Retromolar Ridge in Edentulous Patients: Clinical Considerations

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Purpose: **A removable denture base should cover the mandibular retromolar regions to provide proper basal seal and denture function in edentulous patients. The bony residual ridge form, attached muscles, and covering mucosa provide support, stability, and retention of the planned prosthesis. There is insufficient information regarding bone anatomy, mucosal tissues, and muscles in the retromolar region after tooth loss. The purpose of this study was to examine the tissue morphology in the mandibular retromolar area of edentulous subjects and report on the clinical inferences in prosthetic and implant dentistry.**

Materials and Methods: **Specimens included 75 edentulous and eight dentate dry mandibles examined by macroscopic observations and linear measurements for size determinants in the left and right retromolar regions. Buccolingual histological sections of the mandibular retromolar region from seven edentulous subjects were also examined. The specimens were from the Department of Anatomy and Anthropology, Sackler School of Medicine, Tel Aviv University.**

Results: **The specimens evaluated in this study revealed that a bony retromolar ridge can be large, with adjacent muscles attached several millimeters below its edentulous bone crest, or small, with muscles attached to the buccal and lingual bone crests. In all examined jaws, bony mylohyoid ridges (MR) and buccal shelves with affixed muscle fibers were present regardless of the remaining mandibular bone form and size.**

Conclusions: **The mylohyoid muscles attached to MRs and the buccinator muscles affixed to buccal bony shelves are some of the barriers to the chronic but limited bone resorption, following tooth loss, time of edentulism, systemic factors, and denture wear.**

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INDEX WORDS: morphology, mandibular jaws after tooth loss

THE RETROMOLAR pad is a tissue mass formed by thin non-keratinized mucosa and loose glandular connective tissue, posterior to the retromolar papilla. This pad covers underlying bone with surrounding attached muscle fibers.[1-3] After molar loss, the bony alveolar process and surrounding soft periodontal tissues remodel, mainly resorb, and blend with the retromolar pad.[3-6]

The bony residual ridge, attached muscles, and covering mucosa occupy the mandibular edentulous retromolar region. The bony mandible is connected by muscle fibers to adjacent structures (cranium, tongue, cheeks, hyoid bone), which are important for diverse functions, such as mastication, swallowing, deglutition, and speaking. Therefore, the anatomic foundation of the supporting tissues and the various muscular activities of the cheeks, lips, and tongue are important features of denture function.[7-15]

The mandibular removable denture should be designed to cover the retromolar ridge tissues. The form of the ridge determines the upper and intaglio surfaces of the denture base. The reflection and resiliency of the muscle fibers attached to the mandible at the floor of the mouth shapes the contour of the facial and lingual borders of mandibular dentures.[7,8,12-14]

There is reliable but insufficient information on the different bone, mucosa, and muscle tissue forms and distribution at the mandibular regions in edentulous patients.[2,4-8,11-16] The purpose of

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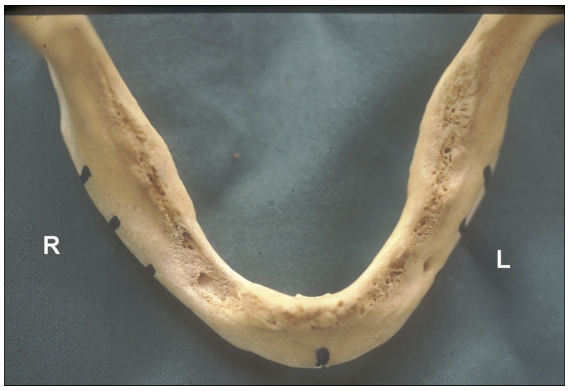

Figure 1. Occlusal view, dry edentulous mandible. Large and round residual ridges present at the left (L) retromolar crest region. Small, thin, bony ridge is seen at the right (R) retromolar crest ridge. The entire edentulous crest has a continuous, irregular track of trabecular bone bound by buccal and lingual cortical plates.

this study was to examine the anatomic attributes of edentulous retromolar mandibles, in dry skulls and histological sections, with their clinical implications.

