EVALUATION OF SKELETAL AND ALVEOLAR BONE DENSITY IN PATIENTS SUFFERING FROM ADVANCED CHRONIC PERIODONTITIS

Thesis

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Dedication

I would like to dedicate this thesis to my loving and supporting husband, my dear little son and my beloved parents to whom I am greatly indebted.

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Introduction

Bone is a vital dynamic connective tissue which is continuously formed and resorbed throughout the whole life. From birth till the age of thirty the rate of bone formation is more than resorption. At the age of thirty, the bone mass shows a rise to a maximum, then a subsequent decline is observed there after. **(Bab and Einborn, 1994; Laycock and Wise, 1996; Marcus et al., 1996).**

Osteoporosis has been defined as a disease characterized by low bone density and microarchitectural deterioration of bone tissues due to an inbalance between bone resorption and formation, favoring resorption and leading to osteoporosis. Thus, osteoporosis is a disease characterized by a low bone mass and a fracture risk. **(Riggs and Melton, 1991; Wactawski – wende et al., 1996)**.

Researches revealed that the Jaw bone is one of the earliest sites manifesting osteopenic changes, particularly the alveolar bone, followed by the cranial bones, ribs, vertebrae and lastly the limbs are affected **(Ortega et al., 1998)**. The mandibular bone mineral density , the width of lamina dura , the level of alveolar bone resorption together with other

parameters were evaluated to distinguish between normal and osteoporotic population **(Kribbs, 1989; Kribbs, 1990; Wowern and Kollerup, 1992; Mohajery and Brooks, 1992 and Taguchi et al., 1995)**.

Peridontal disease is a common infection and represents one of the most prevalent public health problems where it results in loss of connective tissue attachment, reduced alveolar bone levels, increased pocket depth and gingival recession **(Hammerie et al., 1990).**

Several methods have been advocated to determine the clinical parameters and the severity of the periodontal disease **(Hammerie et al., 1990)** .Clinical evaluation of alveolar bone loss in patients with periodontal disease is presently accomplished by radiographic assessment and periodontal pocket measurement **(Green- berg et al., 1976).**

Chalmers 1973 believed that conventional radiographs offer a quick noninvasive, readily available and inexpensive method to assess the mandibular bone. Digital images offer tremendous advantages to dentistry in term of, the potential for lower exposure to radiation, absence of dark room or processing problems and convenience of image enhancement technique. Digital systems are now able to acquire all types of images

including panoramic and cephalometric. **(Moore, 2002).** Thus evaluation of dental radiographs for osseous changes might be a useful measure to screen the patients for osteoporosis.

Von Wowern and Kollerup, 1992 found that among osteoporotic and healthy patients with the same plaque and gingival bleeding index scores, osteoporotic patients revealed significantly greater loss of attachment. Also **Payne et al., 1997 and 1999** found that osteoporosis or osteopenia are now considred to be a risk factor for alveolar bone density loss, leading to the aggrevation of marginal periodontitis.

On the other hand some authors found no statistical difference in probing pocket depth, gingival recession and marginal alveolar bone level between patients with osteoporosis and others with normal bone density. **(Lundstrom A et al., 2001).**

Hence it is worthful to assess the skeletal bone density and to correlate it with the alveolar bone denisty in patients suffering from alveolar bone loss due to marginal periodontitis.

Review of literature

Normal anatomy of periodontium

Periodontium refers to the function unit of the tissues supporting the teeth (dentoperiodontal unit); this term includes the gingiva, dentogingival junction, periodontal ligament, cementum and the alveolar process. There is a relationship between the different parts of the periodontium. Periodontal diseases may be caused by disturbances in this harmonious interrelation **(Lynch et al., 1994).**

I. Normal gingival structure:

The gingiva is described by **Glickman, 1972** as the mucous membrane that extends from the cervical portion of the tooth to the mucobuccal fold.

The gingiva is divided into the papillary portion, which occupies the interdental spaces, the marginal portion, which forms the collar of free gingiva around the neck of the tooth and the attached gingiva, which covers the underlying alveolar bone **(Mac Donald, 1974).**

Orbans, 1977 described the clinical features of the normal gingival tissues as follows:

Color: pale pink and it may vary according to degrees of vascularity, epithelial keratinization, pigmentation and according to the thickness of the epithelium.

Papillary contour: pointed and fill the interproximal spaces to the contact point.

Marginal Contour: thin and end in a knife-like edge.

Texture: Normal stippling is present to varying degrees on vestibular surfaces of the attached gingiva. This type of surface has been described as orange peel – like in appearance.

Consistency: Gingiva should be firm with the attached part firmly anchored to the teeth and underlying alveolar bone.

Exudate: there should be no exudate.

II. Periodontal ligament:

The periodontal ligament is the dense connective tissue attaching the tooth to the alveolar bone. The main function of the periodontal ligament is to support the tooth in its alveolus and to maintain the physiological relation between the cementum and bone **(Sicher, 1976).**

The periodontal ligament consists of collagenous fibers arranged in bundles; these fibers are anchored on one side into cementum and on the other side into the alveolar bone.

