RESIDUAL RIDGE RESORPTION (RRR)

The size of the residual ridge is reduced most rapidly in the first six months, but the bone resorption activity of the residual ridge continues throughout life at a slower rate, resulting in removal of a large amount of jaw structure. This unique phenomenon has been described as residual ridge reduction. The rate of RRR is different among persons and even at different times and sites in the same person. Residual ridge remodelling affects the function of removable prostheses, which rely greatly on the quantity and the architecture of jawbones.

Residual ridge reduction: The reduction of residual ridges is chronic, progressive, irreversible, and cumulative. On average, RRR is greater in mandible than maxilla. Ratio may be 4:1.

**Factors effecting residual ridge reduction**

- Anatomic
- Biologic/metabolic
- Mechanical

**Anatomic factors** RRR
- Quality and quantity of residual bony ridge.
- Period of edentulism
- Age
- Sex

**Metabolic Factors**
- Bone Resorptive Factors
- Bone Formation Factors

Bone Resorptive Factors
- Localized biochemical factors, involved in periodontal disease
- Dental plaque endotoxin
- Osteoclasts activating factor
- Prostaglandins
- Human gingival bone resorption stimulating factor
- Heparin within mast cells
- Trauma under an ill-fitting denture
- Reduces vascularity and oxygen tension.

**Hormonal and nutritional factors**
- Parathyroid hormone
- Parathyroid hormone maintains Ca balance in kidneys, intestine and lactating mammary glands
- Increased PTH
mobilizes excess Ca from bones. Phosphorus also moves from bone to plasma but it is excreted in urine.

Growth hormone: It prevents resorption indirectly. It increases the skeletal mass by increasing the osteoblastic activity.

Thyroclacitonin: It attracts Ca to bone, thus reducing serum Ca levels. It also inhibits resorption by reducing the number of osteoclasts.

Vitamin D: Vitamin D regulates bone resorption of dietary calcium from intestine.

Vitamin B complex and vitamin C: These are essential to maintain the integrity of periodontium. They play an important role in wound healing and resistance to infections.

Pathological factors

Periodontitis: Previously involved bone may be prone to increased resorption under prosthesis.

Diabetes mellitus: Poorly controlled diabetes, whether insulin-dependent diabetes mellitus (IDDM) or non-insulin-dependent diabetes mellitus (IDDM) can be associated with a greater prevalence of severe periodontitis.

Acromegaly: Lengthening of the mandibular ramus, continuous alveolar bone apposition and increased vertical dimension of occlusion are considerable features affecting the design of prosthesis.

Osteoporosis: It primarily occurs among elderly. It may occur due to decreased estrogen levels, lack of calcium intake and or failure in calcium absorption and transportation.

Fibrous dysplasia: It is a combination of bone resorption, fibrosis of marrow structure and disarrangement of bony architecture. It can be of variable types.

Paget’s Disease (Bone maintenance disorder): Simultaneous increase of pronounced resorptive process and accelerated bone deposition. This alternate activity results in a typical mosaic pattern of the affected bone, known as “cotton wool appearance”.

Mechanical Factors: Amount, Frequency, Direction, Duration of forces, Biting forces, Parafunctional forces.
Dampening effect by the mucoperiosteum RRR force factor dampening effect
Healthy jawbone structures are required for the retention of teeth and for maintaining good oral health. Periodontal disease is only one of several conditions that will, if left untreated, will slowly attack and destroy otherwise healthy bone tissues. Natural teeth are attached to our jawbones via a root structure. Depending on the location and size of any given tooth, these root structures will vary in size, depth and complexity. The behaviors of biting and chewing (forces of mastication) produce physical stimulation of each and every root structure which in turn stimulates the immediate bone material that the root is attached to.

Sequelae of tooth loss

- Resorption: The socket gradually remodels until it assumes the shape of the rounded edentulous ridge.
- Tilting
- Drifting
- Occlusal disharmony leads to discomfort, pain, or damage to temporomandibular joints.

Residual Ridge Reduction , : Residual ridge is a term used to describe the shape of the clinical alveolar ridge after healing of bone and soft tissues following tooth extraction.

Histologic evidence of active bone formation in the bottom of the socket is seen as early as 2 weeks after the extraction and the socket is progressively filled with newly formed bone in about 6 months.
Ridge classification  Atwoodt’s classification

Six orders of residual ridge form

Order I  Preextraction
Order II  Postextraction
Order III  High, well rounded
Order IV  Knife edge
Order V  Low, well rounded
Order VI  Depressed

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Loss in external width and height of the bone volume:

Decreased bone width.

