Orthodontic Anomalies and Differences in Gnathometric Variables in Twins

Ortodontske anomalije i razlike u gnatometrijskim varijablama u blizanaca

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Summary

Actuality of gnathometric measurements by means of plaster casts persisting to the present days is stressed and the major research of the kind in twins mentioned. The study included 96 pairs of twins of both sexes (36 monozygotic and 60 dizygotic).

Both qualitative and quantitative variables were evaluated and the results computer-processed. For most parameters evaluated, statistical processing revealed a markedly higher compatibility in monozygotes than in dizygotes. This held particularly true for types and severity of anomalies as well as for all qualitative variables, with the exception of over bite, overjet, class and class severity. The maxilla-related variables were shown to be highly genetically determined, which might be explained by the dynamics of manidbular movements and, possibly, a stronger effect of external factors on its growth and development.

Key words: *gnathometric variables, twins*

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Introduction

Gnathometric analyses have been used since 1909, when they were first introduced by Pont, whose approach in either its original or modified form has been maintained up to these days (1). Measurements by means of plaster casts have not lost in actuality, as evidenced by numerous recently published studies (2–7). In these studies, plaster casts were used for gnathometric analysis, diagnostic improvements and, due to their great number, for designing computer processing software.

Such analyses are very convenient for offering the possibility of three-dimensional measurements and because the greatest part of functional analyses can also be carried out after the cast has been inserted into the articulator (8, 9). Reports on twin studies can be found in both old and recent literature, often revealing differing results, though still indicating a strong genetic influence on particular maxillofacial region structures (10–17).

These were the incentives that motivated us to carry out this type of measurements along with numerous studies of growth and development of the craniofacial region, conducted within the scope of a large-scale project*, the more so as the highly challenging population of twins was included in the study.

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The aims of the study

- To evaluate the distribution of orthodontic anomalies and their severity;
- To assess the frequency and severity of sagittal intermaxillary relations;
- To assess the compatibility of these parameters within the pairs of twins;
- To determine, using analysis of correlation, which of the variables under study show significant relations within the monozygotic and dizygotic pairs; and
- To find out, employing the h and H^2 indices of inheritance, what variables show a significant genetic determination.

Subjects and methods

The study sample consisted of 96 pairs of twins of both sexes, i.e. 36 monozygotic and 60 dizygotic pairs of twins from north-west Croatia.

The sample included 25.8% off all twins from the area and was thus considered representative. The age of the study subjects ranged from 5.8 to 18.8 years. Zygosity was determined on the basis of a polysymptomatic test of similarity and blood tests where necessary.

Qualitative variables were assesed according to the original scheme, whereas quantitative variables were measured to the accuracy of 0.5 mm, employing the method of double testing. Measurements were carried out by the evaluation of standard parameters and within the pairs of twins.

In total, 384 casts were analyzed. Data were processed on the Univac 1101 computer.

The following parameters were *qualitatively* evaluated:

Classes according to Angle were determined on first permanent molars, permanent canines or deciduous canines, depending on the type of dentition.

Severity of these classes was assessed as follows:

1. Singular antagonism;
2. The mandible positioned mesially or distally by a half of the width of premolars;
3. The mandible positioned mesially or distally by the whole width of premolars;
4. The mandible positioned mesially or distally by more than the whole width of premolars.

The following *anomalies* were recorded: primary and secondary crowding, Class III, Clas II/2, open bite, cross bite, diastema mediana and other rare anomalies.

