

## INTERNAL AND EXTERNAL CHANGES IN THE EDENTULOUS MANDIBLE

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### INTRODUCTION

When we examine the plaster casts or many year old denture in the clinic, we sometimes find out there are gross changes in the shape of ridge. The condition of the residual ridge in edentulous patient may vary widely in form. Sometimes, from knife edged ridge to the lower flat ridge, the external morphological changes are very much variable.

Koch (1917)<sup>1)</sup> analysed mathematically to demonstrate a relationship between stress and structure. Krogh-Poulsen, Paffenbarger, and Schoonover (1948)<sup>2)</sup> published two methods of graphing the contour or the "mucosal" surface of plaster casts with microscope in order to compare the "mucosal" surface of various cast of the edentulous mandible. Lam(1960)<sup>3)</sup>, Lammie(1960)<sup>4)</sup>, and Campbell(1960)<sup>5)</sup>, Woelfel and Kreider (1962<sup>6)</sup>, 1968<sup>7)</sup>), Woelfel<sup>8)</sup>(1965), Woelfel, Winter, and Curry (1965)<sup>9)</sup>, studied chiefly contour changes due to resorption in the edentulous mandibles by means of plaster cast tracing and sectioning. Horowitz, and Shapiro (1951)<sup>10)</sup> demonstrated the modifications of mandibular architecture through animal experimentally.

Horowitz and Shapiro (1951)<sup>10)</sup>, Neufeld(1958)<sup>11)</sup>, Sobolik (1960)<sup>12)</sup>, Atwood (1963)<sup>13)</sup> examined resorptional change in mandibular bone with the combination of roentgenogram, dissection, microphotograph, and polaroid.

This report deals with the total summary of character of the bone in the residual ridge, its external contour and internal structural element changes, and the etiology.

### ETIOLOGICAL FACTORS OF BONE RESORPTION IN EDENTULOUS MANDIBLE

#### 1. Atrophying mucosa as an external molding force(The role of surgical technique)

Skin may be drawn across the deficiency. Because of its elasticity, it may be allowed partly<sup>4)</sup>. Especially, the effects of suturing extraction wounds in macacus monkey were experimentarily demonstrated <sup>13), 14), 15)</sup>. If too much soft tissue is excised, and if the reduced mucosa is closely approximated in an esthetically successful surgical closure, the subsequent healing and the cicatrical shrinkage

may result in the continuing resorption of residual ridges<sup>4)</sup>.

## 2. The action of a denture base on the ridge (Stress of force)

If a denture is delivered, for a short time, ridge resorption may occur and relining of the denture base is required, but after the relining is completed, it is often found that a relatively static condition is attained and further relining is not required for a considerable time. A possible explanation of this clinical finding is that when a denture base is first applied over a ridge, an entirely new system of force is imposed on the bone structure.

These forces are different from those that existed when teeth were present or after extraction. Especially, the change in the direction and the magnitude of the force result in a primary osteolytic effect which reduces the internal bony resistance and gives the external molding force newly created opportunity to act. After osteolysis, however, there is a period of reconstruction of bony trabeculae and ridge reduction is halted.

Sometimes a localized high incidence of pressure causes circumscribed complete osteolysis and replacement of bone by fibrous tissue<sup>4, 6, 7, 8, 13)</sup>.

## 3. Disuse atrophy

Stresses which deviated from the normal or are in excess of the limits of tolerance of the tissues, bring about resorption of the bone, but the stresses within the limits of physiological tolerance and applied in the direction of the normal forces of the particular region stimulate bone apposition<sup>4, 10, 11, 12, 16)</sup>. It means edentulous ridge needs normal physiological stimulus-proper stress to retard bone resorption. The reason that the change of alveolar bone resorption is most marked on gross examination is that it is no longer stimulated by the physiologic function of the teeth which helps maintaining of the bone tissue<sup>11)</sup>. But in the comparative study of the resorption of the alveolar ridges in denture-wearers and non-denture wearers, Campbell<sup>5)</sup> said "disuse atrophy" when dentures are not worn is questionable.

## 4. Excessive amount of force

It is generally known that the forces within the physiologic limits of bone are beneficial in their massaging effect. Numerous investigators<sup>17, 18)</sup> stated that with the most favorable ridge condition, patients can tolerate only one-eighth to one-fifth of the maximum bite force on dentures as compared to the natural dentition. So some of items of everyday life food may be difficult to masticate and cause ridge resorption of edentulous patient<sup>12, 19)</sup>.

## 5) All kinds of the related complete denture techniques<sup>6, 7, 8, 9, 20)</sup>

### a. faulty impression

- b. centric relation
- c. faulty balance
- d. disregard of the influence of the temporomandibular joint mechanism upon the occlusions and articulation of the teeth.
- e. failure to eliminate occlusal disharmony
- f. failure to serve the denture

#### 6. Aging

Microradiograph and sectioning of mandible in old age group show a comparative rise in bone resorption and osteoporosis and an increases variation in mineral density in contrast to the young bone.

### EXTERNAL CHANGES

In studying the edentulous mandible, the most marked change seen on gross examination is in the alveolar process. All reports described the evidence of external resorption of the residual mandibular ridge of one degree or another.

In the knife edged ridge, there was considerably more resorption on the sides than at the top. In general, there was more resorption over a wider area on the labial than on the lingual surface, but the greatest majority of the resorption takes place on the external surface of the residual ridge. If we compare the resorption of upper and lower jaw, we can find out following phenomena.

1. In the lower jaw, there was an apparent correlation between the use of dentures and lesser mean vertical and labiolingual dimensions of the ridges.