Superior genial tubercles (which are 2 cm below the crest of bone in dentate state), eventually occupy the superior aspect of the anterior mandibular ridge.

Muscle attachment levels gradually shift occlusally.
In extreme cases muscles may attach on or very close to the crest of the ridge.

Factors effecting residual ridge reduction

1. Anatomic
2. Biologic/metabolic
3. Mechanica

1- Anatomic factors
   - Quality and quantity of residual bony ridge.
   - Period of edentulism
   - Age
   - Sex

2- Metabolic Factors

Quality of bone: On theoretic grounds, the denser the bone, the slower the rate of resorption because there is more bone to be resorbed per unit of time. Metabolic factors: Bone resorption factors Bone formation factors General body metabolism is the net sum of all the building up (anabolism) and the tearing down (catabolism) going on in the body. In equilibrium the two antagonistic actions (of osteoblasts and osteoclasts) are in balance. Ingrowth, although resorption is constantly taking place in the remodeling of bones as they grow, increased osteoblastic activity more than makes up for the bone destruction. Whereas in osteoporosis, osteoblasts are hypoactive, and, in the resorption related to hyperparathyroidism, increased
osteoblastic activity is unable to keep up with the increased osteoclastic activity.

**Bone Resorptive Factors**

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**Mechanical Factors**

- Amount
- Frequency
- Direction
- Duration of forces
- Biting forces
- Parafunctional forces
- Dampening effect by the mucoperiosteum

\[ \text{RRR} \cdot \text{force factor} \]
\[ \text{dampening effect} \]

Other factors
Postoperative scar tissue.
Surgical trauma
Overly retentive denture
Common Causes of Jawbone Deterioration
Numerous events, oral disease, dental conditions and a patient’s history of dental treatments can compromise important jawbone characteristics. Some of the more common causes are listed here:
Trauma: Events that cause a tooth to be knocked out or broken off to the extent that no biting surface exists (such as broken off at the gum line), bone stimulation ceases.

• Extractions: As soon as an adult tooth is removed, and not replaced, bone stimulation ceases for that particular site.
Dentures: Low cost, unanchored dentures are designed to ride or rest on top of gum tissue. Contrary to what many people want to believe, there is no direct stimulation of jaw bone material. Rather, there may be accompanying loss of gum tissue while the all important underlying bone structure slowly resorbs.

• Bridgework: Custom bridges are a popular treatment for replacing missing teeth. The bone structure underlying the span of missing teeth will undergo deterioration (only the anchoring teeth continue to provide important bone stimulation.

• Gross Malalignment: Alignment issues due to growth factors, trauma and untreated extractions can cause situations where certain tooth structures do not have an opposing tooth structure. The unopposed tooth may super erupt and also undergo underlying bone deterioration.

• Abnormalities in the Bite Occlusal Relationship: Dentists routinely maintain a close focus on bite and occlusion. Assessment of the biting surfaces assures normal bite characteristics, overall dental function and patient comfort. Long standing occlusal issues arising from lack of treatment, normal wear and tear and certain TMJ-TMD problems can cause abnormal physical forces that disrupt the balance of the occlusal relationship. When significant, bone deterioration can occur with certain tooth structures.
Advanced Gum Disease: Periodontitis, if left untreated, causes wholesale devastation of all tissues at the site of infection. Bone tissue, gingival tissue and connective tissue all undergo destructive changes that may or may not be fully restorable.

**Rate of resorption**
Most rapid in the first 1 year after extraction and can be as high as 4.5 mm / year.
After healing of residual ridge, annual rate of reduction in height is about 0.1-0.2 mm in mandible
Annual rate of reduction in height is about 4X greater in mandible than in maxilla.

**Pattern of resorption**
Maxilla
The resorption is upwards and inwards (smaller)

Mandible
The resorption is downward and outward (wider)

**Masticatory loads**
- Significantly lower than that produced by natural teeth
- Natural teeth can produce forces up to 175 pounds but usually 40 to 50 pounds
- Denture wearers: the average force was in the region of 22-24 pounds in the molar-bicuspid region. CD wearers are able to generate forces that are only 10-15% of those with natural teeth.

---------Good luck--------Dr. Intisar J. Ismail