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COMPARISON BETWEEN PALATAL CORTICAL BONE THICKNESS AND LABIAL CORTICAL BONE THICKNESS IN NORMAL AND RTA PATIENTS - A PILOT STUDY.

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Abstract:

Aim: To analyse the thickness of cortical bone in the maxillary anterior region in road traffic accident patients.

Background: Maxillary traumatic injuries due to road traffic accidents are increasing risk today. Dental implants are increasingly being considered for the replacement of teeth lost as a result of trauma. The cortical and cancellers ratio of local bone is extremely important for implant stability at the time of surgery and determining the local bone condition is critical for treatment success. This study is an attempt to analyse the amount of cortical bone loss in patient with anterior trauma and the implications it can have in the process of rehabilitation for the patient.

Materials and methods: A total of 20 CBCT radiograph were digitally analysed. The radiographs were categorised as a control group (n=10) and a RTA group (n=10). Patients between the age group of 24 years - 45 years were considered in the study. The labial and the palatal cortical bone thickness were measured at three levels- cervical third, middle third and the apical third, in the region between the canines. The height of of the alveolar bone available at the site of implant placement was also measured. The results were tabulated and statistically analysed.

Results: There was a significant difference in palatal and labial cortical bone thickness between the normal and road traffic accident patients.

Keywords: Implants, Cortical bone, Edentulous space, Dental rehabilitation, Road traffic accident.

Introduction:

Clinical and research studies have now recognized and reported Osseo integrated Dental implants for the replacement of missing teeth as routine treatment option in the recent years [1,2]. Tooth loss after trauma could stem from traumatic dental injuries pending from violence, serious falls, road traffic accidents, gunshots (ballistic) or to delayed complications from trauma such as recurrent endodontic lesions, vertical root fractures, external/internal root resorption and ankylosis which compromise the life of the affected teeth. Esthetics remains the main driving force while treating trauma-related tooth loss involving anterior (maxillary) teeth. The age of the patient is another aspect to be considered. Where accidents happen in childhood with incomplete bony growth it is considered unfavorable for dental implant applications. With trauma occurring in the development stage, interim prosthetic treatment is started to avoid atrophy preserving remaining alveolar bone base as well as following bone growth for future rehabilitation with implant surgery later in adolescence. [3]

Traumatic dental injuries (TDIs) occur worldwide in a varied spectrum with etiologic factors unique to countries[4-10]. Most TDI studies cover children and adolescents with very few studies covering adults [4, 9, 11 and 12]. Globally, violence is the most common etiology for TDI in men and there are three common factors for women, being violence, serious falls and road traffic injuries [9, 13–15]. Classified also are ballistic injuries (gunshots), a severe type of traumatic maxillofacial injuries [16, 17].

Studies reveal the anterior maxilla, especially central incisors are mainly affected by TDIs leading to loss of teeth and thereby causing serious esthetic and functional issues.[9,13, 18–20]. As the science of Implant dentistry targets any edentulous state including loss due to trauma, the International Association of Dental Traumatology (IADT) proposes approaches for immediate care of primary and permanent teeth injuries for the future preservation of dental structures [14, 15, 18, 19, 21]. Several studies and case reports reveal that implants are an acceptable and successful treatment of choice after TDIs [22–24].

While medical history of the patient plays a crucial role systemic conditions too need be favorable for providing implant supported restorations. Genetic, autoimmune and connective tissue diseases are risk factors [25]. Relative contraindications may be habits, diseases, and treatments as well as drug therapies that affect the metabolism, as they affect osseointegration thereby reducing success rates.

Animal studies show that metallic implants do not change location in concordance with three-dimensional bony growth [26–29]. Dental implants do not follow bone development during growth period [30, 26–36]. Studies show implants placed in the early childhood remain in infra-occlusion [34]. For this reason implant treatment is made after confirming the bone development period of patients with hand-wrist radiographs and taking the skeletal age of patient into consideration before making decisions for implant surgery instead of following chronological age. [33, 35]. Availability of hard and soft tissues for rehabilitation strategies to be developed according to size, volume and shape of the defects with special attention to preserve mucosal contours by use of proper technique, considering biotype of soft tissues as well as hard tissue augmentation options are well-planned before hand, taking into consideration vascularisation, number of walls in the defect, available bone height and need for graft.

