ORIGINAL ARTICLE

EFFECT OF VARIATIONS IN BUCCAL BONE THICKNESS, IMPLANT DIAMETER AND THREAD PITCH ON STRESS DISTRIBUTIONS UPON IMPLANT PLACEMENTS AT HIGH INSERTION TORQUES: A THREE-DIMENSIONAL FINITE ELEMENT ANALYSIS

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ABSTRACT

The objective of this study was to investigative the influence of high insertion torques on the stress distribution around dental implants with variations in thread pitch and reductions in buccal cortical bone thickness.

Two bone level dental implants (3.8mm and 5.0mm diameters and a standard length of 10mm) were modeled each having a thread pitch of 0.4mm and 0.65mm. Each implant was placed in two mandibular bone segments having buccal cortical bone thickness set at 2.0mm and 1.5mm. A total of 8 such models were created and discretized with hexahedral mesh elements with an average element size of 0.2mm. Implant-bone interface was simulated with non-linear contacts and friction. Static torque values from 50Ncm to 90Ncm were applied with an increment of 5Ncm on each fully inserted implant. Maximum von-Mises along with maximum frictional stresses were used to record stress distribution within each model.

Maximum stresses seem to follow a linear relation with insertion torque showing an over-all increase in stress magnitudes with 1) a reduction in the diameter of the implants 2) decrease in thickness of the buccal cortical bone and 3) decrease in pitch of the dental implant threads from 0.65mm to 0.4mm. The maximum stress of 171.4 MPa was recorded at 90 Ncm for the 3.8mm diameter implant adjacent to a buccal bone thickness of 1mm with a thread pitch of 0.4mm.

With an increase in insertion torque there is a corresponding increase in the magnitude of stress production. Maximum stresses are primarily distributed in the peri-implant region in particularly the buccal cortical bony plates. The use of profile drills to coronally flare the osteotomy especially in dense bone is highly recommended if the diameter of the final widening drills to place progressively tapered implants is narrower as compared to the diameter of the implants at the neck.

Key Words: *Insertion torques, buccal bone thickness, thread pitch and maximum von-Mises stress.*

INTRODUCTION

Dental implants are placed into slightly undersized, surgically prepared osteotomies such that the implant imparts compressive stresses to the adjacent bony walls upon insertion. The magnitude of insertion torque achieved dictates whether or not the implant is primarily stable, a factor known to have close association with successful osseointegration.[1] Ottoni et al demonstrated that with an increase in insertion torque

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of 9.6 Ncm the chances of failure are reduced by 20%.[2] It has been shown that a baseline insertion torque should be achieved to circumvent micro-motions and hence reduce the possibility of fibrous encapsulation replacing healthy osseointegration. It has also been documented that an excessive insertion torque can be encountered when the implant finds resistance to advancement in an under prepared osteotomy and adjacent to dense, poorly vascularized mandibular cortical bone.[3] An excessive compressive stress transmitted to viable bone can lead to micro-fractures which elicit an osteclastic response leading to bone loss.[4]

The implantation process hence should ideally avoid transmitting excessive stresses as a consequence of an inappropriately high insertion torque but at the same time should ensure primary stability. In addition, lack of stress transmission has been shown to unsatisfactorily stimulate the bone healing process.[5] The recommended insertion torque values are therefore usually in a range of 35Ncm-70Ncm.[6] The ability to achieve primary stability at an acceptable insertion torque depends on not only the surgical variables of implant site preparation but also the anatomy of the implant site. It is observed that the bony walls of the alveolus following extraction undergo resorption such that the centre of the socket is only partially filled with woven bone and the created edentulous site diminishes in all dimensions.[7] The magnitude of this change has been described along with soft tissue volume changes following the extraction of single premolars and molars. It was concluded that the bucco–lingual/palatal dimension during the first 3 months was reduced about 30% and after 12 months the edentulous site had lost at least 50% of its original width.[8] Furthermore, after 12 months of healing the buccal prominence was reduced to a level 1.2 mm apical of its lingual counterpart.[8]

Similarly, implant designs have known to influence stress distribution, micro-motions and optimum placements.[3] Implant thread profiles, face and helix angles of threads, pitch, depth and width influence the pattern of bone-implant contact around threads and consequently alter the magnitude and dissipation of forces in the peri-implant environment.[9,10] Pitch of an implant thread is the distance from the center of one thread to another and is considered to have an influence on the level of torque achieved.[11] It has been shown that as the pitch decreases the stress distribution on implant placement tends to increase, conversely this would translate into an increased primary stability and a better pull-out strength as seen in animal experiments.[12] Orsini et al showed that when primary stability is of concern in weak cancellous bone, increasing the implant surface area by using a smaller thread pitch might be beneficial.[13]

Although finite element analysis has long been used as an effective tool in studying the inaccessible interfaces of dental implants, there are only a few FEA studies that have investigated the effects of varying insertion torque on the stress profiles within bone and the implant-bone interface. Sotto-Maior BS et al concluded that higher insertion torques increased the tensile and compressive stresses within the peri-implant bone tissue.[14] Atieh MA et al in a recent study showed a similar trend however they investigated stress distributions around larger diameter immediately placed implants.[15] The authors concluded that at an insertion torque of 70Ncm, maximum stresses were observed within the crestal cortical bone having a negative linear relationship to bone density. Van Staden et al showed that cortical bone experienced a maximum stress adjacent to the implant neck which increased with time and insertion depth.[16]

No FEA study to date has investigated the influence of varying thread pitch at high implant insertion torque on the stress distributions adjacent to thinner buccal cortical plates. The objective therefore of this FEA based study is to assess stress production at higher insertion torques with variations in thread pitch of dental implants placed adjacent to buccal cortical bone with reduced thicknesses.

