

Introduction

For many edentulous patients having problems adapting to conventional complete dentures, rehabilitation with implant-retained overdenture offers considerable functional and psychosocial advantages.

The use of a wide variety of attachment systems, including stud, magnet and bar attachments have proven both clinically predictable and effective results. The design of attachments should provide equal implant-tissue support and optimum force distribution around the implants to allow bone loading within physiologic levels.

Implants splinted together with bars may decrease the risk of overload to each implant as a result of a greater surface area, load sharing between implants and improved biomechanical distribution. The bar's ability to minimize the potential for micromotion at the bone-implant interface may help successful osseointegration of immediately loaded implants.

Bar attachment are classified according to their biomechanical behavior into rigid, and resilient attachment . In comparison to resilient bar attachment, rigid anchoring of removable prostheses creates stable occlusal plane, reduces loading of denture-bearing areas, and minimizes posterior mandibular ridge resorption. One of the major drawbacks of rigid bar attachment is over loading of the abutments, however

resilient bar attachment encourages torsion-free load transmission to implants .

In an attempt to minimize bone resorption in the edentulous regions due to overdenture rotation during function , short (5-7 mm) and long (13-15 mm) distal cantilever extension bars have been suggested . Such prosthesis design increases prosthesis rigidity, decreases overdenture rotation during function, enhances prosthesis stability and retention, and provides a more conservative surgical and economic treatment. Moreover, it improves chewing and, decreases the incidence of prosthodontic maintenance⁽¹⁾

The number of implant sufficient to support cantilever supported prosthesis is controversial. The original design described by Branemark et al. suggested the use of five interforaminal implants to support a cantilever bar over denture with 15 mm cantilever extension and four implants to support a cantilever bar not exceeding 10 mm. The large number of implant was thought to increase the surface area upon which the stresses are distributed⁽²⁾.

Recently in-vitro and in- vivo studies described the success of implant supported cantilever prosthesis with few implants.. Many studies reported that the minimum number of implants to be used for cantilever prosthesis should be three implants distributed in a tripod pattern to form a stable non-linear pattern. The addition of extra implants with the same distribution would add very little to the function of the tripod.

The slight increase in the surface area along which five or four implants are distributed causes only minor decrease in the stresses transmitted to the supra structure and the supporting bone⁽³⁻⁵⁾ .

Although, numerous in-vivo and in vitro studies have been published evaluating the generalized effect of overdenture attachment on the denture supporting structures ,detailed reports on how many abutments/implants are necessary to support a cantilevered implant-supported mandibular overdenture prosthesis with rigid and resilient attachments are scarce.

Review of literature

Dental Implants

According to the Academy of Prosthodontics, an implant is defined as "Any object or material such as an alloplastic substance or other tissues, which is partially or completely inserted or grafted into the body for therapeutic, diagnostic, prosthetic or experimental purposes"⁽⁶⁾

Also, an implant is defined by the American Academy of Implant Dentistry as "A permucosal device that is biocompatible and biofunctional and is placed on or within the bone associated with the oral cavity to provide support for fixed or removable prostheses". Or simply, "a device designed to be inserted surgically into the body"^(7.)

Dental implants are classified based on their anatomical relation to the alveolar bone that provides support and stability into Subperiosteal (On bone) implants, Transosseous (Through bone) implant and. Endosteal (In bone) implants⁽⁸⁾.

Endosteal implants are the most commonly used implants worldwide. They are manufactured in a 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 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. Root form implants may be further classified according to implant shape, material, surface treatment or resiliency⁽⁸⁾

The criteria of success in implant dentistry remain complex.. The vast majority of clinical studies reporting success and failure do not qualify the type of success achieved. Instead, the term success primarily has been used interchangeably with survival of the implant and the term failure has been used to indicate that the implant is no longer present in the mouth. The following criteria were used to define implant success: Absence of mobility, absence of persistent subjective complaints (pain, foreign body sensation, and dysesthesia), absence of recurrent peri-implant infection with suppuration, absence of continuous radiolucency around the implants ⁽⁹⁻¹¹⁾. In addition no pocket probing depth more than five millimeter, no bleeding on probing, and annual vertical bone loss after the first year of service not exceeding 0.2 mm ⁽¹²⁻¹⁴⁾.

The main predictors for implant success are the quantity and quality of bone, the patient's age, the dentist's experience, location of implant placement, length of the implant, axial loading, and oral hygiene maintenance. Primary predictors of implant failure are poor bone quality, chronic periodontitis,

systemic diseases, smoking, unresolved caries or infection, advanced age, implant location, short implants, an inadequate number of implants, parafunctional habits and absence/loss of implant integration with hard and soft tissues. Inappropriate prosthesis design also contributes to implant failure ^(9,10,14).

Implant overdentures are contraindicated in patients with systemic disorders (e.g. immune deficiencies, endocarditis, bleeding disorders, insulin-dependent diabetes, liver cirrhosis, acute or chronic infectious diseases), and also in patients addicted to drugs, alcohol, and heavy smokers. Presence of inadequate bone (height and width) for support or poor oral hygiene also contraindicates the use of implant overdentures ⁽¹⁵⁾.

