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Primary stability achieved during implant surgery and bone loss at recovery in patients of a private dental institution — A retrospective analysis

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ABSTRACT

Implant stability plays a critical role for osseointegration, without osseointegration long term success cannot be achieved, primary stability occurs from mechanical attachment with the cortical bone. It is the gold standard for success of implants. This is a descriptive clinical study carried out in saveetha dental college and hospital, Poonamallee, Chennai. All the patients who underwent single or two-unit implant surgery were selected. The study setting was done from university predominantly south Indian populations and data with regard to primary stability at placement, level of the implant with bone, crestal bone loss at stage 2 recovery were retrieved from the digital case sheets. Data were entered using SPSS software, and Chi-square test was used for inferential analysis, with a P-value < 0.05 was said to be statistically significant. The results obtained indicate more implants are placed with primary stability in 30-40 Ncm(49.8%). More frequently placed crestal relation is equi crestal region (84.4%) and crestal bone loss was less than 1-2mm is seen(87.3%) at stage 2 recovery. The results were subjected to statistical chi-square test, and it is observed that primary stability at 30-40 Ncm or greater did not have any significant association with crestal bone loss. An equi crestal placement of the implant was preferred irrespective of implant type.

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INTRODUCTION

Implant stability plays a critical role in successful osseointegration. Successful osseointegration is a prerequisite for functional dental implants (Albrektsson and Zarb, 1992). Osseointegration is a prerequisite for a functional dental implant. Osseointegration is defined as direct bone anchorage to an implant body which can produce a foundation to support the prosthesis. Implant stability is a requisite characteristic of osseointegration (Romanos *et al.*, 2014). Without it, long term success cannot be achieved. Continuous monitoring of quantitatively and objectively is important to determine the status of implant stability. Osseointegration is also a measure of implant stability which can occur in two stages. They are primary stability and secondary stability (O'Sullivan *et al.*, 2004). Primary stability mostly occurs from mechanical attachment with the cortical bone. Secondary stability offers biological stability through bone regeneration and bone remodelling (Brunski, 1992). Primary stability is affected by the bone quality and quantity, surgical technique and implant geometry which is length diameter and surface characteristics. Secondary stability is affected by primary stability. Primary stability is a gold standard for the success

of implants. It prevents the formation of connective tissue layers between implant and bone, consequently ensuring bone healing (Cochran *et al.*, 1998). Secondary stability begins to increase at 4 weeks after the implant placement (Aparna *et al.*, 2011). Implant surgery should not be performed during pregnancy period as implants are an elective procedure (Basha *et al.*, 2018). People prefer implants in the anterior region because everyone is considered with aesthetics and confidence during a smile. Placement of narrow implant in the anterior maxillary region (Ariga *et al.*, 2018). Periodontal and oral health should be maintained (Jyothi *et al.*, 2017) well to prevent any oral microorganism invading oral health (Selvan and Ganapathy, 2016). A high survival rate and less bone loss were obtained both for crestal and subcrestal implants placement without the formation of microgap at abutment interface (Duraisamy *et al.*, 2019). A subcrestal placement of the implant should be preferred which reduces the probability for the implant to become exposed in the future (Ganapathy, 2016) and thus avoid the risk of suffering from peri implant pathologies (Vijayalakshmi and Ganapathy, 2016) and help in maintaining the oral health of the patient (Subasree *et al.*, 2016). The implant must be strategically placed to allow the crowns to emerge through the gum tissues in exactly the right direction. Patients should plan on three to six months of healing time after implant placement (Ganapathy *et al.*, 2017). Implants can vary in how the crown attaches to the abutment and post either cemented to the abutment or screwed through the abutment to the post (Ashok and Suvitha, 2016).

Implant stability decreases during early weeks of healing followed by an increase (Jain *et al.*, 2017). This is related to the biologic reaction of the bone to surgical trauma during the initial bone remodelling phase, bone and necrotic materials resorbed by osteoclastic activity are reflected by a reduction in implant stability quotient(ISQ) value (Atsumi *et al.*, 2007; Aparna *et al.*, 2011). This process is followed by new bone apposition initiated by osteoblastic activity, therefore leading to adaptive bone remodelling around the implant (Atsumi *et al.*, 2007). An accelerated formation of bone to implant contact contributes to a faster increase in secondary stability. This biological princess eliminates the decrease in primary stability and ensures consistency of stability overtime without the drop during the healing period (O'Sullivan *et al.*, 2004).