METHODOLOGY

Two 3D finite element models of a bone block representing the second pre-molar region of a sectioned mandible were created in Solid Works Premium 2013 software (Dassault Systèmes Solid Works Corporation, Concord, MA, USA). Each bone block consisted of two bodies modeled separately having an inner trabecular structure surrounded with an outer shell of cortical bone. The dimensions of each model were similar apart from the thickness of the buccal cortical bony plates which were kept at 2mm and 1mm (Fig 1a-1d).

The two bone level implants selected in this study were designed and modeled in Solid Works Premium 2013 with dimensions acquired from the manufacture (SM internal, DIO Corp, 1464 Wooclong, Haeul'ldae-iw, Pusan City, Korea). The diameters of the fixtures were 3.8mm and 5.0mm with a standard length of 10mm (Fig 2). To investigate the effect of variations in pitch of the threads, each of the two implants had a thread pitch kept at 0.65mm and 0.4mm (Fig 3). The height of the double threads at the coronal one-third and those of the body threads were 0.13mm and 0.35mm respectively with a tolerance of ± 0.001mm.

The dimensions of the simulated bony segment included a height of 16mm with a 6mm distance from the apex of both implants to the base of the models. The maximum bucco-lingual dimension of the 3.8mm and 5.0mm implant models were 9.11mm and 9.89mm respectively. To realistically replicate the dimensions of the osteotomies, the final widening drills used prior to the use of the profile drills, were designed and modeled with dimensions of the drills acquired from the manufacturer (Fig 4a-4c). The positioning of the dental implants within each model was kept such that not only an exact overlapping was accomplished, thereby simulating precise placement but also the area of buccal bone would make identical contacts with the threads of the two implants (Fig 5). A total of 8 models were created.

The geometries were imported in ANSYS Workbench 14.5 to generate hexahedral mesh elements using the advanced multi-zone sweep meshing with additional size controls. The solving time for hexahedral mesh elements is less as compared to tetrahedral elements without compromising accuracy. In addition, such elements not only give better stress transfer of parameters at interfaces but also give more control on mesh clustering.

The mechanical modeler used from the ANSYS package presents with one of four formulations to choose from when defining the contact between components. In this study the augmented Lagrange formulation was chosen since compared to the pure penalty method, it usually leads to reduced penetration and is less sensitive to the magnitude of the contact stiffness coefficient. The concept behind both formulations is the introduction of a force at the contact detection points that have penetrated across the target surface with the express purpose of eliminating the penetration. Since it is assumed that the implant remains snug-fit in the bony segment, especially since profile drills were not used to flare the upper 3mms, it is important to leave a provision for a negligible penetration of two solid bodies i.e. mesh deformation and hence for a contact force to be generated. The optimal value for contact stiffness in the augmented Lagrange method is one that generates a converged result in a reasonable number of iterations with a resulting penetration that is inside acceptable tolerance. However, such an optimal value will often vary as the load path progresses. To enhance convergence, the program automatically adjusts the stiffness based on the current mean stress of the underlying elements and allowable penetration.

Each model presented with a total of 10, 04,990 nodes and 289,715 elements. The implant presented 49, 5862 nodes and 14, 6842 elements. The cancellous and cortical bones presented 25, 9635 and 24, 9493 nodes and 81,335 and 70,538 elements, respectively. The element sizes of the implant, cortical bone and cancellous bone bodies were 0.1mm and 0.3mm respectively.

The properties of the implant and bone were considered to be isotropic, homogenous and linearly elastic. The moduli of elasticity (E) of the cortical and cancellous bones were set at 13.7 GPa and 1.37 GPa respectively while the Poisson's (n) ratio for both was 0.3.[17] The elastic properties of the titanium implant were E = 103.4 GPa and n = 0.35.[18] The density of cortical and cancellous bones were set at 2g/cm3 and 1g/cm3 respectively.[19]

Boundary conditions were set by constraining the mesial and distal surfaces of the bone block along with the base of the model with zero degrees of freedom. Static torque values from 50Ncm to 90Ncm were applied with an increment of 5Ncm on each fully inserted implant with the assumption that the maximum torque value is achieved in the finally few turns of implant placement (Fig 6).[20] The interface between the implant and the cortical bone was kept as frictional with non-linear contact zones to effectively simulate stress creation during the final turn of implant insertion. The co-efficient of friction was kept at 0.3.[21]

Since von-Mises stresses are the normally used predictors of failures associated with ductile materials such as bone and are also indicators of an equivalent stress state, this criteria was used along with maximum frictional stresses to record stress distribution within each model.[22]

Statistical Analysis

Since there were two outcome variables being assessed (maximum von-Mises and maximum frictional stress) two linear regression models were generated to assess the impact of the independent variables i.e. torque, implant diameter and bone thickness on each of the two outcome variables. Pearson's correlation coefficient values were calculated for the predictors and the outcome variables.

