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Alveolar Ridge Defect Diagnosis: An Evidence Based Approach

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Abstract

Background: After tooth extraction, a cascade of inflammatory reactions is activated and the extraction socket is temporarily closed by blood clot. Epithelial tissue begins its proliferation and migration with in the first week and disrupted tissue integrity is restored. The size of the residual ridge is reduced most rapidly in the first 6 months, but the bone resorption activity continues throughout life at a slower rate, resulting in considerable quantity of loss of jaw structure. Bone morphology, including cortical bone thickness, bone height, and width, can influence surgical procedures such as placement of dental and orthodontic anchorage implant. Diagnosis and accuracy in determining the exact location, extent and configuration of bony defects are of utmost importance to determine prognosis, to plan treatment and to preserve the teeth in the long run. Because determination of the depth and to some extent, the width of bony defects is an important parameter in the prognosis of treatment. Different procedures have been employed for evaluating morphologic changes which include cephalometric examination, surgical re-entry and direct measurements and radiography.

Keywords: Alveolar Ridge, Alveolar Ridge defect, Osseous Defect, Osseous Topography

Introduction

The alveolar wall is surrounded by the supporting bone with which it forms an anatomical unit. The supporting bone includes the buccal and oral cortical plates and the septa. The cortical plates are in continuity with the cortices of the body of the jaws. Cancellous bone is interposed between the alveolar wall and the cortical plates [1].

A wide number of changes such as atrophy and complete deprivation of attachment apparatus takes place post extraction. Healing of hard as well as soft tissues is generally uneventful post-extraction. Some amount of loss in alveolar bone and structural alterations in the soft tissue overlying the tooth is expected post removal of tooth. Hard tissue and overlying soft tissue are both expected to undergo horizontal and vertical changes in dimensions.

A major limitation for successful implant placement remains the problem of inadequate alveolar ridge width. Thus, to satisfy the ideal goals of implant dentistry, the hard and soft tissues need to present in ideal volume and quality.

Alveolar width deficiency can represent loss of buccal (labial) cortical or medullary bone, or both. Deficiency of the buccal cortex (cortical plate) after tooth extraction can present significant difficulty in implant reconstruction. The buccal cortical plate with a thickness, 2 mm next to an implant appears to have a higher risk of subsequent resorption.

It is important to establish a proper diagnosis based on the alveolar ridge assessment before initiation of the treatment plan. Different techniques have been used to assess the amount of apico coronal and buccolingual bone resorption. Evaluation of the same with various techniques clinically have been done which includes solid models, prefabricated stents, evaluation with the help of photographs, and microscopical study which includes animal models. Initial clinical evaluation supplemented by radiographic images helps in most cases to distinguish two-dimensional (2D) versus (3D) alveolar bone deficiency. Evaluation of the dimensions of the available alveolar bone is an important prerequisite [2].

Osseous Topography:

The bone contour normally conforms to the prominence of the roots, with intervening vertical depressions that taper toward the margin. Alveolar bone anatomy varies among patients and has important clinical implications.

The height and thickness of the facial and lingual bony plates are affected by the alignment of the teeth, the angulation of the root to the bone, and occlusal forces. On teeth in labial version, the margin of the labial bone is located farther apically than it is on teeth that are in proper alignment. The bone margin is thinned to a knife edge, and it presents an accentuated arc in the direction of the apex. On teeth in lingual version, the facial bony plate is thicker than normal. The margin is blunt, rounded, and horizontal rather than arcuate [3].

FACTORS AFFECTING ALVEOLAR RIDGE RESORPTION:

The rate of residual ridge resorption continues throughout the lifetime depending on various factors resulting in 3-4 times bone loss in mandible as compared to maxilla.

a) Anatomic factors

It includes volume of bone and characteristic of bone. Residual ridge resorption varies with the volume and characteristic of bone of the residual ridge. More the amount of bone present, more the quantity of resorption will be seen. Sometimes large ridges are resorbed rapidly, and some knife-edge ridges may remain with little changes for long period of time. Bone loss is greater in broad ridges, because there is more bone present to be per unit time. The rate of vertical bone loss is faster in small ridges than broad ridges. The density of the bone is another major factor to be considered for the ridge resorption. Irrespective of the degree of calcification of the bone, the metabolic activity of the resorption does not manifest in the density and the osteoclastic activity of the bone.

b) Metabolic factors

Residual ridge resorption changes with localized or systemic bone resorptive factors and also affected by certain bone formation factors. It includes vitamin D supplements and calcium. Bone metabolism depends on cell metabolism of osteoblast and osteoclast. Inflammatory mediators like prostaglandins are considered as playing an important role in increasing the rate of residual ridge resorption. The rates of metabolism of osteoblasts and osteoclast cells are affected by thyroid hormones.

c) Mechanical factors

Bone undergoes corresponding changes through its own specific metabolism. Mechanical Factors Bone becomes stronger when it is constantly used during physical activity. The bone that is disused will tend to subside. When limited force is applied to living bone, it leads to some unknown mechanism of remodeling of bone through the periodontal ligament. The residual ridge is exposed to different types of forces after the teeth are removed [4].

