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EFFECT UPON THE GROWTH OF THE JAWS OF ASYMMETRICAL (CROSSWISE) REMOVAL OF TEETH IN THE DOG

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(Received May 24, 1954)

The influence exerted upon the growth of the jaws by removal of several teeth has been extensively studied. By removing the teeth from the same half of both the upper and the lower jaw in young animals, a stunted growth is induced in the edentulous halves *(Landsberger)*. Similar effects were observed after grinding the crowns to the gum margin's level, without removing the roots *(Baker)*. In our former studies, tooth removal was restricted partly to one of the jaws (upper *or* lower, alternately); effects of uni- and bilateral tooth removal were studied *(Adler*, 1, 2). After unilateral removal of the teeth from one jaw of young dogs, stunted growth was observed not only in the edentulous mouth quadrants, but growth seemed to be slightly inhibited in the opposed one also, in spite of being endowed with a full complement of teeth *(Adler*, 1). After bilateral massive tooth removal in young dogs, stunted growth was demonstrated also in the bone supporting the opposing dental arch *(Adler*, 2).

In order to gain further information upon the role played by the presence and functioning of the teeth in the normal growth process of the jaw-bones, it seemed necessary to carry out experiments in young animals, by removing the teeth crosswise, i. e. from the one half of the upper, and from the *contralateral* half of the lower jaw, and to observe the changes in growth induced. On experiments of this type, no reports were found in dental literature.

In the present paper, results of a few experiments are briefly reported.

Technical data

Three mongrel dogs were used in the experiments, with litter-mates as controls.

In a pointer bastard (female), at the age of 8 weeks, the right upper and the left lower deciduous teeth were removed, and as many of the subjacent tooth germs as were easily accessible. 10 months later the dog was sacrificed, at the age of one year.

A similar mutilation of the denture was carried out in two kuvasz bastards; in the one, the right upper and left lower, in the other, the left upper and right lower deciduous teeth were removed, and several — but by far not all — subjacent permanent tooth germs, at the age of 7 weeks. These animals were sacrificed 14 months later.

Tooth-removal was performed in intraperitoneal Nembutal-anesthesia.[1] The postoperative course was uneventful. The dogs were kept in kennels together with the controls and other

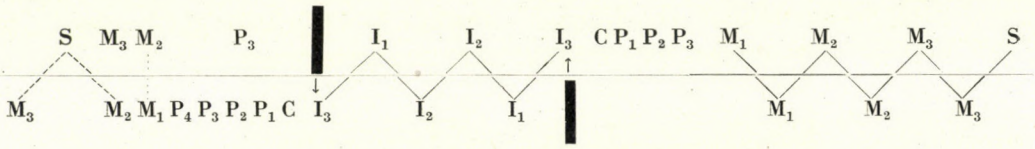
[1] Nembutal was kindly supplied by Abbott Laboratories, Greenford, England.

dogs, all receiving identical food. Taking the food was seemingly in no way disturbed in the experimental animals.

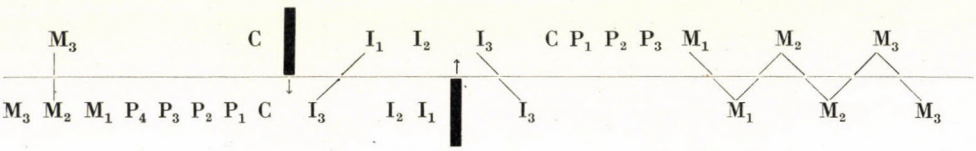
Measurements were carried out on macerated skulls, including the mandibles.

The tooth formulae of the sacrificed experimental animals are as follows :[2]

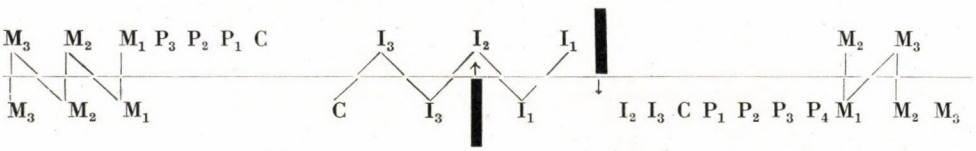
Pointer :



Kuvasz A :



Kuvasz B :



The pointer was described in another connection by *Adler* and *Hradecky*. For comparison's sake, some measurements of animals, reported in a former paper *(Adler, 1)* have also been taken into account.