Additionally a comparative analysis was performed to assess any difference in maximum von-Mises and maximum frictional stresses between implants of the two different pitch intervals (0.4 mm and 0.65 mm). The independent sample T test was performed to compare the stress values for the two groups of implants.

RESULTS

Numerical values of maximum von-Mises stress and maximum frictional stress at the 9 levels of insertion torques were calculated (Tables 1 and 2). Very strong negative correlations were found between bone thickness, implant diameter and von-Mises ($r = -0.84$, $p < 0.001$ and $r = -0.84$, $p < 0.001$ respectively). A moderately positive correlation was found between torque and von-Mises stresses ($r = 0.43$, $p < 0.001$). Similarly, strong negative correlations were found between bone thickness, implant diameter and maximum frictional stresses ($r = 0.81$, $p < 0.01$ and $r = 0.02$, $p < 0.001$ respectively). A moderately positive association was calculated between torque and maximum frictional stresses ($r = 0.44$, $p < 0.001$).

Maximum stresses seem to follow a linear relation with insertion torque showing an over-all increase in

TABLES 1 AND 2: DISTRIBUTION OF VON MISES STRESS AND MAXIMUM FRICTIONAL STRESS FOR DIFFERENT TORQUE, PITCH AND BONE THICKNESS FOR THE 3.8MM AND 5.0MM DIAMETER IMPLANTS

3.8mm Implant				
Buccal Bone Thickness 1mm				
Thread Pitch= 0.4mm			Thread Pitch=0.65mm	
Torque N-cm	Max Von Mises MPa	Max Frictional Stress MPa	Max Von Mises MPa	Max Frictional Stress MPa
50	95.259	99.883	71.399	72.041
55	104.790	109.910	78.538	80.444
60	114.310	119.900	85.678	89.850
65	123.840	130.890	92.818	93.250
70	133.360	139.880	99.957	100.660
75	142.890	149.870	107.100	109.060
80	152.420	160.870	114.240	114.460
85	161.940	169.860	121.380	122.870
90	171.470	179.850	128.520	130.270
Buccal Bone Thickness 2mm				
Thread Pitch= 0.4mm			Thread Pitch=0.65mm	
Torque N-cm	Max Von Mises MPa	Max Frictional Stress MPa	Max Von Mises MPa	Max Frictional Stress MPa
50	71.927	76.030	72.168	73.840
55	79.119	84.620	79.384	80.940
60	86.311	89.220	86.601	87.030
65	93.504	101.830	93.818	95.110
70	100.700	102.430	101.030	103.200
75	107.890	113.030	108.250	108.290
80	115.080	123.630	115.470	119.370
85	122.270	129.230	122.680	123.460
90	129.470	140.830	129.900	130.540

5.0mm Implant				
Buccal Bone Thickness 1mm				
Thread Pitch=0.4mm			Thread Pitch=0.65mm	
Torque N-cm	Max Von Mises MPa	Max Frictional Stress MPa	Max Von Mises MPa	Max Frictional Stress MPa
50	40.107	48.265	34.088	35.378
55	44.116	50.891	37.497	39.309
60	48.126	55.520	40.905	42.247
65	52.137	58.146	44.314	47.184
70	56.147	61.773	47.723	49.121
75	60.157	66.400	51.132	52.058
80	64.167	72.027	54.540	57.995
85	68.177	78.653	57.949	59.932
90	72.187	85.028	61.358	63.870
Buccal Bone Thickness 2mm				
Thread Pitch= 0.4			Thread Pitch=0.65mm	
Torque N-cm	Max Von Mises MPa	Max Frictional Stress MPa	Max Von Mises MPa	Max Frictional Stress MPa
50	38.692	42.883	32.700	33.024
55	42.559	49.900	35.969	36.625
60	46.428	54.893	39.239	42.228
65	50.297	57.885	42.509	45.830
70	54.165	59.876	45.779	49.432
75	58.034	65.868	49.049	52.034
80	61.903	68.859	52.319	56.637
85	65.771	72.851	55.589	59.239
90	69.640	78.842	58.859	63.841

