The Use of Bone Expanders in Conjunction with Dental Implant in the Management of Horizontally Atrophic Mandibular Alveolar Ridges

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Dedication

To my Family

Abstract

Aim of the study: The aim of the study was to clinically and radiographicaly evaluate the use of bone expanders in conjunction with dental implants to manage horizontally deficient mandibular alveolar ridges.

Material and method: 8 patients, 6 females and 2 males in which 12 dental implants were inserted. Their ages ranged from 22 years to 51 years with a mean age of 39.5 years. The implants were placed in cases suffering from horizontal mandibular alveolar ridge deficiency in the molar region using Microdent non-traumatic bone expansion system to obtain a wider bony base for ideal implant placement. Three months later, the patients were rehabilitated with final prosthesis. Digital panoramic radiograph were taken postoperatively, in the same day of surgery, the next were taken after three months postoperatively. Finally, digital panoramic radiograph were taken for all patients six months postoperatively.

Results: As regards the bone width, the bone width increased by 56.81% which allowed the placement of wider implant with greater surface area, enhanced implant angulation, better alignment and proper axial orientation. As regards the bone density, it was assessed by dividing the bone surrounding the implants into two zones. The first zone was located just adjacent to the implant and represented the osseointegration zone (implant-bone interface). While the second zone was located just around the first one and represented the bone surrounding the implant (response to functional load). The bone density in both zones showed no statistically significant change in mean bone density at 3 months, the reading increased dramatically at 6 months which may be due to the effect of functional loading during the period between 3 and 6 months.

Conclusion: Within the limits of this study, this technique appeared to be reliable and simple, with reduction of morbidity and times of dental rehabilitation as compared with other techniques such as autogenous bone grafts and guided bone regeneration. Survival and success rates of implants placed in the treated areas are consistent with those placed in native bone.

Key words

Horizontally deficient mandibular alveolar ridges, Threaded bone expanders, Bone density, Ridge expansion, Osseointegrated implants.

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Introduction

Titanium implants have been used for many years with good long term prognosis, the success of the prosthesis requires mechanical stability and biocompatibility with the surrounding host tissue. The earliest record of dental implants dates back to ancient Egyptians and pre-Columbians, an excavated skull from A.D 600 showed implanted tooth shaped piece of shell replacing lower incisor.[(1)]

The concept of endosseous oral implantology appeared in the nineteenth century, in 1809 Magilio, inserted gold implant into freshly extracted socket and the crown was attached only after the soft tissue healed. In 1898 Payne described implantation of silver capsules and later the author implanted porcelain intraosseous.[(2)]

Several metals have been implanted, ceramics, gold, tantalum, stainless steel, cobalt and nickel based alloys all these materials showed different degrees of osseointegration, however, the titanium remains the material of choice due to its surface oxide layer which is completely inert and does not react with body fluids.

Osseointegration was originally defined as a direct structural and functional connection between ordered living bone and the surface of a load-carrying implant.[(3)] It is now said that an implant is regarded as osseointegrated when there is no progressive relative movement between the implant and the bone with which it has direct contact.[4] In practice, this means that in osseointegration there is an anchorage mechanism whereby non vital components can be reliably and predictably incorporated into living bone and that this anchorage can persist under all normal conditions of loading.[5]

This study was conducted in order to clinically and radiographicaly evaluate the use of bone expanders in conjunction with dental implants to manage horizontally deficient mandibular alveolar ridges.

Review Of Literature

The need to replace missing teeth with something similar to the root of the tooth has always been a concern to dentists. Implant dentistry is the second oldest discipline in dentistry (oral surgery is the oldest). An endosteal implant is an alloplastic material surgically inserted into a residual bony ridge, primarily as a prosthodontic foundation.[6] The prefix endo means (within) and osteal means (bone).[7]

Root form implant history dates back to thousands of years and includes civilizations such as the ancient Chinese, who 4000 years ago, carved bamboo sticks in the shape of pegs and drove them into the bone for fixed tooth replacement. The Egyptians, 2000 years ago, used precious metals with similar peg design. [8]

In 1950, Pre-Ingver Branemark,[9] the Swedish physical anatomist who was interested in bio-physical engineering surgically inserted titanium chambers in tibia of rabbits in order to observe the blood flow through them, the chambers not only improved blood flow, but also showed high degree of biocompatibility. Later on, Branemark placed these chambers in arms of human volunteers, the author was impressed with the soft tissue tolerance of titanium and its integration to bone when he tried to remove them. In 1960, Branemark and his associates [9] designed a preliminary study on dogs by placing unloaded titanium implants that where left for several months to fuse to bone. The perfect results encouraged Uno Breine, the plastic surgeon in the team, to direct the work towards oral implantology.

Long term success in implant dentistry requires the evaluation of more than 50 dental criteria,[10] however the doctors training and experience and the amount and density of available bone in the edentulous site are primary determining factors in predicting individual patient success.

