The Contribution of Albin Oppenheim to Orthodontia

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WHILE THE RESEARCH of Dr. Albin Oppenheim in the field of orthodontia is known to the orthodontists all over the world, probably very few realize the breadth of his work. He received his medical degree before his dental degree, and he served a long list of internships in the various fields of medicine. He had many hospital appointments and was, for a long time, connected with service on fractures of the jaws and other injuries. Early in his work he became especially interested in the structure and function of bone, and it is in this field that his most striking contributions were offered.

In any field of research irrespective of previous effort, there comes a time when an investigator produces a piece of work that becomes the classic for all time. There had been a great deal written on the tissue changes through orthodontic treatment before Oppenheim's articles in 1911. One investigator thought that the bone was bent, and another that the tooth plowed through the substance of the bone by means of absorption on one side and deposit on the other. I think it was Oppenheim's fundamental studies of bone that enabled him to recognize in his experimental material on the monkeys that orthodontic treatment when properly executed showed fundamental characteristics that had not previously been recognized. When bone is growing rapidly either under physiologic or mechanical influences of the proper grade, the resting alveolar process of slow, normal growth is transformed, beginning at the alveolar border into a type of bone found only in natural growth where the bone is forming rapidly under forces exerted in one direction. The best examples of this kind of growth are found in the ends of the long bone, and still better in the bones surrounding the crypt of rapidly developing permanent teeth. Naturally the transformation begins at the alveolar border because at this point growth of bone is always most active and the forces exerted on the teeth are most effective.

Dr. Oppenheim showed the changes both on the side of push and on the side of pull and that, while the changes on both sides are very similar in appearance, there are important differences in the way in which they are produced. On the side of pull the fibers attached to the bone stimulate the growth of osteoblasts and spicules of bone are built up in the direction of the pull. Then osteoclasts absorb bone between these spicules and a series of parallel spicules are developed, and the form of the alveolar border at this position is changed, becoming considerably thicker than it was before. On the side towards which the tooth is being pushed there is also bone formation and bone absorption. The osteoclasts cut the resting alveolar process into spicules which are also in the direction of the force, and then

these spicules are elongated at the end away from the tooth. These changes beginning at the alveolar border progress toward the apex, and so after thirty or forty days all stages in the changes can be observed in the wall of the alveolus. If the forces applied are not great enough to seriously constrict the peridontal membrane and interfere with its circulation, the tooth will move in a *modified direction of eruption,* and there will be no movement of the apex of the root in a direction opposite to that of the crown. But, if the force is sufficient to interfere with circulation, tissue activity is slowed and then some very undesirable results are produced at this point. There should be a ratio between the rate of growth of the tooth in the occlusal direction and the rate of extension in the direction produced by the orthodontic movement. This ratio is, of course, not uniform in all patients or at all ages.

In the 1911 work all phases of movement were included. Elongation, rotation and the absolute necessity for the use of light force was emphasized from beginning to end. It is not strange when you consider the origin of orthodontic treatment that it should have taken so long and been so difficult to have the orthodontist realize that a force just sufficient to stimulate cell activity, and probably that means also circulatory activity, will produce the best results. It is very difficult for the orthodontist to understand that the force exerted by the appliance does not move the tooth but should set up cell activities in the tissues which carry the tooth in the direction of the force.

A summary of Dr. Oppenheim's work published in 1911 may be arranged under the following headings.

(1) He described the characteristic structure of the alveolar process around a resting or more precisely physiologically erupting tooth. The bone is covered on the labial and lingual side by the periosteum and on the side of the tooth by the peridontal membrane, the two uniting at the occlusal border, but there is a layer of subperiosteal bone under the periosteum and a layer of fiber bone, imbedding the fibers of the peridontal membrane on the tooth side. The space between is occupied by cancellous bone. As the tooth erupts there is active growth of bone at the occlusal border imbedding the principal fibers of the peridontal membrane. These are confined in bundles of considerable thickness. This is then attacked by osteoclasts from the marrow spaces of cancellous bone, cutting out cavities of considerable size. The osteoblasts then lay down layers of bone around this space which contain no fibers. In this way a layer of fibrous bone imbedding the fibers of the peridontal membrane is left lining the alveolus. This is not a continuous layer but has many communications with the cancellous bone, forming openings through which blood vessels pass to and from the cancellous bone and peridontal membrane. Cryer called this the cribriform plate or sieve-like plate.

(2) When light force is applied by an orthodontic appliance, the first change is that the principal fibers which have been in large, compact, conspicuous bundles become less conspicuous and their place is taken by fine fibers. The large blood vessels become less apparent and a great number of capillary vessels are produced by budding from the walls of the antecedent large vessels.

(3) There is bone formation and bone absorption *both* on the side of pull and on the side of pressure. The concept deserving emphasis is that the bone of the alveolar process around the physiologically erupting tooth is changed into the characteristic structure of bone growing rapidly under the influence of force in one direction.

(4) The changes in the structure of the tissue begins at the occlusal border of the alveolar process and extends toward the apex.

(5) If the force is excessive there is interference with circulation, thrombosis occurs in the vessels and the tissue transformations do not occur.

(6) If the force has been properly used, the apex of the root moves only in the direction of eruption.

(7) If the apex of the root moves in a direction opposite to that of the crown, it is because the forces used have been excessive and the root, in its middle portion, has been forced against the bony wall of the alveolus before the bone of the alveolar wall could be reorganized.

(8) In normal treatment the tooth should react as a one-armed lever. If it reacts as a two-armed lever, the force has been excessive. Finally Dr. Oppenheim showed the way in which the characteristic structure of resting or physiologically growing alveolar process is restored during retention.

The importance of this work can scarcely be overestimated. For the first time it gave to the profession a clear statement of the changes that occur in the tissues and the cellular activity by which they are produced. This made it possible for men to think of tooth movement in terms of cells and cell activity instead of springs and jackscrews. It emphasized most strongly the importance of the use of light pressure and the constancy of their direction. The profession has only begun to apply the results of this research in the treatment of cases.

In his later writings Dr. Oppenheim devoted considerable attention to the development of the idea that there is no such thing as physiological tooth movement in orthodontic treatment. By definition this seems self-evident. The teeth have come into their position of malocclusion by the action of physiological forces but they can be restored or guided into their positions of normal occlusion by the proper application of artificial forces. Tissues possess a certain degree of tolerance to insult and still retain their vitality and the capacity to return to their normal condition.

The application of artificial force in an orthodontic appliance must be considered an insult which must be kept within the range of tissue tolerance. This idea strongly emphasizes the importance of Dr. Oppenheim's 1911 contribution. Space does not allow the discussion of Dr. Oppenheim's contributions in other fields than orthodontia. A list of these contributions is appended. A perusal of their titles indicates the breadth of his work, and it is probable that there are a good many articles published in Europe that cannot be found.

The orthodontist will always have a great debt of gratitude to Dr. Albin Oppenheim.

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