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# Concerning the variation in the number, shape and size of incisors in fissiped carnivores

**O zmienności liczby, kształtu i wielkości zębów siecznych u drapieżnych (*Carnivora*)**

A b s t r a c t. A survey of innate deviations from the typical number, shape and size of incisors in fissiped carnivores, so far recorded in available literature, has been carried out and the opinions on their ontogeny and etiology are discussed. Four possible ontogenetic mechanisms have been distinguished to explain different cases:

(1) splitting of a tooth germ,

(2) fusion of tooth germs,

(3) development of an additional tooth germ on the dental lamina, and

(4) failure in the formation of a tooth germ on the dental lamina.

It is suggested that the most frequent cause of these deviations are mutations.

Nearly all living fissiped carnivores have typically six incisors in each jaw (see, e.g., EWER, 1973: 69—70), which is true of both their primary and replacing dentitions. Nevertheless, in this group of mammals inborn deviations from this number and from the incisor shape and size characteristic of a given species are not infrequent. They have been recorded from various families, for instance, from the *Canidae* (e.g. HENSEL, 1879; AGDUHR, 1921; HITCHIN and MORRIS, 1966; DOLGOV and ROSSOLIMO, 1964; VAN BREE and SINKELDAM, 1969), *Ursidae* (RAUSCH, 1961), *Procyonidae* (HALL, 1940), *Mustelidae* (e.g. BATEMAN, 1970; BERKOVITZ and THOMSON, 1973; GLAS, 1977; RUPRECHT, 1978; WOLSAN, 1983b) and *Felidae* (HEROLD, 1956; MANVILLE, 1963; KRATOCHVÍL, 1965; TAYLOR, 1965; HELL, 1968), and both from wild animals (e.g. MARSHALL, 1952; MANVILLE, 1963; ASAHI and MORI, 1980; BUCHALCZYK et al., 1981; WOLSAN, 1983a) and from reared ones (e.g. AGDUHR, 1921; REINWALDT, 1958; DÖCKE, 1959; HITCHIN and MORRIS, 1966; BERKOVITZ, 1968). They occur both in the deciduous dentition (see HITCHIN and MORRIS, 1961, 1966; BERKOVITZ, 1968, 1969; BERKOVITZ and THOMSON, 1973) and in the permanent teeth (see, e.g.,

REINWALDT, 1963; VAN GELDER and MCLAUGHLIN, 1961; LÜPS et al., 1972; OPATRNÝ, 1972, 1973). They generally appear more often in males than in females (see, e.g., VAN BREE and SINKELDAM, 1969; GLAS, 1977; RUPRECHT, 1978), which induced this last author to think that the genetic conditioning of supernumerary upper incisors is connected with sex. Literature however describes also cases in which in the examined carnivore material they occurred in more or less equal numbers in both sexes (e.g. BERKOVITZ, 1968) or even more often in females (e.g. WOLSAN, 1983b).

## SUPERNUMERARY INCISORS

They appear either one-sidedly (in the right or the left jaw half) or on both sides, resulting in the presence of, respectively, seven (see, e.g., HILZHEIMER, 1905; RAUSCH, 1961; REINWALDT, 1963; KRATOCHVÍL, 1965; BERKOVITZ, 1969) or eight incisors in a jaw (see, e.g., SUSSDORF, 1896; HILZHEIMER, 1908; TAYLOR, 1965; GLAS, 1977; BUCHALCZYK et al., 1981). The supernumerary incisors occur the most frequently in the upper jaw (see, e.g., NEHRING, 1882; BERKOVITZ and THOMSON, 1973; BERKOVITZ and POOLE, 1977; GLAS, 1977; ASAHI and MORI, 1980) and very rarely in the mandible (see MANVILLE, 1963; DOLGOV and ROSSOLIMO, 1964; OPATRNÝ, 1972, 1973; RUPRECHT, 1978). They are situated either within the tooth row (see, e.g., HEROLD, 1956; MANVILLE, 1963; REINWALDT, 1963; TAYLOR, 1965; BERKOVITZ, 1969) or outside, labially to it (see HILZHEIMER, 1905; MANVILLE, 1963; TAYLOR, 1965; BATEMAN, 1970) or lingually (see, e.g., HILZHEIMER, 1908; DOLGOV and ROSSOLIMO, 1964; OPATRNÝ, 1972, 1973; BUCHALCZYK et al., 1981). In the *Canidae,* in the literature represented in this respect chiefly by members of the genera *Canis* and *Vulpes,* supernumerary incisors were found in the medialmost position, i.e. between I1 of one half of the jaw and that of the other (AGDUHR, 1921; REINWALDT, 1963), between I2 and I3 (HILZHEIMER, 1905; DÖCKE, 1959; DOLGOV and ROSSOLIMO, 1964; BUCHALCZYK et al., 1981) and between I3 and C (SUSSDORF, 1896; HILZHEIMER, 1905); in one case such a tooth has been described as situated exactly lingually to I2 (DOLGOV and ROSSOLIMO, 1964). As regards the family *Ursidae,* I know only of two cases of additional incisors, found by RAUSCH (1961) in black bears *(Ursus americanus);* they were situated beside I3. In the *Mustelidae,* in the literature represented in this respect chiefly by members of the genus *Mustela,* supernumerary incisors occur the most frequently in the second position counting from the midline, i.e. between I1 and I2 (see, e.g., BERKOVITZ, 1968; BATEMAN, 1970; OPATRNÝ, 1972, 1973; BERKOVITZ and THOMSON, 1973; GLAS, 1977), considerably more rarely as the medialmost incisor (see REINWALDT, 1958; GLAS, 1977) and exceptionally