Osseous Defects

The bone loss which is induced by periodontitis occur either single or in different combination forms. The identification of these osseous defects on surgical exposure of bone is clinically challenging as the osseous surgery are based on the diagnosis and it becomes imperative for a clinician to understand these defects and categorize them well to have better therapeutic approaches. Intimate knowledge of all these periodontal osseous defects associated with periodontal disease is essential [5].

Definition: Osseous defects are defined as the alterations in the morphology of the alveolar bone (GPT). As these defects act a crucial role either in initiating or progressing the disease, alveolar

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architecture influences the occurrence of disease induced defects.

Developmental osseous defects or abberations:

The Bulbous Bone Contours: The enlargements in bone which are caused because of exostoses, buttressing bone formation and sometimes as an adaptation to function.

The Exostoses: Exostoses are out growths of varied shape and size in the bone which can also occur as sharp ridges, nodules either large or small, projections which may be appear as spikes, or in any one of these combinations,

Fenestrations: The areas in which the root is devoid or denuded of supporting alveolar bone and the surface of the root is covered by periosteum of b one, overlying gingiva and in these types of defects we can see the intact marginal bone and generally seen as isolated areas.

Dehiscence: These are the areas with denuded bone where marginal bone is lost. They are seen often on the facial bone compared to lingual and common in the anterior teeth compared to posterior teeth with bilateral frequency.

Acquired osseous defects:

The Buttressing Bone (Lipping) formation: Alveolar bone formation at some instances occurs to buttress the bony trabeculae which are weakened due to bone resorption and if it occurs within the jaw, termed as central buttressing bone formation and if it occurs on the external surface of bone, termed as peripheral buttressing bone formation.

Marginal Gutter: The shallow linear defect which is present in between the marginal alveolar bone of the radical cortical plate or inter-dental alveolar bone.

Ledges: These are plateau-like margins of bone which are caused due to resorption of the thickened bone plates usually the buccal\labial bone [6].

Classification Of Alveolar Ridge Defect

Bone quality in implant dentistry indicates architecture, three-dimensional orientation of architecture & bone mineral density.

Bone quantity determines the amount of bone (Bone Level) present. Reduction in the height & width of alveolar process can result in aesthetic/functional problems.

Classification systems are generally used to establish guidelines for treatment of a particular clinical situation. Viewed in this context, such classifications should aid in defining the clinical problem, predicting realistic treatment outcomes, and realizing proposed treatment limitations.

In 1985, Lekholm and Zarb presented a classification of the jawbone based on shape and quality to be used to analyze implant anchorage. They described five groups of mandibular and maxillary cross-sectional shapes

a. Most of the alveolar ridge is present.
b. Moderate residual ridge resorption has occurred.
c. Advanced residual ridge resorption has occurred (only basal bone remains).
d. Some resorption of the basal bone has started.
e. Extreme resorption of the basal bone has occurred.

The authors also described four groups of bone quality:

1. Almost the entire jawbone is composed of homogenous compact bone.
2. A thick layer of cortical bone surrounds dense trabecular bone.
3. A thin layer of cortical bone surrounds a core of dense trabecular bone.
4. A thin layer of cortical bone surrounds a core of low-density trabecular bone.

According to Seibert ridge defects in edentulous regions can be divided into three classes

a. Class I: loss of tissue in the buccolingual direction with normal height in the apical-coronal direction.
b. Class II: loss of the tissue in the apical-coronal direction, with normal width in the buccolingual direction.
c. Class III: a combination of Class I and Class II (loss of both height and width).

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The most recent classification is that given by Palacci–Ericsson classification of the alveolar ridge (2016)[7].

	Vertical loss		Horizontal loss
Class I	Intact and healthy papillae	**Class A**	Intact/slightly reduced buccal tissue
Class II	Limited loss of the papillae less than 50% loss	**Class B**	Limited loss of the buccal tissue
Class III	Severe loss of the papillae more than 50% loss	**Class C**	Severe loss of the buccal tissue
Class IV	Absence of papillae (edentulous areas)	**Class D**	Extensive loss of buccal tissue associated with limited amount of attached mucosa

Methods Of Determining Alveolar Bone Defect

In order for the clinician to become aware of the morphology of the alveolar process of his patient, two analyses of osseous form are necessary. The first is superficial, and is accomplished at the initial examination of the patient. The second, a precise assessment of bone morphology, is obtained after initial therapy has been completed and just prior to any surgical intervention.

