EFFECT OF RESILIENCY OF ATTACHMENT ON THE SUPPORTING STRUCTURES OF MANDIBULAR MINI IMPLANTS SUPPORTED PROSTHESIS

A Thesis
Submitted to faculty of dentistry
Ain Shams University
In partial fulfillment of the requirement for doctor
Degree in Oral and Maxillofacial Prosthodontics

By
Shaimaa Lotfy Mohamed Oda
M.D.S.,Ain Shams University
(2008)

Faculty of Dentistry
Ain Shams University
(2012)

Supervisors

Prof. Dr. Ingy A. Talaat Lebshtien

Professor and Chairman of Removable Prosthodontics Department,
Faculty of Dentistry,
Ain Shams University

Dr. Magdy Eid Mohamed

Assistant Professor of Removable Prosthodontics

Faculty of Dentistry,

Ain Shams University

تحت إشراف

أ. د/ انجي أمين طلعت لبشتين

أستاذ ورئيس قسم الاستعاضة الصناعية
كلية طب الأسنان - جامعة عين شمس

د/ مجدي عيد محمد
أستاذ مساعد بقسم الاستعاضه الصناعيه
كلية طب الاسنان - جامعة عين شمس

تأثير درجة المرونه لمثبتات الاطقم المحمولة على الانسجة المحيطة بالغرسات صغيرة القطر بالفك السفلى

رسالة مقدمة الى قسم الاستعاضة الصناعية

كلية طب الاسنان- جامعة عين شمس

كجزء متمم للحصول على

درجة الدكتوراه فى الاستعاضة الصناعية للفم والوجه والفكين

مقدمه

الطبيبة/شيماء لطفى محمد عودة

ماجستير الاستعاضه الصناعيه

٢٠٠٨

كلية طب الاسنان

جامعه عين شمس

٢٠١٢

INTRODUCTION

The prosthetic management of the edentulous patient has long been a major challenge for dentistry. For well over a century, complete maxillary and mandibular dentures have been the traditional standard of care. However, most patients wearing conventional complete dentures are dissatisfied with their dentures; this is particularly common with the mandibular one. The most probable cause for this is the smaller denture bearing area, unfavorable distribution of occlusal forces resulting in increased rate of bone resorption, loss of denture stability and retention, pain as well as patient discomfort.

Recent scientific studies carried out over the past decade have determined the benefits of a mandibular two-implant overdenture. Rehabilitation with implant-retained overdenture offers considerable functional and psychosocial advantages. Preservation of the residual ridges, tactile discrimination, improvement of masticatory performance, retention and stability, maintaining occlusion and vertical dimension have been reported in the literature .

Implant supported over dentures enhances masticatory function and propriception. It reduces trauma to the underlying tissues, thereby reducing rate of bone resorption. It maintains occlusion and vertical dimension and attains more patient tolerance.

The diameter of standard (original) root form implant is 3.75mm which requires at least 6mm of bone in the facio-lingual direction for successful placement without additional bone grafting. From a biomechanical point of view, it is well documented that a residual plate

that is less than 2 mm in thickness could have an adverse affect on bone stress levels and crestal bone maintenance.

Recently root form small diameter mini-implants ranging in diameter from 1.8 or slightly more than 2mm have been used to support conventional denture with atrophied mandible without bone grafting. These so-called mini implants were formerly introduced to support fixed provisional restorations. Recently successful oral rehabilitation with mini implants in more definitive treatments has been reported for partially and completely edentulous patients.

Mini implant reduces bleeding, decreases post-operative discomfort, shortens healing time and provides immediate loading. Since decreasing the diameter increases the risk of implant fracture because of reduced mechanical stability and the risk of over loading, it is recommended to increase the number of implants to improve initial stability.

Small diameter implants are available as a one-piece implant with stud attachment incorporated in the implant and rubber O-ring attachment or metal female part, housed in the fitting surface of the denture. The metal female part, permits less resiliency but twice the retentive force than that provided by the O-ring system.

The use of resilient denture liner in implant retained over dentures provides a resilient connection between the implant and the prosthesis. With the denture in position, the components interlock to form a retentive unit, mechanically attaching the superstructure to the attachments. Resilient denture liners are used for edentulous patients to reduce functional and non functional stresses transmitted to the ridge. Soft liners could be used in order to absorb some of the energy produced by

masticatory impact. Hence, a soft liner serves as a shock absorber between the occlusal surfaces of the denture and the underlying oral tissues.

Although researches have been concentrated on the influence of different attachments on the peri-implant bone loss, there is little information concerning the effect of resilient denture liner on peri-implant bone loss.

