The Origin of Supernumerary Teeth.[1]

By

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The supernumerary tooth has attracted much interest ever since the middle of the nineteenth century, when the theory of evolution was accepted as the basis of all research in natural history. The occurrence of such teeth seemed to argue strongly that the present human denture has evolved from an ancestral type with a greater number of teeth and that there have also been many dentitions. For this reason investigations of the phylogeny of the tooth and the theories developed from it have formed the basis and background of the study of supernumerary teeth.

COPE-OSBORN's theory of differentiation (1889), KÜKENTHAL and RÖSE's theory of concrescence (1892), and BOLK's dimeric theory (1914) each in their way support the opinion that the supernumerary tooth has phylogenetic significance. Yet there are many other opinions on the genesis of the supernumerary. Various opinions have also been expressed as to its dentition.

No statistical studies on supernumerary teeth have been published in Finland and on the whole this question has been but little investigated here. At the suggestion of Professor J. KIVIMÄKI I have therefore made a series of investigations to determine the incidence of supernumerary teeth, the age at which they erupt, their form and position in the dental arch, and their size. I studied their occurrence in connection with different

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pathologic conditions and with duplicate teeth, and — with the aid of familial investigations — I tried to find out whether there is a hereditary tendency. Above all I attempted to answer the question whether the occurrence of supernumerary teeth is an atavistic, progressive, regressive, or irregular phenomenon.

The many different criteria have resulted in a diversity of opinion regarding the causes of supernumerary teeth. As it has been almost impossible to prove any of them, many varying hypotheses have been presented. The different theories are:

1. Theory of atavism;
2. Postpermanent dentition;
3. Division of a tooth-germ within the same tooth generation;
4. Theory of hyperproductivity.

The question of the dentition of supernumeraries is essentially related to these theories.

From whatever standpoint regarded, the dentition of normal teeth is always quite definite but not that of a supernumerary: as it is not essentially a part of any dentition, its simultaneous function with other teeth of the same dental arch has not been considered an adequate criterion of its dentition, although teeth belonging to the same dental arch are usually regarded as parts of the same tooth generation.

While, in the tooth-changing zone, the time of function and eruption and also the shape of supernumerary teeth have been considered very important, supernumerary molars have been interpreted almost independently of the time of eruption in different ways chiefly on the basis of the position of the tooth in the dental arch, and this latter is no doubt a factor of great importance assuming that there are four dentitions, viz. most labially the prelacteal, and more lingually the deciduous, the permanent and the postpermanent dentitions. Studies of man in this respect have not been possible to any appreciable extent. Even the adherents of the theory of concrescence seem to regard it as only a theoretical possibility that a supernumerary tooth might belong to a prelacteal dentition: in practice it has been considered much more probable that it is a part of a postpermanent or third dentition (Adloff). Interpreted as a product of division, its dentition has been easy to determine: naturally a part of a tooth belongs to the same dentition as the tooth itself. Adherents of the theory of overproduction do not seem to have given special attention to the dentition of super-

numerary teeth; they have simply been regarded as parts of the dentition at the time of which they have appeared, regardless of small differences in time.

The essential part of the material consists of 42 dental arches containing supernumerary teeth; these were found when examining 10,015 subjects, elementary and secondary school children aged 6 to 18 years and recruits aged 20 to 22. The results appear from the following table:

Table 1.

	No. of Examined	No. of Permanent Dental Arches with Supernumerary Teeth	No. of Erupted Supernumerary Teeth Contained	Per Cent	Impacted Teeth
Recruits	5,012	32	32	0.64	—
School children Girls	2,503	3	3	0.12 [1]	—
School children Boys	2,500	7	11	0.44	1
Total	10,015	42	46	0.46	1

The second part of the material is composed of cases discovered during 15 years among private patients and at examinations of army personnel.

Table 2.

	No. of Permanent Dental Arches with Supernumerary Teeth	No. of Erupted Supernumerary Teeth Contained
Private Patients Women	12	12
Private Patients Men	16	18
Recruits	20	22
Total	48	52

In addition three casts were available, two of permanent arches and one of a deciduous arch. Of all these 93 cases, there were personal data. The material includes cusps in the molars, duplicate teeth, size anomalies, and 17 removed supernumerary teeth (Collection I). I also had access to the collection in the Dental School of Helsinki University comprising 125 casts with supernumerary teeth, duplicate teeth, and 19 removed teeth (Collection II).

The entire material is as follows:

Table 3.

