The journal of
PROSTHETIC AND IMPLANT DENTISTRY
Official Publication of Indian Prosthodontic Society
Kerala State Branch
jpid.ipskerala.com

COMPARATIVE EVALUATION OF CRESTAL BONE LEVEL IN RELATION TO IMPLANTS PLACED USING CONVENTIONAL OSTEOTOMES AND BONE EXPANSION SCREWS

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https://doi.org/10.55231/jpid.2022.v06.i01.03

BACKGROUND AND OBJECTIVES: *The comparison of crestal bone loss in relation to implants placed using conventional drilling osteotomy method and using bone expansion screws in maxillary region.*

METHODS: *The crestal bone loss was measured after implant placement and after a period of six months, and the results analyzed. Equal number of male and female patients of comparable age group who opted implant treatment were selected.*

RESULTS AND DISCUSSION: *After a period of six months of implant placement, a mean value of 1.37 mm of crestal bone loss was noticed for implants placed using conventional osteotomy method while a mean of 0.73 was noticed in relation to implants placed using expansion screws.*

CONCLUSION: *The implants placed using bone expansion screws show less crestal bone loss compared to implants placed using conventional osteotomy method in maxillary edentulous ridge having less than ideal bone width. It infers that the bone expansion method using expansion screws is more reliable and relatively noninvasive way of implant bed preparation.*

Key words: ***Crestal bone level; Conventional osteotomy; Bone expansion screws; Implants.***

Over the past few decades, removable dentures have given way to fixed prosthetic options due to the demand for esthetics and comfort. The major breakthrough; the concept of "osseointegration" in dentistry by Dr. Per Ingvar Brånemark[1] along with continued research benefited in the rehabilitation of edentulous patients.

In the maxillary region, the advanced resorption of alveolar bone and relatively lesser bone density poses a challenge for implant placement. Many techniques have been tried for widening edentulous ridge, including osteoinduction[2,3] osteoconduction[4], onlay block bone grafting, alveolar distraction osteogenesis[5], guided bone regeneration and splitting to expand the ridge[6,7]. They come with limitations including harvesting bone from oral sites, highly technique sensitive, lower patient compliance and increased morbidity.

Less invasive techniques using osteotomes and bone expansion screws help to shorten treatment length, avoid additional surgical appointments, reduce trauma to patient and conserve the maximum amount of alveolar bone and decrease

morbidity[8]. Bone expansion screws utilize a thread former configuration allowing expansion and lateral condensation of bone, when used in increasing diameters inserted with a torque wrench. They allow 'corticalization' of the implant site which is advantageous for the primary stability of implants in rather cancellous bone of maxillae according to Lekholm & Zarb[9](1985).

This study was aimed to compare the crestal bone loss whichoccurred in relation to implants placed by 'bone spreading technique using bone expansion screws with conventional method of osteotomy preparation. Both methods are employed for placing implants in edentulous ridge with enough bone height as well as a minimum required width. Estimation of peri-implant crestal bone loss is an important parameter for evaluation and prognosis of implant success[10].

METHODS:

It is an observational clinical studyconducted according to the guidelines of the localethical committee of Thiruvananthapuram dental college(IEC/E/4/2016/DCT/dtd 06/12/16).

This clinical study included patients with healthy remaining dentition, good oral hygiene, no retained roots/pathologic lesions, adequateinter-arch clearance, adequate quality and quantity of bone, no known systemic disease, availability for follow-up. Patients with smoking habit/drug or alcohol abuse, Radiation treatment to head and neck, ongoing chemotherapy, pregnant and lactatingwomen, post-menopausal women, patientsunder corticosteroids and immune-suppressants, Patients reporting after recentextraction (less than 3 months) were excluded.

Total sample size was 30. Consecutive cases satisfying inclusion and exclusioncriteria were selected till the sample size was achieved. The patients were given written information regarding the risks of implant surgery and their written informed consent was obtained.

