The Development Of The Denture From The Orthodontist's Point Of View

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In this contribution I am not attempting to bring anything new but to make real what is known. To visualize academic facts, to make dry bones live. I am going to show you one skull after another and try to make you see them as living things, changing from one to the other. I make no apologies because the facts have been in print. To remember the printed word is one thing; to visualize the facts expressed in words is another.

As the development of the body repeats the development of the species, the mind repeats the development of knowledge, and each one has to pass over the road already trodden for ages, but fortunately the longer the road has been used the more easily and rapidly it is traversed. Histology is studied at one time and in a certain place. Anatomy in another place and a different time. Too often they never get together. I am going to show you histologic processes and then try to make you see the working of living cells in these dry bones. Because we usually see them dead and dry, it is difficult to think of bone as living. It is difficult to think of bone as always in process of change; to appreciate that it more rapidly responds to changes of environment than any other tissue, and that it is first to show the effect of lack of food and nutrition. It is still more difficult to picture bone as a storehouse, a reservoir of materials without which life can not continue.

Anyone may be able to recite the names osteoblast and osteoclast, to give the structural elements of bone and even to describe their arrangement, but few ever think of what is going on in life, how these elements behave. We see them still and dead. We cannot think of them as active in constant change, but until we do, we can not practice orthodontia intelligently. I shall try to make these tissues live.

It needs to be repeated at every opportunity that orthodontia is a biological problem. That teeth are moved not as a house is moved by mechanical force, but that the mechanical force is simply a stimulus to activity of living tissue, and the tissue growth or reaction carries the teeth along. This is the fallacy of those who have attempted to tabulate the forces required in orthodontic treatment. The relation of the force to the movement is never

a simple or direct one as in mechanics but like a living unit, is always intermediate, and is a variable. The same stimulation does not produce the same reaction in two different cells any more than it does in two different persons or the same reaction in the same person at different times. To make the practitioner think through tissue to tooth movement and through tissues to tooth stability and function has so far been largely impossible, and one need only read the writings of those who have undertaken researches on the tissue changes in tooth movement to see that they have not always escaped the purely mechanical concept.

Much has been written about physiological tooth movement and recently in several places the statement has appeared that there can be no such thing as physiological orthodontic movement. To maintain this thesis requires a restrictive definition of physiological. This incident is in point. An orthopedic surgeon once said that the correction of club-foot is exactly comparable to orthodontic treatment. In club-foot, there is no disease and no pathology. It is a defective growth. By the use of mechanical influences, the direction and form of growth is changed back towards the normal and then the normal function of carrying the weight of the body completes and maintains the normal form. This is almost a perfect statement of what constitutes physiological orthodontic treatment.

Very early in the development of the embryo the mesenchimal cells in the anlaga of the jaws differentiate producing bone-forming cells, osteoblasts, which begin the calcification of spicules of bone. Almost immediately the mass is covered by the beginning of the periosteum and from then on growth proceeds by formation of bone under the periosteum with constant transformation of the spicules.

The formation spreads and in a section through the mandible of a young pig the bone is surrounding Meckels cartilage and is growing up to surround the forming tooth germ of the temporary incisors. The bud for the permanent tooth is just beginning.

The histological mechanism for the growth and molding of bone is beautifully shown in a section of the mandible of a nine months human infant, for which I am indebted to Dr. I. Schour. The bone may grow by the osteoblasts laying down layers of subperiosteal lamellae which are immediately absorbed and rebuilt into Haversian system lamellae. Then as soon as enough compact bone has been formed to sustain the required force, absorption starts in the Haversian systems and cancellous bone is formed. The bone may be modeled by the reversal of this process. Absorption occurs under the periosteum which removes all of the subperiosteal bone and part of the Haversian system bone, and, to maintain the strength, lamellae are laid down

in the cancellous bone converting it into Haversian system bone. During life, these transformations are going on adapting the bone to the stresses it is required to sustain. In this section, many examples of these processes are seen, and though the activity has been halted by the death, (fixation), of the tissues, the imagination can easily set them in motion.

The surface of the mandible is formed by a cortical plate extending from the alveolar border on the labial around the lower border of the bone and to the alveolar process on the lingual. The crypt wall surrounding the developing tooth is shown swung like a hammock from the cortical plate. The separation of the crypt of the permanent tooth and the alveolus of the temporary one is just beginning. The bone is rapidly increasing in height by the growth of bone in the alveolar process carrying the temporary tooth occlusally and labially, and this will soon carry the apex of its root above the crypt of the permanent tooth.