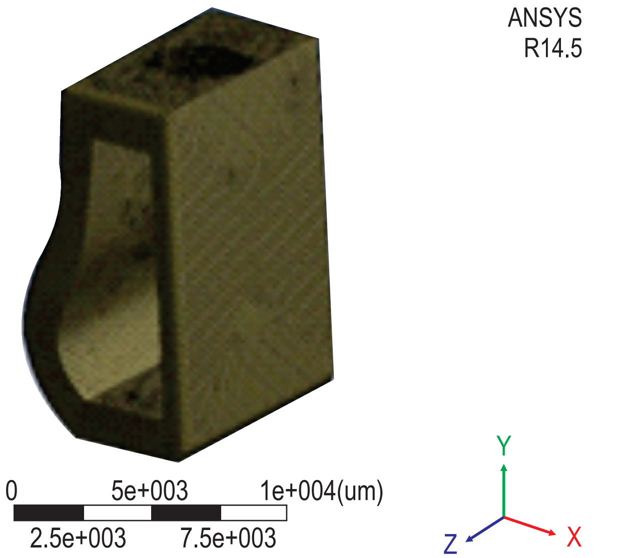


Fig 1a: Outer cortical shell with buccal bone having a thickness of 1mm

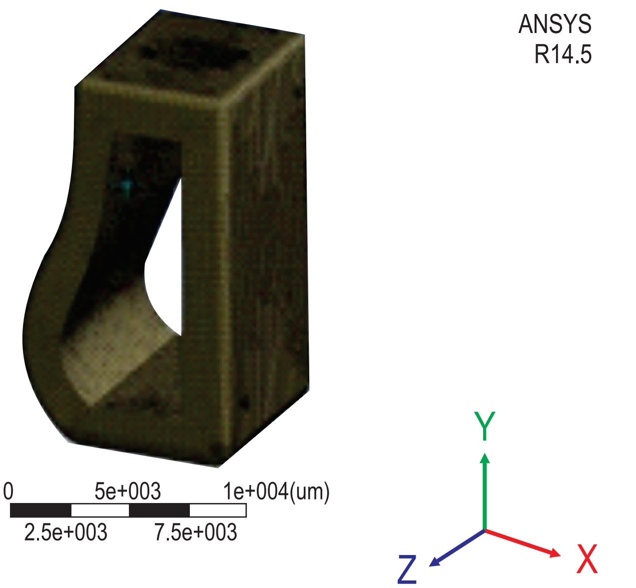


Fig 1b: Outer cortical shell with buccal bone having a thickness of 2mm

stress magnitudes with 1) a reduction in the diameter of the implants 2) decrease in thickness of the buccal cortical bone and 3) decrease in pitch of the dental implant threads from 0.65mm to 0.4mm.

Since the coronal one third of the osteotomies were narrower as compared to the diameters of the implants, the stresses around the necks of the implants as a consequence of under-preparation was noticeably much higher (Fig 7a-7d). Variations in bone thickness, diameter and pitch did not considerably alter stress distributions, which were primarily concentrated in the crestal area in particular the buccal cortical bone (Fig 8a-8d).

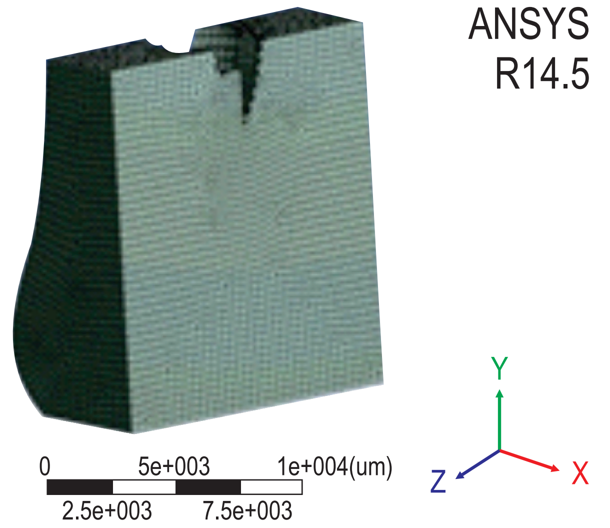


Fig 1c: Inner cancellous bone.

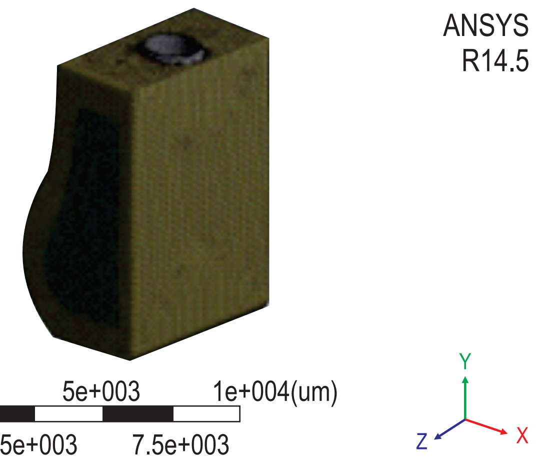


Fig 1d: Implant inserted in bone block

Fig 2: Modeled implants with diameters 3.8mm and 5.0mm having a standard length of 10mm.

Fig 3: 3.8mm diameter implants with pitch of thread set at 0.4 mm (a) and 0.65 mm (b).

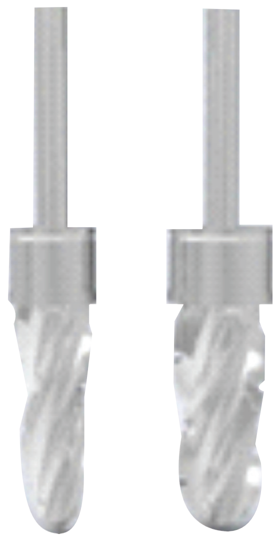
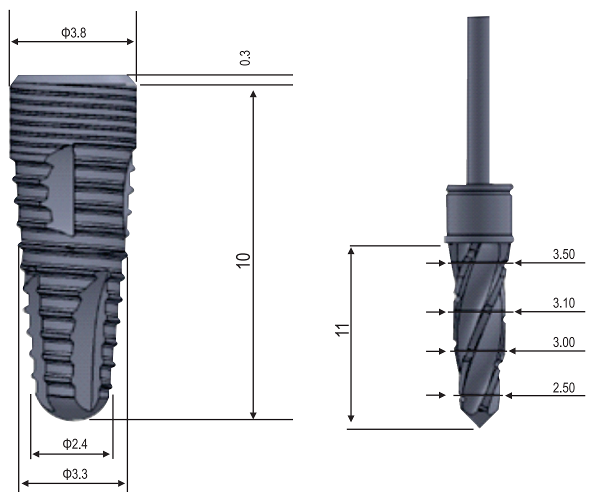


Fig 4a: Modeled final widening drills used for 3.8mm (left) and 5.0mm (right) diameter implants.