Materials and Methods

A collection of 75 edentulous and eight dentate (control group) dry mandibles from the Department of Anatomy and Anthropology, Sackler School of Medicine, Tel Aviv University, were examined macroscopically. The experimental sample consisted of edentulous adult jaws (42 males, 26 females, seven gender unknown). Specimens were edentulous with mature bone residual ridges at the places formerly occupied by the natural teeth. There were no signs of tooth sockets and/or remaining bony alveolar process to indicate recently extracted teeth (Fig 1).

Data were not available for specimens regarding age, time of extractions, and sequence of tooth loss.

Linear measurements were taken with a caliper (Calipretto, Renfort Co., Hilzingen, Germany). The height of the edentulous bone retromolar ridge, between the crest and the base of the mandible, was measured (in mm) 1 cm anterior to the intersection of the mandibular body with the ascending ramus. The horizontal length of the mylohyoid ridge (MR) and the vertical distance from the center of the MR to the residual crest were measured at the lingual surface of the edentulous jaw (Fig 2).

For control, eight mandibles with a complete complement of premolar and molar natural teeth were examined. The heights of the dentate retromolar ridges

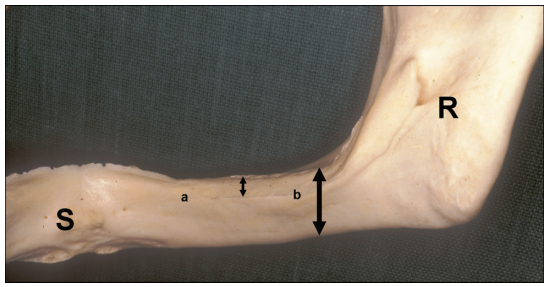

Figure 2. Lingual surface of an edentulous mandible. Mental spine (S). Mandibular ramus (R). Thick vertical arrow marks the height of the edentulous mandibular body. Distance between a and b indicates the length of the mylohyoid ridge. Thin arrow is the distance between the edentulous crest to the center of the mylohyoid ridge.

were measured from the crest of the tooth's alveolar process to the jaw base, 1 cm anterior to the body-ramus junction. The horizontal length of the MR and the vertical distance from the center of the MR to the alveolar process of the corresponding molar were also measured to compare with the edentulous specimens.

All bone measurements were taken on both the left and right sides of the 75 edentulous and eight dentate jaws. Two examiners (JP, BA) rated the linear values according to accepted anthropological methods.[17-21]

Calibrations produced a 95% correlation between examiners.

In addition, buccolingual histologic sections of the retromolar regions, 1 cm anterior to the mandibular body intersection with the ramus, from seven edentulous subjects (four male and three female), from the dissection room of the Department of Anatomy and Anthropology, Sackler School of Medicine, Tel Aviv University, were examined.

Results

Dry Bone Specimens

Left and right homologous edentulous retromolar ridges were not always similar, and sometimes not even alike in shape or size (Fig 1).

The edentulous mandibles at the retromolar regions (150 measurements in 75 jaws) varied in height from 10 to 27 mm (mean value 18 mm, standard deviation 9.3). At the mandibular lingual surface the MR, an anteroposterior oblique bony line, was always present, and varied in length from 20 to 46 mm. The vertical distance from the center of the MR to the crest of the edentulous jaw was extended from 0 to 10 mm (Table 1).

Table 1. Length of the Mylohyoid Ridge and Distance from the Edentulous Crest*/Alveolar Process** to the Mylohyoid Ridge (in mm)

		Length of the Mylohyoid Ridge	*Distance from the Edentulous Crest* (alveolar process**) to the Center of the Mylohoid Ridge*
Edentulous jaws*	Range	20–46	00–10
	Mean (s.d.)	34.7 (5.6)	3.62 (2.35)
Dentate jaws**	Range	18–47	14–31
	Mean (s.d.)	33.2 (4.6)	23.9 (2.04)

*150 measurements in 75 edentulous jaws.
**16 measurements in eight dentulous jaws.

In all edentulous jaws studied, the buccal shelf, another well-defined bone structure at the buccal retromolar region, was also present (Figs 1, 3–5).

