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Implant Macrodesigns And It's Effect On Crestal Bone Loss: A Report Of Two Cases

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Abstract

Implant is a prosthetically driven surgical treatment modality which replaces the missing tooth.
Cylindrical implants which were popular earlier resulted in loss of crestal bone and subsequent implant failure, which led to the development of threaded features converting occlusal loads into a more favourable compressive loads at the bone interface. In the recent era of implantology, most of the common implant thread design marketed are V- shaped thread design. However, because of generation of higher shear forces generated by V-shaped thread design, modification has been made in the form of square, reverse buttress and buttress where the axial load is dissipated through compressive loads while a V-shaped thread design transmit axial force through a combination of compressive, tensile, and shear forces which may have an influence of crestal bone loss. Thus, the present case report intends the use of two thread designs (V-shaped and buttress thread design) and its influence on crestal bone loss using CBCT radiographic analysis.

Keywords Thread designs, crestal bone loss, CBCT

INTRODUCTION

A dental implant also known as an endosseous implant or fixture is a prosthesis that interfaces with the bone of the jaw or skull to support a dental prosthesis such as a crown, bridge, denture, or facial prosthesis or to act as an orthodontic anchor. The basis for modern dental implants is based on a biological process called osseointegration, in which materials such as titanium or zirconia form an intimate bond with the bone. The aim of the implant therapy is to restore tissue contour, function, comfort, aesthetics and speech.[1] Dental implant role is to transfer the mechanical force that is created during chewing to the supporting osseous tissues within the mandible and maxilla.[2] The importance of biomechanical factors such as the bone-implant interface, implant thread design , the length and diameter of implants, type of loading, the quality and quantity of surrounding bone that has been strained by evaluated in numerous literature and it has been proven that the selection of implant thread sign plays an important role in the successful long term outcome of the treatment.

In the early 1980's, cylindrical implants were quite popular, and were largely advocated for implant supported prosthesis however after few years of loading cylindrical implants resulted in loss of crestal bone and subsequent implant failures were reported so to overcome the limitation of cylindrical implants , implants with various micro and macro threaded design have been introduced in surgical implant dentistry which has the marked ability to convert occlusal loads into a more favourable compressive loads at the bone interface which may lead to increase in bone mass density and decrease in crestal loss of bone at the implant bone interface.[3]Threaded implants thus could reduce both bone stress and implant bone sliding distance, hence potentially improving initial implant stability and long term implant survival and success rates.

Implant design is an important factor affecting implant primary stability and ability of implant to sustain loading during and after osseointegration.[4] Two major categories of implant designs are macro design and micro design. Macro design includes body shape and thread design e.g. thread geometry, face angle, thread pitch, thread depth. Micro design includes surface morphology implant materials and surface coating. Factors that play direct role in treatment outcome related to bone preservation is implant design in the form of body shape, thread design, surface texture and drill protocol during preparation of osteotomy site and it also affects primary implant stability.

There is a strong impact of biomechanics on long term maintenance of interface between implant and bone. So understanding of the bone quality and quantity is important to increase success rate.

Implant thread design has been found to influence the type of force transferred to the surrounding bone. Generally, implants introduced had V- shaped design. Presently available thread designs include:- V-shape, square shape, buttress, reverse buttress.

The amount of shear force generated by the different thread design increases as the thread face angle increases. **Misch et al**[5] suggested that V thread , reverse buttress thread have 300,150 thread face angle and buttress thread has 45 degree angle whereas the square thread design is perpendicular to the long axis. Hence, V-shape threads generate higher shear force than both buttress and square thread with square thread generating the least shear force.

In squared and buttress threads, the axial load of these implants are mostly dissipated through compressive force while V-shaped and reverse buttress threaded implants transmit axial force through a combination of compressive, tensile and shear forces.[6]

Hence, the aim of this present case report was to evaluate the crestal bone loss around implants of two different thread designs- Buttress and V-shaped thread design using a clinico-radiographic CBCT analysis.

CASE REPORT 1

A 38 year old male patient reported to the department of Subharti Dental College and Hospital, with a chief complaint of missing mandibular posterior 36 tooth region. A written informed consent was taken. After assessing the pre-treatment records and identifying vital anatomic landmarks an implant supported prosthesis was planned to replace the missing tooth.

Anaesthesia was achieved administering 1:100000 lignocaine as nerve block and sub-crestal incision using 12 no blade was given and a full thickness mucoperiosteal flap was raised. (fig.1). A lance drill was used as the first drill to prepare the osteotomy site which was inserted to the depth of the cortical bone corresponding to the length of the implant chosen followed by sequential drills of the length and diameter of the implant to expand the osteotomy, paralleling pins was used to verify that the desired angulation of the implant is correct. After achieving the desired length and diameter of the osteotomy site, a V shaped threaded implant was carried with the help of mount (fig.2) and placed on the desired site with the help of a beam type torque ratchet. After achieving the desired primary stability, cover screw was placed using a hex driver.