Implant Overdenture

An overdenture is "A removable partial or complete denture that covers and rests on one or more remaining natural teeth, roots and/ or dental implants". Another definition describes it as "A prosthesis that covers and is partially supported by natural teeth, teeth roots and/ or dental implants⁽⁶⁾". The dental profession is more aware of the problems associated with a complete mandibular denture than any other dental prosthesis to achieve optimal denture retention and stability. This may be due to poor jaw and ridge relationship, psychological condition, reduced neuromuscular

coordination, inadequate quality and quantity of available bone and alveolar mucosa, or inadequate vestibular depth⁽¹⁶⁾.

The use of implant overdenture with its great support, retention, stability is considered an ideal treatment modality and one of the most beneficial treatments rendered to the edentulous patients^(8,10). In recent decades, implant-supported restorations have proven to be a reliable, predictable, and effective treatment modality. Over the last 10-15 years, the survival rate for implants and implant-supported restorations has reached as high as 96 to 98%.⁽¹⁷⁾.

The patient gains several advantages with an implant supported overdenture. The mandibular complete denture often moves during jaw movements during function and speech. Contraction of mentalis, buccinator, or mylohyoid muscles can lift the denture off the soft tissues, representing a major embarrassing problem for the patient⁽¹⁸⁾.

The stability of an overdenture is dramatically improved compared with conventional denture. Retention of the prosthesis is enhanced by the use of mechanical attachment with no need for maximum soft tissue coverage and prosthesis extension. This is very important for new denture wearers, patients with tori or exostoses or low gagging thresholds⁽¹⁹⁾.

Another benefit gained by the enhanced stability and retention offered by overdenture is keeping the prosthesis in

place during speech preventing clicking sound elicited by teeth contact due to denture movement. Tongue and perioral musculature may resume a more normal position because they are not required to limit mandibular denture movement⁽²⁰⁾.

The implant overdenture patients showed higher rates of comfort, stability, and ability to chew. They also reported higher ability to chew hard foods. Even in patients with an extremely resorbed mandible, significant improvement in masticatory functions after rehabilitation with implant supported overdenture was reported^(21,22).

Proprioception is the awareness of a structure in time and place. The receptors in the periodontal membrane of the natural tooth help determine its occlusal position. Although endosteal implants do not have a periodontal membrane, they provide greater occlusal awareness than complete dentures⁽²⁰⁾.

Placement of implants is an adjunctive factor to help decreasing bone resorption. After extraction of mandibular teeth, an average of 4mm vertical bone loss occurs during the first year, and continues in smaller values over the next 25 years. The bone under an overdenture may resorbs as little as 0.6 mm vertically over 5 years, and long term resorption may remain at less than 0.1 mm per year⁽²³⁾. In clinical trials comparing the efficacy of overdentures and conventional complete dentures, patients reported that overdentures provide

better function than mucosa-supported complete dentures. Less bone resorption, more stability and retention were also reported⁽²⁴⁾

Despite the functional advantages offered by implant supported and retained overdentures, some disadvantages are reported. Food impaction under the denture and food debris trap against implants, bars or attachments because of the shortened flanges is considered by some patients as a very annoying problem that they always compare with their old complete dentures^(8,10).

The implant supported and retained overdenture is difficult to fabricate in cases presented with insufficient inter-arch space to give room for attachment, denture teeth and adequate bulk of acrylic denture base to resist fracture. If a space less than 12 mm from soft tissue to occlusal plane is not available an osteoplasty is needed to create the needed space, otherwise a fixed prosthesis will be more preferable^(8,25).

An implant supported or retained overdenture usually needs more maintenance than a fixed one due to the wear of the. O-rings or clips wear and must be replaced regularly, and the need for relining to overcome soft tissue support changes should be considered ⁽⁸⁾.

Classification of Implant Overdenture:

Implant overdenture may be classified as follows ^(8,26-27)

I - According to the mode of support:-

1- Mucosa supported overdenture: The overdenture is almost totally supported by the alveolar ridge and attached to two implants through resilient attachments or magnets. The overdenture is able to rotate around the implant attachment to settle on the resilient tissues of the residual ridge to decrease the stresses upon the implants.

Mandibular overdentures supported by few intraforaminal implants are regarded today as a treatment modality for geriatric patients whose requirements from the prosthesis are often straight forward and for whom more complicated treatments are inappropriate. For the rehabilitation of the edentulous mandible placement of only one or two implants will minimize the risk to patients and tissues in a simple and a cost-effective way. There is no scientific evidence that failures occur more often with a small number of implants (generally two), and the success of using few implants has been clearly demonstrated ⁽⁸⁾.

2- Implant supported overdenture: The denture is supported by four to six implants are usually rigidly connected with a bar on which the occlusal forces fall completely and the

mucosa does not contribute to any load sharing. The denture touches the tissues only at its border to prevent the accumulation of food underneath the denture.