beside I3 (see RUPRECHT, 1978). All the cases of additional incisors that I know of in the family *Felidae* concern members of the genus *Lynx* and in all of them the additional tooth lies between I3 and C, often closer to the canine than to the incisor (see HEROLD, 1956; MANVILLE, 1963; KRATOCHVÍL, 1965).

The supernumerary incisors are for the most part very similar in shape to the adjacent incisor in the row (see, e.g., HILZHEIMER, 1908; REINWALDT, 1958; DOLGOV and ROSSOLIMO, 1964; OPATRNÝ, 1972, 1973; BUCHALCZYK et al., 1981), whereas in size they correspond to it (see, e.g., REINWALDT, 1958; DOLGOV and ROSSOLIMO, 1964; OPATRNÝ, 1972, 1973; BUCHALCZYK et al., 1981) or are smaller (see, e.g., HENSEL, 1879; HILZHEIMER, 1908; REINWALDT, 1963; DOLGOV and ROSSOLIMO, 1964; KRATOCHVÍL, 1965); BATEMAN (1970) observed in the material of mustelids examined by him that if a jaw contained seven incisors, the supernumerary tooth and its neighbour were often smaller than the teeth holding the similar position in a "normal" jaw. In most cases quoted in the present paper the supernumerary incisor and its neighbour had separate alveoli, although these teeth having partly united alveoli (DOLGOV and ROSSOLIMO, 1964) and one common alveolus (BATEMAN, 1970) have also been recorded.

## MISSING INCISORS

Innate deficiencies in the incisor dentition occur unilaterally (in the right or the left jaw half) or more rarely bilaterally, resulting in the presence of, respectively, five (see, e.g., MANVILLE, 1963; RANTANEN and PULLIAINEN, 1970; LÜPS et al., 1972; GLAS, 1977; WOLSAN, 1983b) or four incisors in a jaw (see, e.g., AGDUHR, 1921; REINWALDT, 1958; DÖCKE, 1959). They were reported both from the upper jaw (e.g. AGDUHR, 1921; REINWALDT, 1958; DÖCKE, 1959; MANVILLE, 1963; VAN BREE and SINKELDAM, 1969) and from the lower (e.g. REINWALDT, 1958; RANTANEN and PULLIAINEN, 1970; LÜPS et al., 1972; RUPRECHT, 1978; WOLSAN, 1983b), this last category being clearly prevalent in mustelids (see, e.g., MARSHALL, 1952; GLAS, 1977). Both in the *Canidae*, in the literature represented in this respect by members of the genera *Vulpes* and *Canis*, and in the *Mustelidae*, represented chiefly by members of the genera *Mustela* and *Martes*, the missing incisors are most frequently I1's (see, e.g., respectively, DÖCKE, 1959; PARADISO, 1966; VAN BREE and SINKELDAM, 1969; LÜPS et al., 1972, and MARSHALL, 1952; REINWALDT, 1958; GLAS, 1977; WOLSAN, 1983b), more rarely I2's (see, e.g., respectively, VAN BREE and SINKELDAM, 1969; RANTANEN and PULLIAINEN, 1970, and MARSHALL, 1952; GLAS, 1977; RUPRECHT, 1978) and, exceptionally, I3, found by MARSHALL (1952) in a mustelid.