Numerous studies describe different techniques and to assess stability upon the implant placement. One of the most popular digital methods is resonance frequency analysis(RFA), Osstell system and periotest (Garber *et al.*, 2001). Regarding clinical methods, percussion test measuring insertion torque prevails over others. Implant stability Quotient (ISQ)-55 to 80. Higher values of ISQ for mandible and lower values of ISQ for maxilla. ISQ greater than 65 has more implant stability. Periotest value has low mobility which is about 8 and high mobility which is 50. Factors influencing primary stability are implant geometry, bone density and quality and the surgical protocol (Adell *et al.*, 1981).Therefore it is essential to assess the implant stability at different time points in order to ensure successful osseointegration. The main objective of our study is an analysis of higher primary stability achieved during implant surgery and its relevance to crestal bone loss even before loading.

MATERIALS AND METHODS

This is the clinical study carried out in Saveetha Dental College and Hospitals, Poonamallee, Chennai. The study evaluated the implant placed using in house diagnostic and treatment software. Inclusion criteria which were dependent on the number of patients undergoing simple implant prosthesis replacement with all clinical data examinations available. The data primarily looked to included for primary stability, crestal relation, bone loss and type of implant. All Implants placed were selected based on the clinical and radiological examinations. Cone Beam Computed Tomography Imaging Device and Panoramic Xray were used for preoperative planning. The study followed a two-stage surgical protocol and followed all standard procedures for implant placement. The study setting was to screen patient data from the university's digital database. Sample data from June 2019 to April 2020 were collected. Data collection was from case sheet entries of 519 patients, details were extracted, and tabulation was done. The data looked at primary stability achieved at implant placement, level of implant platform to crestal bone at the surgery and crestal bone loss at stage 2 recovery phase. The data retrieved was imported to SPSS with defined variables, and the results were subjected to chi-square test to determine the significance level with respect to primary stability achieved during implant surgery and associated relevance to crestal bone loss at recovery phase.

RESULTS AND DISCUSSION

More implant is placed with primary stability is 30-40 Ncm, about 49.8%. More frequently the crestal relation is in equi crestal region, about 84.4%. The implant type which is used frequently is Straumann

about 40%. Crestal bone loss during stage 2 recovery phase was assessed between 1-2mm in about 87.3%.

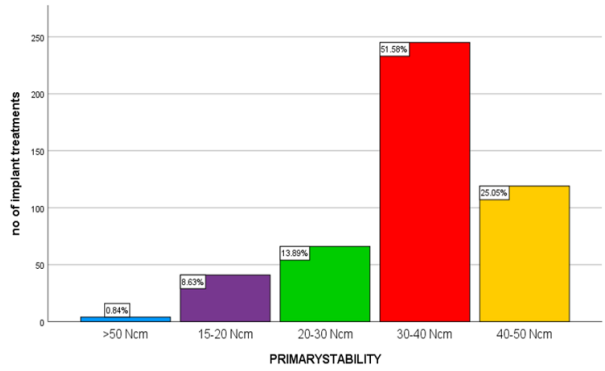

Figure 1: This graph represents frequency distribution of number of implants placed and primary stability achieved during surgical phase

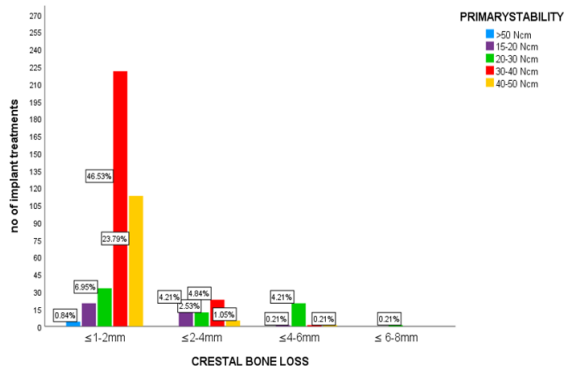

Figure 2: This graph represents associations between crestal bone loss and primary stability

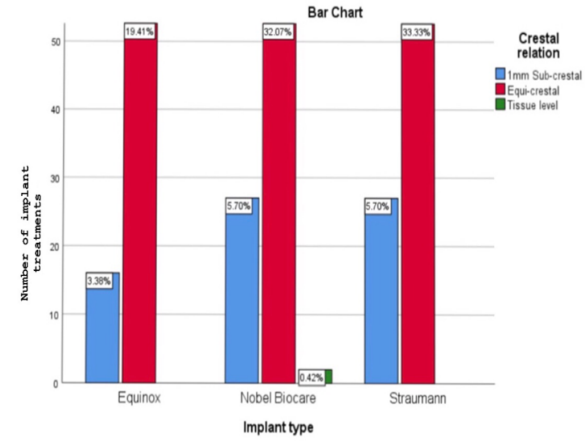

Figure 3: This graph represents associations between implant type and the crestal relation

Our study shows implant placed with primary stability ranges from 15-20Ncm is 7.9%, 20-30Ncm is 12.7%, 30-40Ncm is 49.8%, 40-50Ncm is 28.8% and more than 50Ncm is 0.8%, So here the higher primary stability is 30-40 Ncm which is in accordance with many types of research which states that insertion torque used was 30-45Ncm (Gomes *et al.*, 2014) And a few other types of research opposed our study (Insua *et al.*, 2017). (Figure 1, Figure 2).