In the dentate control group (16 measurements in eight jaws) the heights of the mandibles at the retromolar regions varied from 16 to 36 mm (mean 23 mm, SD 8.3). The bony MR lengths ranged from 18 to 47 mm, and the distance from the center of the MRs to the bone crests of the corresponding alveolar process ranged from 14 to 31 mm (Table 1).

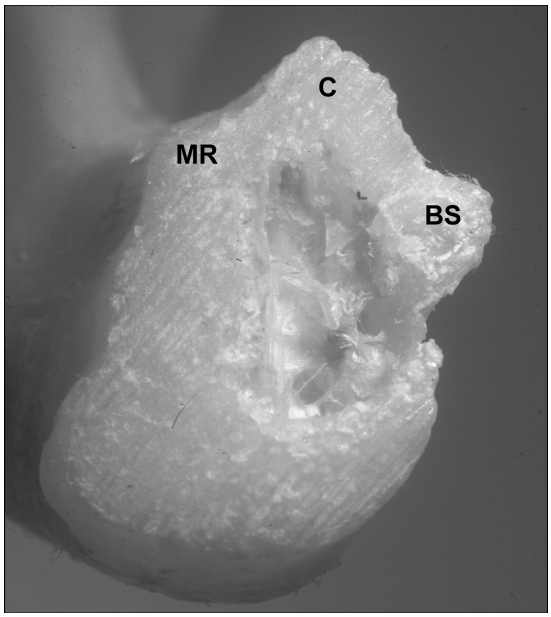

Figure 3. Buccolingual dry bone section at the retromolar region. Buccal shelf (BS) at the buccal surface and mylohyoid ridge (MR) at the lingual surface surround the edentulous bone crest (C).

Histologic Sections

A non-stratified epithelium over loose connective tissue fibers formed the mucosa of the edentulous retromolar ridges. The sub-mucosa contained

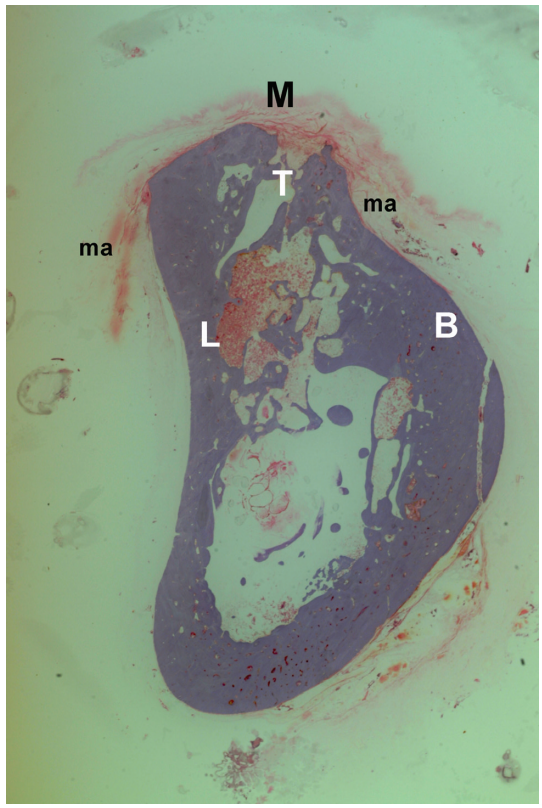

Figure 4. Buccolingual histologic section of an edentulous ridge at the retromolar region from a 67-year-old female's specimen. Trabecular bone (T) is flanged by the buccal (B) and lingual (L) cortical plates. Muscle attachments (ma) are located several mm apical to the bony crest. The covering soft tissues mucosa (M) follows the upper bone contour.

Figure 5. Buccolingual histologic section of a robust bony edentulous mandible at the retromolar region from a 59-year-old male's specimen. The thin shallow mucosa (M) does not follow the bone morphologic configuration. Muscles (ma) are attached almost at the same level with the occlusal end of the bony ridge. Buccal (B) and lingual (L) lateral cortical plates surround trabecular bone (T) at the crest.

scattered glandular tissue with muscle fibers attached to the buccal and lingual surfaces of the residual bone ridge. Bone tissue at the crest of the residual ridge was trabecular (Figs 1, 3–6).