2. In the upper jaw, the same relationship was apparent in regard to the labiolingual dimension of the ridges, but not the vertical.

In midsagittal profile, we can observe the general sequence of the resorbing mandible.

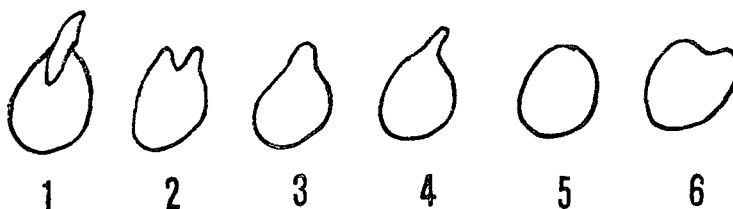


Fig. 1. Sequence of external change of human mandible after extraction in midsagittal profile.

**Order 1:** Pre-extraction: The lower central incisor is in its socket with very thin labial and lingual cortical plates with the lamina dura.

**Order 2:** Post-extraction: The healing period includes clot formation, clot organization, filling of the socket to the height of the cortical plates with new

trabecular bone, and epithelization over the socket site.

**Order 3:** High, Well-Rounded Residual Ridge: The cortical plates are rounded, narrowing of the crest of the ridge has begun, and remodeling of the internal trabecular structure has taken place.

**Order 4:** Knife edged Residual Ridge: There is marked narrowing of the labiolingual diameter of the crest of the ridge.

**Order 5:** Low-Well Rounded Residual Ridge: The end result of progressive labiolingual narrowing of a knife edged ridge is the disappearance of the knife edged portion. A more widely rounded, but considerably lower residual ridge remains.

**Order 6:** Depressed Residual Ridge: Resorption has continued below the level of the genial tubercle.

#### PARTIALLY EDENTULOUS AREA

There may be intus-susceptive growth of new skin from the edges of the wound toward its central point.

#### INTERNAL CHANGE

As external resorption occurs, both the cortex and the medulla are remodeled. As the ridge gets narrower mostly at the expense of the medulla. In the knife edged ridge, the labial and lingual cortical plates merge into one.

##### (1) Cortical Plate

The lingual cortical plate is generally about two to three times as thick as the labial plate which all but disappears in some specimen. Therefore, a portion of the cancellous bone of the central portion of the mandible could be seen through a defect in the cortical plate.

There was little or no cortical layer at the crest of the ridge in orders 2, 3, and 5 (Fig. 1.), but in order 4 where the remolded labial and lingual plates to form a knife edged ridge. The cortical plate at the crest of the ridge arranged 4.5mm. in a vertical direction.<sup>11, 13).</sup>

##### (2) Haversian System or Osteon

There is a usually a definite increase in older age in the number of incompletely mineralized and incompletely closed osteon, especially in osteoporosis. Occasionally, the central canal of an osteon is completely occluded with calcified material which appears even more radiopaque than the osteon itself.

##### (3) Trabeculae

The trabeculae of the body of the edentulous mandible are completely disorga-

nized in some and much finer in texture than in the case of the dentulous mandible. There seems to be no definite pattern of trajectories of the trabeculae until the anterior limit of the ramus is approached.

In a few instances, the trabeculae are some what perpendicular to the residual ridge in the region near its superior border. It seems possible that the trabecular pattern will rearrange itself in such a manner that it would indicate resistance to the stresses applied through such an appliance. This fact coincides with Wolff's law that all changes in the function of bone are attended by definite alterations in its internal structure. Several investigators <sup>19, 20, 21, 22)</sup> demonstrated the relationship between stress and structure.

There is a definite thinning of the cortical plate of the lower border of the mandible. Some of the thinning may be at the expense of the inner surface of the body of the mandible which leads to an over-all diminution in its size.

In some specimen, the resorption of the bone seems to leave nothing but the cortical plates which are greatly thickened and exhibit a disappearance of the trabecular pattern. This may be so extreme that the mandible is composed actually entirely of solid compact bone. Sometimes edentulous mandibles show a very a very thin cortical plate of bone over-all, and very fine trabeculation throughout the interior portion, but trabeculations do not show any definite pattern.

The trabecular pattern of the ramus, including the coronoid and condyloid processes, remains fairly constant whether the teeth are present or not. In general, the only change that is evident following the loss of teeth is that the trabeculae become finer, and the mass of the bone is reduced.

The condylar process undergoes the least changes of trabeculation of any portion of the bone as a result of the loss of the teeth, but due to the result of aging and a general diminishing in function. Horowitz and Shapiro<sup>19)</sup> conducted an interesting study related to the modifications of mandibular architecture in the rat. When the temporalis muscle was removed on one side, modifications of internal structure of the mandible of the operated side are consistent with loss of functional stimuli. The trabecula pattern shows alterations as compared with the control mandible. The form of direction of the head and neck of the condyle could be modified.

It has been claimed that the angle of the mandible changes during life as a result of the aging process and the loss of teeth. However, it may be that the pattern of resorption is such that this is not true, but only appears to be so because of the change in the external form of the bone and not a change in the angle.

#### TRABECULATION OF PARTIALLY EDENTULOUS MANDIBLE

The change in the partially edentulous mandible, in the region where the teeth

have been extracted, consists of a disorganization and disorientation of the trabecular from the typical patterns of bridged or radiating trabeculae surrounding the teeth. The trabeculae are changed to the finer, less dense pattern which is characteristic of the edentulous area. There does not seem to be any other significant change either in the trabecular pattern or in the gross structure of the bone except resorption.

### CONCLUSION

The internal and external architecture of edentulous mandible is subject to change constantly throughout life, and the degree of change is influenced directly by the external conditions.

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