Figu 4b: Dimensions of the 3.8mm diameter, 10mm length implant compared to the dimensions of the final widening drill used in the study.

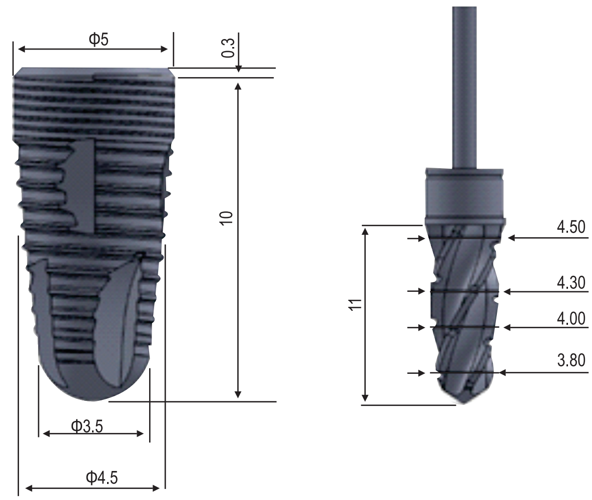


Fig 4c: Dimensions of the 5.0mm diameter, 10mm length implant compared to the dimensions of the final widening drill used in the study.

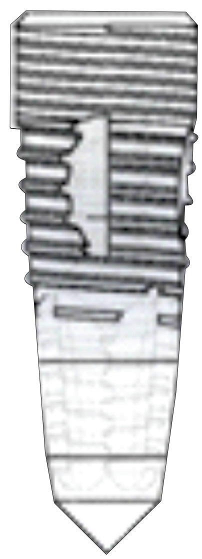


Fig 5: Designing of the geometry showing the implant placed exactly into the space created by the surgical drill.

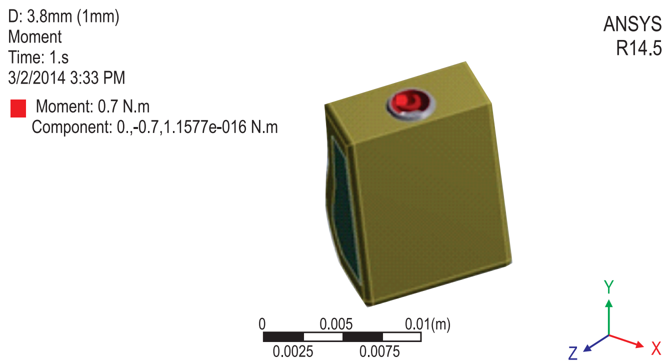


Fig 6: Torque of 70Ncm being applied on a 3.8mm implant adjacent to a 1mm thick buccal bone assumed to be at the final turn of implant seating.

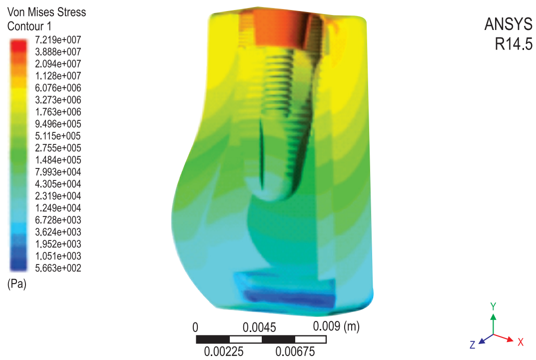


Fig: 7a

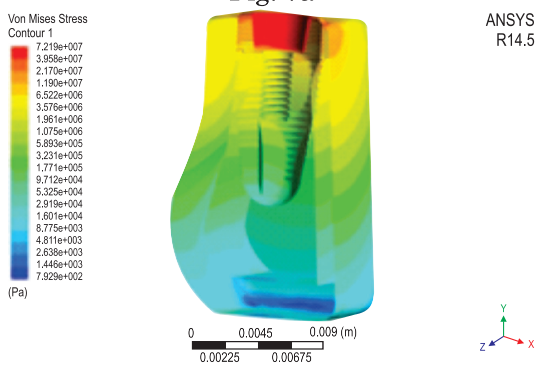


Fig: 7b

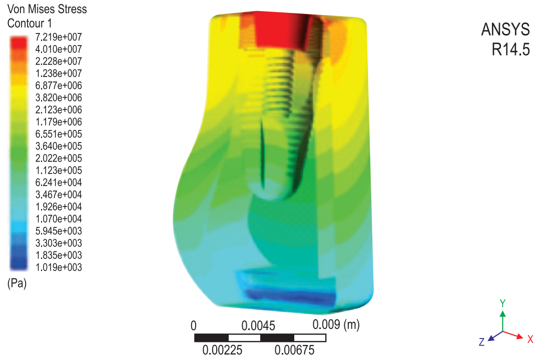
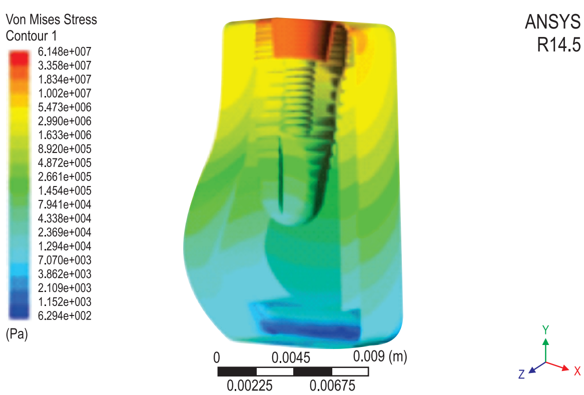


Fig: 7c

Fig 7a-7c: Maximum von-Mises stress distributions at insertion torques of a) 50Ncm b) 70Ncm and c) 90Ncm around a 5.0mm diameter implant have a pitch of 0.4mm adjacent to 2mm of buccal cortical bone.