Findings

A striking asymmetry of the viscerocranium is obvious in all three animals. With the teeth in occlusion, a discrepancy is seen between the upper and lower dental arch «midlines», amounting to 5—8 mm in the different specimens.

[2] In the tooth formulae molars are marked by M, premolars by P, cuspids by C, and incisors by I, with numerical indexes showing their order mesio-distally. Thus, I_1 the innermost (central) incisor, P_2 the second premolar, etc. — Supernumerary molars observed in the pointer are marked by S.

The «midline» of the dental arches is emphasized by a thick vertical line and arrow, pointing to that tooth in the opposing dental arch that lies vis-à-vis, when teeth are in occlusion.

Occluding tooth units are connected by thin straight lines. When only a punctiform contact exists between opposing teeth, the connecting line is dotted.

In an older generation of kuvasz-bastards from the same source, familiar «progenia» was observed *(Adler* and *Hradecky)*. In the non-operated control litter-mate kuvasz the lower incisors bite just in front of the uppers. In the operated animal A the «overjet» of the lower incisors amounts to 12 mm, while in the animal B it is not greater than in the control. While in the control pointer-

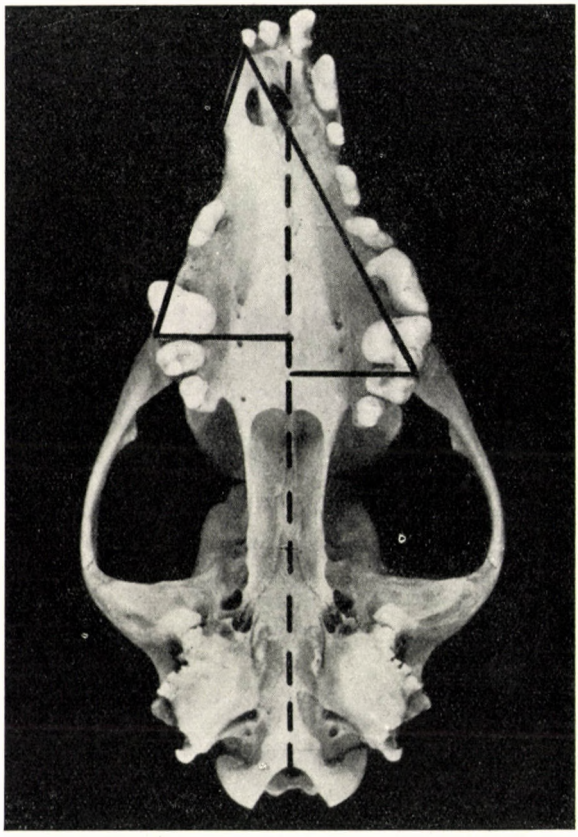


Fig. 1. Deflection of the *sutura mediana palati* ; forward-shift of the molars. Interrupted line : sagittal symmetry axis relying upon *spina nasalis posterior* and *foramen occipitale magnum*. The anterior end of the median palatal suture is connected with the buccodistal cusp of the second molar bilaterally, by full lines. The forward shift of the second molar is obvious, by connecting the distobuccal cusp with the aforementioned symmetry-axis. (Pointer.)

bastard there was no progenia, partial reversion of the incisor overbite is seen in the operated animal.

Regarding the maxillae (Fig. 1), the median palatine suture deviates markedly from the median sagittal plane of the cranium in all specimens. The deviation is the most marked in the pointer. The median sagittal plane of the cranium was determined relying upon an anatomical landmark at the anterior

circumference of the *foramen occipitale magnum*, and upon the *spina nasalis posterior*, i. e. dorsally from the maxilla. At the most ventral end of the suture, in kuvasz B the deflection from the median sagittal plane is approximately 1½ mm less than is the discrepancy between the upper and lower midlines with occluding teeth. No similar difference was demonstrated in the other two specimens.