	Permanent Dental Arches	Deciduous Dental Arches	No. of Supernumerary Teeth Contained	Lateral Cusps in the Molars	Duplicate Teeth	Size Anomalies
Collection I	92	1	102	10	3	2
Collection II	122	3	159	—	6	—
Total	214	4	261	10	9	2

The incidence of supernumerary teeth in the different parts of the dental arch is of importance in that it can serve as a basis for a study on the genesis of supernumerary teeth.

The material shows, first, that the incidence of supernumerary teeth in recruits is remarkably high, 0.64 per cent. In school children it is 0.28 per cent; this is evidently due to the fact that a great number of supernumeraries do not erupt until military age. A difference is noted between the sexes: boys had over three times as many supernumerary teeth as girls. The cases from my private practice seem to support the same opinion though the difference is not so great: 40 per cent of the supernumerary teeth occurred in women and 60 per cent in men. In both collections supernumeraries were practically as frequent on the left as on the right side.

The age at which supernumerary teeth erupt has often been related to their dentition, and this question naturally is important in studies of such teeth.

My study shows that in Finns these teeth generally erupt within the same period as the normal permanent teeth, *i. e.* between the ages of 5 and 18 years, according to EKMAN's investigations. My material includes no supernumerary teeth in children under 6 years. On the other hand, it seems that time may elapse between the eruption of permanent teeth and of supernumerary teeth and this interval may vary from a few years to several decades. Late eruption of supernumeraries is evidently less frequent in the incisor area than in other dental groups.

In dividing supernumerary teeth as to form, it seems justified to follow BUSCH as I have done below:

Table 4.

	Collection I		Collection II	
	Number	Per cent	Number	Per cent
1. Peg teeth	42	42	40	25.7
2. Multiple-cone teeth	12	12	18	11.7
3. Teeth of typical shape	41	41	96	61.5
4. Intermediate forms	5	5	2	1.5
Total	100		156	

The form of supernumerary teeth and their position in the dental arch do not seem entirely independent of each other: there exists some kind of correlation. Peg teeth are most frequent in the area of the upper central incisors or in their immediate neighbourhood. They also occur bilaterally.

Supernumerary teeth of typical shape are most frequently found in the area of the lateral incisors, in and on both sides of the dental series.

The size and type of supernumerary teeth seem to be related in such a way that a particular kind of tooth is smaller or larger than another. I have been able to study the size of the teeth only to a slight extent, but it seems that peg teeth are smaller than other types of supernumerary teeth.

Studying the location of supernumeraries in the different areas in the light of the above theories, the conclusion is reached that their origin cannot be explained by the atavism theory. Assuming that the mammalian dental formula has originally been 3.1.4.3. and that one incisor and two premolars have disappeared in the course of phylogenetic development, their ratio of incidence in these regions should be 1:2 if these teeth were atavistic. The study shows that the number of extra teeth is far greater in the incisor areas, viz. 87 per cent of all supernumeraries, but in the premolar areas the corresponding figure is only 4 per cent. In the collection of the Dental School these figures are 66.7 and 12.2 per cent respectively. The incidence of supernumerary teeth in the upper and lower arches would also be expected to be practically equal. In Collection I the proportion of extra teeth in the upper arch is 83 per cent and in the lower arch 17 per cent, in Collection II these figures are 75.6 and 24.4 per cent respectively. These percentages do not speak in favour of the theory of atavism. In addition, the material includes some cases with four incisors

on the same side whereas a form with four incisors is unknown in animals. Both the collections include cases with two canines, and a second canine is also unknown in animals.

The so-called paramolars in the molar area have been considered to have phylogenetic significance especially by BOLK; he regards them as residua of previously existing deciduous teeth because they are situated labial to the molars. My results are not in agreement with this opinion: in one case there was a paramolar lingual to the series at a point to which it cannot possibly have moved from the labial or distal side of the series.

Based on comparative root apex studies and the lingual position of supernumerary teeth, ANT-VUORINEN and WESKI consider that in some cases — notably in the incisor area — supernumeraries belong to a postpermanent dentition. However, it seems that developmental variation and position cannot be decisive when there is no difference in the time of function and no resorption in the roots of the permanent teeth. It appears that the developmental stage of the root apices of these teeth may vary greatly as compared with the adjoining permanent teeth. In some cases the root apex of a supernumerary may be as well developed as those of the adjacent teeth, in some more, in some less. This variation may probably be ascribed to the fact that the supernumerary tooth has developed in the dental lamina prior to, simultaneously with, or some time after the neighbouring teeth. There is thus no reason to regard supernumerary teeth as parts of a postpermanent dentition.