REVIEW OF LITERATURE

Complete denture and mandibular ridge

The loss of teeth results in resorption of the surrounding alveolar bone and lead to atrophic edentulous ridge which lead to several clinical anatomic problems, among which: decreased width and height of supporting bone, prominent mylohyoid ridge, progressive decrease in attached mucosa, prominent superior genial tubercles, forward movement of prosthesis, elevation of prosthesis with contraction of mylohyoid and buccinators which serving as posterior support, thinning of mucosa, increase of size and activity of tongue, decrease of neuromuscular control with aging, and compromised esthetic appearance of the face[(1)].

For long time, the tissue supported complete denture has been regarded as the prosthesis of choice for the treatment of edentulous mandible [(2)]. There is still no reliable method to predict the outcome of complete denture treatment, and there are many problems related to treatment with complete dentures [(3)].

A study of the positional changes of complete dentures due to the alveolar resorption revealed particularly marked changes of the lower denture. In addition to a pronounced settling on the basal seat, the lower denture displayed also a forward slide on the residual ridge. The upward rotation of the mandible and the forward slide of the lower denture lead to a reduction in the horizontal overlap and in some patients, even to a horizontal overlap of the lower teeth over the upper one[(4)].

The residual ridge supporting complete denture inherently unstable due to unpredictable resorption and remodeling of alveolar bone when natural teeth are removed. Consequently, resorption of the residual ridge disturbs the comfort and retention of a denture, which in turn can irritate

the peripheral mucosa to produce an epulis fissuratum [5]. Clinical trial reveals that discomfort of an ill fitting complete denture especially in the mandible, can be very difficult for the denture wearer to manage [6].

Residual ridge reduction

The ideal denture supporting ridge is defined as "That ridge possessing adequate bone support for dentures, bone covered by adequate soft tissue, no undercuts or overhanging protuberances, no sharp ridges, adequate buccal and lingual sulci, no scar bands that prevent normal seating of the dentures, no muscle fibers or frenula to interfere with the periphery of the prosthesis, satisfactory ridge relationships between maxilla and mandible, no soft tissue folds, or hypertrophies on the ridge or sulci, and a ridge free of neoplastic disease" [3].

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 [7]. Differences have been observed between individuals in the amount and speed at which alveolar bone is lost. This is 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 [8,9].

Campbell [10] observed that patients wearing complete dentures presented smaller edentulous ridges than edentulous patients with no denture treatment. In patients with complete dentures there is a greater degree of mandibular resorption than maxillary resorption. Studies such as that of **Atwood** [11] show that mandibular loss is four times greater

than maxillary loss. These resorption differences are attributed to the fact that the support surface for complete lower denture is smaller as mandibular ridge provides less than one quarter of the support offered by the peridontium to the natural teeth and as such, the pressure exercised on it is much greater [12].

Management of the mandibular ridge

Edentulism can be a debilitating handicap. **Zarb** described endentulous individuals who could not function as denture cripples [13]. Difficulties with complete denture prostheses arise from the inability to function with the mandibular prostheses. Factors that adversely affect successful use of a complete denture on the mandible include: the mobility of the floor of the mouth, thin mucosa lining the alveolar ridge, reduced support area and the motion of the mandible. These factors alone can explain the difficulty of wearing a denture on the mandibular arch compared to the maxillary arch. The maxilla exhibits much less mobility on the borders of the denture than the mandible, moreover having a stable palate with thick fibrous tissues available to support the prostheses and resist occlusal forces. These differences explain most of the reasons why patients experience difficulty with using a complete denture on the mandibular arch compared to the maxillary arch [14].

Few treatment options are available for reestablishing the supporting tissue volume for dentures. These options include:

1- Preventive prosthodontics:

Successful denture includes many features whose goal is to reduce the amount of force transmitted to the ridge, thereby reduces residual

ridge resorption. Prosthetic factors include broad base coverage in order to widely distribute the force thus reducing the force per unit area. Also, decreasing the number of dental units, decreasing the buccolingual width of teeth, and improving tooth form in order to decrease the amount of force required to penetrate a bolus of food. Avoidance of inclined planes to minimize dislodgement of dentures and reduce shear forces, centralization of occlusal contacts to increase denture stability and maximize compressive forces is also required. It was also reported that provision of adequate tongue space to improve denture stability during speech and mastication and providing adequate interocclusal distance during rest position of the mandible, to decrease the frequency and duration of tooth contacts which inturn reduce amount of force transmitted to the residual ridge [15, 16].

2- Surgical Rehabilitation:

A) vestibuloplasty

It is the surgical procedure by which the oral vestibule is deepened by changing the soft tissue attachments. This procedure increases the size of denture bearing area and the height of the residual alveolar ridge. Vestibuloplasty is indicated when an adequate amount of bone is present in the mandible, 12-15 mm of bone height may be considered the minimum. [17]

The most beneficial site for vestibuloplasty is in the anterior part of the mandible. Not only is this the easiest part of the mouth to work in, but the mentalis muscle is a major cause of denture displacement [18].