In all the pictures of the skulls you must clothe the dry bones with millions of living cells that are constantly working converting each one into the next. One who has seen moving pictures of cell activity can picture what is going on, but we know very little of the controls that govern the processes.

In the development of the face, the growth of the maxillary bones holds the leading role, and in these bones the border of the alveolar processes is the area of most rapid growth. The development of the denture is therefore one of the most important factors in the development of the face. At birth, the maxillary bones are but a framework, a sort of carton divided into compartments in each of which is housed the germ of a tooth, for at that time these bones contain, partially-formed, all of the temporary teeth and all of the permanent ones, except the second and third molars.

As teeth emerge from the bone they are carried occlusally by the growth of bone. The incisors at the middle line appear first, and then each tooth proceeds distally. The incisors and, therefore, the entire denture, through the entire period of development, continue to move downward and forward in the upper jaw, and upward and forward in the lower. The temporary denture is completed in about three years, but during all the period of its function, continues to move occlusally and forward largely under the influence of the growing permanent teeth.

I will not describe what the skulls show better than words can depict, but emphasis should be laid on certain things: the relation of the temporary and permanent incisors and cuspids to the growth in the anterior portion of the arch, and the increase of the cuspid-to-cuspid arc; the extent of the movement of the temporary molars during the period of the mixed denture; the

change of the axillary angle of the cuspids and bicuspids during and after eruption. Especially should be emphasized the extent of the movement of the denture after the eruption of the second molars axial with the increased vertical height of the maxillary bones, and the distance of the apices of the roots from the floor of the nose and the inferior border of the mandible.

In the development that has been followed, it is clear that the growth in the posterior part of the maxillae and the development of each succeeding distal tooth influences the occlusal and forward movement of the denture, but it is difficult to see how the addition of bone to accommodate three permanent molars can be added at the posterior end of the maxilla and palate and still have increased room in the pharynx. The craniometric study of skulls shows evidence that the entire face, including the maxillary bones, swings out from a position under the brain-case. This becomes an important factor in the relation of the denture to the cranium. At present it seems that an important item in this growth occurs at the spheno-occipital, the palito-maxillary, and the temporo-zygomatic sutures, and these sutures always lie in the same or parallel planes. Craniometric studies have shown that the tip of the pterygoid process moves downward nine millimeters and forward an equal distance while the maxilla is growing at the distal to accommodate the three molar teeth. Growth in these sutures would seem to necessitate readjustment in others. Anthropologists have been very reluctant to admit the growth of bone at sutures as a developmental factor in the growth of the skull. Sometime ago I undertook a study of the structure of the suture to determine if possible whether the suture showed a histological mechanism capable of such growth and adjustment. The suture is found to be strikingly similar to the peridental membrane and shows the capacity for both growth and adjustment to indefinite limits.

In recent work at the University of Illinois, Dr. Brodie has shown the presence of the maxillo-pre-maxillary suture, and the presence of suture-like structures in other places in the maxilla. Dr. H. J. Noyes, studying the naso-palatine duct, has also noted similar conditions. The writer has for a long time had a growing conviction that the complicated processes and buds which unite in the formation of the pre-maxillary bones maintain for a long time, after the gross anatomical union, a certain amount of independent growth, and that this is adjusted and accommodated by the presence of sutures. It is extremely laborious work but I believe that a minute study of this area would add to our knowledge and perhaps explain some ortho-dontic problems.

The anatomic and histologic method is of course handicapped by the necessity of comparing different individuals, and therefore introduces all

the factors of individual variation. The work of the Bolton-Broadbent Foundation has made it possible to follow the growth of the same individual. Dr. Broadbent has kindly loaned me a movie film made from the records of one individual. This visualizes, in a wonderful way, the changes that we have tried to study from different individuals.

The work of this Foundation is undoubtedly adding more to our knowledge of the development of the denture than any other source. It must be remembered, however, that this can progress but slowly for it takes twenty years to follow one individual to the completion of the denture.

Finally, it should never be forgotten that knowledge of the development of the denture is the most fundamental requirement for the practice of orthodontia.

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