Successful osseointegration from the clinical standpoint is a measure of implant stability, which occurs after implant integration [37]. Osseo integration of an implant is assessed by the primary and the secondary stability achieved. Primary stability is associated with the mechanical engagement of an implant with the surrounding bone, whereas bone regeneration and remodelling phenomena determine the secondary (biological) stability to the implant [37, 38]. A secure primary stability is positively associated with a secondary stability [39].

One of the most crucial predictors of long-term implant success is initial implant stability which depends on the depth and density of the bone, implant selection, and precision of the surgical technique. A good idea of implant stability can be obtained by tactile sense during the seating process and also by checking and verifying adequate torque resistance capability of the implant that has been seated. Nowadays, radiofrequency analysis is used to measure and verify this implant stability. The technology involves fixing a transducer to the implant and by applying a steady-state resonance frequency to the implant, the advantage of which is that it is not dependent on measuring implant movement in just 1 direction but also provides evaluation of complete bone–implant interface.[40]

RFA is often done using the Osstell Mentor device (Osstell™, Integration Diagnostics, Gothenburg, Sweden), which provides results in the form of the implant stability quotient (ISQ), with values ranging from 1 (lowest stability) to 100 (highest stability). RFA is non-invasive and non-destructive. Hence it can be performed during osseointegration. It has been used to measure differences in osseointegration patterns while attempting to use different approaches in implant surgery [41-42].

After achievement of primary stability type of implants for loading should be decided, which is related to implant number, localization, length, diameter, splinting options. Basically, functional immediate, non-functional immediate, early or delayed loading protocols are applied, followed by prosthetic supra-structure design and material.[3] Secondary stability (SS) refers to the increase in stability due to bone formation and remodelling of the surrounding bone [43].

Osseointegration is the principle biologic and biophysical process that has made dental implant therapy predictably effective for replacing missing teeth. Histologically, osseointegration is the direct structural and functional integration between organized, living bone tissue and the surface of a load-bearing implant without intervening soft tissue between the implant and bone. This process was accidentally discovered by Swedish bone researchers who realized that a tight bond of metal implant to bone could be used to anchor implants in jawbones to support prosthetic teeth and also provide anchorage in other parts of the face and body.

The concept of dental osseointegration is based on the primary goal in implant placement which is to achieve and maintain an intimate bone-to-implant connection and is defined clinically as the asymptomatic rigid fixation of an alloplastic material (the implant) in the bone with the power to resist occlusal forces [40]

Materials and Method:

A total of 20 CBCT radiographs were collected over a period of 4 months from the department of Implantology, Saveetha Dental College & Hospitals, Chennai, Tamilnadu, India. The radiographs were categorised as a control group (n=10) and a RTA group (n=10). Patients between the age group of 24 years-45 years with presence of edentulous space in the maxillary or mandibular anterior region, with no known systemic illnesses were considered for the study. The labial and palatal cortical bone thickness was measured in the edentulous region and in the adjacent dentulous region. The measurements were made at 3 different levels- cervical third; middle third, apical third and the average of the values were considered. The values were entered in an excel sheet and analysed using SPSS software. A student T- test was performed to compare the cortical bone thickness in both the groups.

Results:

This study was conducted in the department of prosthodontics in Saveetha Dental College and Hospitals. The study utilised 10 pre-treatment CBCT radiographs of control and road traffic accident patients. The thickness of the labial cortical bone and palatal cortical bone were measured and compared in both the groups. The difference in thickness of the palatal and labial cortical bone in the control and in road traffic accident patients was found to be statistically insignificant. (table 1)

Table 1: Correlation between the palatal and labial cortical bone thickness in both the groups.