The procedure was completed with repositioning and suturing the surgical flap with 3-0 Polyglycolic Acid/Polylactic Acid Sutures (PGA/PLA) sutures. A post-operative R.V.G was taken to assess the final positioning(fig.4).Post-operative instructions and antibiotics were prescribed to the patient . Clinical and radiographic assessments for crestal bone loss using CBCT analysis was done at 3 months and 9 months post-crown delivery(fig.5).

Fig 1: FULL THICKNESS MUCOPERIOSTEAL FLAP RAISED

Fig 2: V SHAPED THREADED IMPLANT BEING CARRIED WITH THE HELP OF A MOUNT.

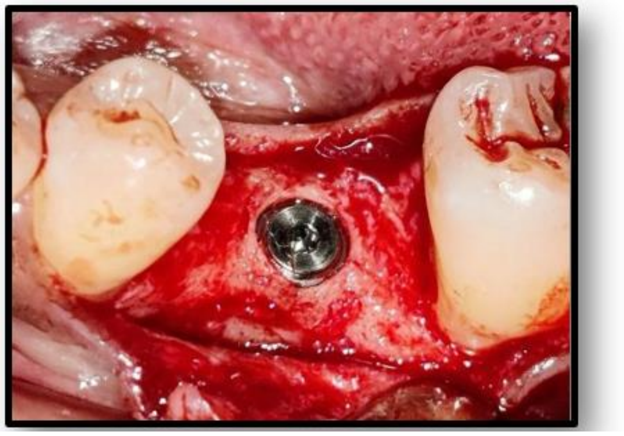

Fig 3: COVER SCREW PLACED

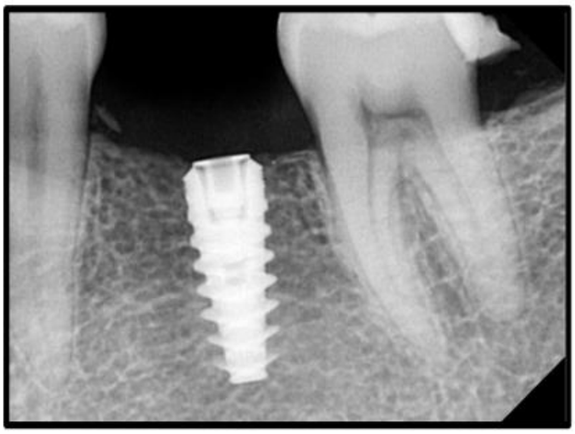

Fig.4: POST OPERATIVE RVG

Fig.5: BASELINE CBCT

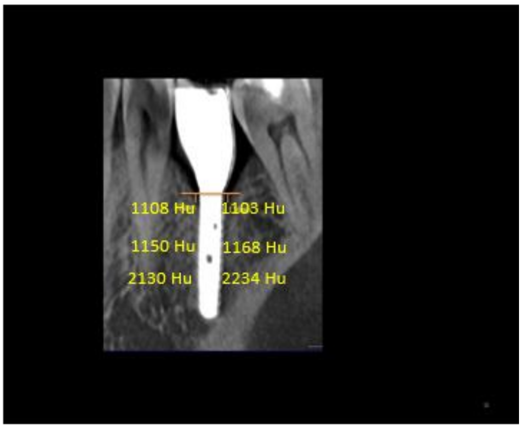

Fig 5: 9 MONTHS CBCT WITH BONE DENSITY(Hu)

CASE REPORT 2

A 32 year old female patient reported to the department of Subharti Dental College and Hospital, with a chief complaint of missing mandibular posterior tooth region.

After assessing the pre-treatment records and identifying vital anatomic landmarks of 36 tooth region, similar protocol for the surgical implant placement was followed with subcrestal incision using 12 no blade followed by full thickness mucoperiosteal flap reflection (fig.6). After preparation of the osteotomy site using the lance drill and sequential drills of the desired length and diameter of the implant to expand the osteotomy of the desired site. After achieving the desired length and diameter of the osteotomy site a buttress shaped thread design implant was carried with the help of a mount (fig.7) and placed on the desired site with the help of a beam type torque ratchet. After achieving the desired primary stability cover screw was placed using a hex driver (fig.8).

A post-operative RVG was taken (fig.9).Post operative instructions and antibiotics were given to the patient. Clinical and radiographic assessments using CBCT was done at 3 months and at 9months post-crown delivery (fig.10).