IMPLANT SELECTION

Based on the evaluation of diagnostic casts and CBCT (Figure 1,2), titanium root form implant (GenXT) dimensions were determined for each patient. A safe distance of minimum 2mm was kept from anatomical structures such as maxillary sinus. The surgery was done under antibiotic coverage. Betadine solution (5%) was used to disinfect the extra-oral as well as intra-oral tissues. The patient was asked to rinse with 1.2%mg/ml chlorhexidine gluconate mouthwash for one minute. The site of implant surgery was anesthetized by local infiltration injection of 2% lignocaine with 1:200000 adrenaline (cadila pharmaceuticals).

Group A – Conventional osteotomy method

Initial preparation was done using pilot drill followed by sequential drilling using progressively larger drills. The drilling was done using physiodispensor under copious irrigation of normal saline. The drill depth was assessed using depth gauge. Once the planned implant diameter was achieved, implant was placed with the help of an implant mount.

Group B – Bone expansion screw method

Pilot drill was used on the proposed implant site to reach the desired depth. Bone expansion screws in the order of increasing diameters were inserted into the bone cavity. Screws of diameter 3.5mm, 4.0mm and 4.5mm were used (Figure 3). A torque wrench was used to insert the screw cautiously and slowly upto the desired depth. The last screw spreader used had to beslightly smaller in diameter than the implant diameter. Implant was placed with the help of an implant mount and inserted using torque wrench (Figure 4).

In either of the above methods, immediate loading single stage implants were placed in each patient using immediate loading protocol. An interim restoration was cemented on the day of surgery after implant placement (Figure 5). Digital periapical intraoral radiographs were taken immediately after implant placement and after sixmonths (Figure 6). Regular clinical follow-up was done at one month, three months and six months after implant placement.

RESULTS AND OBSERVATION

From the digital radiographs, the distance from the mesial crestal bone level to the apex of the implant was measured with the help of Romexis software. The measurements were subjected to statistical analysis using Students t –test.

The crestal bone levels in relation to implants placed using both methods were measured immediately and after six monthsof implant placement. Comparison of crestal bone level of implants placed using both the methods were measured immediately and after six monthsof implant placement. After a period of 6 months of implant placement, a mean value of 1.37mm of crestal bone loss was noticed for implant placed using conventional osteotomy method while a mean of 0.73 was noticed in relation to implants placed using bone expansion screws (Graph 1,2). The study was significant at 0.01 level (Table.1)

DISCUSSION

Figure.1: Frontal view

Figure.2: CBCT

Figure.3: Using bone expansion screws

Figure.4: Implant placement

Figure.5: Provisional restoration

Though there are various surgical methods for implant bed preparation, the conventional drilling osteotomy technique has been the most used, irrespective of the quality of bone. A scientific backup of various studies shows consistent results with good primary stability and success rate when performed in good quality bone of adequate volume[11]. But the removal of precious bone by drilling is a major concern particularly in narrow edentulous maxillary ridge of relatively poor bone quality (D2, D3 or D4).

The present study was conducted to compare the crestal bone loss that occurred in relation to implants placed using bone expansion screws, with that of conventional osteotomy method using bone drills. Crestal bone loss being an important parameter for the evaluation of success of an implant, it is possible to assess the reliability of using bone expansion screws for implant placement; which is a more conservative procedure. Bone expansion screw method is primarily intended for placing implants in edentulous areas with sufficient bone height but insufficient bone width as well as poor bone quality.