Buccolingually, the retromolar bone ridge can be large and round with muscles attached several mm below its edentulous crest (Fig 4), or small and thin with the adjacent muscles inserted up to the ridge crest (Fig 5).

The covering mucosa can follow the bone crest form (Fig 4) and may not conform to the underlying bone surface (Figs 5, 6).

Discussion

Gender, genetics, systemic conditions, tooth loss sequence, length of edentulous time, denture wear, and other unknown factors influence the chronic remodeling process of the edentulous

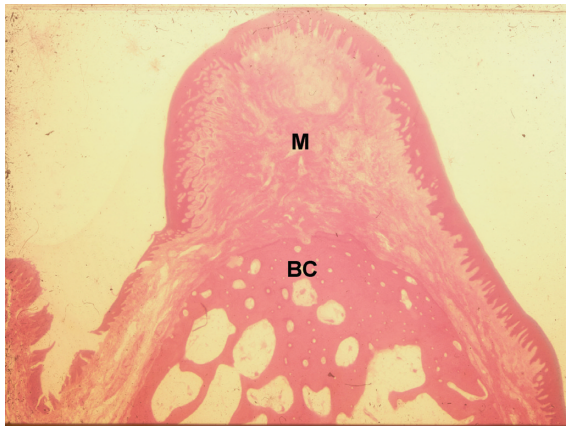

Figure 6. Closer view of a buccolingual section at the crest of the residual ridge from a 60-year-old female's specimen. Thick square mucosa (M) does not conform in size or shape to the underlying round bone crest surface (B).

jaw;[21-25] however, this resorptive pattern is limited. The entire edentulous mandibular body has never been known to completely resorb.

Furthermore, physiological spontaneous fracture of the mandible does not occur.[26-28] The jaws always retain their bony body with its MRs, buccal shelves, and eventually, their attached muscles even in thin, highly resorbed edentulous mandibles. This was observed in all the dry specimens, the histologic sections examined in this study, and in all cases described in the available dental literature.[2,4,6,11,12,14,19]

Therefore, it is suggested that the mylohyoid muscles attach to the bony MRs, the buccinator muscles attach to the bony buccal shelves, and the additional muscles that surround the mandible are some of the factors that limit chronic bone resorption of the edentulous jaw.

In the dental literature, histologic buccolingual sections[2,4,6,11] and imaging[29,30] of the edentulous retromolar regions support the present findings that the covering mucosa does not always conform to the underlying bone surface. Therefore, cross-sectional radiographs, such as computerized or conventional tomography, are necessary before implant planning to know the form of the soft tissues in relation to the underlying bone and to determine the correct location for implant insertion.

Conclusions

After mandibular molar extraction, the alveolar process and surrounding periodontal tissues remodel and resorb toward the base of the mandible, blending with the retromolar tissues to form the edentulous retromolar ridge.

According to the specimens in this study, bone resorption, extensive as it may be, did not progress beyond the MRs or past the buccal shelves and their attached muscles.

The oral muscles that surround and are attached to the bone surfaces of the edentulous mandible may be among the determinants that limit the chronic and irreversible residual bone tissue resorption. The oral contour of the mucosal tissues does not always follow the underlying bone form.

