Osteoporosis and Residual Ridge Modeling

The clinical and patho physiologic views of osteoporosis has been refined recently to the concept of Type I and II osteoporosis.

Type I Osteoporosis is defined as the specific consequence of menopausal estrogen deprivation, and characteristically presents the bone mass loss, notably in the trabecular bone.

Type II Osteoporosis reflects a composite of age related changed in intestinal, renal and hormonal function. Both cortical and trabecular bone are affected in Type II osteoporosis.

3.Mechanical factors

a. Functional factors:

Functional factors include the frequency, intensity, duration and direction of forces applied to bone which are translated into cellular activity, resulting in either bone formation or bone resorption, depending upon on the patients' individual resistance to these forces.

Wolff's law postulates that all changes in the function of bone are attended by definite alterations in its internal structure. Forces within physiologic limits of bone are beneficial in their massaging effect. On the other hand, increased or sustained pressure, through its disturbance to the circulatory system, produces bone resorption. The amount and frequency of stress and its distribution and direction are important factors in treatment planning. Although the total amount of the necessary masticatory stress cannot be diminished, increasing tissue coverage and decreasing the length and width of the occlusal table may lessen the load/unit area.

The frequency of stress application modifies the reaction of alveolar bone to external forces. Constant pressure on bone causes resorption, while intermittent forces favor bone formation. Since recurrent forces over short intervals of time have essentially the same resorbing effect as constant pressure, a rest period between meals is beneficial. For this reason, the patient should be warned that gum chewing has a destructive effect on the bone.

Bruxism is an expression of nervous tension, which manifests itself as gnashing, grinding or clenching of the teeth while the patient is asleep or awake. Since most denture patients do grind their teeth in sleep, the dentures should not be worn

during this period. Thus, the supporting structures are afforded the rest period essential to the maintenance of the alveolar bone. While grinding of the teeth when the patient is awake may be a habit of tension, it may also be caused due to lack of interocclusal distance.

The principal concern should be in the pattern and position of the posterior teeth. There are two mandibular movements associated with mastication: a closing/cutting movement and a lateral or grinding movement. A sharp cusp will penetrate a bolus of food with less force than a flat occlusal form. However, a law of physics explains that forces applied to an inclined plane produce a resultant force or vector perpendicular or right angles to the plane. Applying this principle to occlusal form, the resultant force of the steep incline of high cusps would produce a lateral force, which might cause alveolar resorption.

Stress distribution favorable to healthy alveolar bone maintenance is dependent principally upon bilateral balanced occlusion. Balanced occlusion is that arrangement of the teeth, which will permit the necessary mandibular movements without tending to dislodge the denture or traumatize the supporting structure.

b. ***Prosthetic factors***

The prosthetic factors are extremely difficult to evaluate because of tremendous number of variables, including anatomic, metabolic and functional factors. The traditional design of dentures includes many features whose goal is to reduce the amount of force to the ridge and to thereby reduce RRR.

These prosthetic factors include

-broad-area coverage (to reduce the force per unit area).
- decreased number of dental units.
- decreased bucco-lingual width of teeth.
- improved tooth form (to decrease the amount of force required to penetrate a bolus of food).
- avoidance of inclined planes (to minimize dislodgement of dentures and shear forces).
- centralization of occlusal contacts (to increase stability of dentures and to maximize compressive forces).
- provision of adequate tongue room (to increase stability of denture in speech and mastication).
- adequate inter-occlusal distance during rest jaw relation (to decrease the frequency and duration of tooth contacts).

