A Discussion of the Distribution of the Bone of the Alveolar Process*

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Of all the structures related to the teeth, there is none with which we should be more cognizant than bone. The successful treatment of malocclusion is so dependent upon the reaction of bony tissue that the orthodontist must be thoroughly familiar with its physical properties, its histology and anatomy. The alveolar process, because of its close relationship to the roots of the teeth, certainly merits particular consideration, especially from orthodontists who use appliances capable of producing bodily movements of the teeth.

Black defines the alveolar process as "the projection of bone which grows up around the roots of the teeth, and forms the sockets in which the roots of the teeth are held by their membranes."

We shall not go into a discussion of the histology of the alveolar process other than to state that it has all the characteristics of true bone. Haversian systems are found in the thin alveolus, the number and distribution being proportionate to the nutritional needs. The presence of several complete Haversian systems in the larger trabeculae of the cancellous bone gives evidence of the nutritional requirements for the support of the masticatory mechanism.

The outer surface of the alveolar process, which is continuous with the outer surface of the maxilla and mandible, is formed by a compact layer of bone called the cortical plate. The alveoli, or sockets into which the roots of the teeth fit, are bounded by a thin, definite wall which is pierced by a great many openings. These have been called cribriform plates or sieve-like plates. They unite with the cortical plates of bone at the border of the alveolar process, and are fused with it on their labial and lingual sides.

Cope, in an extensive paper entitled "Mechanical Causes of the Development of the Hard Parts of Mammalia" demonstrates, by a comparison of fossil skeletons and present day structures, how the development of the living forms of this generation have been influenced by mechanical conditions. He teaches that these present forms are adaptations to physical environment.

With this principle of bone structure before us, we now turn to a description of the distribution of the bone of the alveolar process.

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Normally the alveolar process envelops the roots of the teeth to within a short distance of the gingival line, varying from one to three millimeters in the young adult. On the labial surface of the upper incisor roots there is a strong development of compact bone to resist displacement from biting and tearing forces. The upper canine teeth have distinct ridges of bone over their roots labially and their apices are deeply embedded in the bone. The upper premolars and molars exhibit a thin plate of very compact bone buccally over the apical portion of their roots. This bone thickens toward the occlusal portion forming a definite ridge. This formation is for the purpose of preventing these teeth from tipping buccally under the stress of mastication.

On the lingual side of the upper teeth the progressive thickening of the alveolar process from the border toward the apex is much greater than on the labial and buccal surfaces. The lingual plate is greater in bulk but less dense than the labial and buccal plate. The distribution of the bone on the lingual surface is much more uniform than on the labial and buccal surfaces. Even the large lingual root of the upper first molar, diverging strongly to the lingual, seldom forms a ridge or prominence in the process covering its lingual surface.

In the lower jaw, the immediate borders of the alveolar process, on the labial sides of the incisors, are rather thicker than in the upper jaw, often amounting to a decided ridge. In this region the incising and tearing stress is approximately at right angles to the long axis of the teeth and the arrangement of the compact and cancellous bone is more complex but follows a definite plan in accordance with the individual peculiarities of occlusion. At the canine, the border of the alveolar process is very thin but a gingival ridge, corresponding with that of the upper jaw, though not so prominent, begins at about the first or second premolar and runs to the second molar. This thins away over the middle section of the roots of the premolars and first molar. At the lower second molar, the rising of the external oblique ridge, for the formation of the anterior border of the coronoid process, causes a thickening of the buccal bony covering of the root, while at the third molar this ridge rises to a level with the border of the alveolar process.

On the lingual surface of the lower anterior teeth the border of the alveolar process is a smooth, thin edge, and the covering of bone over the roots is progressively thicker toward their apices. This bone is much thicker but less dense than that which we find on the labial and buccal surfaces of these roots. In this portion the process is high. From the first premolar, backwards, the height of the alveolar process diminishes. The border of the

alveolar process remains thin as far as the first or second molar, but the bony covering of the roots is rapidly thickened toward their apices. The greatest thickness is over the lingual side of the apical half of the roots of the second molar and the occlusal half of the roots of the third molar.

MacMillan states, "In no place elsewhere in the body, not excepting the neck of the femur, are bone mechanics more beautifully illustrated." Noyes also emphasizes this factor and writes, "The bone of the alveolar process is arranged so as to give the greatest possible support with the least possible bulk and where there is an increase in bulk it is to meet some special force."

As is well known the alveolar process is built upon the bodies of the maxillae and mandible for the express purpose of holding the teeth in position. It is totally subservient to the teeth, being resorbed when they are lost.

MacMillan is a firm believer in the idea that the alveolar process is purely a product of function. This seems to be a disputable point. The consensus of opinion among writers upon this subject seems to be that some other factors in addition to function are responsible for the normal development and distribution of the alveolar process.

Wright points out that in cases of complete ankylosis from early childhood, the alveolar process is developed around the roots of the teeth. In these cases there has been a total absence of masticatory function. The bone of the process in these cases of ankylosis presents no definite arrangement of the trabeculae when examined histologically. The point to be remembered is that the bone is formed around the teeth. Angle also makes note of the fact that the bone is formed about the roots of the teeth regardless of regularity. What MacMillan terms "disuse atrophy" of the alveolar process can hardly in itself be responsible for its destruction.

The laying down of the bone of the alveolar process seems to be governed by the inherent growth force of the cells or what J. Sims Wallace terms "liberating stimuli." The type of bone that is developed in the mandible and maxilla, after the hereditary force has been expended, is apparently due to a number of factors.

McKevitt classifies the bone of the alveolar process under three headings, namely: hypocalcemic, normal and hypercalcemic. He attributes the development of these types of bone to normal and abnormal calcium metabolism as governed by the parathyroid glands. Many other present day writers including Howe, Mellanby, Drain, Boyd, Hawkins and others place diet and vitamins as the prime factors in the development of normal bony tissues associated with the supporting structures of the teeth.

From an orthodontic standpoint traumatic occlusion appears to be a much more potent factor in bringing about destruction of the alveolar process than disuse.

Stillman and McCall define traumatic occlusion as "an abnormal occlusal stress which is capable of producing or has produced an injury to the periodontium." From this we can see, as Wright states, that traumatic occlusion has to pass the point of physiological tolerance of the tissue before harm is done.

The orthodontist has a great responsibility placed upon him as far as the preservation of the alveolar process is concerned. A large part of alveolar destruction so frequently caused by malocclusion can be prevented by the establishment of normal occlusion. The normal relationship of the inclined planes of all the teeth when the jaws are closed, the proper relation of the dental arches to skull anatomy and the normal function and development of the structures in and about the oral cavity must be evolved by him if the alveolar process is to be preserved throughout life.

In conclusion it may be said that no one factor is responsible for the development of a normal masticatory apparatus. Hereditary influences, developmental forces, the prenatal diet of the mother, proper nourishment of the child and the normal action of the forces that develop occlusion and which can be supervised by the orthodontist, are all important. The eugenist obstetrician, pediatritian and orthodontist must all work together.

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