8a

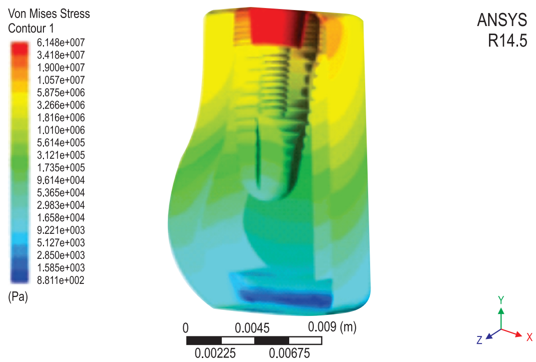


Fig: 8b

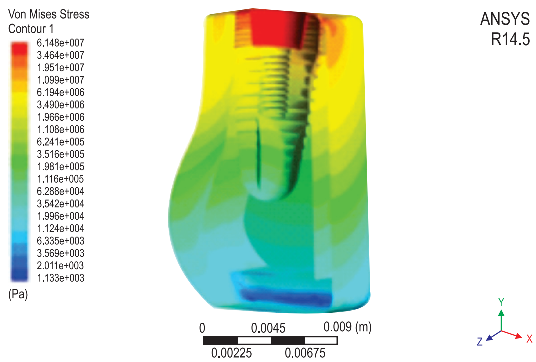


Fig: 8c

Fig 8a-8d: Maximum von-Mises stress distributions at insertion torques of a) 50Ncm b) 70Ncm and c) 90Ncm around a 5.0mm diameter implant have a pitch of 0.65mm adjacent to 2mm of buccal cortical bone.

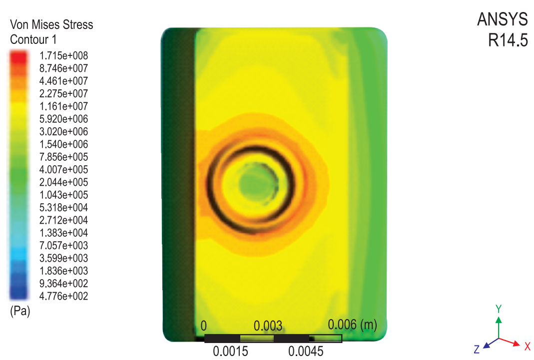


Fig: 8d

The maximum stress of 171.4 MPa was recorded at 90 Ncm for the 3.8mm diameter implant adjacent to a buccal bone thickness of 1mm with a thread pitch of 0.4. The 5.0mm diameter implant in a similar situation i.e. with a thread pitch of 0.4 in contact with the 1mm buccal bone at an insertion torque of 90Ncm showed a maximum stress of 72.18 MPa which is 123% less than the stress observed around the 3.8mm implant. The stress distributions seem to be most favorable with the 5.0mm diameter implant, having a pitch of 0.65 adjacent to a buccal bone thickness of 2mm.

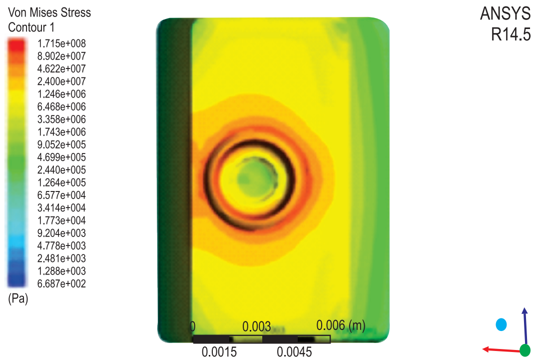


Fig: 9a

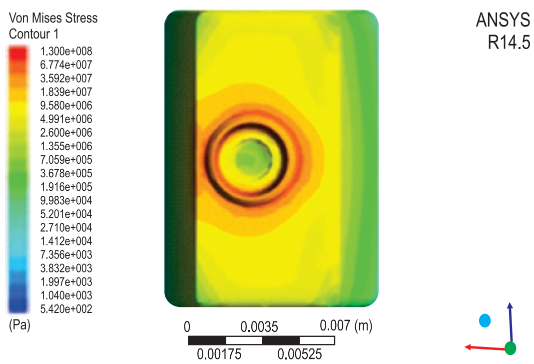


Fig: 9b

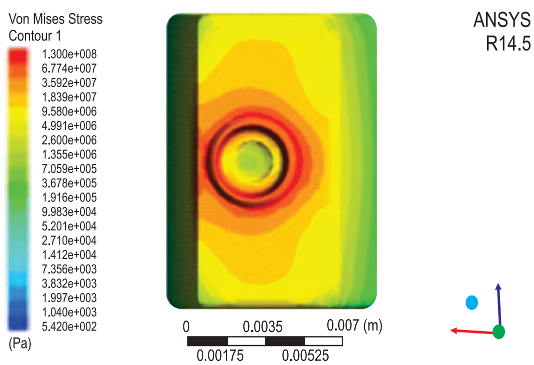


Fig: 9c

Fig 9a-9c: Top view of 3.8mm diameter implant with stress distributions at insertion torques of a) 50Ncm b) 70Ncm and c) 90Ncm with thread pitch of 0.4mm adjacent to 1mm thick buccal cortical bone.