Supernumerary teeth have been attributed to division of tooth-germs but this seems possible only where there is atrophy of the adjacent teeth and the supernumerary tooth is small. BOLK's theory of schizogenous division seems, however, to lack adequate foundation. If the deuteromer differs from the protomer, an extra tooth should always be situated palatal or lingual to the series, and in the two parts resulting from division there should be no tuberculum dentale, which is occasionally the case; if, on the other hand, a tooth-germ underwent division so that the central zone with its cusps would fail to develop, the resulting teeth — which should be side by side in the series — should have no grooves or cusps, which they often have.

The most probable explanation appears to be that supernumerary teeth in all parts of the dental arch are the result of proliferation of the dental lamina and arise from independent dental

elements, judging from the fact that they are often of normal size as compared with the adjoining teeth and from their frequently normal shape. They seem to be parts of the dentition with which their eruption coincides in time. The opinion of MATHIS — that supernumerary teeth are not related in time to any of the dentitions — deserves attention.

Supernumerary teeth in connection with pathologic conditions must be dealt with separately. In a way they corroborate the view that the supernumerary tooth must be explained by something else than phylogenetic development. Cleft jaw seems not always to coincide with the sutura incisiva; this study, as well as previous ones, seems to show that the course of this suture varies. Seventy-six skulls in the Museum of the Department of Anatomy [of Helsinki University] were studied in this respect and the results showed that the sutura incisiva ended

		Per cent
at the alveolus of the canine	in 38 cases	50.0
between the canine and the lateral incisor...	» 32 »	42.1
between the canine and the first premolar ..	» 4 »	5.3

This shows that the intermaxillary bone has a considerable range of variation. As the measurements of the embryonal processes also probably vary and as the degrees of variation of the intermaxillary bone and, on the other hand, of the embryonal processes unite in different ways, supernumerary teeth may probably develop owing to different causes. When such a tooth is small it may have arisen through splitting of a tooth-germ, but when it is of normal size it may also be due to proliferation of the dental lamina at the ends of the embryonal processes which have failed to unite.

Only one case was available for the study of supernumerary teeth in connection with dysostosis cleidocranialis: a skull in the Museum of the Department of Anatomy. This skull contains so many supernumeraries as to convey the impression that one can actually here speak of a third dentition. Vertical replacement of permanent teeth by a later dentition is still noticeable in this skull, at least in the lower arch. In dysostosis the changes are known to involve only the bone and not the epithelium, and thus the extra teeth may in these cases probably be attributed to the folding of the epithelial dental lamina which develops normally in the midst of defectively developing bone.

In this material extra teeth occur also in hyperplasia of the enamel possibly due to rachitis. The origin of these supernumeraries may be the same as in the case just described.

Duplicate teeth have been widely studied. It is generally considered that one component of a duplicate tooth is a supernumerary. Opinions differ, however, as regards whether here is a question of synodontia, *i. e.* fusion of two tooth-germs, or schizodontia, *i. e.* division of one tooth-germ, in which latter case the term "supernumerary tooth" is not appropriate. With the aid of roentgenograms it is possible to study the internal structure of supernumerary teeth, in other words the tissues that are common to both components, but whether the formation is essentially synodontia or schizodontia can probably not be determined by any means after the tooth has developed. In the case of synodontia the fusion of tooth-germs is probably due to so-called growth pressure which, in a young organism, is a very important factor.

The part played by heredity in the origin of the supernumerary tooth is also of interest. Although man is not a profitable subject for heredity investigations, some results are obtainable by familial studies. In the present series the results are negative. Twenty families in which one member had one or several supernumerary teeth were examined and it seems evident that there is no dominant inheritance because, if so, these teeth would occur regularly in successive generations. A recessive heredity is mostly very difficult to discover. The appearance of supernumeraries was not sex-linked in any of the cases in which heredity was suggested, and thus it may be concluded that this anomaly is not inherited, at least not according to any definite formula.

The supernumerary tooth has previously been regarded as a regressive phenomenon, *i. e.* as the result of division into its original components of a tooth which may disappear in the course of development, in other words, is in reduction. It has also been attributed to some kind of progressive tendency. In both cases the supernumerary tooth would reflect a regular development and it should therefore have some function or purpose. This can scarcely be said to be the case. On the whole supernumerary teeth have been found more frequently in men than in women, whereas reduction is more common in women. Consequently these teeth seem to have no connection with reduction or with regressive development. Their presence together with reduction in the same

dental arch indicates that the supernumerary tooth cannot be progressive or regressive but must be looked upon as an irregular anomaly.

