Stresses Induced By Different Implant Abutment Designs Retaining Mandibular Overdenture on Denture Supporting Structures (Strain Gauge Analysis)

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بسم الله الرحمن الرحيم

[ولَسَوْفَ يُعْطِيكَ رَبُّكَ فَتَرْضَى]

صدق الله العظيم

سورة الضحى – الاية ٥

Dedication

To my Great Father & Mother

To my Lovely Husband

To my Dear Brothers

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INTRODUCTION

Teeth loss results in progressive alveolar ridge resorption, which may be especially debilitating to the patient who has worn a mandibular complete denture for a period of time. As the alveolar ridge resorbs, stability and retention of the denture prosthesis diminishes, resulting in a reduction of comfort, chewing ability, and facial esthetics. These factors lead to general dissatisfaction with the mandibular prosthesis, causing the patient to seek an alternative treatment.

Implant supported overdentures treatment partly overcome many of the problems posed by conventional complete dentures like progressive bone loss, poor stability and retention and low masticatory efficiency.

Root form end-osseous implant system is recommended to be used in supporting overdenture, as it is designed to resemble the shape of natural tooth root and to provide stress distribution over a greater surface area, less fracture possibility and more support and retention.

Retention can be achieved by different attachments as bar attachment, stud attachment, magnetic attachment and telescopic overdentures.

Ball and socket attachments (high profile implant abutment) are prosthetic alternative in implant restoration of totally edentulous patients, as they allow unharmful movement of the denture over the implant. They are recommended in cases where bone resorption is extensive; when better function is required they are easy to connect, quick and hygienic, as well as economical as they require only two implants only in the anterior region of the mandible, one on each side of the arch.

On the other hand, low-profile implant abutment over denture attachment such as locator and GPS attachment was used to reduce the abutment restoration height on implants. The locator attachment has a self-aligning feature. The male denture component is designed with a skirt that easily locates the mating implant abutment. The question is which is better regarding stresses induced using strain gauge analysis on the denture bearing area either using GPS abutment or ball abutment in implant retained overdenture prosthesis.

Review of Literature

Bone resorption in edentulous alveolar processes has been studied extensively, and the conclusion has been reached that it is a chronic, progressive and irreversible process that occurs in all patients [(1)].

Differences have been observed between individuals in the amount and speed at which alveolar bone is lost, which have been attributed to a diversity of factors such as age, sex, facial anatomy, metabolism, oral hygiene, parafunctions, general health, nutritional status, systematic illnesses, osteoporosis, medications and the amount of time the patient has been edentulous [(2,3)]

Lack of stimulation to the residual bone due to tooth loss with its periodontal ligament support causes a decrease in the trabeculae and bone density with loss of the external bone width and height, a perfect example of disuse atrophy. Periodontal bone loss before teeth extraction, hyperparathyroidism, hypogonadism and nutritional deficiencies share in accelerating bone resorption. Bone loss is not limited to the alveolar bone; also portions of the basal bone may be resorbed [(4,5)].

Complete denture are the traditional form of treatment for the edentulous patient [(6)]

In patients with complete dentures there is a greater degree of mandibular resorption than maxillary resorption.

Studies such as that of Atwood or Tallgren [(7,8)] showed that mandibular loss is four times greater than maxillary loss. These resorption differences are attributed to the fact that the support surface

for the complete lower denture is smaller and as such, the pressure exercised on it is much greater.

This resorption can render the current prosthesis inadequate in terms of both function and esthetics and can lead to the necessity of fabricating a new denture. [9,10]

Lack of retention and stability of mandibular denture is a common problem among edentulous denture wearers [11].

Investigators have found that a direct relationship exists between prosthesis retention and patient satisfaction [12,13,14]

Denture retention is defined as the resistance to vertical and torsional stresses, or the resistance of a denture to removal in a direction opposite that of its insertion.[15]

Dental implant

In patients with edentulous mandibles, the stability and retention of a complete denture can be managed by the selective placement of implants.[16]

Regarding the applicability of implantology, it is well known through the numerous publications on longitudinal studies that the success rate of implants placed in the anterior mandible is very high and with minimal clinical impediments.[17]

In addition, the positive effect of implants on the mandibular ridge resorption has also been scientifically proven.[18,19]

According to the Academy of Prosthodontics[20], The dental implant can be defined as "A prosthetic device of alloplastic material implanted into the oral tissue beneath the mucosal and / or periosteal layers and/or within the bone to provide retention and support for fixed or removable prosthesis".

The dental implants provide bony support via the dental implant fixture while the dental implant abutments connect the dental implant to a fixed or removable dental prosthesis.[20]

Osseointegration is a process whereby clinically asymptomatic rigid fixation of alloplastic materials is achieved and maintained in bone during functional loading.[21]

Osseointegration is seen as the close contact between bone and implant . The bone response, which means rate, quantity and quality, are related to implant surface properties.[22,23]

In 1981 Albrektsson et al. [24] emphasized the bio-compatibility, morphology, surface treatment, condition of recipient site, surgical technique, and control of loading condition as key factors of successful osseointegration in dental implants. They also reported other factors needed for successful implant therapy such as patient selection, experience of the surgeon, initial stability of the implant, placement timing, esthetics, and responsiveness to the grafting material [25-28]

The use of endosseous implants for successful restoration of patients with partial or total tooth loss has been well-established. The use of dental implants to support prosthesis offers several advantages among which maintaining bone, vertical dimension, proper occlusion, increasing

occlusal force, improving masticatory performance, phonetics, esthetics and increasing stability and retention [29,30].

Endosteal implants are the most commonly used implants worldwide. They are manufactured in a wide variety of widths, lengths, designs and materials to allow the dentist to choose the most suitable implant for each case. Because of the advantages of the root form implant, it is now the first and the most realistic choice on selection of implant as it offers a wide stress distribution over a great surface with excellent retention and easy surgical procedure with fairly good healing [31,32].

Classification of the root form implants

I-According to shape of implant

- **Cylinder or (press-fit) implant**

This type depends on microscopic retention and/or bonding to the bone, and is usually pushed or tapped into a prepared bone site. The cylinder may be solid or hollow called hollow basket cylinder [33].

- **Screw shaped implant**

This type is threaded into the bone site and has obvious macroscopic retentive elements for initial bone fixation [33].

II- According to the insertion technique

- **Press fit technique**

In this type of unthreaded implants, the implant site is drilled slightly smaller than the actual implant size, where the implant is pressed into the recipicient site with slight friction[34].

- **Self tapping technique**

In this type of threaded implants, the implant threads are used to tap its site during insertion [34].

Regarding the morphology of the implants, the initial stability was enhanced by self-tapping implants and the success rate was also increased [35,36]

- **Pre-tapping technique**

These are threaded implant where their sites are previously tapped using bone tap instrument before insertion[37].

III- According to surgical stages

- **One stage surgery**

The implant body is inserted into the bone where its abutment portion penetrates the oral mucosa into the oral cavity [38].

- **Two stage surgery**

The implant body is completely embedded in bone for complete osseointegration. The implant body is then exposed and the healing abutment is placed for soft tissue healing before impression is made for prosthetic fabrication[39].

IV- according to the time of installation

- **Immediate implants**

They are placed into a prepared extraction socket following tooth extraction [40].

- **Immediate delayed implants**

They are placed within 6-12 weeks after the tooth loss[41,42].