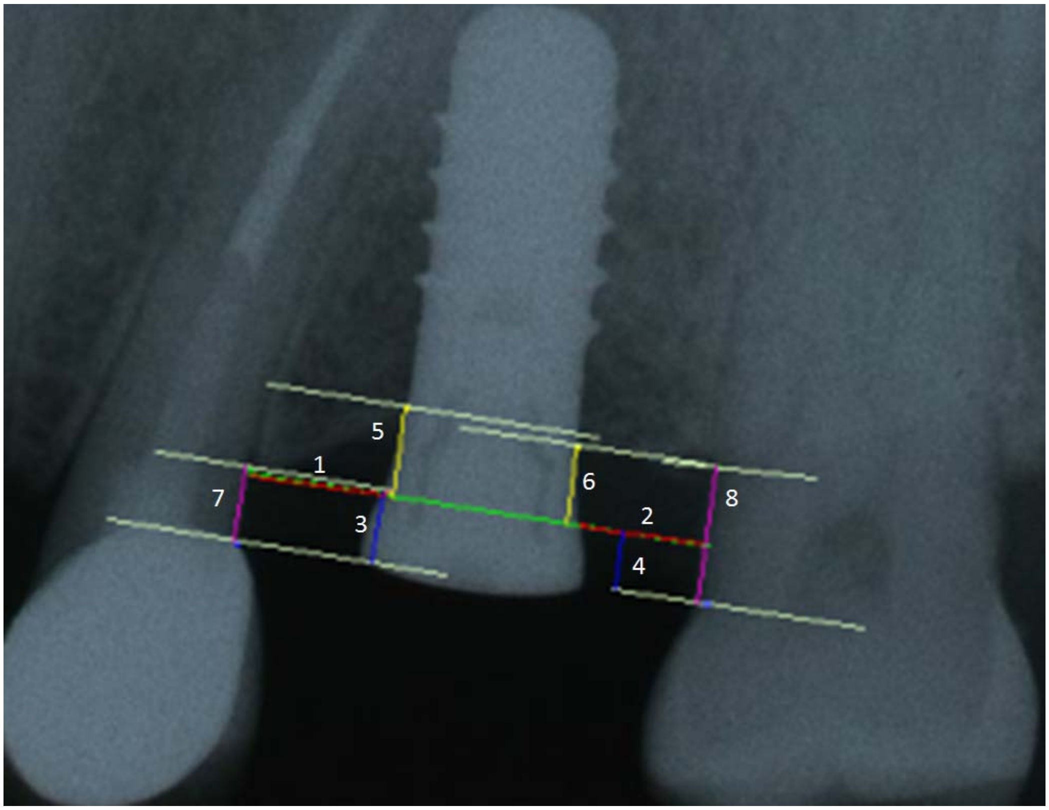

Figure 4: Actual lines for measurements.

mTID	N	Mean of mesial tooth bone loss	Std. Deviation
<1mm	5	0.87.	0.38
1-1.5mm	11	0.59	0.45
>1.5mm	118	0.36	0.48

N: Number of sites

mTID: Horizontal distance between mesial tooth and implant

Table 1: Means, standard deviation of bone loss at mesial tooth for different values of horizontal implant-tooth distance (Review-Implant placement)

dTID	N	Mean of distal tooth bone loss	Std. Deviation
<1mm	9	1.09	0.94
1-1.5mm	12	0.44	0.41
>1.5mm	85	0.36	0.53

N: Number of sites

dTID: Horizontal distance between distal tooth and implant

Table 2: Means, Standard deviation of bone loss at distal tooth for different values of horizontal implant-tooth distance (Review-Implant placement)

mCEJ-PL	N	Mean of mesial tooth bone loss	Std. Deviation
<3mm	65	0.49	0.49
3-6 mm	58	0.32	0.50
>6 mm	11	0.26	0.35

N: Number of sites

mCEJ-PL: Distance between CEJ of mesial tooth and Platform or top of implant

Table 3: Means, Standard deviation of bone loss at mesial tooth for different values of coronoapical implant-tooth position (Review-Implant placement)

dCEJ-PL	N	Mean of distal tooth bone loss	Std. Deviation
<3mm	73	0.40	0.52
3-6 mm	28	0.52	0.76
>6 mm	5	0.40	0.65

N: Number of sites

dCEJ-PL: Distance between CEJ of distal tooth and platform or top of implant

Table 4: Means, Standard deviation of bone loss at distal tooth for different values of horizontal implant-tooth distance (Review-Implant placement)