Fig 6: FULL THICKNESS MUCOPERIOSTEAL FLAP RAISED

Fig 7: BUTTRESS THREADED IMPLANT BEING CARRIED TO THE OSTEOTOMY

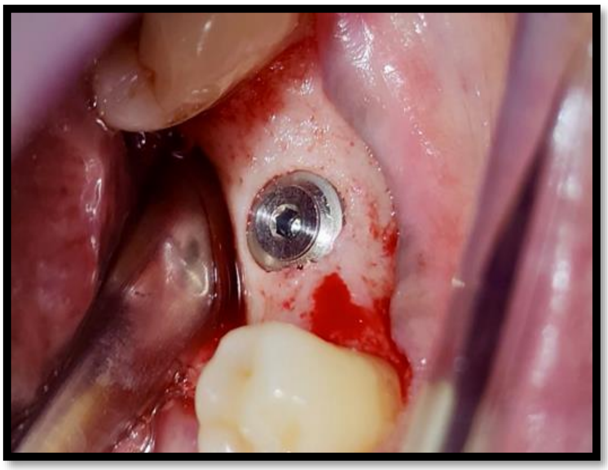

Fig 8: IMPLANT PLACED

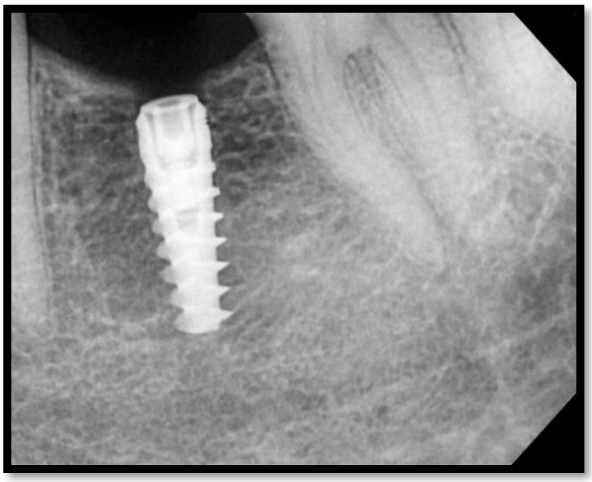

Fig 9: POST OPERATIVE RVG

Fig 10: BASELINE CBCT

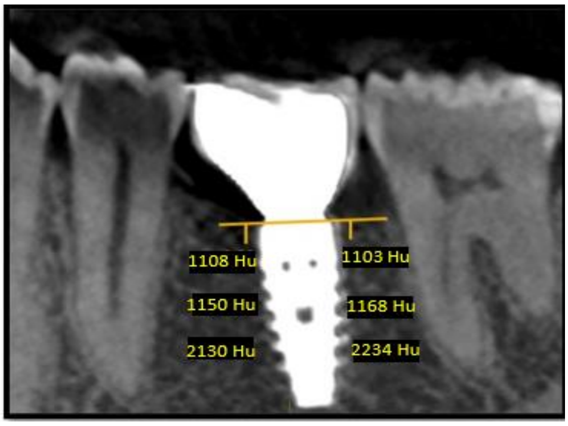

Fig 10: 9 MONTHS CBCT WITH BONE DENSITY(Hu)

RESULTS

Based on the CBCT analysis which was done at 3 months and at 9- months post-crown delivery, minimal bone loss was observed in (V-shaped thread design) and no crestal bone loss was observed in (Buttress thread design).Based on the CBCT analysis, higher bone density was also observed in buttress thread design as compared to V shaped thread design with bone density increasing from coronal to apical.

DISCUSSION

The type of force applied at the implant – bone interface may influence the degree and strength of osseointegration. Three types of loads are generated at the interface; compressive, tensile and shear forces. In general, materials are strongest under compressive loads and weakest to shear loads.[6] Hence, an ideal implant thread design should provide a balance between compressive and tensile forces while minimizing shear force generation.

The amount of shear force generated by the different thread shapes increases as the thread face angle increases which is the angle between the upper and lower surfaces of the thread and the line perpendicular to the long axis of the implant. **Misch et al**[5] suggested that V shaped thread design has 300 thread face angle, reverse buttress has 150 thread face angle and buttress thread design has 45 thread face angle. In buttress thread design, the axial load is dissipated through compressive force, while V-shaped threaded implants transmit axial force through a combination of compressive, tensile and shear forces. A shear force in a V shaped thread is 10 times greater than the shear force on a buttress thread ,thus causing more crestal bone loss than buttress thread design.[7] The reduction in shear loading at the thread bone interface provides for more compressive load transfer, which is particularly important in compromised bone density, short implant lengths, or higher force magnitude.[8]

When primary stability is a concern, implants with smaller pitch are beneficial by increasing bone implant contact.[9]Thread depth is more critical for dissipating peak stresses within the bone than thread width and the optimal values of thread depth and width may vary depending on thread shape and other geometric factors. In general, threads with increase in thread depth (passive implants) may be an advantage in areas of softer bone as it causes condensation of bone and creates a denser lining along the implant surface also in areas of higher occlusal force. The more shallow the thread depths, the easier it is to thread the implant in dense bone, and less likely bone tapping is required prior to implant insertion.

So, in the present case report, minimal crestal bone loss was observed in (V-shaped thread design) and no crestal bone loss was observed in (Buttress thread design) 9 months post-crown delivery**.** Based on the CBCT analysis , higher bone density was also observed in buttress thread design as compared to V shaped thread design.

CONCLUSION

Within the limitations of the study, it can be concluded that buttress threaded implant macro design have minimal effects on the crestal bone loss post implant placement as compared to the V shaped implant thread design which has more shear forces resulting in crestal bone loss which may have an influence on implant success . However, more researches on various implant macro designs and its influence on crestal bone loss are required which may play a pivotal role in successful implant therapeutics and on patients wellbeing.

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