In both cases I know from the families *Ursidae* and *Procyonidae* the third lower incisor was missing. One of them has been reported by RAUSCH (1961) from a black bear and the other by HALL (1940) from a raccoon *(Procyon lotor).* As regards the family *Felidae,* one case known to me was found by HELL (1968) in a European lynx *(Lynx lynx),* the missing tooth being the second upper incisor.

## INCISORS OF ATYPICAL SHAPE AND SIZE

Variation in size and shape can be observed not only in the supernumerary teeth (see above) but also in other members of the incisor dentition. Among these last there were both smaller (BATEMAN, 1970) and, much more frequently, larger teeth than might have been expected, judging by their position in the tooth row (e.g. VAN GELDER and MCLAUGHLIN, 1961; REINWALDT, 1963; HITCHIN and MORRIS, 1966; HELL, 1968; WOLSAN, 1983b). In most cases the large size of such teeth is accompanied by their unusual shape. It generally consists in the existence of the doubling or forking of a tooth, varying in degree and situated distally (see, e.g., AGDUHR, 1921; VAN GELDER and MCLAUGHLIN, 1961; BATEMAN, 1970; WOLSAN, 1983a, 1983b) or, more rarely, proximally (see BATEMAN, 1970), or in the presence of a proximodistal groove in the enamel, running all along the tooth, accompanying or not such a split (see AGDUHR, 1921; HITCHIN and MORRIS, 1966; BATEMAN, 1970); the cross-sections of these teeth often show two or sometimes even three pulp chambers comprised in one common enamel organ (see HITCHIN and MORRIS, 1966; BERKOVITZ and THOMSON, 1973).

Incisors characterized by their congenital atypical size only, or by both size and shape, most frequently appear on one side, i.e. in the right or the left half of the jaw (see, e.g., VAN GELDER and MCLAUGHLIN, 1961; REINWALDT, 1963; DOLGOV and ROSSOLIMO, 1964; BATEMAN, 1970; WOLSAN, 1983a) or, more rarely, on both sides (see HITCHIN and MORRIS, 1966; BERKOVITZ and THOMSON, 1973). They were more frequently found in the upper jaw (e.g. HITCHIN and MORRIS, 1966; BATEMAN, 1970; BERKOVITZ and THOMSON, 1973; BERKOVITZ and POOLE, 1977; RUPRECHT, 1978) than in the lower (HITCHIN and MORRIS, 1961, 1966; DOLGOV and ROSSOLIMO, 1964; WOLSAN, 1983a, 1983b). Both in the family *Canidae,* in the literature represented in this respect by the genera *Canis* and *Vulpes,* and in the families *Mustelidae,* represented by the genera *Mustela, Martes* and *Mephitis,* and *Felidae,* represented by the genus *Lynx,* such teeth occur mostly in the medialmost and MORRIS, 1961, 1966; REINWALDT, 1963, for *Mustelidae* see VAN GELDER and MCLAUGHLIN, 1961; BATEMAN, 1970; BERKOVITZ and position in a jaw quadrant (for *Canidae* see AGDUHR, 1921; HITCHIN

THOMSON, 1973; RUPRECHT, 1978; WOLSAN, 1983b, and for *Felidae* see HELL, 1968), more rarely as the medialmost teeth but one (for *Canidae* see DOLGOV and ROSSOLIMO, 1964, and for *Mustelidae* see WOLSAN, 1983a) and exceptionally as the lateralmost incisors (for *Mustelidae* see WOLSAN, 1983b). They appear, for the most part, in jaw quadrants with a typical number of three incisors, as one of them (see, e.g., AGDUHR, 1921; HITCHIN and MORRIS, 1966; BATEMAN, 1970; BERKOVITZ and THOMSON, 1973; WOLSAN, 1983a), or in quadrants with only two incisors (see, e.g., HITCHIN and MORRIS, 1966; VAN GELDER and MCLAUGHLIN, 1961; REINWALDT, 1963; HELL, 1968; WOLSAN, 1983b); in the latter case they are always situated beside the position in which the incisor is missing. The presence of an atypical incisor beside a supernumerary one has been described from one specimen only (DOLGOV and ROSSOLIMO, 1964).

## ONTOGENY

Only a few authors supplement their descriptions of the cases of innate deviations from the typical number, shape and size of incisors in fissiped carnivores by attempting to explain the ontogeny of such teeth. These are, among other authors, REINWALDT (1958, 1963), HITCHIN and MORRIS (1961, 1966) and BERKOVITZ and THOMSON (1973).

