The Relationship Between Third Molar Agenesis And Reduction In Tooth Number

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Third molar agenesis is undoubtedly the most common dental reduction with up to 50% of some groups affected according to Hellman.[10] Even confining attention to whites and taking into account only those groups studied radiographically, sex-adjusted population estimates of third molar agenesis range from 7% to 26%. These estimates have been calculated from data of Nanda,[11] Goblirsch,[8] Banks[1] and Hellman.[10]

Throughout the reports on third molar agenesis, there are repeated suggestions that other teeth are more frequently missing when one or more third molars are congenitally absent. In some cases, as in Thomsen's study of the isolated people of Tristan da Cunha,[13] the association may be due to intensive inbreeding and chance assemblage of rare (but independent) genes. In other studies, as in the Minnesota investigation of Brekhus *et al.*,[3] the association between third molar agenesis and other missing teeth may be due to the method of selection since only subjects with conspicuous deficiences in tooth number were subjected to intensive radiographic review. And frequently, as in Pedersen's excellent monograph on the East Greenland Eskimo,[12] missing teeth are treated separately so that associations between M_3 agenesis and other missing teeth are then difficult to unravel.

Nevertheless, there are theoretical as well as factual reasons to expect an increased incidence of other missing teeth when one or more third molars are congenitally absent. Such an association has been demonstrated in the mouse according to Grüneberg[9], quoted by Brash.[2] Third molar agenesis may be considered as symptomatic of a field affecting the remaining "unstable" teeth I_2, P_2 and so on. Since M_3 is last in the molar row, reduction in the distal segments of the incisor and premolar rows may be anticipated when the third molars are missing. In this line of thinking, reductions in tooth number should never be considered alone, but always in relation to the presence or absence of the third molar.

We have, therefore, given particular attention to the subject of third molar reduction and its association with other missing teeth using an extensive sample of 498 individuals, all subjected to careful radiographic appraisal and review.

METHODS AND MATERIALS

The present study is based upon two discrete groups of subjects, the first lacking one or more third molar teeth as confirmed radiographically, and the second possessing all four of these variable last molars.

In the first group we have combined 78 private orthodontic patients (A. B. L.) lacking one or more third molar teeth and 22 subjects from the Fels Longitudinal Series similarly lacking at least the mandibular left third molar. As with Banks,[1] our own longitudinal survey of over 200 cases shows that the absence of the third molars cannot be confirmed in all cases until the four-

teenth year (i.e. the critical age) and the third molar agenesis groupings were so selected.

For controls, we have made use of 398 orthodontic patients all fourteen years of age or older, and all with a full complement of third molar teeth fully confirmed by radiographic investigation. The presence or absence of other teeth, in this group as well, was based on clinical examinations, review of dental casts, investigative records and complete jaw and head x-rays.

The approach, then, involved an experimental group (characterized by third molar agenesis) and a control group (possessing all four third molar teeth). The question at hand was whether the former subjects, lacking one or more third molar teeth, exhibited a larger proportion of missing teeth of other classes than did the control group unaffected with respect to third molar agenesis itself.

Although it is known that the incidence of third molar agenesis varies with sex, with a higher proportion in the female than in the male, the method of intra-individual comparisons used in this study made it unnecessary to correct the tabulations for this attribute. However, in other reports on this subject, including estimates of population incidence, due corrections for sex have been made.[5,7]

Findings

As shown in the first table, where the number of missing teeth in each class and quadrant are separately tabulated, far more teeth of other classes were missing in the third molar agenesis group than in the controls. Moreover, more specific classes of teeth were affected by reduction in the third molar agenesis group than in the control group. Among children lacking one or more third molars, central and lateral incisors, canines, both premolars and second molars were in some cases missing. Only the first molar teeth were consistently present. On the other hand, in the group unaffected by third molar agenesis, only the lateral incisors and second premolars were affected by number reduction.