In the past, the available bone was not modified and was the primary intraoral factor influencing the treatment plan. Today the prosthodontic needs and desires of the patient should be first determined, after the intended prosthesis is designed, the patient force factors and bone density are then evaluated. The key implant positions, implant number, and size are determined. After all these factors are considered, the most important element in the implant region is the available bone.[11]

Following tooth extraction, healing of alveolar bone and associated soft tissue progresses quickly, predictably and usually without complications. Classical descriptions of extraction site healing indicate that two-third of the extraction socket typically fills with bone with the most coronal aspect of the socket filling with fibrous soft tissue.[12,13]

Tallgren[14] reported the amount of bone loss occurring during the first year after tooth loss is almost 10 times greater than the following years. In the anterior maxilla, there is a loss reaching up to 40% in height and 60% in alveolar width during the first 6 months.[15] While the posterior edentulous mandible resorbs at a rate approximately four times faster than the anterior edentulous mandible.[16]

In order to preserve the form of the alveolar crest after tooth loss, researchers began to think in a new concept (alveolar ridge preservation and implant site development). Nevins et al[17] evaluated the effect of augmenting sockets with inorganic bovine bone compared with untreated controls. CT scans where taken immediately, after 60 days and 90 days postoperatively. There was significantly less bone resorption seen in the sites grafted with a mean loss of 2.42 mms in height compared with 5.24 mms in controls (about 30% of the ridge height). Also autogenous grafts or allograft where used to fill the bone defect and to prevent resorption after tooth loss.[18]

Root replica made of materials like Poly Lactic Acid (PLA)[19] or Bioglass[20] were used by some researchers. In 2009 a study was performed by G. Araújo et al[21] that proved that the placement of Bio-Oss® collagen in the fresh extraction socket served as a scaffold for tissue modeling but did not enhance new bone formation. In comparison with the non-grafted sites, the dimension of the alveolar process as well as the profile of the ridge was better preserved in Bio-Oss®-grafted sites. Another research used the principles of GTR on the extraction sockets, a study made on two teeth extracted from the same patient from the same dental arch , one socket was covered with a ePTFE membrane and primary closure, whereas the other was treated with flap advancement and primary closure. The results of the study showed 0.5 mm in vertical loss compared to 1.2 mms loss in controls, also 1.8 mm in bone loss compared with 4.4 mms in controls.[22] These studies proved the importance of alveolar ridge preservation after extraction.

In order to state the condition of the ridge and the available bone, several classifications were made, starting in 1963 Atwood[23] presented a classification of bone loss after tooth loss in the anterior mandibular area. In 1974 Weiss and Judy[24] developed a classification of the mandibular atrophy and its influence on subperiosteal implant therapy. In 1982 Kent[25] presented a classification of alveolar ridge deficiency designed for alloplastic bone augmentation. In 1985 another bone volume classification was proposed by Lekholm and Zarb[26] for residual jaw morphology related to the insertion of Branemark fixtures the mandible was only described in loss of height. In 1986 Fallschussel[27] made a classification as the Atwood classification but for the maxilla.

In 1985 Misch and Judy[10,28-34] established four basic divisions of available bone for implant dentistry which follows the natural resorption phenomena of each region. They determined the different implant approach to each category. The angulation of bone and crown height was also included for each bone volume, as they affect the prosthetic treatment. The original four divisions of bone were further expanded with two subcategories to provide an organized approach to implant treatment options for surgery, bone grafting and prosthodontics.

Available Bone height:

It is measured from the crest of the edentulous ridge to the opposing landmark. The available bone height in the edentulous site is the most important dimension for implant consideration, because it affects both the implant length and crown height which affects force factors and esthetics.

Available bone width:

It is measured between the facial and lingual plates at the crest of the potential implants site. It is the next most significant criterion affecting long-term survival of implant. An implant of 4 mms crestal diameter usually requires more than 6 mms of bone width to ensure sufficient bone thickness and blood supply. The initial width of the available bone is related to the initial crestal bone loss after implant loading.

Available Bone Length:

The mesio-distal length of the available bone in an edentulous area is often limited by adjacent teeth or implants. As a general rule an implant should be placed at least 1.5 mms from the adjacent tooth and 3 mms from the adjacent implant. This dimension compensates for the width of an implant or tooth crestal defect. Which is usually less than 1.4 mms. As a result, if bone loss occurs at the crest module of an implant or from periodontal disease with a tooth the vertical bone defect will not spread horizontally, and cause bone loss on the adjacent structure.

Available Bone angulation:

It represents the natural tooth root trajectory in relation to occlusal plane. Ideally, it is perpendicular to the plane of occlusion, which is aligned with the forces of occlusion and is parallel to the long axis of the prosthodontic restoration. Rarely does the bone angulation remain ideal after the loss of teeth.[35-37] In the edentulous ridge with wide bucco-lingual dimensions, wider implants can be selected. They decrease amount of stresses transmitted to the crestal bone, in addition, the greater width of bone offers some latitude in angulation during implant placement.