A. Examination of osseous form during the initial examination

During the initial examination the practitioner can gain a concept or "feeling" of the general topography of the alveolar process. To accomplish this attention must be given to: the general form and contour of the jaws, the alveolar arch, and the dental arch; the position, size and state of eruption of the teeth; the depths of the sulci or periodontal pockets; and the interpretation of a full-mouth roentgenographic survey.

Both Edentulous And Dentate Subjects:

1. Form and Thickness of the Gross Alveolar Process:

Although one may visually categorize the alveolar process as being either thick or thin, this impression must be confirmed by palpation. Palpation below the mucogingival junction along the middle of the alveolar process will quickly reveal this fact. Minute exostoses and bony ledges, as well as areas of extreme thinness, will also be noted with palpation. When the alveolar process is thin, it portrays a "washboard" feel or character. This "washboard" effect is a reflection of the interdental grooving within the process and the prominence of individual tooth roots.

2. Full-mouth Roentgenographic Survey:

Routine full-mouth roentgenographic examinations have a limited, but valued, use in determining the actual shape of an alveolar process. The primary limitation is the fact that the radiographs do not accurately portray the outer cortical bone plates. In spite of this they are a great aid in determining the general height of the alveolar process in respect to the teeth.

a. **Periapical radiography:** The paralleling technique for periapical radiographs presents a fairly reliable estimation of the object being

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examined in the vertical and mesiodistal dimension. It provides high-resolution images with fine bony detail of the area being examined. The technique, however, permits only a limited area of the dentoalveolar region to be visualized and no cross-sectional (buccal-lingual) information is provided.

b. **Panoramic radiography:** Panoramic radiography gives a general overview of the jaws and relevant anatomic landmarks and can aid in the identification of gross pathologic abnormalities in the jaws. They can provide an estimate of the ridge height at a specific location when a radiographic marker of known dimensions is used. Panoramic radiographs also only provide information of the vertical and mesiodistal dimensions of a region and do not offer cross-sectional (buccal- lingual) information. In cases of bony undercuts or knife-edged ridges, measurements from these images can be misleading. Due to its many inherent limitations, panoramic radiography is considered suboptimal as a single imaging source for preoperative implant site assessment.

c. **Posterior bite-wing films:** which quite accurately show the level and contour of the crestal aspect of the inter-dental septum. With careful reading of the bite-wing films, one can closely determine the amount of horizontal bone loss that has taken place. Extreme irregularities in the crestal contours of the interdental septa will be evident where there has been drastic vertical bone loss around individual teeth.

d. **Cone beam computed tomography (CBCT):** The introduction of cone beam computed tomography (CBCT) has overcome the shortcomings of conventional radiography and has established a new era of implant imaging. The technology has improved diagnostic information and treatment outcomes due to visualization of the anatomy at potential implant sites in three dimensions (3D) with submillimeter accuracy. Software programs permit versatile reformatting capabilities that allow slicing of the scan to be performed in any plane; this can be performed to obtain sectional images in the optimum orientation for implant site assessment.

For Dentate Subjects:

1. Tooth Size and Position:

Tooth-arch discrepancies are frequent indicators of alterations in bone form. Teeth that appear too large for the jaw structure often indicate either the presence of relatively thin bone or absence of bone over the coronal aspect of their roots. In addition, the extreme size of the teeth may create a crowding and mal-positioning of the teeth which in itself is indicative of definite known bone variations. Notation of the position of the tooth in the arch is one of the most reliable indicators of the quantity of bone underlying the investing tissues.

2. Sulcus and Pocket Depths:

It is commonly accepted that in health the epithelial attachment closely mirrors or follows the contour of the cementoenamel junction. Therefore, any discrepancy in the pocket probing from this healthy or typical pattern may be interpreted as a like alteration in the underlying osseous form. A determination of this sort can only be made if an adequate number of pocket readings on each tooth are made. At a minimum there must be six readings, one on the mesiobuccal, the buccal, the distobuccal, the mesiolingual, the lingual, and the distolingual aspect of each tooth in the area of concern.

B. Examination Of The Osseous Form Prior To Surgical Intervention

If the surgical approach is to be taken, intimate familiarity with the position, shape and magnitude of any and all osseous deformities must be acquired. This is mandatory for determining the most appropriate surgical approach. Several techniques may be utilized by the clinician to accurately depict the osseous contour beneath the soft tissues. These techniques include: the probing and plotting of the position of the epithelial attachment; the probing of the bone surface through the soft tissues; and the use of special roentgenographic techniques.

In Edentulous Subjects:

Ridge-Mapping Measurements:

Assessment of the bucco-lingual dimension of the osseous ridge also is needed for proper treatment planning. An alternative method is ridge mapping using a caliper device under local anesthesia. The pointed tips of the instrument penetrate buccal and lingual soft tissue layers and measure the bucco-

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lingual width of the underlying bone. This procedure is performed chairside and provides instant information. Ridge mapping may obviate tomographic imaging.