TABLE I

MISSING MAXILLARY AND MANDIBULAR TEETH IN M_3 AGENESIS AND IN AN UNAFFECTED (CONTROL) GROUP

Tooth	M_3 Agenesis Grp. N = 100 Right	Left	Control Grp. N = 398 Right	Left
Maxillary I_1	0	0	0	0
Mandibular I_1	3	2	0	0
Maxillary I_2	10	9	4	3
Mandibular I_2	0	0	0	0
Maxillary C	0	0	0	0
Mandibular C	0	1	0	0
Maxillary P_1	1	1	0	0
Mandibular P_1	1	1	0	0
Maxillary P_2	3	1	1	0
Mandibular P_2	5	9	5	4
Maxillary M_1	0	0	0	0
Mandibular M_1	0	0	0	0
Maxillary M_2	1	1	0	0
Mandibular M_2	3	1	0	0
Total Maxillary	15	12	5	3
Total Mandibular	12	14	5	4
Total Missing	27	26	10	7

The tendency toward a far greater incidence of missing teeth of other classes in the children with third molar agenesis is further apparent in the second table where the data are summarized for each tooth separately. Among the children with third molar agenesis, all teeth except first molars showed a tendency toward reduction. In all, there were 53 missing teeth of various classes in the 100 children with third molar agenesis as compared with 17 missing teeth in the 398 controls. Corrected for

TABLE II

PREVALENCE OF MISSING TEETH IN M_3 AGENESIS GROUP AS COMPARED TO (UNAFFECTED) CONTROLS

Tooth	Agenesis Group (N = 100)	Controls (N = 398)
I_1	5	0
I_2	19	7
C	1	0
P_1	4	0
P_2	18	10
M_1	0	0
M_2	6	0
Total	53	17
No. per 100 individuals	53	4

the size of the unequal samples, therefore, the incidence of missing teeth was 13-times as great in the third molar agenesis group as in the control group. In actual numbers there were 53 missing teeth in the children characterized by third molar agenesis against an expected number of four missing teeth based upon the control group frequency. Using the Chi-squared test as a measure of association and comparing the tendency toward reduction in third molar teeth with number reduction in other tooth classes, a highly significant Chi-squared value of 157.1 was obtained.

The tendency for a far higher prevalence of missing teeth in association with third molar agenesis is perhaps best demonstrated on a percentage basis. Comparing the percentage of *individuals* missing one or more teeth of a specific class in the M_3 agenesis group and in the unaffected (or control) group, the dramatic difference is abundantly clear. As shown in Figure 1, in the affected group both I_2 and P_2 are characterized by incidences of agenesis greater than 10%, and only M_1 is never missing. On the other hand, in the control group the percentage of individuals characterized by one or more missing teeth in any tooth class never rises above 1.5%, and only I_2 and P_2 are so characterized. Thus, the incidence of individuals missing other teeth is up to ten times higher in the group of children characterized by third molar agenesis and the majority of all missing teeth are associated with reduction of third molar number (Figure 2).

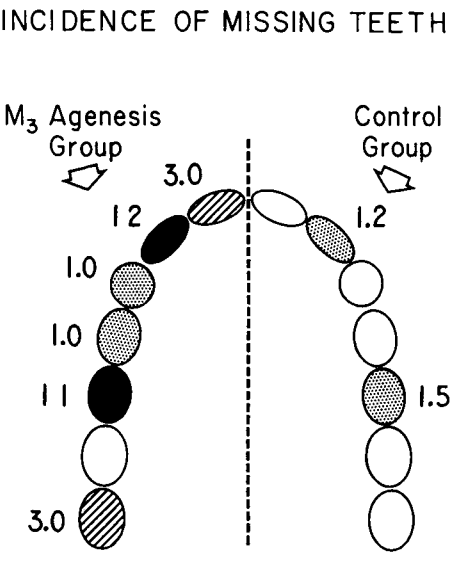

Fig. 1

Fig. 1. Per cent of individuals characterized by one or more missing teeth of each class, in the third molar agenesis group (left) and the control group (right). As shown by the shading and percentages, the third molar agenesis group is characterized by a variety of missing teeth and incidences through 12%. In the control group the incidences are far lower (1-2%) and only two teeth (I_2 and P_2) are affected.

