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Prosthodontic management in residual ridge resorption: Article review

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***Abstract*---**Bone resorption is a chronic, progressive disease and irreversible process that occurs in all patients and can be classified into six different types. There are some of pathological and etiological factors that may cause resorbed ridge such as anatomical, prosthodontics, metabolic and systemic factors. The present article, were reviewed the literature concerning on possible mechanism, diagnosis, etiological factors and how to manage and prevent of resorbed ridge for edentulous patients.

***Keywords*---**residual ridge, resorption etiological factors, mechanism, diagnosis, management resorbed ridge.

Introduction

The success of the complete denture relies on the fulfillment of the three basic properties which are retention, stability, and support. Mandibular dentures usually faced more difficulties in achieving these three properties than maxillary dentures, (1) because, the mandible ridge has a lesser residual ridge for retention and support (2) and has greater resorption rate than the maxilla. According to some studies by Atwood and Tallgren show that mandibular bone resorption is four times greater than in the maxilla (3, 4). Residual ridge reduction is one of the main causes of loss of denture stability and retention especially in mandibular complete dentures. Extreme resorption of the maxillary and mandibular ridges also, results in sunken appearance of cheeks, unstable and non-retentive dentures with associated pain and discomfort. Therefore, poses a clinical challenge towards the fabrication of a successful removable prosthesis (5). Residual ridge resorption is a complex biophysical process and a common occurrence following extraction of teeth. It is the most dramatic during the first year after tooth loss followed by a slower but more progressive rate of resorption thereafter. (6)

Gross features
Similarities

- With increased resorption or resorptive age, the mandible does not widen with the narrowing of the
- Maxilla, nor there is a change in the posterior maxillomandibular width relations progressively.
- The arch width of the mandible exceeds the arch width of the maxillae in the molar region by an average of 6 to 7 mm after sufficient resorption established a definitive alveolar crest.
- The progressive and irreversible mandibular alveolar resorption is progressive and irreversible, with the rate being greatest in the early stages of edentulism and decreasing with loss of bone, longevity of edentulism, and attendant wearing of dentures.

Differences

The speed and direction of alveolar bone loss is not similar in maxilla and mandible (Bergman & Carlsson, 1985; Salonen, 1994). Faster and more dramatic changes take place in the mandible (de Baat *et al.,* 1993). In maxilla the changes occur evenly around the dental arch, but more on buccal and labial side than on the palatal side. In mandible resorption proceeds more in labio-lingual and vertical directions. Unlike in maxilla, the speed of bone loss in mandible is different in different parts of the jaw: distal parts of the residual ridge disappear faster than the anterior parts. Today, implant treatments are well-documented procedures to replace missing teeth or to provide retention for complete dentures. An early issued implant can even slow down the inevitable RRR. From the medical point of view there is limited contraindication for the use of osseointegrated implants (Oikarinen *et al.*, 1995), but the implant treatments are still too expensive for the majority of elderly.

Bone resorption also is a chronic, progressive and irreversible process that occurs in all patients (7). A classification of edentulous jaw is very important as it simplify description of the residual ridge and thereby assist communication between clinicians; aid selection of the appropriate surgical prosthodontic technique; offer an objective baseline from which to evaluate and compare different treatment methods; and help in deciding on interceptive techniques to preserve the alveolar process. A classification of the edentulous jaws has been developed based on a randomised cross-sectional study from by Cawood et al, 1988, Arising from these morphological studies of edentulous jaws they found that the basal bone does not change shape significantly, unless subjected to harmful local effects such as the overloading of ill-fitting dentures. Moreover the alveolar bone changes shape significantly in both the horizontal and vertical axes following a predictable pattern (8). Cawood and Hawell classify the residual ridge to basic six classes:

- Class I – dentate
- Class II -immediately post extraction.
- Class III- well-rounded ridge form, adequate in height and width.
- Class IV - knife-edge ridge form, adequate in height and inadequate in

width.
- Class V flat ridge form, inadequate in height and width.
- Class VI - depressed ridge form, with some basilar loss evident.

Moreover they found that the Pattern of bone loss varies with sites. Anterior mandible - bone loss is vertical and horizontal (from the labial aspect). Posterior mandible - bone loss is mainly vertical. Anterior maxilla - bone loss is both vertical and horizontal (from the labial aspect). Posterior maxilla - bone loss is both vertical and horizontal (from the bu]ccal aspect) (3). There are several factors that accelerate the residual ridge resorption, Atwood postulated the main four factors which are anatomic, prosthetic, metabolic and functional factors. The anatomical factor, the shape and size of the alveolar ridge has great effect as the well-formed broad ridges show less resorption than narraw thin ridge as the force received per unit area will be less in the former. Moreover the types of the bone show great effect on the rate of bone resorption (9).

The remodeling of bone is influenced by the force that applied on it which may result of Habits factor like parafunctions hapit such bruxism.(11) and misuse of prosthesis such as Intensive denture wearing, unstable occlusal conditions, Immediate denture treatment and use of improper designed denture. However Campbell observed that patients wearing complete dentures wearer presented with smaller edentulous ridges than edentulous patients with no denture treatment (10). Also the patients with complete dentures there is a greater degree of mandibular resorption than maxillary resorption (3,4). Metabolic and Systemic Factors has great effect on the rate of bone resorption which include Age, race, present of systematic illnesses such as osteoporosis, nutritional status especially calcium and vitamin D,(9) and the amount of time the patient has been edentulous (11).