	N	Correlation	Sig.
Group 1 labial cortical thickness & Group 2 labial cortical thickness	10	-0.061	0.866
Group 1 palatalcorticalthickness & Group 2 palatalcorticalthickness	10	-0.273	0.446

Discussion:

Zengin et al. [6] evaluated and recorded TDIs using the World Health Organization classification that was modified by Andreasen et al. In a group of 5800 patients, 255 had TDI which is 4.4% wherein TDIs were mostly in the age group of 11–20 years. As for gender distribution, the most affected were males, 153 cases and females were, 102 cases. Etiological factors of the traumatic injury was related to falls with prevalence at 68.2%, and trauma during outdoor activities with prevalence at 56.1%. Among the most frequently injured teeth are the upper central incisors with primary teeth injuries with prevalence at 64.5% and permanent teeth injuries with a prevalence rate of 72.5% simple crown fracture the most frequent type of TDI seen in both primary and permanent dentition with a percentage of 63% in primary and 47% incidence in permanent dentition.

Regarding replacement of single teeth that are lost due to trauma with implant supported prostheses, Chesterman et al. [44] proposed a protocol -

1. Evaluation of tooth replacement methods
2. Planning for provision of an implant supported restoration.
3. Providing an implant supported restoration.

Seymour et al. [45] records the need for team approach in the rehabilitation of severe trauma cases underlining the importance of co-operation between general practitioners and specialists while providing treatment.

Primary implant stability, though a merely mechanical phenomenon is a key factor that influences the survival rate of these implants depending on local bone quality and quantity. It is outlined as an assessment of clinical movement between the bone and implant following its placement. [46, 47] [48-50] Leckholm and Zarb (L&Z) have classified bone into 4 distinct types (51), based on the morphology and distribution of cancellous and cortical bone. Type 1 bone is usually made up of dense cortical bone, whereas Type 4 comprises mostly loose cancellous bone. [51] Several studies have revealed a correlation between L&Z classification and primary implant stability, though subjective in nature [52, 53]. The primary goal in implant placement is to achieve and maintain an intimate bone-to-implant connection. This concept is known as dental osseointegration. Dental osseointegration is defined clinically as the asymptomatic rigid fixation of an alloplastic material (the implant) in bone with the ability to withstand occlusal forces.

Cortical bone provides more primary stability than cancellous bone. An implant placed into bone with a high percentage of cortical bone component will have greater primary stability and therefore be less susceptible to movement during osseointegration. Engaging 2 cortical plates is another means of achieving initial stability. In contrast, an implant site that has a more cancellous nature will provide less primary stability, making the implant–bone interface more susceptible to occlusal and other forces. This difference is managed Clinically by having a period after implant placement when the implant is not loaded (no prosthesis is attached to the implant). Such implants can be kept covered by soft tissue during this period and uncovered when sufficient osseointegration is likely to have occurred. [40] Adequate primary stability for a dental implant could be interpreted by insertion torque values greater than 30 N/cm2. Primary stability of implants may well be measured by use of Resonance Frequency Analysis (RFA) method [54–56].

The achievement of implant stability is the most important predictor of the suceess of an implant in the long run. the major risk factor for implant failure is poor quality and quantity of bone which may be a result of excessive bone resorption or an impairment in the healing process [57-59]. Studies have reported higher incidence of failure of implants in the maxilla owing to the reduced thickness of cortical bone as compared to the mandible when all the other factors were comparable [60-62]. Hence the primary challenge faced by a clinician during the rehabilitation of a trauma patient is the bone volume and quality available.

In the present study the thickness of the labial and palatal cortical bone at the edentulous and adjacent dentulous site were compared in both control and RTA group. The difference in the amount of cortical bone loss in the control and in the RTA group was found to be statistically insignificant. This suggests the presence of minimal difference in the cortical bone thickness in RTA patients as compared to the control group. This could be because of the small sample size considered for the study. A proper knowledge of the degree of deficit present in the region would be helpful to the clinician in finalizing a treatment plan. Complex treatment options such as bone grafting, guided bone regeneration application, distraction osteogenesis, and delayed implant loading can be opted for in cases with compromised bone.

Limitations:

This study was a retrospective study that measured the cortical bone thickness from CBCT images of patients. The study did not categorize according to the gender of the patient. Other factors that influence the stability of the implant such as implant geometry and surgical technique were not considered. The sample size considered for the study was limited. More in depth studies are required in this area to improve our understanding about the requirements and challenges faced by the clinicians during the rehabilitation of trauma patients.

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