Discussion

It is now perfectly clear that third molar number reduction is far from an isolated dental abnormality. Rather, as occasionally suggested in the earlier literature, it is intimately related to number reduction in the permanent

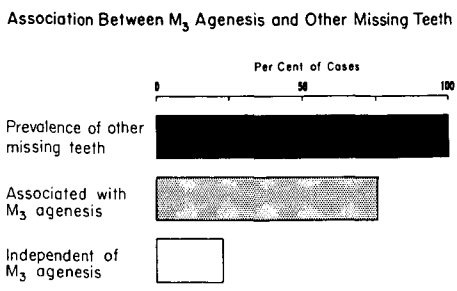

Fig. 2

Fig. 2. Association between third molar agenesis and other missing teeth. Seventy-six per cent of missing teeth of other morphological classes are found in the third molar agenesis group, while only 24% of such missing teeth are independent of third molar reduction.

dentition as a whole. When one or more third molar teeth are congenitally absent, the probability of other missing teeth rises thirteen-fold. If a third molar tooth is missing as confirmed radiographically after the critical age of fourteen, even the more "stable" teeth, I_1, C and P_1, may be lacking. Where any third molar teeth are missing, the probability of other missing teeth of any class is considerably greater.

These particular findings, based on a combined sample of 498 individuals, are perfectly consistent with the genetic theory first set forth in paleontological context by Butler[4] of an extendible reduction "field." Viewed broadly, third molar agenesis may represent the effects of such a field. In its weakest form, in the minimum degree of genetic expression, the tendency toward reduction affects M_3 alone, or even the mandibular third molars alone.* In stronger form, possibly as a separate allele, it affects the "unstable" second teeth in the incisor and premolar groups. In its strongest form, or perhaps greatest degree of expressivity, the reduction "field" also encompasses I_1, P_1, C and M_2 — teeth ordinarily rare in their absence.

While number reduction of I_2 and P_2 may be independent of third molar agenesis in some pedigrees, it no longer makes sense to report such abnormalities without reference to third molar status. From the present data we now estimate that over 75% of all missing teeth are associated with third molar agenesis. Only in a minority of cases, then, may reductions in the number of other teeth be considered as genetically independent. It would therefore appear that reductions in tooth number, particularly missing lateral incisors and premolars, may be less complicated from a genetic point of view than previously thought. One gene, or one allelic series, may well account for the bulk of reduction in tooth number, with third molar agenesis serving as an indication of the genetic "carrier" state.

At the same time we must mention that third molar agenesis is not associated with tooth reduction alone. As previously demonstrated by us,[5,6,7] absent third molar teeth are associated with delayed calcification and movement of the remaining premolar and molar teeth. Where M_3 is missing, calcification and movement timing of the posterior teeth P_1 to M_2 is substantially delayed, even during the early years of life. When M_3 is missing, the formation sequence tends disproportionately to be P_2 M_2 but when the third molar is present, the M_2 P_2 formation sequence tends to obtain instead.[5]

Summary

When one or more third molar teeth are missing, the incidence of other missing teeth rises thirteen-fold. Agenesis of third molar teeth is associated with number reduction in six of the seven

*The population incidence of agenesis of any mandibular third molar (11%) is approximately twice that for any comparable maxillary third molar (6%) in the present study.

remaining teeth as contrasted with number reduction of only the more variable second incisors and second premolars in the unaffected controls. As previously described,[5,6,7] third molar agenesis also relates to differences in tooth calcification and movement timing of the remaining teeth and to variability in formation and eruption sequences.

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