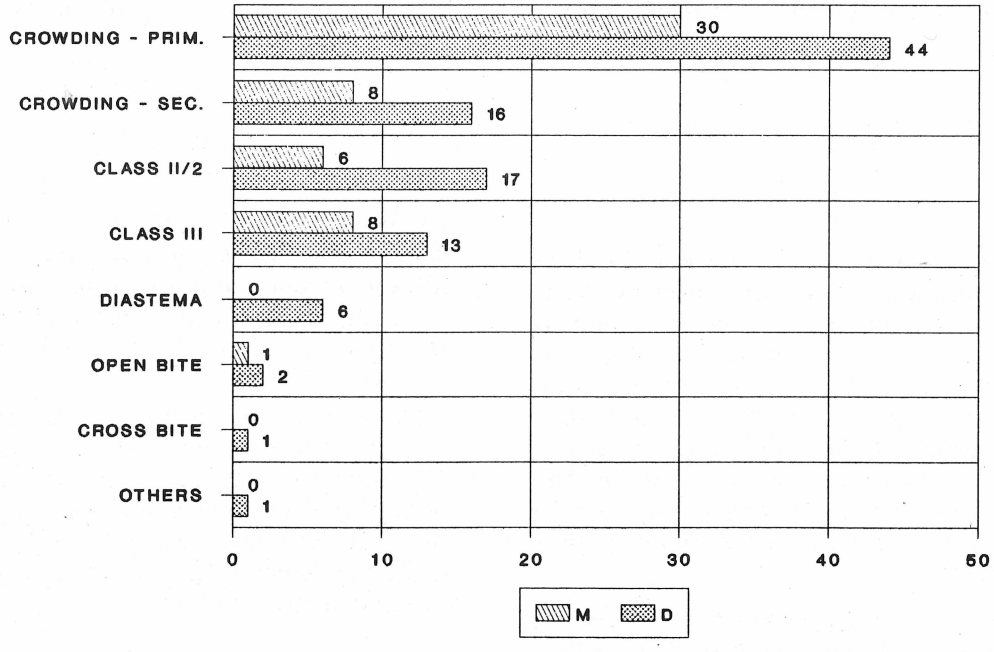

Figure 1. *Prevalence of anomalies*
Slika 1. *Učestalost anomalija*

Severity of anomalies was assessed according to the original five-stage scheme:

1. Initial symptoms;
2. The anomaly becoming more pronounced;
3. The anomaly moderately expressed;
4. The anomaly strongly expressed; and
5. Extreme anomaly.

The following variables were *quantitatively* assessed: upper anterior width (UAW), lower anterior width (LAW), upper posterior width (UPW), lower posterior width (LPW), anterior length (AL), palatal height (PH), overjet (OJ) and anterior overbite (OB).

In addition to the basic data, analysis of variance with tests of homogenecity, analysis of correlation for all the monozygote and dizygote variables, within-pair analysis of correlation coupled with tests of significance, and indices of inheritance according to the equations listed below were also statistically processed:

$$h = \frac{rMZ - rDZ}{1 - rDZ}$$

$$H^2 = 1 - \frac{(1 - rm^2)}{(1 - rd^2)}$$

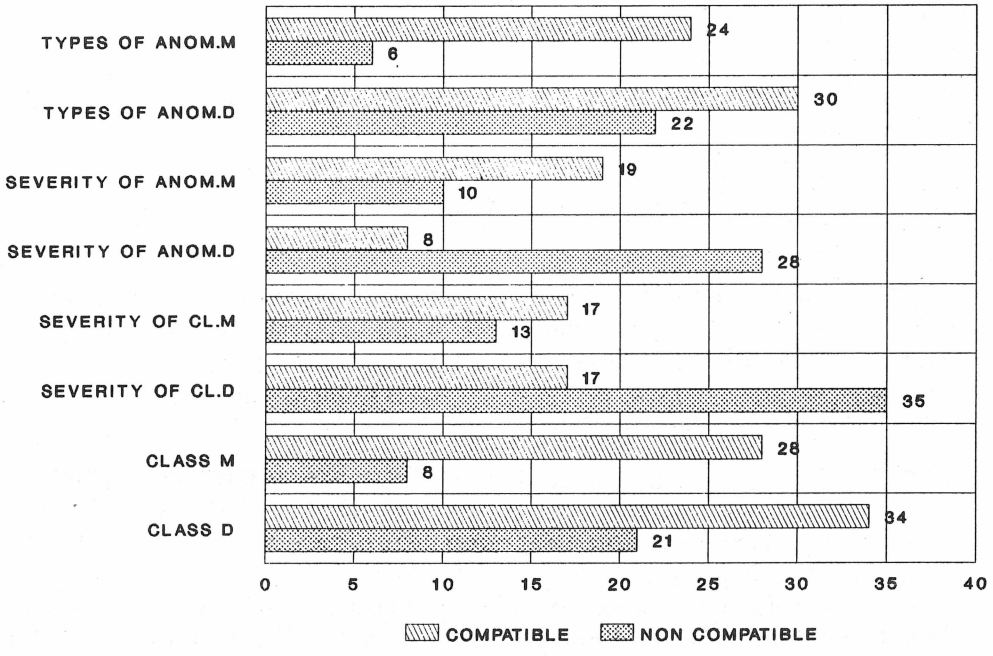

Figure 2. *Compatibility of the types and severity of anomalies, classes and severity of classes*
Slika 2. *Podudarnost vrste i intenziteta anomalije, intenziteta klase i nalaza klase*