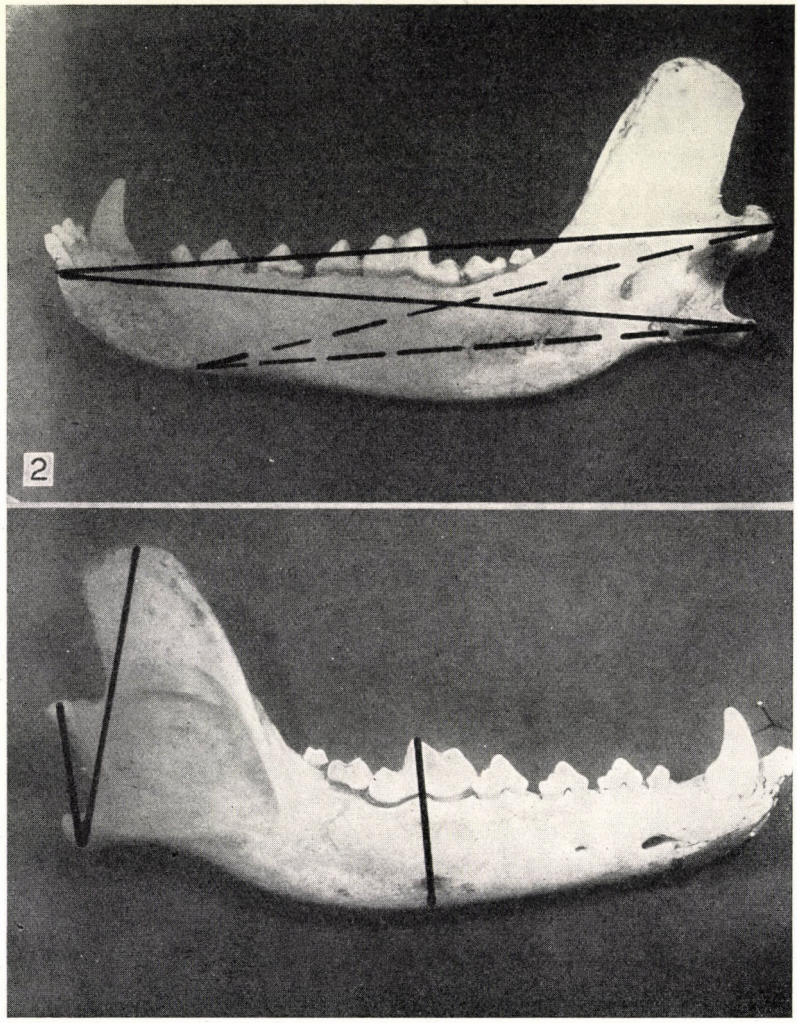


Fig. 2. Mandibular measurements. Full lines: connections between «infradentale» and the condylus on the one hand, between «infradentale» and the tip of the angulus on the other hand. Interrupted lines: connections between condylus and the tip of the angulus, respectively, and the most distal point of the median suture at the caudal surface of the mandible

Fig. 3. Mandibular measurements. Height of the condylus from the tip of the angulus. Height of the coronoid process from the tip of the angulus. Height of the highest molar cusp from the lower border of the mandible

In the partly edentulous halves of the maxillae, the non-removed molars occupy a more mesial position than their contralateral mates. This forward shift of the molars amounts to 8—9 mm. Accordingly, the chord drawn between the central fossa or any cusp of any molar and the anterior end of the median palatine suture is markedly shorter on the operated side than contralaterally. This is only partly due to the mesial shift of the molars ; partly it must be ascribed to the aforementioned deflection of the median palatine suture.

On the operated side the breadth of the maxilla appears to be somewhat reduced in comparison to the non-operated side. This difference is marked not only in the ventral portion of the upper jaw where symmetry is strongly influenced by the deflection of the midline suture (the latter forming the natural symmetry-axis to be relied upon), but in the dorsal portion also. The difference is slight, but certainly demonstrable, amounting to 1—2 mm.

In the mandible, the *distance* between the most caudal point of the angulus' tip and the most cranial point at the circumference of the coronoid process is in all specimens 1 to 2 mm longer on the partly edentulous side than contralaterally, where all mandibular teeth are present (whereas some maxillary teeth were removed). No appreciable difference exists between operated and non-operated sides as to the height of the condyloid process, as measured from the tip of the angulus (Fig. 3).

In order to gain some information upon the length of the horizontal ramus, two chords were measured (Fig. 2) : the one between the angulus' tip and the most dorsal point of the median suture on the caudal mandibular surface ; and that between angulus and the most ventral point of the median suture, lying as far caudally from «*infradentale*» as compelled by unilateral removal of the incisors. The first chord was the same on operated and non-operated sides in all specimens, in the second one differences of 1 to 1½ mm were found, the distance being reduced on the partly edentulous side.

A marked difference exists furthermore in the distance between the lower (caudal) border of the mandible and the highest cups of the lower first molar, the distance being 1—5 mm longer on the non-operated side of the mandible (Fig. 3).