References

1. Sicher H, DuBrull E: Oral Anatomy. St. Louis, MO, Mosby, 1970, pp 179-181
2. Martone AL, Edwards LF: Anatomy of the mouth and its related structures. J Prosthet Dent 1962;12:817-834
3. The Glossary of Prosthodontic Terms. Eight Edition. The Academy of Prosthodontics. J Prosthet Dent July 2005;94:69
4. Pendleton EC: The minute anatomy of the denture bearing area. J Am Dent Assoc 1934;21:488-497
5. Enlow D. Section I: Alveolar bone, in Lang BR, Kelsey CC (eds): International Prosthodontic Workshop on Complete Denture Occlusion. Ann Arbor, MI, The University of Michigan School of Dentistry, 1973, pp 3-48
6. Gruber H, Solar P, Ulm C: Maxillomandibular anatomy and patterns of resorption following atrophy, in Watzek G (ed): Endosseous Implants. Scientific and Clinical Aspects. Chicago, IL, Quintessence, 1993, pp 29-62
7. Brill N, Tryde G, Cantor R: The dynamic nature of the lower denture space. J Prosthet Dent 1965;15:401-418
8. Tryde G, Olsson K, Jensen SA, et al: Dynamic impression methods. J Prosthet Dent 1965;15:1023-1034
9. Pietrokovski J, Chapman R: Foundation for the removable denture. Part 1. The residual ridge. Refuat Hapeh Vehashinayim 1977;26:21-26
10. Pietrokovski J, Mersel A: The foundation for removable partial dentures. Part II. The adjacent structures. Compend Contin Educ Dent 1982;2:93-104
11. Falschsussel GKH: Zahnarztliche implantologie. Wissenschaft und Praxis. Berlin, Quintessence, 1986: 34-85, 241-247
12. Davis DM. Developing an analogue/substitute for the mandibular denture bearing area, in Zarb GA, Bolender CL, Eckert S, et al (eds): Prosthodontic Treatment for Edentulous Patients. St. Louis, MO, Mosby, 2004, pp 232-251
13. Carr AB, McGivney GP, Brown DT: Support for the distal extension denture base, in: Carr AB, McGivney GP, Brown DT (eds): McCracken's Removable Partial Prosthodontics. St. Louis, MO, Mosby, 2004, pp 287-299
14. Rahn AO, Heartwell CM: Anatomy and Physiology. Textbook of Complete Dentures. Philadelphia, PA, Lea & Febiger, 1993, pp 1-46
15. The Arnheim Consensus on Preprosthetic Surgery. Arnheim, Holland: The European Prosthodontic Association Meeting Booklet, 1989: 2-17
16. Worthington P, Rubenstein JE: Problems associated with the atrophic mandible. Dent Clin North Am 1998;42:129-160
17. Evans RE, Bass WM (eds): Human Osteology, A Laboratory and Field Manual of the Human Skeleton. Springfield, MO, The Missouri Archeological Society, 1971, pp 90-113
18. Olivier G: Practical Anthropology. Springfield, IL, Charles C. Thomas Pub, 1969, pp 16-88
19. DuBrul L (ed): Sicher and Dubrul's Oral Anatomy (ed 8). St. Louis, MO, Mosby, 1988, pp 75-84
20. Quirynen M, Mraiwa N, van Steenberghe D, et al: Morphology and dimensions of the mandibular jaw bone in the interforaminal region in patients requiring implants in the distal areas. Clin Oral Implants Res 2003;14:280-285
21. Pietrokovski J, Harfin J, Levy F: The influence of age and denture wear on the size of edentulous structures. Gerodontology 2003;20:100-105
22. Klemetti E: A review of residual ridge resorption and bone density. J Prosthet Dent 1996;75:512-514
23. Xie Q, Ainamo A, Tilvis R: Association of residual ridge resorption with systemic factors in home-living elderly subjects. Acta Odontol Scand 1997;55:299-305
24. Carlsson GE: Responses of jawbone to pressure. Gerodontology 2004;21:65-70
25. Nishimura I, Garrett N: Impact of Human Genome Project on treatment of frail and edentulous patients. Gerodontology 2004;21:3-9
26. Libersa P, Roze D, Dumousseau T: Spontaneous mandibular fractures in a partially edentulous patient: case report. J Can Dent Assoc 2003;69:428-430
27. Banks P: Killey's Fractures of the Mandible (ed 4). London, Butterworth, Heineman & Wright, 1991, pp 1-112
28. Thaller SR: Fractures of the edentulous mandible: a retrospective review. J Craniofac Surg 1993;4:91-94
29. Shetty V, Benson B: Orofacial implants, in White SC, Pharaoh MJ (eds): Oral Radiology. Principles and Interpretation (ed 5). St. Louis, MO, Mosby, 2000, pp 677-692
30. Grossman CB: Magnetic Resonance Imaging and Computed Tomography of the Head and Spine (ed 2). Philadelphia, PA, Williams & Wilkins, 1995, pp 3-78