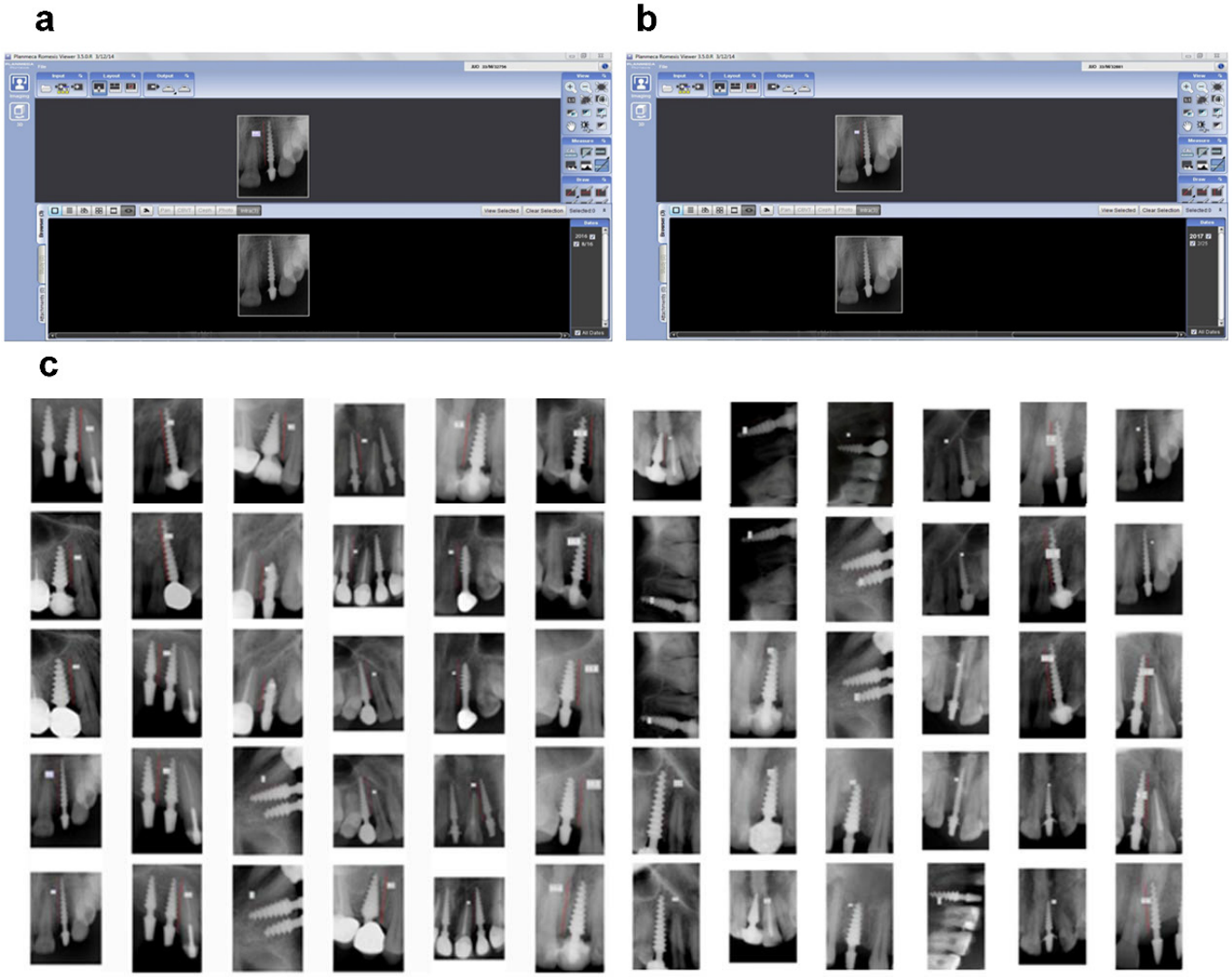


Figure.6: Intraoral periapical radiographs taken immediately after implant placement and after six months.

