The Muscles Of Mastication And Their Functions - A Review.

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The first consideration of this subject should logically refer to certain evolutionary changes. A fundamental assumption of comparative anatomy is that at any given age of the earth's history the course of evolution was not equally advanced in all members of a given zoological group, but there were a few hold-overs from a previous epoch living in an out-of-date stage of development, the progressives and the freaks. By comparing these grades we can see a given organ, the jaws and teeth for example, in different stages of evolution in different kinds of related animals. Another source would be in the embryology of the individual.

To give an example of the various changes, we might summarize those affecting the jaws into seven stages.

First, in the agnathous stage the future jaws are represented by cartilaginous supports of one of the anterior gill slits.

Second, the gnathous stage where the primary or inner jaws (Meckel's cartilage) are homologous with the branchial arches. The outer jaws are represented by tooth-bearing skin.

Third, the complex jaws of lower vertebrates which include an inner core and a sheathing of osseous and dentigerous plates. This jaw articulates with the skull by way of an articulate bone and of a quadrate bone.

Fourth, the mammal-like jaw of higher reptiles in which the dentary bones of each side have become enlarged and the elements behind the dentary bones diminished.

Fifth, the typical mammalian jaw where the dentary bone establishes a new articulation with the squamous of the temporal bone, while the articulate bone and quadrate bone dwindle into the malleus and incus of the ear.

Sixth, that stage of evolution in which the jaws of primates are involved in a shortening of the body of the mandible and with a reduction of the formula of the teeth so that the two premolars are lost. We also see the mandible fused at the symphysis.

Lastly, there is the outgrowth of the chin, a refinement of the jaw as seen in the human.

Considering osteology with a subject matter pertaining to myology is far from being logical, but one is dependent upon the other. The shape of a bone is in adjustment to the particular nature of the stresses to which it is subjected as, for example, gravitation and muscular contraction. The presence or absence of a given bone as determined by its phylogenetic history has its bearing on the muscular variations in the area involved. There has been a persistence in the retention of skull elements from fish to man in that all are present except the prevomers, ectopterylids and quadratojugals. The importance of this statement is that those remaining throughout are greatly

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changed in form and when this occurs one has but next to follow the changes in function—one in particular being the muscles of mastication.

The muscles of mastication arose as extensions of the body musculature that were used in the spasmodic contraction and expansion of the branchial apparatus. With the change from feeding on minute organisms to active predacious habits, one pair of gill arches and their muscles became enlarged and began to function as jaw muscles while the enlarged shagreen denticles around the mouth began to function as teeth. As we now know, the changes that have occurred in tooth anatomy have exercised a profound molding influence upon both the form and relations of the bones of the jaws and upon the supporting elements of the skull.

The adductor muscles of primary jaws originally stretched across the primary joint between the palatoquadrate bone and Meckel's cartilage like middle flexors of branchial arches. The temporal muscles of all lower vertebrates have their insertion on or near the proximal end of Meckel's cartilage. Later the insertion spread to the ascending process of the dentary bone and it took over the increasing load. By a continuation of this process the ascending ramus of the dentary bone began to press upon part of its own muscle mass, thus giving rise to the fossa and interarticular disc and finally initiating the mammalian temporomandibular joint. In addition there were changes taking place in the area of what is now called the zygomatic arch that influenced the origin of the temporal muscle. Because of the stresses that were being generated by the jaw muscle it was most necessary that this muscle have an origin of great support, this being today called the temporal fossa.

In the carnivorous, the temporal muscle essentially functions as a speed mechanism — in man the purpose of the temporal muscle is two-fold; first power and second speed. In the horse of the herbivorous group the mechanics of mastication point definitely to its being one of power. The masseter and pterygoid muscles in these animals are well developed; they have a small glenoid fossa present and, with this combination, their jaws have great freedom of movement but with little control.

The teeth are the fundamental units that are responsible in determining the joint and the musculature and, as teeth divide themselves into classes or groups as incisors, canines, premolars and molars, the movements of the jaw are coming under greater control. Of course, with this refinement there are musculature and joint changes.

Normal functioning muscle has that property known as muscle tone which may be spoken of as being a state of partial contraction. The muscle fibers of a muscle act on the all or none law meaning that only certain fibers at a time are in a state of chronic contraction. These fibers finally relax when waste products are built up in their immediate area and another group repeats the performance. Those muscles that do not have tone fail to react as fast as those possessing this quality. This explanation is admittedly elementary, but whenever discussing muscles an understanding of their physiology should always be considered.