Our study shows crestal relation of the implant placed in equi crestal region is 84.4% followed by subcrestal region is 15.3%, and tissue level is 0.4%. So, here more frequently in equi crestal region. This is in accordance with many other studies (Balshi *et al.*, 2007) and few studies opposed our study by saying that the position of the implant is placed subcrestal because of body design of the implant was tapered, and the apical design gives self drilling ability (Kaboosaya, 2019),(Figure 3).

In Figure 1, X-axis denotes the primary stability and Y-axis denotes the number of patients who underwent implant treatment. The distribution indicates 30-40 N was the highest achieved primary stability-51.58% among the total number of implants placed followed by 40-50N of primary stability-25%.

In Figure 2, X-axis denotes the crestal bone loss at recovery and Y-axis denotes the primary stability achieved during the surgical phase. Primary stability at 30-40N indicates 46.5% of crestal bone loss less than 1-2mm and a mere 4.21% of crestal bone loss of less than 2-4mm and 4-6mm seen in 15-20 N and 20-30N primary stability respectively. Pearson Chi-square-180.678 df- 12 P=0.000 P<0.05, indicating the association was highly significant statistically. The association indicates more implants are placed at 30-40N, and 40-50N of primary stability and associated crestal bone loss is less than 1-2mm at the recovery phase.

In Figure 3, X-axis denotes the implant type and Y-axis denotes the crestal relation. Blue colour represents 1mm subcrestal, red colour represents equi crestal and green colour represents tissue level. Pearson Chi-square- 43.288 df- 16 P=0.000 P<0.05 indicating the association was highly significant statistically. The association indicates more equi crestal level chosen as majority irrespective of implant type.

Our study shows the implant type, which is used frequently in our study is Straumann 40% followed by Nobel biocare 37.3% and equinox 22.6% and straumann implants placed with higher torque values. The greater insertion torque was associated with the type of drills used, and this is in accordance with few researchers who states straumann implant type uses parallel cutting drill with speed ranging from 400 to 600 rpm using intermittent motions with the

use of copious saline using external flow (Shokri and Daraeighadikolaei, 2013). And few researchers have suggested internal irrigation as an important way to preserve bone but not mentioned about the apical over preparation (Soto-Penaloza *et al.*, 2017).

Our present study shows that crestal bone loss during Stage 2 implant placement was observed less than 1-2mm is 87.3%, 2-4mm is 11.6%, 4-6mm is 1% and 6-8mm is 0.2% with mean primary stability at 40 N or greater and statistically significant in comparison to primary stability ($p<0.05$). Some of the previous literature agreed with our study by stating that associated crestal bone loss is less than 1mm (Palacios-Garzón *et al.*, 2019) and few other literature opposed our study by explaining the crestal bone loss is more than 3mm (van Eekeren *et al.*, 2016). The crestal bone change is inevitable but should be within an acceptable limit with the stability achieved. The study design indicates that even with higher primary stability values crestal bone loss was within the range of other study reports.

The crestal bone loss has been associated with the prosthesis, axial loading, incomplete prosthesis seating, immediate loading and use of cements (Ajay *et al.*, 2017) Numerous dental luting agents are used either temporarily or permanently for cementation of the restorations leading to bone loss (Kannan and Venugopalan, 2018). The present study was looking at crestal bone loss even before loading, multiple factors can play a role on bone loss, but this was targeted to check if varying primary stability has any effect on crestal bone level (Ashok *et al.*, 2014). Implant stability is essential but should also be not a reason for bone loss (Venugopalan *et al.*, 2014).

CONCLUSION

Within the limitations of this study, it is observed that primary stability at or greater than 30 Ncm to 40Ncm had limited effect on crestal bone loss. The associated crestal bone loss during Stage 2 recovery phase of implant placement was observed at less than 1-2mm, which was an acceptable range and equi crestal positioning of implant was preferred over subcrestal positioning.

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Conflict of Interest

The authors declare that they have no conflict of interest for this study.

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