Treatment and Prevention of RRR: The best way to manage the problem of residual ridge resorption is by using every means to prevent it.
a. *Prevention of loss of natural teeth.Clinicians must try to retain residual roots whenever feasible.*
b. *Proper design of dentures and maintenance*.
--- Optimal tissue health prior to making impression.
--- Impression procedures
--- Minimal pressure impression technique.
--- Selective pressure impression technique: places stress on those that best resist functional forces
--- Adequate relief of non stress bearing areas eg. Crest of mandibular ridge.
--- Broad area of coverage helps in reducing the force /unit area(Snow Shoe Effect) increased denture bearing area can greatly reduce the load per unit area on the underlying mucosa and improve denture comfort, always assuming that the OVD is not excessive.
--- Avoidance of inclined planes to minimize dislodgment of dentures and shear forces.
--- Centralization of occlusal contacts to increase stability and maximize compressive forces.
--- Provision of adequate tongue room to improve stability of denture in speech and mastication.
--- Adequate interocclusal distance during jaw rest to decrease the frequency and duration of tooth contact. Correcting the occlusal vertical dimension: Clinical studies have shown increased (excessive) OVD to be a common fault in many dentures. Guidelines suggest 2-4 mm of freeway space, but this may need to be increased in order patients or for those patients with atrophic mucosa overlying the residual ridges.
--- Occlusal table should be narrow
The concept and arrangement of teeth in neutral zone helps the teeth to occupy a space determined by the functional balance of the oro- facial and tongue musculature. Eliminating disruptive occlusal contacts, which lead to denture instability
In general, occlusal tables tend to be too large. This leads to problems of support and stability, which put too much pressure on the atrophic mucosa during function.
--- Overdentures help minimize ridge resorption and contribute to enhance retention stability, support of prosthesis along with preservation of proprioception.
--- The introduction of dental implants has revolutionized clinical practice. Use of implants for providing implant supported or implant assisted prosthesis also helps avert continuing residual ridge resorption.

Reducing the forces required to drive the denture teeth through the bolus of food*:* This may be achieved by either increasing the denture bearing area or reducing the size and altering the morphology of the occlusal table.
1- *Increasing the denture bearing area*:
The smaller the size of the fitting surface of the denture, the greater are the loads applied to the underlying mucosa. In such cases, the denture bearing area may be increased using green stick impression compound before relining or by using a chair-side relining material prior to the denture being relined conventionally.
2- *Reducing the size and altering the morphology of the occlusal table*.

c. Nutrition
--- It has been seen that one of the cofactor in RRR is low calcium and vitamin D metabolism.
--- Diet counseling for prosthodontic patients is necessary to correct imbalances in nutrient intake.
--- Denture patients with excessive RRR report lower calcium intake and poorer calcium phosphorus ratio, along with less vitamin D.

d. Preprosthetic surgery:
*** Excessive RRR leads to loss of sulcus width and depth with displacement of muscle attachment more to the crest of residual ridge.
*** Osseous reconstruction surgeries, removal of high frenal attachments, augmentation procedures, vestibuloplasties etc may be required to correct these conditions.
e. ***Immediate dentures:*** Some authors claim that the extraction followed by immediate dentures reduces the ridge resorption.

f. Overdentures Tooth supported over dentures help in improved stress distribution there by maintaining the integrity of residual ridge.
A study was conducted with overdentures supported by canines and it was seen that, the bone loss was 0.6mm whereas 5mm in conventional complete dentures.

g. Osseointegration and implant
Precautions during extraction to reduce RRR When a tooth is removed the labial plate should be preserved.
--- The labial periosteal covering should remain intact as its inner layer is responsible for remodeling of bone.
--- If a bone has to be removed it must be the palatal plate.

Important Notes:

1. Reduction of residual ridges (RRR) needs to be recognized for what it is a major unsolved oral disease which causes physical, psychologic, and economic problems for millions of people all over the world.
2. RRR is a chronic, progressive, irreversible, and disabling disease. At the present time, the relative importance of various cofactors is not known.
3. Much is known about the pathology and the pathophysiology of this oral disease, but we need to know much more about its pathogenesis, epidemiology, and etiology.
4. The ultimate goal of research of RRR is to find better methods of prevention or control of the disease. Because prevention is the key