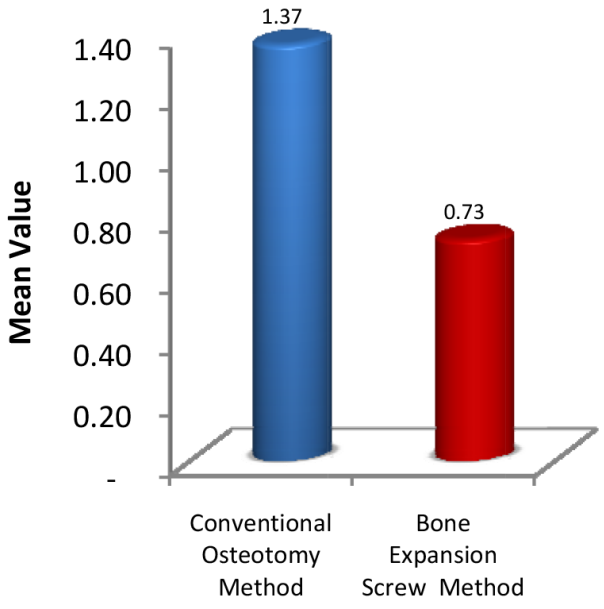
When it comes to implant treatment in narrow edentulous ridges, there are numerous ridge augmentation methods, but most of these surgical procedures are invasive, involves risk of infection and takes longer time period to reach their goal[7,12,13].

Bone expansion using screws and osteotomes are two relatively atraumatic methods indicated for implant bed preparation in edentulous ridges of poor bone quality and inadequate width. The concept of bone expansion screws was introduced to overcome theshortcomings of osteotomes such as the difficulty in controlling malleting force as well as the risk of bone fracture. The screws can be engaged into the receptor bone with the help of a ratchet or torque wrench. With the introduction of larger diameter screws, bone is pushed and condensed laterally which allows a slow and gradual expansion of the bone laterally rather than losing bone by drilling.[14,15] The implant should be 0.5 mm larger in diameter than the size of the screw last used to expand bone[16]. The softer bone quality found in type III and type IV maxillary bone is improved by laterally compacting the medullary bone[16]. The increased bone rigidity achieved by bone condensation results in improved primary stability of implants[14]. Patient compliance is also more with this method[16].

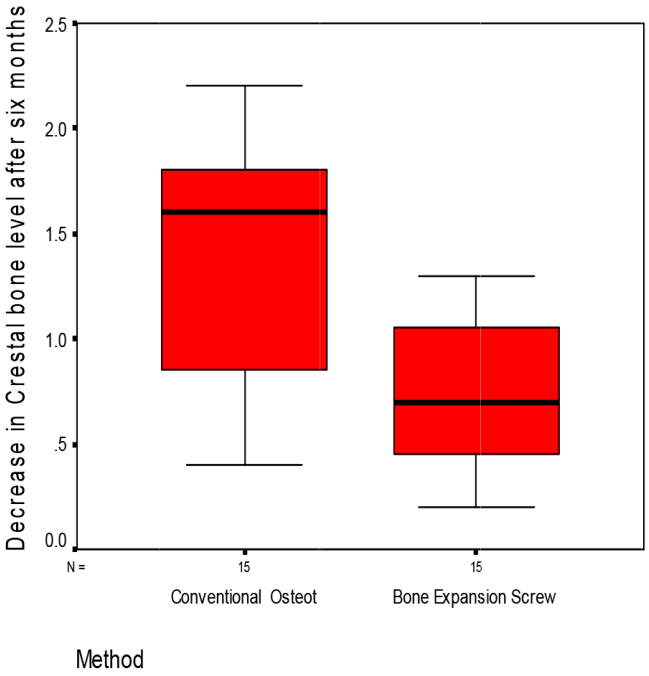
One of the drawbacks of using bone expansion screws is that resilience of bone sometimes requires revision of the osteotomies with final sizing drill before implant placement. Also. a continuous full turn in thin dense bone can lead to excessive osteo- compression[16]. It can only be performed in cases with cancellous bone within the cortical bone on both sides[17].

Immediate loading root form implants were used for the study aiming at a shorter treatment period with a stable and fixed long-term interim

Graph 1: Comparison of Decrease in Crestal bone level Six months after implant placement between Conventional Osteotomy Method and Bone Expansion Screw Method



Graph 2: Box plot for Decrease in Crestal bone level after six months:Conventional Osteotomy Method and Bone Expansion Screw Method



restoration on the day of surgery[18]. This treatment option also aims at maintenance of the hard and soft tissue contour and reducing the waiting period[18]. The highly acceptable clinical success rate of immediate loading implants has been studied and proved by many pioneers like Maria Chatzistauraw et al[19] in 2003, Degidi M[20], Piatteli A in 2005, Cannizzaro et al[21] in 2011, Yoo et al[22] in 2006 etc.