Fixed implant-supported prostheses, as well as the concept of removable implant-supported overdentures provide a comparable level of long-term success⁽²⁴⁾.

The implants may have a distal cantilever extension order to maximize the retention of the distal component. However, this could be associated with increased loads on the implants during mastication. This design is beneficial for patients with knife edge ridge, sharp mylohyoid ridge, high muscle attachments, sensitive mucosa or superficial placement of mental foramen^(1,2,27).

3. Combined mucosa implant-supported overdenture: The overdenture gains its support from both the implants and the tissues. This type needs fewer implants with the benefit of lower cost and shorter surgical and prosthetic procedures. The design may be beneficial for cases of unfavorable arch relationship or cases of moderate to advanced resorption⁽⁸⁾. The implant mucosa-supported prosthesis depends on the idea of load sharing between the implants and the mucosa of the distal extension. In most cases it utilizes fewer number of implants usually two interforaminal implants^(8,28).

The load sharing is obtained by allowing the prosthesis movement under functional loads. The movement is allowed by the resiliency of the attachment used as in stud attachments and/or by a spacer layer between the superstructure and the attachment as in bars or resilient telescopic attachment⁽²⁹⁾ and/or flexion of the denture base at the distal extension provided that intimate contact exist between the denture base and the load bearing mucosa⁽³⁰⁾.

Misch proposed two prosthetic options for implant supported overdentures depending on the amount of implant support ⁽⁸⁾.

1- A removable overdenture which is completely supported by implants. Usually 5 or 6 implants in the mandible and 6 to 8 implants in the maxilla are required for such type of prosthesis. The restoration is rigid when inserted, the overdenture attachments connect the removable prosthesis to a tissue bar or a superstructure that splints the implant abutments.

2- A removable overdenture combining both implants and soft tissues support.

Some authors found that there is no significant differences between overdentures supported by two implants and overdentures supported by four implants placed in the interforaminal region in reducing the principle stresses or peri-

implant health. The use of more implants to support a mandibular overdenture should be considered in cases presented with, dentate maxilla, sensitive mucosa , high muscle attachments , sharp mylohyoid projections, large V- shaped ridges and patients with high retention needs^(4,28).

On the other hand other researches have found that retention, stability and occlusal equilibration of the overdenture were improved slightly with an increasing number of implants, besides increased load capacity of the prosthesis which effectively increases the masticatory load generated by the mandible. The improvements to the overall performance of the prosthodontic treatment provided by using additional implants are not clearly understood^(17,26,27).

II-According to the connection between the abutments:-

1- Unconnected implant system: The implants are not connected with a bar. Less clinical and laboratory work are needed for such a design which makes it more economic. The attachments should be resilient in function to protect the supporting individual implants from the forces of mastication. Ball and socket and magnets attachments are the most commonly used types⁽⁸⁾.

2- Connected implant system: The implants are connected with a bar which allows distribution of functional forces to all the implants. The number of implants is variable

starting from two up to five implants. The bar acts as a splint between them. The bar attachment can provide either rotational movement between the bar and the overlying sleeve (bar joint) or rigid fixation (bar unit) depending on the number and distribution of the implants^(8,).

Wright et al. (1995) clinically compared resilient bar attachment with rigid parallel sided bar. They concluded that bars with resilient joints have shown to give a slight increased incidence of problems associated with the denture bearing mucosa⁽³²⁾.

Branemark who established the concept of osseointegration recommended that; in the edentulous mandibular jaws implants should be installed between the mental foramina to support an implant full prosthesis ⁽²⁾. The anterior region offers several advantages; as the greatest available height of bone is found anteriorly between the mental foramens, a region that represents optimal density of bone for implant support. He recommended that anterior forces on the anterior part of the mandible should be resisted by implants or bars, whereas forces on the posterior part may be directed on soft tissues area such as the buccal shelf^(17,31).

Implant mucosa supported overdentures have been accused to enhance posterior bone resorption. Posterior ridge resorption was compared in patients treated with two implant-

retained mandibular overdenture and conventional denture patients. The results showed that bone resorption in the posterior mandible in implant mucosa supported overdentures may occur two or three times faster than resorption found in complete dentures⁽³³⁾.

The use of entirely implant-supported prosthesis result in considerable delay in the resorptive process of the posterior mandibular ridge and may even contribute to increase in the amount of posterior bone height even when no posterior implants are inserted⁽⁸⁾.

Implant mucosa-supported overdentures is considered a geriatric treatment modality that should not be performed as a final prosthesis for young patients, but only as a transitional prosthesis until the economic status allows an upgrade to an entirely implant supported overdenture which requires the placement of four or more implants^(8,32).

The range of whole prosthesis movement (PM) and consequently the nature of support is classified into PM0, PM2, PM3, PM4 and PM6 ⁽⁸⁾.

In PM0 the prosthesis shows no movement under function and it requires implant support mechanics similar to that of fixed restorations. This prosthesis type can be obtained irrespective of the type of attachment used. For example although stud attachments allow for six directions of