Results and discussion

The results are presented in Figures 1 – 4 and Table 1. The distribution of anomalies in the total sample revealed the highest prevalence of all crowded conditions, folowed by Class II/2 and Class III, whereas the prevalence of diastema, open bite, cross bite and other anomalies was found to be considerably lower (Figure 1). These findings did not differ from the distribution observed in the rest of the population, reported on by a number of authors (18–21).

A relatively high percentage of inherited anomalies, first of all Class II/2 and Class III, resulted from the duplicity of cases, since these anomalies – with a few exceptions – tended to occur compatible within a pair of twins.

No significant differences were recorded in the distribution of anomalies between monozygotes and dizygotes, but the sample was relatively small for any definite conclusions to be made.

A study of compatibility of the types of anomalies (Figure 2), revealed the same anomaly

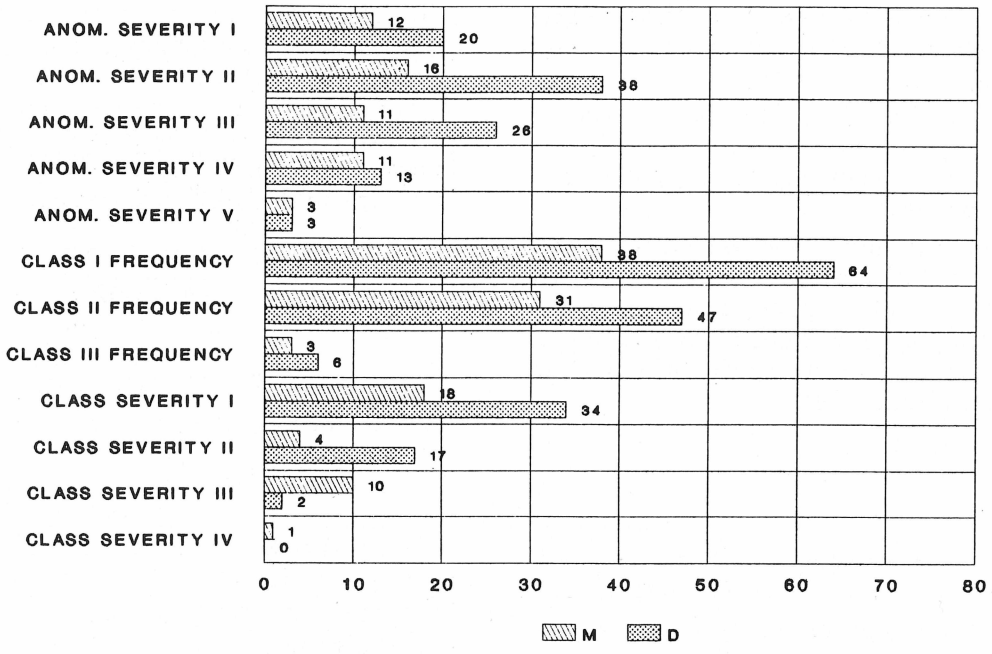

Figure 3. *Severity of anomalies and classes, frequency of classes*
Slika 3. *Intenzitet anomalije, učestalost i intenzitet klase*

to be shared by 80% of monozygotes and only 57,7% dizygotes, as expected. The monozygotic pairs in whom different anomalies were observed, however, appeared to deserve particular attention. Thus, for example in three such pairs one member had stage I primary crowding, whereas no anomaly, could be found in the other. In another such pair of twins, one member had open bite as a consequence of oral habit, while the other was eugnathic. The finding in the last pair of this subgroup was quite disputable due to its diversity: in one member, all the deciduous incisors posed in a ridge relation were still present, whereas in the other the eruption of permanent teeth had already started in quite a normal relation. Thus, the differences recorded within each of the five pairs of twins were minimal.