Discussion

By means of crosswise (partial) tooth removal we intended to induce bilaterally analogous disturbances of the masticatory function, simultaneously with *differences* in the set of teeth between the two sides. Hereby we hoped to gain some information about the roles in inducing growth changes, played on the one hand by changes in masticatory function (comparing our present results with those of our former studies). on the other hand by the absence of teeth.

It is interesting to note that in the maxilla, practically the same changes were observed on the partly edentulous sides of this series as after removal of both the upper and the lower teeth on the identical side or of the upper teeth only. In the mandible, however, the situation is different. In the present series no differences were found in the chord between the angulus' tip and the most dorsal point of the median mandibular suture at the caudal surface of the lower jaw, whereas a slight difference — varying between somewhat more than ½ and 2 mm — was found between the operated and non-operated sides in animals whose

Fig. 4. Deflection of mandibular median suture in Kuvasz B, indicating asymmetry of alveolar processes, in spite of symmetry of the basal arch

teeth had been removed either on the one side of the mandible only or on the same side of the maxilla and mandible. — The chord between the angulus and a point caudally from «*infradentale*» was equally smaller on the operated side in the animals of the present series and of the former ones.

In the mandible a basal arch and an alveolar portion are known to exist. The basal arch was supposed not to be influenced by the presence or absence of the teeth *(Häupl)*, whereas the existence of an alveolar portion is known to be dependent on the presence of the teeth and their sockets (Fig. 4). — In the light of our aforementioned findings this statement needs revision. It is not the mere

presence or absence of the teeth that exerts an influence upon the basal arch, but changes in the (masticatory) function induced by the unequal distribution of the teeth between the two sides (compelling the animals to chew their food unilaterally) are capable of causing growth differences even in the basal arch. Thus, the growth of the basal arch depends to some — though slight — extent on the presence of the teeth and their functioning during mastication.

By what factors was induced the growth difference of the condyloid process in the present series, we are unable to decide, since no consistent difference was found in the condyloid process' height after unilateral removal of both the upper and the lower teeth, and a greater height was found on the operated side after unilateral removal of the upper teeth only as well as of the lower teeth.

Summary

The growth of the maxilla and of the mandible was studied in dogs in which at the age of 7 to 8 weeks the teeth had been removed from the one side of the upper, and from the contralateral side of the lower jaw. Growth changes induced in the maxillae were identical with those found after unilateral removal of the upper teeth only or of both the upper and the lower teeth unilaterally. In the mandible, differences were found in the chord between the angulus and a point caudally from «*infradentale*», but none in that chord between angulus and the most posterior point of the median suture at the mandible's lower border. In the latter, differences were found in animals whose teeth had been removed unilaterally from the mandible or from both the mandible and the maxilla. Unilateral absence of the teeth seems, therefore, capable of inducing some change in the basal arch of mandible, by way of changing masticatory function. This seems to supply proof that the growth of the mandibular basal arch is also subject to influences by the masticatory function, in dependence on the presence and distribution of the teeth.

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ДЕЙСТВИЕ АСИММЕТРИЧНОГО (ПЕРЕКРЕСТНОГО) УДАЛЕНИЯ ЗУБОВ НА РАЗВИТИЕ ЧЕЛЮСТЕЙ СОБАК

П. АДЛЕР

Автор исследовал развитие верхней и нижней челюстей у собак, которым в возрасте 7—8 недель были удалены зубы из одной стороны верхней и из противоположной стороны нижней челюстей. Вызванные изменения в развитии верхней челюсти были иден-

тичными с изменениями, обнаруженными после одностороннего удаления только верхних зубов, или же после одностороннего удаления как верхних, так и нижних зубов. В нижней челюсти были найдены разницы расстояния между углом и одной каудальной точкой «infradentale», однако, не было обнаружено разницы расстояния между углом и верхней точкой среднего шва нижнего края нижней челюсти. В последней были обнаружены разницы у животных, зубы которых были односторонно удалены из нижней челюсти, или как из верхней, так и из нижней челюстей. Следовательно, одностороннее отсутствие зубов может, повидимому, вызвать некоторые изменения в базальной дуге нижней челюсти вследствие изменения жевательной деятельности. По всей вероятности, этим подтверждается, что жевательная деятельность, — в зависимости от присутствия и распределения зубов, — оказывает действие и на базальную дугу нижней челюсти.

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