In his two papers the first of the above-mentioned authors describes the supernumerary permanent incisors found in the medialmost positions in a fox (*Vulpes vulpes*) and in two polecats (*Mustela putorius*) and, in addition, he noted the lack of the first permanent incisors in a mink (*Mustela vison*). In a premaxilla of another fox he observed only two alveoli, of which the medial was much larger than the alveoli of both I1 and I2 in the other premaxilla of that specimen. He explained the origin of these cases by changes in the length of the dental lamina. An increase in the length of the lamina was responsible, according to him, for the origin of the supernumerary teeth, whereas the lack of the teeth was due to a decrease. The development of the atypically large tooth to which the above-mentioned alveolus belonged was, according to this author, also caused by the shortening of the dental lamina, which however was not accompanied by a reduction in the number of tooth germs but only by their crowding, which made it possible for two of them to fuse together.

HITCHIN and MORRIS (1961, 1966) carried out a histological study on the ontogeny of deciduous and permanent incisors of atypical shape and size in Lakeland terriers (*Canis familiaris*). They found some jaw quadrants with only two incisors, of which the medial was larger than and mostly differed in shape from the usual one, and, more rarely, quadrants with three incisors, to be sure, the medialmost of which

however outsized its "normal" counterpart and varied in shape from it. These authors state that in both cases the primary developmental abnormality was the persistence of the interdental lamina. They suggest that in the first case it came to the herniation of the enamel organs between the two layers of the lamina persisting between the germs of the first and the second incisor and in consequence to the more or less complete fusion of these two germs; on the other hand, in the second case the persistent dental lamina broke close to the germ of the first incisor and its enamel organ might suddenly burst between the two layers of the lamina.

BERKOVITZ and THOMSON (1973) made a histological investigation of the development of supernumerary deciduous and permanent upper incisors in albino ferrets (*Mustela putorius*). They observed the presence of the supernumerary teeth in the second position, counting from the midline (between I1 and I2), as well as jaw quadrants with three incisors, to be sure, the medialmost of which however showed differences in shape and size from the typical tooth. They suggest that here each supernumerary deciduous incisor came to be as a result of a complete dichotomy of the medially situated germ of the deciduous first incisor in its early developmental phase and that the deciduous teeth of atypical shape and size are due to an incomplete dichotomy. They think that each supernumerary deciduous incisor gives rise to the corresponding permanent tooth germ, which develops from the dental lamina separately and subsequently either undergoes a resorption or fusion with the germ of the first incisor, or remains as a separate supernumerary incisor. The fusion may be complete, if it occurs in an early phase of development, and it may produce a "normal" tooth; an incomplete fusion is therefore responsible for the origin of permanent teeth of atypical shape and size.

It is noteworthy that if all the cases of congenital deviation from the characteristic number, shape and size of incisors quoted in the present paper were gathered together, one could follow a nearly continuous range of variation from the development of four up to eight incisors in a jaw or from two to four incisors in a jaw quadrant. Under this variation occasional jaw quadrants may have:

(1) only two but typically developed incisors (see, e.g., WOLSAN, 1983b),

(2) also two incisors, but one of them, adjacent to the position in which the tooth is missing, larger than usual, though not differing in shape (see, e.g., HITCHIN and MORRIS, 1966),

(3) same as in item (2) only that the incisor adjacent to the position in which the tooth is missing, besides being larger, is also characterized by the presence of a groove, varying in the degree of its formation, or another sign of the splitting of the tooth (see, e.g., VAN GELDER and MCLAUGHLIN, 1961; HITCHIN and MORRIS, 1966; WOLSAN, 1983b),

(4) three incisors developed in the manner characteristic of a given species,

(5) also three incisors only that one of them developed as in item (2) (see WOLSAN, 1983b),

(6) three incisors, too, but one of them developed as in item (3) (see, e.g., AGDUHR, 1921; HITCHIN and MORRIS, 1966; BATEMAN, 1970 BERKOVITZ and THOMSON, 1973; WOLSAN, 1983a),

(7) four incisors, the supernumerary tooth being very small and partly sharing the alveolus with its neighbour, which besides shows a sign of splitting (see DOLGOV and ROSSOLIMO, 1964),

(8) four incisors, too, of which the supernumerary one and its neighbour, bearing no traces of being united, share one alveolus (see BATEMAN, 1970),

(9) also four incisors, the supernumerary tooth being smaller than its neighbour, but either of them in its own alveolus (see, e.g., HENSEL, 1879; REINWALDT, 1963), and

(10) as in item (9) only that the supernumerary tooth is more or less the same size as its neighbour (see, e.g., DOLGOV and ROSSOLIMO, 1964; OPATRNÝ, 1972, 1973; BUCHALCZYK et al., 1981).