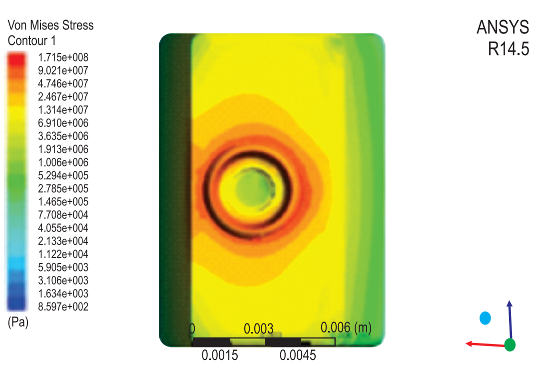


Fig: 10a

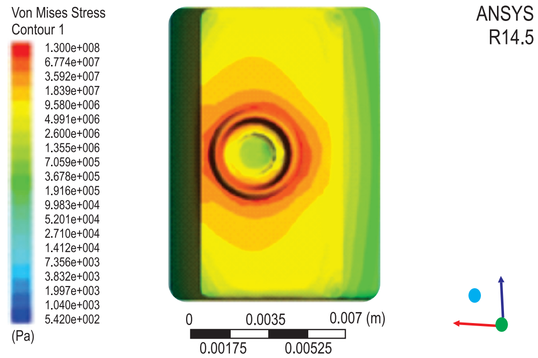


Fig:10b

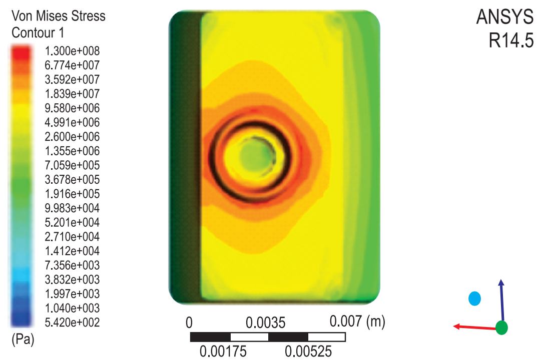


Fig: 10c

Fig 10a-10c: Top view of 3.8mm diameter implant with stress distributions at insertion torques of a) 50Ncm b) 70Ncm and c) 90Ncm with thread pitch of 0.65mm adjacent to 1mm thick buccal cortical bone.

The comparison between von-Mises stress values generated for the two implant diameters showed that there was a mean difference of 12.47 + 8.13 MPa between implants of pitch intervals 0.4 mm and 0.65 mm. However, this difference was not found to be statistically significant (p = 0.13). When the maximum frictional stresses was compared for the two groups, a significant mean difference of 17.49 + 8.12 was calculated (p = 0.04).

DISCUSSION

The insertion torque of the implant, which is the moment of force needed to screw the implant into position, reflects the intimate tridimensional contact between the walls of the implant osteotomy and the implant surface. Although, primary stability is clinically measured by insertion torque, insertion torque in turn is influenced by the host bone density, implant geometry, dimensions of the surgical preparation and the surface characteristics of the dental implant such as the pitch of the threads.

Although, several studies have suggested that high insertion torque values do not necessarily translate into high degrees of primary stability above a certain value, the general clinical consensus still is that implant stability immediately and early after placement is desirable, because the relative motion between implant and bone could risk osseointegration.[23]

It is common practice to use "under-dimensioned" drilling dimensions in an attempt to increase the primary stability.[24] However, although greater degrees of insertion torque levels can be achieved by placing implants in sites of undersized dimensions, the host to implant early response can be affected, because high degrees of bone mechanical strain can evolve immediately after placement. High compression caused by elevated insertion torque has been claimed to disturb the local microcirculation, leading to necrosis of osteocytes, bone resorption, and finally to implant failure.[6] This phenomenon, which is also called pressure necrosis, seems to be widely accepted by the scientific community and even though little experimental evidence is available to prove this hypothesis, the possibility of inducing hypoxia due to excessive stresses and consequently disturbing the angiogenesis dynamics needs to be considered.[25]

Bone is considered as both flexible and fragile when subjected to external loads. With the application of an external force, bone initially behaves elastically with a maximum deformation capacity of 3% i.e. when the external force is removed bone recovers to its original form without any residual strain.[26] If however, the loading is increased in magnitude the strain eventually does not remain linearly related to stress and the material does not further behave elastically. At this point on the load-deflection curve the material is said to enter the plastic region such that permanent damage is said to accrue within the material. If loading tends to increase any further, bone eventually experiences ultimate failure and the specimen is said to have fractured catastrophically. The point at which the bone breaks can either be viewed as exceeding the ultimate strain (15,000 $\mu\varepsilon$ for cortical bone) or the ultimate yield stress (190 MPa for cortical bone).[27] Yield failure however is not a sudden transition from plastic deformation to breakage and for ductile materials such as bone, failure first arises through ultra-structural micro-cracks within the hydroxyapatite and the disruption of the collagen fibrils. The yield strain of cortical bone in compression is on the order of 6800 $\mu\varepsilon$, suggesting that a safety factor of 2 exists between peak strains caused by normal functional activity and the point where damage begins to accumulate.[28] The yield stress for cortical bone is 130 MPa, which is where substantial cracking of the tissue would start to occur.[28]