III.BONE

The alveolar bone is a specialized part of mandibular and maxillary bone that forms the primary support structure for the teeth. Alveolar bone is the least stable of the periodontal tissue, because it is subjected to continous modeling and remodeling associated with tooth eruption and functional requirements **(Sodek and Mckee, 2000).**

Structure:

The bone is the main constituent of the adult skeleton, bone tissue supports fleshy structure, protects vital organs and contain the bone marrow, where blood cells are formed. It also serves as a reservoir of calcium, phosphate and other ions that can be released or stored by bone to maintain constant concentrations of these important ions in the body fluids. **(Marcus et al., 1996).**

Structurally, bone is a specialized connective tissue composed of the bone matrix and three cell types: osteocytes, osteoblasts and osteoclasts **(Boyd, 1977).**

Metabolites are unable to diffuse through the calcified matrix of bone, so the exchange between osteocytes and blood capillaries occur through canaliculi. All bones are lined on both internal and external surface by layers of tissue containing osteogenic cells; endosteum on the inner surface and periosteum on the outer surface **(Weiss & Greep, 1997).**

Bone Cells:

Osteoblasts

Osteoblasts are responsible for bone formation (osteogenesis). The principle tissues that are capable of giving rise to osteoblasts are bone marrow, periosteum, endosteum, and the periodontal membrance **(Kessel, 1998).** Osteoblasts are located at these surface of bone tissue side by side resembling simple epithelium. When they are activated, osteoblasts have cuboidal to columnar shape and basophilic cytoplasm **(Boyd, 1977).**

Osteoblasts arise from progenitors of the marrow and also mesenchymal cells through the action of bone morphogenetic proteins (BMPs). BMPs are the only factors that have been found capable of initiating osteoblastogenesis. Other factors such as transforming factor β, platelet – derived growth

factor (PDGF), insulin like growth factor (IGFs), and fibroblast growth factors (FGFs) promote osteoblast proliferation. **(McCauley & Nohutch, 2002).**

Labeling studies suggest that transition time from an osteoblast to an osteocytes is 3-5 days. The active matrix – forming osteoblast has two options for further maturation on the bone surface. It either becomes encased in the mineralized matrix differentiating further into osteocytes, or remains quiescent on the mineralized surface and is designated as a bone lining cell. Once surrounded by newly formed matrix, osteoblasts are referred to as osteocytes. **(Weiss & Greep, 1997; Kessel, 1998)**

Osteocytes

Osteocytes are considered the most differentiated cell of osteoblast lineage. Osteocytes cell bodies present in spaces called laucunae. As osteoblasts become surrounded by intercellular matrix, they extend many long, slender, finger like extension that contact those of near by osteocytes. This results in many small channels called canaliculi, that extend through out the bone matrix. **(Holtrop, 1975; Boyd, 1977; Kessel, 1998).**

Osteoclasts:

Osteoclasts are cells responsible for bone resorption and gain access to sites of resorption via the blood supply. Osteoclasts are very large, extensively motile, multinucleated cells, whose capacity to degrade hard tissue depend upon cell matrix contact. In areas of bone undergoing resorption, osteoclasts are found to lie within enzymatically etched depressions in the matrix known as howships lacunae. They usually have acidophilic cytoplasm. In an active osteoclast, the surface facing bone matrix is folded into irregular often subdivided projections forming ruffled border. **(Teitelbaum, 2000).**

Bone Matrix:

Bone is formed of organic and inorganic phase. The organic phase of bone plays in determining the structure and the biochemical properties of the tissue. The organic phase is formed of collagenous and noncollagenous proteins. Noncollagenous proteins as growth factors, cytokines, and extra cellular matrix (ECM) proteins such as osteonectin, osteopontin, bone sialoproteins and proteolipids make small contribution to the overall volume of bone and major contributions to its biologic function **(Marcus et al., 1996)**.

The inorganic component of bone is composed mainly of calcium phosphate mineral analogous to crystalline hydoxyapetite **(Kaplan et al., 1994).**

Periosteum and endosteum:

The external and internal surfaces of bone are covered by layers of bone forming cells and connective tissue called periosteum and endosteum. The principle function of periosteum and endosteum are nutrition of osseous tissue and provision of continuous supply of new osteoblasts for repair or growth of bone **(Weiss & Greep, 1997).**

Intermediary Organization of Skeleton:

Frost in 1986 coined the term "intermediary organization" (I.O) of skeleton to describe the regulation of bone cell activity. He found that bone cells do not function individually. He inferred that bone cell activity was regulated by an order of control higher than a single cell (osteoblast or osteoclast) or a single function (resorption or formation). The link between osteoblast and osteoclast function has been referred to as coupling **(Ivey and Baylink, 1981).**