Effect of abutment position on stress induced by lower complete overdenture (strain gauge analysis)

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Dedication:

My dearest family thanks for providing me with help, love and support in my life journey. I really owe you a lot. I thanks God for having such a great family

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Introduction

Tooth –supported overdenture is one of the most effective preventive prosthetic measures in the treatment of pre-edentulous patients with severely mutilated dentition. Numerous articles have addressed the functional benefits of complete dentures supported by few remaining natural roots. These natural physiologic abutments offer more support and stability for denture, reducing stresses transmitted to the alveolar bone and thereby preserve the alveolar bone height,the role of proprioceptors present in their retained roots is not only feedback mechanism but also directioning and tactile force sensitivity,dimensional discrimination and motor responses.The discriminatory tooth proprioceptors are also important for mandibular positional sensitivity and centric relation record [(1,2)].

Appropriate abutment selection is a vital step in the successful management of overdenture treatment.Several factors determine the selection of overdenture abutments.The number, position, and distribution of the prospective abutments are among the most important factors to be considered during selection of overdenture abutments [(3)].

The rectangular abutment distribution gained by retaining the cusped and second bicuspid or a molar bilaterally provide wide load distribution and maximum support and stability of the overlaid prosthesis.This distribution also has the advantage of providing occlusal stability.Unfortunately this distribution requires a large number of remaining abutment teeth. Moreover, most patients who are

candidate for complete denture rarely presented by these abutments that can saved by periodontal and endodontic therapy [4].

The triangular support gained by retaining the cusped teeth and one central incisor, and the biangular support gained by retaining the cusped teeth where the occlusal forces has the greatest destructive potential are most commonly used for overdenture treatment[3].

Although absence of posterior support is considered the main disadvantage of theses distributions, over the past several years, reports have described the considerable psychological benefits to the patient and favorable clinical results obtained by overdenture supported by one central and or two canine. Inspite the fact that bilateral abutment distribution constitutes a base for abutment selection , the use of isolated abutment has been accepted by some investigators to improve mandibular denture support and stability[2] .

Sound periodontium is essential for success of overdenture treatment .The effect of overdenture abutment tooth contour, denture base materials and occlusal design on the abutment teeth and their periodontium have been studied however little attention was directed to the critical distribution of abutment teeth.[3]

In vitro stress analysis studies have been widely used to provide good understanding of the nature of stresses acting on dental structures. In vivo test has to be repeated under the same conditions every time standardizing all the variables except the one under investigation which is clinically impossible. Thus comparative studies would be more accurate and practical if they are laboratory performed.

Many experimental stress analysis methods have been employed to evaluate load distribution. These techniques involve, photo –elastic stress analysis, finite element stress analysis and strain gauge stress analysis[5]. The strain gauge stress analysis was used in this study to evaluate the effect of overdenture abutment tooth position on the stresses induced on the denture supporting structures.

Review of literature

Overdenture is defined by Heartwell and Rahn [6] as" A denture prothesis that replaced the lost or missing natural dentition and associated structure of the maxilla and\ or mandible and receives partial support and stability from one or more modified natural teeth".

Overdenture is also defined as" a removable dental prosthesis that covers and rests on one or more remaining natural teeth and or dental implant. It also called overlay denture, overlay prosthesis, and superimposed prosthesis" [7].

Indications of overdenture

Overdentures were initially prescribed for patients exhibiting congenital and acquired defects, in patients presenting cleft palate, microdontia, amelogenesis imperfecta, partial anodontia and traumatic loss of many teeth. Rehabilitation of these conditions by overdenture treatment affords a very workable and simple solution to the problem [8].

Overdenture treatment is also indicated in the abscence of enamel as in dentinogenesis imperfecta and in patients with severe attrition and abrasion. The dentine must be protected and there is a definite indication for covering the existing teeth with cast copings [3,9].

Overdenture treatment is also indicated when a patient has four or less retainable teeth in the dental arch, especially when the denture is opposed by natural teeth or removable partial denture. An

overdenture is able to resist the increased occlusal forces exerted by the opposing natural teeth. Overdenture can be an alternative line of treatment to single denture opposing few natural teeth [10, 11]..

Overdenture can be placed immediately, if hard and soft tissues underlying them are in a reasonably stable state. The overdenture is preferred to the lower complete denture for patient with knife-edge ridges, that provide inadequate support for the denture. The retained teeth for overdenture can provide optimum support for this denture [10].

Overdenture may be also used to improve abnormal maxillomandibular relation, thereby enhancing both function and esthetics [12].

Overdenture is also indicated in patients with unfavourable tongue positions, muscle attachment, residual ridge, and difficult stability or retention cases [11].

Contraindications of overdenture

Contraindications for overdenture are relatively few and are related to the absence of patient's motivation to maintain an impeccable oral environment [13]. Overdenture treatment is contraindicated when the remaining natural teeth are adequate to restore the dental arch with fixed or removable partial denture [6, 14 , 15]. Cooper and Ellinger [16] found that grossly malposed teeth are difficult to be used as abutment for overdenture, especially posterior teeth that are titled more than 25^0.

Inadequate interarch distance is not suitable for construction of overdenture prosthesis. As there is no sufficient space to accommodate the overdenture and so it may result in overcontoured, bulky un ethestic prosthesis [15].

Heartwell and Rahn [17] mentioned that, systemic complications would make the use of necessary clinical procedures needed for overdenture construction unsatisfactory. They added more specific contraindications related to the periodontal and endodontic procedures.

Advantages of overdenture

- **Preservation of the supporting structure:**

Vertical and lateral forces result in excessive denture movement that contributes to resorption of bone in the edentulous area. An overdenture can prevent the loss of the remaining oral structure. The retained natural teeth help to stabilize the overdenture, and to dissipate the vertical forces, thereby decreasing the stress on the edentulous area. In addition, the retained teeth maintain the bone surrounding the teeth. Complete or partial overdenture is an excellent mode of treatment of mutilated teeth for preservation of the residual ridge[16, 18].

Overdenture therapy is based on the philosophy that, retained teeth used as abutments preserve the alveolar bone [19, 20]. The retained roots help to maintain the height and integrity of the alveolar ridge. The remaining roots are considered the best physiologic supporting

factors for dentures, reducing stresses transmitted to the alveolar bone and thereby preserve the alveolar bone height [21].

Overdnture distributes forces of mastication more uniformly over the roots and denture supporting soft tissue. This causes less trauma and reduces the alveolar bone resorption.[22] In addition reduction of the abutment offers favorable crown root ratio , that allows axial occlusal loading and reduces lateral stresses falling on the abutment teeth. This decreases the amount of abutment mobility and improves the periodontal conditions of potential abutment [13].

- **Preservation of the masticatory proprioception**

The preservation of the retained roots with periodontal ligaments lead to marked improvement in the oral masticatory function. Proprioception present in these retained roots being responsible for the determination of the amount, direction, and position of the masticatory forces. This enhance the masticatory performance and the chewing ability [13].

The proprioception nerve endings in the periodontal ligament feed information to the neuromuscular system during jaw movement and centric jaw relation record [23, 24].

The proprioception sensitivity appears to be impaired if not lost entirely when teeth with their associated periodontal structures are removed [25].