Digital periapical radiographs taken immediately after implant placement and six months later were used for measuring crestal bone loss. The measurements were made from the crest of the bone to the apex of the implant with the help of Planmeca Romexis software. Study by Penarrocha[23] et al in 2004 shown that conventional periapical films and digital radiographs were more accurate than orthopantomography in the assessment of perimplant bone loss. In order to reduce any bias in technique, all the radiographs were taken by the same person who is qualified and skilled for the same.

In the present study, analysis of difference in the crestal bone level in relation to implants placed using conventional drilling osteotomy method and using bone expansion screws immediately after implant placement and after a period of six months has been done. Descriptive statistics along with Box plot was used to describe Crestal bone level between two different methods at immediately after and six months after implant placement. Independent sample t-test was used for the comparison of difference in crestal bone level after six months between the two methods. For all statistical interpretations. $p<0.05$ was considered the threshold for statistical significance. Statistical analysis was performed by using a statistical software package SPSS, version 20.0.

After a period of six months of implant placement, a mean value of 1.37 mm of crestal bone loss was noticed for implants placed using conventional osteotomy method while a mean of 0.73 was noticed in relation to implants placed using bone expansion screws. The mean crestal boneloss for Branemark implants has been determined to be 1.5mm for the first year, followed by a mean bone loss of 0.1 mm per year by Adell et al[1]. This value was confirmed by Cox and Zarb[24] with their 5-year report.

The present study was statistically significant at 0.01 level. There is significantly lesser bone loss in relation to implants placed using bone expansion screws after a period of six months when compared to implants placed using conventional osteotomy using bone drilling. Here the implants were placed in edentulous maxillary ridge which was classified as belonging to D2, D3 or D4 type bone. Ridges having a minimum of 4.5 mm width were included in the study. The impression made can be that the lateral bone condensation by bone expansion screws improved the quality of porous medullary bone of maxillae[14]. This technique conserved all of the bone in the surgical site[14,15]. A study done by Nishioka et.al[14] in 2009 showed that the maxilla with insufficient buccolingual width and relatively less dense bone can be managed well by using bone expansion screws.

Bone expansion screws allow the placement of greater diameter implants than when conventional method of osteotomy is used. Each 1 mm increase in diameter of implant increases the surface area by about 20–30%, which in turn decreases crestal stress and eventually crestal bone loss[11] Incidence of green stick fractures are minimized and there is no thermal injury to bone[16].

The results of the present study indicate that thread-former and "screw-type" design is more appropriate for placing implants in areas of buccal bone resorption and in soft maxillary bone, than the conventional osteotomy drilling. With proper patient selection, evaluation, pre-surgical planning, careful execution of surgical technique and post-operative follow-up, favorable results can be achieved. Long term data regarding

the outcome and success rates would require randomized studies to evaluate the predictability of this technique.

LIMITATIONS OF THE STUDY

1. Due to constraints in the number of study subjects, a descriptive study was conducted.

2. In addition to crestal bone level, other parameters such as durability, gingival health[25], etc. have to be taken into consideration to evaluate the predictability of using bone expansion screws more effectively.

3. The study is also limited by the fact that there can be subjective errors in digital intraoral radiographs even though taken by the same person under samesettings.

CONCLUSION:

Within the limitations of the study, the following conclusions were drawn after analysis of the results:

• Implants placed using bone expansion screws showed lesser crestal bone loss compared to that in relation to implants placed using conventional osteotomy method in maxillary edentulous ridge having less than ideal width.

• The bone expansion method using bone expansion screws is much more reliable and relatively noninvasive way of implant bed preparation than conventional osteotomy method in maxillary edentulous ridges of poor bone quality and inadequate width.

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