Zusammenfassung.

Bestrebt, die Genese der überzähligen Zähne klarzulegen, habe ich die Umstände untersucht, welche für die Beantwortung der Frage, ob der überzählige Zahn eine atavistische, progressive, regressive oder irreguläre Erscheinung ist, von Bedeutung sein können.

Überzählige Zähne habe ich fast ausschliesslich in permanenten Zahnbeständen angetroffen, unter Milchzähnen ausserordentlich selten.

Laut meinen Untersuchungen ist die Häufigkeit des Auftretens von ausgebrochenen überzähligen Zähnen bei Schulkindern im Alter von 6—8 Jahren 0.28 %, bei 20—22-jährigen Wehrpflichtigen 0.64 % und im Durchschnitt 0.46 %.

Das relativ häufige Auftreten von überzähligen Zähnen auf dem Gebiet der Schneidezähne sowie die geringe Häufigkeit des Auftretens auf dem Gebiete der premolaren sowie die Existenz überzähliger caninus Zähne weisen darauf hin, dass solche Zähne eine phylogenetische Bedeutung nicht besitzen. Es scheint, dass die überzähligen Zähne bei gesunden Individuen vertikal permanente Zähne nicht ersetzen, und aus diesem Grunde kann man sie wohl nicht zu den sog. postpermanenten Zähnen (Dentition) rechnen.

Eine Aufteilung des Zahnkeims ist wahrscheinlich oft der Grund zur Entstehung eines überzähligen Zahnes, wenn auch hierbei keine Zähne von normaler Grösse entstehen.

Vor allem sind wohl die überzähligen Zähne ein Ergebnis der Überproduktion der Zahnleiste.

Die in Verbindung mit pathologischen Zuständen angetroffenen überzähligen Zähne haben wahrscheinlich auch ihre Ursache in den beiden obenerwähnten Umständen. Doch ist wohl im Zusammenhang mit Lippen- und Gaumenspaltungen in gewissen Fällen die Verlängerung der Zahnleiste und in Verbindung mit Knochenaffekten die Faltung der Zahnleiste die primäre Ursache der Überzähligkeit der Zähne. Sofern sich ein überzähliger Zahn überhaupt vererbt, geschieht dies nach meinen Untersuchungen wenigstens nicht in dominanter Weise, und auch nicht

in irgendwelchem anderen deutlichen und regelmässigen Vererbungsschema.

Eine planmässige, progressive oder regressive Entwicklung scheint ein überzähliger Zahn nicht aufzuweisen. Man kann ihn wohl für eine irreguläre Anomalie halten.

Résumé.

En essayant d'élucider la genèse de la dent surnuméraire, j'ai examiné les circonstances pouvant avoir une importance si on veut répondre à la question: La dent surnuméraire est-elle un phénomène atavique, progressif, régressif ou irrégulier?

J'ai rencontré des dents surnuméraires presque uniquement dans les dentitions permanentes; très rarement dans les dentitions de lait.

D'après mes recherches, la fréquence d'apparition des dents surnuméraires est de 0.28 % chez les écoliers de 6 à 8 ans, de 0.64 % chez les soldats de 20 à 22 ans et en moyenne 0.46 %.

La fréquence d'apparition relativement grande des dents surnuméraires dans la zone incisive, et sa rareté dans la zone prémolaire, ainsi que l'existence de canines surnuméraires nous montrent que de telles dents n'ont pas d'importance phylogénétique.

Comme il semble que les dents surnuméraires chez l'individu sain, ne remplacent pas verticalement les dents permanentes, il ne convient sans doute pas de les compter comme appartenant à la dentition postpermanente.

Une division du germe peut souvent être à l'origine de la dent surnuméraire, même s'il ne se developpe pas de dents de taille normale.

Mais la plupart des dents supplémentaires peuvent être une surproduction de la rainure dentale.

Les dents surnuméraires rencontrées en conjonction avec des états pathologiques, proviennent vraisemblablement aussi des deux causes indiquées ci-dessus. Il est cependant possible que dans certains cas avec fissure de la lèvre ou du palais ou avec affection de l'ossature l'allongement et le plissement de rainure dentale soient la cause primaire des dents surnuméraires.

Dans quelle mesure la dent supplémentaire est-elle héréditaire? Selon mes recherches, le cas ne se produit au moins pas d'une

manière dominante, et ne correspond à aucun schéma d'hérédité clair ou régulier.

La dent surnuméraire ne semble pas présenter de développement rationnel, ni progressif, ni régressif. On peut donc la considérer comme une anomalie irrégulière.

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