The results of our study shows that the 3.8mm diameter implant with a thread pitch of 0.4mm, in contact with a 1mm buccal cortical bone thickness at an insertion torque of 90Ncm surpasses the ultimate yield strength of human cortical bone and hence such a combination of variables can lead to breakage of the cortical plate. If micro-cracking of cortical bone is to initiate somewhere in the 130MPa region, it would be prudent not to raise the insertion torque of the smaller diameter implants above 70Ncm, especially when the cortical plate encountered is thin and/or the pitch of the implant being used is less. This could either mean preparing the osteotomy with the use of a profile drill to flare the upper 3-4mms or simply to keep the insertion torque less than 50Ncm.

Larger diameter implants do provide an element of leeway in terms of favorable stress distributions at higher insertion torques, however, it has been seen though mathematical calculations that the fixation achieved for the larger diameter implants in terms of compressive stresses imparted onto the internal walls of the osteotomies is less as compared to those of smaller diameter implants.[29] If such is true, larger diameter implants would need to be inserted at higher torques to achieve the same level of fixation or stability in bone. Although, a consensus regarding the maximum acceptable insertion torque does not seem to strictly exist, such a protocol should be based not just on host-bone and surgical factors but on factors such as implant diameters, thread configurations and design parameters of drills.

The maximum diameter of the tapered widening drill for the 3.8mm and 5.0mm diameter implants as mentioned in the system product catalog is 3.5mm and 4.5mm (Fig 4b and 4c). This difference of 0.3mm and 0.5mm respectively causes stresses to concentrate around the upper 3mm of both implants at torques higher than 50Ncm and up to 90Ncm.[14] The presence of micro-threads on the upper 3mms in addition to a snug-fit of the implants in an un-flared osteotomy further increases stress due to friction as seen by the values of maximum frictional stresses in our study.[3]

It needs to be mentioned that our study had its share of limitations. Firstly, bone is not isotropic; rather bone being heterogeneous behaves differently in differently directions, an important variable which was not considered in our study.[30] The material properties of bone used in our study replicated type 1 mandibular, dense bone and values of maximum von-Mises and maximum frictional stresses might not depict the effect of higher insertion torques in all types of bone qualities. Also, bone having elastic potential under loading would deflect thereby altering the equivalent stress distributions.[31]

Since the chances of compression necrosis at insertion torques higher than 50Ncm are known to possibly affect osseointegration that can lead to early failures, it is advocated to keep insertion torque under check when placing implants in dense bone or when the thickness of the buccal cortical plate is reduced. Implants having larger diameters, with higher pitches should be chosen. Under preparing the osteotomy for a tapered implant with the intention of achieving adequate primary stability can be counterproductive as this could not only lead to excessive stresses as a consequence of higher insertion torques but also lead to incomplete seating of the implant. Although the results of the present study can add data to the implant-bone behavior influenced by the high values of the insertion torque, further animal and clinical investigation studies are needed to confirm these findings.

CONCLUSIONS

With an increase in insertion torque there is a corresponding increase in the magnitude of stress production. Maximum stress follows a linear relationship with thickness of buccal bone, diameter of implant and pitch of threads. Maximum stresses are primarily distributed in the peri-implant region in particular to the buccal cortical bony plates. If the diameter of the final widening drills to place progressively tapered implants is narrower as compared to the diameter of the implants at the neck, the use of profile drills to coronally flare the osteotomy especially in dense bone is highly recommended.

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OBITUARIES

Mr. Sheikh Inayatullah

Sheikh Inayat Ullah, Chairman Khyber Mail/ Khyber Printers, Peshawar passed away on 18th May 2014 after prolonged illness.

He was born on 27th July 1935 and graduated from Peshawar.

Mr Inayat Ullah was looking after the printing and publishing process of 'Pakistan Oral & Dental Journal' for the last nearly thirty years. He had a pleasant personality.

He leaves behind two sons and a daughter. His elder son Mr Rizwan Inayat will be looking after the publishing process of 'Pakistan Oral & Dental Journal'.

In Mr Inayat Ullah we have lost a person who looked after the publishing work of this journal with great devotion. May Allah rest his soul in peace. Ameen.

Dr. Hatim Jatoi

Members of the editorial board of 'Pakistan Oral & Dental Journal' announce with deep sorrow the sad demise of Dr Hatim Jatoi, Associate Editor of 'Pakistan Oral & Dental Journal'. He died on 10th June 2014 in Karachi.

He graduated from Institute of Dentistry, University of Medical & Health Services, Hyderabad, Sindh and got his post graduate qualification from 'College of Physicians Surgeons, Pakistan. He served at LMC and for few years in Saudi Arabia.

Our readers know that 'News from Sindh' was his regular column. His great and devoted services for the journal will always be remembered. May Allah rest his soul in peace, Ameen.