The existence of this almost continuous variation suggests that the developmental processes taking place in the ontogeny of the cases under consideration probably also pass in a continuous manner into each other and that their primary anatomic abnormalities (see HITCHIN and MORRIS, 1961, 1966) may be similar in nature. However, to settle this problem it is necessary to carry out closer embryological studies. At any rate, on the basis of the embryological studies so far made, chiefly by HITCHIN and MORRIS (1966) and BERKOVITZ and THOMSON (1973), and the external appearance of the cases of innate deviations from the characteristic number, shape and size of incisors in fissiped carnivores it may be assumed that in the ontogeny of some of these cases it came to a split of the tooth germ, in others to the fusion of the germs and still other supernumerary incisors may have been brought about by the development of an additional germ produced on the dental lamina, whereas some cases of missing incisors may have been due to a failure in the formation of a tooth germ on this lamina. Below, I try to explain which of these mechanisms may have taken place in the ontogeny of the cases in question, the numbers of cases corresponding to those given above:

(1) In some of the cases characterized above in the first item there may have been a failure in the formation of one of the "normal" tooth germs on the lamina and in others it may have come to a complete fusion of two adjacent "normal" germs in an early developmental phase (cf. REINWALDT, 1958; WOLSAN, 1983b); BERKOVITZ and THOMSON

(1973) suggest that if the fusion of the germs occurs early enough, it may result in the production of a tooth of typical shape and size.

(2) These cases may have come to be as a result of a complete fusion of two adjacent "normal" tooth germs, which fusion however took place in a later phase than in cases included in item (1) (cf. REINWALDT, 1963; HITCHIN and MORRIS, 1966).

(3) As in item (2) only that the fusion was not complete (cf. HITCHIN and MORRIS, 1961, 1966; REINWALDT, 1963; WOLSAN, 1983b).

(5) As in item (2) only that the fusion involved a "normal" germ and probably a germ formed additionally on the dental lamina (cf. WOLSAN, 1983b).

(6) In some cases included in the category characterized in the sixth item above an incomplete split of a "normal" tooth germ may have occurred and in the remaining ones it may have come to an incomplete fusion of a "normal" and an additional tooth germ formed on the dental lamina (cf. AGDUHR, 1921; HITCHIN and MORRIS, 1961, 1966, BATEMAN, 1970; BERKOVITZ and THOMSON, 1973; WOLSAN, 1983a); it can be inferred from the size and shape of the separated parts of the tooth, which of these processes we are concerned with in a given case; see items (9) and (10) below.

(7) and (8) In these cases a "normal" tooth germ was probably affected by the process of splitting rather than by the fusion with an additional germ produced on the dental lamina (cf., respectively, DOLGOV and ROSSOLIMO, 1964, and BATEMAN, 1970).

(9) and (10) In some cases characterized in the corresponding items above a complete split of a "normal" tooth germ may have taken place and in the remaining ones it may have come to the formation of an additional germ on the dental lamina, which germ had not undergone a fusion with its neighbour (cf. REINWALDT, 1958, 1963; DOLGOV and ROSSOLIMO, 1964; TAYLOR, 1965; BATEMAN, 1970; BERKOVITZ and THOMSON, 1973). It can be inferred from the shape and size of the supernumerary incisor which of these mechanisms we are concerned here with, that is, if it is very similar in shape to its neighbour in the tooth row and its shape and size disagree with the gradient of these qualities along the row*, it may be assumed that it originated owing to the split of the tooth germ of its neighbour; on the other hand, if it does not fulfil these two conditions, it is very probable that it originated in the second of the ways mentioned.

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* Such a gradient is a characteristic feature of nearly all mammalian dentitions and whether its existence is explained in agreement with the Field Model (BUTLER, 1939) or with the Clone Model (OSBORN, 1978), it is impossible for a tooth produced from its own separate germ not to develop according to this gradient.

## ETIOLOGY

There is no doubt as to the fact that at least in most of the cases quoted in the present paper the inborn deviations from the characteristic number, shape and size of incisors are inherited (see, e.g., HITCHIN and MORRIS, 1961, 1966). However, it is not possible that the same genes should be responsible for all these cases, and so different genes brought about the deviations described, for instance, by HITCHIN and MORRIS (1966) and different ones those recorded by BERKOVITZ and THOMSON (1973), etc.