B) Augmentation surgeries:

Reconstruction of the residual ridge with autogenous bone or bone derivatives to increase lower denture stability has been used with varied success [19, 20]. When autogenous bone is used the factors of hospitalization, cost, and the extensive nature of some bone grafting procedures limit the application of this method of ridge replacement. In addition there is the probability that a portion of the bone graft subsequently may be lost by resorption[21]. This is considered as a major problem that lead to the search for alternative grafting materials, so a porous ceramic implant material was developed with pore size of 100 to 750 mm as an alternative material to autogenous bone grafts which called hydroxyapatite [22]. The use of this procedure is associated with some complications such as migration of the material, nerve dysesthesias, difficulty achieving height augmentation, and inadequate increase in strength of the mandible [23, 24].

C) Implants

Dental implants are "Prosthodontic devices of alloplastic material, implanted into the oral tissues beneath the mucosa and/or within the bone to provide retention and support for fixed or removable prosthesis [25].

Implant-supported prostheses are today often used in rehabilitation of partially or totally edentulous patients. The outcome of these procedures has been described in several reviews. The results of implant treatment have mostly been very good with survival rates of 85 to 99 % [26-28].

Classification of Dental Implants

Dental implants are classified according to their anatomical relation to the bone into:

A-Mucosal inserts:

Mucosal insert is a metal insert attached to the tissue surface of a removable prosthesis that mechanically engages undercuts in a surgically prepared mucosal site. It is also called button implant, intramucasal implant [29, 30].

Many modifications have been introduced ended by introducing (Tandem concept) in which mucosal insert of double head connected with bar was introduced. This system includes temporary and final inserts. The temporary insert is left for seven days allowing the tissues to heal around it, then it is replaced by the final one upon which the denture is placed on its relieved area. This final insert is called (Tandem Denserts) [31].

B-Subperiosteal implants:

This implant type is located subperiosteally. It consist of cast metal framework that fits on the residual ridge beneath the periostieum and provides support for dental prosthesis by means of posts or other mechanisms protruding through the mucosa[32].

Garefis [33] emphasized that the subperiosteal implants are indicated where there is insufficient amount of bone in width and depth and when no other type of dental implants can function effectively.

Boyne and James [34] modified the basic design of the subperiosteal implants by using detachable posts to control inflammtions around the post, and the use of hydroxyapatite coating to improving the metal-bone interface. Recently, one stage surgery was advocated by the

use of CAD-CAM technique to develop three-dimensional model upon which a subperiosteal implant can be made [35].

C-Transosseous implants:

This implant penetrates the whole thickness of bone from the inferior border of the mandible transosteally to the oral cavity [36]. It is either in the form of seven pins or five pins depending on the case. It can be used in the anterior region of the mandible as a partial support for tissue borne overdenture [37].

Small [38] reported the most recent type of this implant which is the staple bone plate implant. It is used to rehabilitate the atrophic edenulous mandible through providing a fastening system to the inferior border of the mandible. Communication with the oral cavity is achieved by means of two threaded transitional pins which act as a stabilizing device for a complete or partial prosthesis.

D-Endodontic Stabilizers:

It is a tooth root-lengthing implant. It has no site of premucosal penteration because it is placed into bone through the apices of natural teeth. This implant offers one stage treatment for the stabilization of teeth that have inadequate crown-root ratio [39].

E-Endosseous implants:

It is a device placed into the alveolar and/or basal bone of the jow and transecting only one cortical plate. They are fabricated from different biotolerant materials and made of different designs [36]. **Joblonsky** [40] clarified that the prefix “end” means within and “osteal” means bone.

Endosseous implants are the most commonly used implant type, and this is the fastest growing part of the implant market. Many materials have been used for implants, including ceramics such as aluminum oxide and metals ranging from alloys of gold, titanium and nickel- chrome-vanadium to commercially pure titanium [41].

A Root form implant is an endosteal dental implant shaped in the approximate form of a tooth root. Root form implants can be further classified according to implant design into threaded and non - threaded cylindrical or press-fit [25]. Threads are used to maximize initial contact, improve initial stability, and enlarge implant surface area and favor dissipation of interfacial stress [42-44].

Osseointegration:

The concept of osseointegration was introduced by Branemark in the 1960. Osseointegration is a biological concept. It defined as the healing process by which bone regains its original shape (i.e. before implant placement) and includes the embedded titanium body as if it were osseous tissue [45]. **Albrektsson** and **Wennerberg** [46] stated that osseointegration is considered as direct functional and structural connection between living bone and the surface of a load- bearing implant. Also osseointegration defined as the successful incorporation (and hence rigid fixation) of an alloplastic material within the surrounding bony bed [47]. Osseointegration represents a dynamic process both during its establishment and its maintenance [48].

An experimental study in the dog was made to validate a proposed model of **Berglundh** et al. [49] and to evaluate the rate and degree of osseointegration at turned (T) and sand blasted and acid etched (SLA)