C. EXAMINATION OF THE OSSEOUS FORM FOLLOWING SURGICAL EXPOSURE OF THE BONE

Direct Caliper Measurements Following Surgical Exposure of the Bone:

Following surgical flap reflection, ridge width can be measured directly on the exposed bone at the various locations of the guide holes using the same caliper device and stent as described previously [8].

Discussion

The alveolar wall is surrounded by the supporting bone with which it forms an anatomical unit. The supporting bone includes the buccal and oral cortical plates and the septa. The cortical plates are in continuity with the cortices of the body of the jaws. Cancellous bone is interposed between the alveolar wall and the cortical plates. In some locations, the amount of cancellous bone is minimal, and sometimes there is none.

The bony separation between adjacent teeth in a dental arch is termed as interdental septum [3].

The changes which are observed in the alveolar process architecture may differ in form, distribution and degree within same individual at different sites as well as between individuals.

The use of dental implants to support prosthodontic restorations has a high success rate. Careful diagnosis and treatment planning are critical for a favorable outcome. Evaluation of the dimensions of the available alveolar bone is an important prerequisite[2].

Diagnosis and accuracy in determining the exact location, extent and configuration of bony defects are of utmost importance to determine prognosis, to plan treatment and to preserve the teeth in the long run. Because determination of the depth and to some extent, the width of bony defects is an important parameter in the prognosis of treatment.

Different procedures have been employed for evaluating morphologic changes which include cephalometric examination, surgical re-entry and direct measurements.

Direct caliper measurement following surgical exposure of the bone would seem to be the most accurate measurement and could be considered the ‘‘gold standard. The ability of the radiographs to detect periodontal osseous defects is relatively low, especially for defects of small depth and/or small buccolingual width [9].

Cone Beam Computed Tomography (CBCT) Offers clinician 3-Dimensional view for accurate diagnosis and treatment.

Summary And Conclusion

After tooth extraction, a cascade of inflammatory reactions is activated and the extraction socket is temporarily closed by blood clot. Epithelial tissue begins its proliferation and migration with in the first week and disrupted tissue integrity is restored. The most striking feature of extraction wound healing is that even after healing of the wounds, the residual alveolar ridge undergoes a lifelong catabolic remodeling[10].

Bone morphology, including cortical bone thickness, bone height, and width, can influence surgical procedures such as placement of dental and orthodontic anchorage implants. To obtain optimum functional and aesthetic prosthetic reconstructions sufficient amount of alveolar bone volume and favorable architecture of the alveolar ridge are essential.

The identification of these osseous defects on surgical exposure of bone is clinically challenging as the osseous surgery are based on the diagnosis and it becomes imperative for a clinician to understand these defects and categorize them well to have better therapeutic approaches. Intimate knowledge of all these periodontal osseous defects associated with periodontal disease is essential [11].

Refrences:

1. Saffar JL, Lasfargues JJ, Cherruau M. Alveolar bone and the alveolar process: the socket that is never stable. Perio 2000. 1997 Feb;13(1):76-90.
2. Araújo MG, Lindhe J. Dimensional ridge alterations following tooth extraction. An experimental study in the dog. J. Clin. Periodontol. 2005 Feb;32(2):212-8.

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3. Newman and Carranza's Clinical Periodontology, 13th Edition.
4. Klemetti E. A review of residual ridge resorption and bone density. J Prosthet. Dent. 1996 May 1;75(5):512-4.
5. Davies RM, Downer MC, Hull PS, Lennon MA. Alveolar defects in human skulls. J Clin Periodontol. 1974 Jun;1(2):107-11.
6. Karn KW, Shockett HP, Moffitt WC, Gray JL. Topographic classification of deformities of the alveolar process. J Periodontol. 1984 Jun;55(6):336-40.
7. Palacci P. Classification of Alveolar Ridge Defects in Implant Dentistry. Horizontal Alveolar Ridge Augmentation in Implant Dentistry: A Surgical Manual. 2015 Dec 15;7:72.
8. Easley JR. Methods of determining alveolar osseous form. J Periodontol. 1967 Mar;38(2):112-8.
9. Pepelassi EA, Tsiklakis K, Diamanti-Kipioti A. Radiographic detection and assessment of the periodontal endosseous defects. J clin. periodontol. 2000 Apr;27(4):224-30.
10. Tan WL, Wong TL, Wong MC, Lang NP. A systematic review of post-extractional alveolar hard and soft tissue dimensional changes in humans. Clinical oral implants research. 2012 Feb;23:1-21.
11. Chen LC, Lundgren T, Hallström H, Cherel F. Comparison of different methods of assessing alveolar ridge dimensions prior to dental implant placement. J periodontol. 2008 Mar;79(3):401-5.

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