Balance, or lack of balance, is the essential with which we are most concerned in orthodontics. From the beginnings of embryonal life we see balance in the growth and development of the organism manifested everywhere. After birth we again witness many striking examples of the balancing of natural forces or agencies which directly or indirectly influence and mold the de-

veloping dental apparatus as muscles, bone, teeth, etc.

Whenever one sees a normal denture, he finds that in that individual, throughout life, there has been a balancing of all the forces, external as well as internal, which together influence the dental apparatus in its unfolding. When there has been a disturbance of this balance, whenever any part of the apparatus has failed to do its rightful share or done more than its rightful share, one finds a resulting malocclusion, the extent of which depends upon the degree to which the rightful forces of nature have been disturbed or thrown out of balance.

Muscles are arranged as antagonists and protagonists but these groupings are always arranged as to be in balance with one another. The balance of muscles in relation to those of the back of the neck region must be accounted for anteriorly. In this respect the mandible plays a great part in that the muscles from the cranium that are draped to the mandible and are known to us as the "muscles of mastication" are the upper connecting link of this balance. The lower part of the muscular arrangement is made up of those running from the mandible to the hyoid bone and thence to the thorax. They are known as the hyoid groupings. This arrangement is literally one of inverted suspension. We are concerned at this time with the upper group or the muscles of mastication, namely the masseter, temporal, external pterygoid and internal pterygoid.

This group of muscles also acts as a balance among themselves in a normal denture. By this is meant the position of the condyle in relation to the glenoid fossa as determined by the mean pull of the group. Through this muscular action the mandible is centered and is a chief point of diagnosis in malocclusion. If the tooth mass of one side is equal to that on the other side and excursion of these teeth is normal, we should expect to see them in correct positions and the midline of the mandible should be in the sagittal plane. To establish this plane the forehead, nose and chin are used as the determining line and any deviation from this must be considered in diagnosis. Normally the area from both condyles to the midline between the incisors is considered as an isosceles triangle. The possibilities of variations of this are numerous. The position of the isosceles triangle may be changed by rotation so that one condyle is farther forward than normal in relation to the fossa; the condyle of the other side stays in its correct position. In this condition the midline will be off-center when the jaws are closed but, on opening, it will tend to center itself on the midline as the one condyle can go no farther forward than its already abnormally closed position. The muscle playing the part here is the external pterygoid. Another condition occurs where there is an underdeveloped area or areas in the mandible causing a distortion of this isosceles triangle. Another incidence, and probably the most common form of this irregularity of the midline, is due to loss of tooth substance. Because of habit or paralysis of the muscles of mastication of one side, the mandible, when in a closed position, has the condyles in the fossae and midline centered, but upon opening, the jaw is thrown to one side due to one condyle remaining in the fossa while the other one functions normally. In other words, if the isosceles triangle is rotated as in the first condition stated, we find the mandible can move toward the center but not toward the other side or laterally. In the second condition where the isosceles triangle is distorted, the closed mouth position is correct but the patient can not center

the jaw on opening, but can go laterally. If the jaw is unsymmetrical and off-center we should expect symmetrical movement as the condyles are correct.

Another function of the muscles of mastication takes place during the act of swallowing. In the first stage, following the bolus of food being centered on the dorsum of the tongue and while the tongue is being raised from front to back to eventually force this bolus through the fauces, there is an action on the part of the muscles of mastication to bring the teeth together into occlusion. In swallowing this is only a part of the wave but it is essential to its completion.

A functional force that the masticatory muscles impart to the development of the denture is known as the anterior component of force. This is the antagonist to the posterior forces exerted by the two groupings of musculature about the mouth; one force radiating from the orbicularis oris with origins not in the immediate denture area and, second, the buccinator which encompasses the denture. This powerful forward force is produced by a combination of factors. The most important one becomes effective with the eruption and occlusion of the first permanent molars. A vector of force in a forward direction is produced as the occlusal surface and the axes of these teeth are not at right angles to each other. This vector is assisted by the muscular force of the buccinator as it crosses the denture and by the forward push of the masseter muscle in contraction. The anterior component of force from the molars is powerful and is transmitted through the contact points to the teeth mesial to them.

The force of mastication in transmitting stresses through the medium of the inclined planes of the occlusal surfaces of the teeth is a factor of great developmental significance. One depends on it to the utmost if a normal denture is to be produced. The masticatory muscles transmit, through the medium of the teeth, stresses that radiate throughout the basal bones along certain definite lines. The architectural pattern laid down is the one most efficient for normal growth and development.

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