Periodontal disease refers to the inflammatory processes that occur in the tissues surrounding the teeth in response to bacterial accumulations, or dental plaque, on the teeth. The bacterial accumulations cause an inflammatory response from the body. The chronic and progressive bacterial infection of the gums leads to alveolar bone destruction and loss of tissue attachment to the teeth. (12) Bone resorption rate are much higher In postmenopausal older women, due to inadequate of formation of new bone tissue are associated with estrogen deficiency. (13) although in those cases the rate of bone resoption can be control by treat the causes by drugs that increase bone mineral density as Bisphosphonates, RANKL inhibitors, SERMs-selective, estrogen receptor modulators, hormone replacement therapy and calcitonin.(14) moreover the light weight bearing exercise tends to eliminate the negative effects of bone resorption.(15)

Pathogenesis of RRR

Immediately following the extraction, any sharp edges remaining are rounded off by external osteoclastic resorption, leaving a high well rounded residual ridge. As resorption continues from the labial and lingual aspects, the crest of the ridge becomes increasingly narrow ultimately becoming knife-edged. As the process continues, the knife-edge becomes shorter and even eventually disappears,

leaving a low well rounded or flat ridge. Eventually, this too resorbs, leaving a depressed ridge (18). The resorption phase lasts about 8–10 days, presumably the life span of the osteoclast after completion of one resorption lacuna, the osteoclast can move along the bone surface and restart resorption or undergo apoptosis. (19) The rate of reduction in size of the residual ridge is the maximum in the first three months and then gradually tapers off. (20) The rate of residual ridge resorption differs from person to person and even at different times and sites in the same person and also affects the function of removable prostheses, which relies greatly on the quantity and the structure of jaw bones.(18

Management of residual ridge resorption

The prosthodontics management of patient with severe residual ridge resorption can be either with or without surgical intervention.

Prosthesis without surgical intervention

As the residual ridges resorb, the tissues become unsupported and displaceable. So it's need to modifiy a When use of conventional impression techniques will result in a distorted impression. Therefore, the impression technique needs to be modified. A number of modified impression techniques for resorbed mandibular ridge have been suggested by various authors such as admixed (26), functional (27) all green (28) , and cocktail technique (29) . All these techniques capture the primary and secondary load-bearing areas without distortion of the residual ridge. (30) The use of these impression techniques has the following advantages: they can be easily controlled to gain maximum coverage; (20) they can be corrected readily; (31) they can be used to accurately determine the extent of the mucobuccal reflections; and (32) they can be used to direct pressure toward the load-bearing areas, specifically, the buccal shelf and the slopes of residual ridges in the mandible (33).

The other technique for increases retentive and stability of complete denture is neutral zone technique. It uses with patients with highly atrophic mandible. So it of the most effective techniques is to counteract the problems of positioning the posterior teeth leading to a stable denture (34). Also the use of soft liners material for complete denture became popular in dentistry because they have brought many clinical advantages. These materials have the ability to help in healing of the inflamed mucosa, distribute the functional load in the support area of the prostheses and improve their adaptation and retention of complete denture (35). Moreover, due to cushioning effect provided by soft liners, lesser amount of forces are transferred to the underlying bone during various functions as compared to one without soft liners, This leads to a reduction in residual ridge resorption.

In order to preserve the alveolar ridge and reduce the amount of stress transferred, certain general principles must be kept in mind during fabrication of complete denture. This may be achieved by having broad area of coverage under the denture base (to reduce the force per unit area) (36). A decrease in the number of denture teeth; decrease in the buccolingual width of teeth; improved occlusal tooth design form (to decrease the amount of force required to penetrate a bolus of food) are some of the other techniques that may also be used.(37)

During tooth setup the aim should be to reduce the number of inclined planes (to minimize dislodgement of dentures and shear forces) and achieve a centralization of occlusal contacts (to increase stability of dentures and to maximize compressive load). Accurate recording of maxillomandibular relationship will ensure optimum vertical rest dimension which will decrease the frequency and duration of tooth contacts, thereby giving adequate rest to the underlying ridges. (38)

Prosthesis with surgical intervention

In aim of achieve maximum retention and stability an implant-supported prosthesis is a reliable protocol in the management of complete edentulism (21). Whereas, mandibular with two implant retained overdenture treatment is considered the 'gold standard' for the treatment of the edentulous mandible. This is based on the efficacy of this treatment modality as regards function, nutrition, and overall quality of life, balanced with patient preferences and expectations, treatment planning, prosthodontic management, and predicted costs.(33) However, the cost factor for such treatment over conventional dentures appears to be the only area of concern regarding its acceptability among all practitioners. With the increasing competition and marketing strategies adopted by the implant manufacturers, the cost of such implants will be sufficiently lowered for them to become affordable across the economic spectrum of patients. This will make implant supported prostheses a realistic option to rehabilitate all patients with poor ridges effectively and economically (39).

Also, the Bone grafting is a surgical procedure that replaces missing bone with material from patient′s own body, an artificial, synthetic, or natural substitute. Bone grafting is possible because bone tissue has the ability to regenerate completely if provided the space into which it has to grow. As natural bone grows, it generally replaces the graft material completely, resulting in a fully integrated region of new bone. Distraction osteogenesis (DO) is a method of generating new bone following a corticotomy or an osteotomy and gradual distraction. The method is based on the tension-stress principle proposed by Ilizarov.(40) The gradual bone distraction creates mechanical stimulation which induces biological responses and consequently bone regeneration. This is accomplished by a cascade of biological processes which may include differentiation of pluripotential cells, angiogenesis, osteogenesis, and bone mineralization (41).

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