Nearly all cases of supernumerary incisors and those bearing signs of splitting, found by BATEMAN (1970) in his material of 936 skulls of mustelids, occurred in the upper jaws of ferrets, polecat/ferret hybrids and polecats. In consequence, he suggests that the gene recombination rather than mutation is responsible here for the appearance of the supernumerary upper incisors and that it is just the presence of the ferret genes may favour the recombination that induces this state in hybrids. He assumes further that the polecat genes have not such a potential and the occurrence of supernumerary upper incisors in the dentition of a specimen identified as a polecat might indicate that in fact it is a polecat/ferret hybrid. This theory however seems hardly probable, because supernumerary incisors have been found in many wild polecats (see BERKOVITZ and POOLE, 1977; GLAS, 1977; RUPRECHT, 1978) and in many other carnivore species (see above).

SUSSDORF (1896) treats the supernumerary upper incisors described by him from a dog (*Canis familiaris*) as "atavistic" and BERKOVITZ (1968, 1969) as well as BERKOVITZ and THOMSON (1973) claim that the presence of supernumerary incisors described by them from albino ferrets and polecats may possibly be explained in two ways: firstly, that they appear due to a present-day gene mutation or secondly, that they are of evolutionary significance and represent a tooth once present in the functional dentition. In his papers of 1968 and 1969 BERKOVITZ leans towards the second explanation rather than the first one. However, having taken into consideration the palaeontological data concerning the order in which the cheek teeth were lost in course of the evolution of mammals and the theoretical models proposed by BUTLER (1939) and OSBORN (1978) for the explanation of the ontogeny of mammalian heterodonty and so, respectively, the Field Model and the Clone Model, it is hard to imagine that in the case of incisors such losses might involve other teeth than the extreme ones in a jaw quadrant, and yet BERKOVITZ (1968) and BERKOVITZ and THOMSON (1973) found the supernumerary teeth in the second position counting from the midline. ZIEGLER (1971) suggests that such losses of incisors in Mesozoic therian mammals proceeded posteroanteriorly, but the fact that the extreme

lateral incisor is the largest and the medialmost one the smallest in fissiped carnivores would rather indicate that as regards the ancestors of the *Carnivora,* it was just the other way round. In my opinion, therefore, these of the supernumerary incisors mentioned in the present paper might at most be regarded as "atavistic" which occupied a position between I3 and C and/or between right and left I1's and were shaped in agreement with the gradient of shape and size along the tooth row. It should however be kept in mind that no recent and, with one possible exception described by VAN VALEN (1966) from a specimen belonging to the genus *Deltatheridium* (presumably of the Early Palaeocene), no extinct eutherian mammals with more than six incisors in a jaw are known so far (ZIEGLER, 1971)*.

And so it seems that the most frequent cause of the deviations from the characteristic number, shape and size of incisors in fissiped carnivores, quoted in this paper, are, in all probability, mutations.

Translated into English
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* This statement is true, if the discernment of the dental classes is based on the generally applied premaxillary/maxillary suture system, but it is false, if OSBORN's (1978) system has been adopted (see, however, BUTLER, 1978).

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STRESZCZENIE

Cechą charakterystyczną niemal wszystkich drapieżnych (*Carnivora*) jest obecność sześciu zębów siecznych w każdej szczęce. Notowane są jednakże od czasu do czasu okazy z wrodzoną większą lub mniejszą ich liczbą, a także przypadki występowania mniejszych lub większych siekaczy, aniżeli by to wynikało z ich pozycji w szeregu zębowym. Znane są również zęby sieczne o wrodzonym nietypowym kształcie, polegającym na istnieniu w różnym stopniu wyrażonych oznak rozdzielenia zęba.

Praca ta zawiera przegląd przytoczonych dotychczas w literaturze takich właśnie przypadków wrodzonych odchyleń od charakterystycznej liczby, kształtu i wielkości siekaczy u drapieżnych. Dyskutowane są również tutaj poglądy na ich ontogenezę i etiologię.

Autor wyróżnił cztery możliwe mechanizmy ontogenetyczne dla wyjaśnienia różnych przypadków:

(1) rozszczepianie zawiązka zębowego,
(2) zlewanie się zawiązków zębowych,
(3) wytworzenie dodatkowego zawiązka na listwie zębowej,
(4) niewytworzenie zawiązka na listwie zębowej.

Sugeruje on, że najczęstszą przyczyną pojawiania się cytowanych w tej pracy przypadków są mutacje.

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