As for compatibility of the severity of anomalies, a significant difference was also recorded between the monozygotes and dizygotes. Thus, among monozygotes the severity of anomalies was shown to be compatible in 56.7%, while among dizygotes such findings were obtained in 32.7% only, which indicated incompatibility of the severity of anomalies in as many as 67.3% of dizygotes, as expected (Figure 2).

Great differences among particular groups of subjects were observed by the evaluation of class severity according to their compatibility (Figure 2). Among monozygotes, the same severity was observed in as many as 65.5% of the pairs examined, whereas among dizygotes this percentage was much lower.

The within – pair compatibility of classes was wery high in both study groups (Figure 2), but was found to be higher in monozygotes than in dizygotes.

Concerning the severity of anomalies, stage II was most frequently found in booth groups under study, whereas stage V was most rarely observed (Figure 3).

The analysis of the class prevalence showed that most subjects from both groups belonged to class I (53.7%), with almost identifical percentage of monozygotes and dizygotes (Figure 3). Similar results were also obtained when classes II and III were observed. Such a class distribution showed the twin population under study to be characterized by the same features as those obtained in the rest of the population. No futher comparisons can be made at present, since the results reported on elsewhere are considerably different (22–24).

Analyzing the class severity, stage I was found to prevail in booth groups of subjects under

study, whereas stage IV was most rarely observed; among dizygotes it was present at all. The distribution of stages II and III varied, as can be seen in Figure 3.

Figure 4 presents mean differences in the values of particular variables within pairs from both study groups. It can be clearly seen that the differences for all the quantitative variables were lower among the monozygotic pairs of twins.

The analysis of correlation of the same variables within the monozygotic pairs of twins separately showed the coefficients (rM) to be mar-

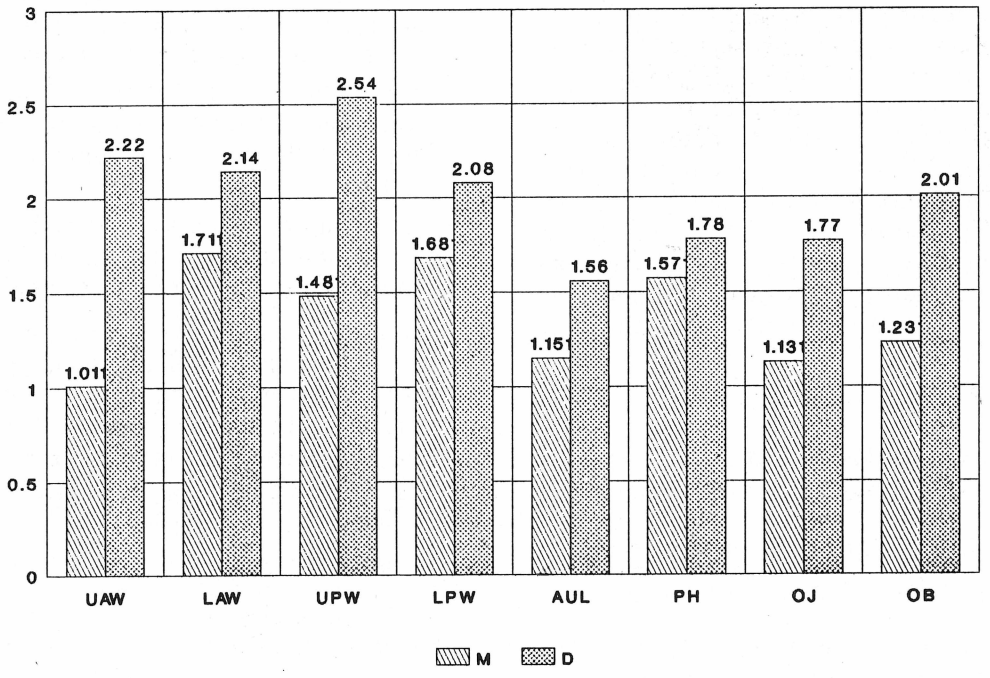

Figure 4. *Mean differences of variables within pairs of twins*

Slika 4. *Srednje vrijednosti razlika pojedinih varijabli unutar parova blizanca*

Table 1. *Coefficients of correlation for the same variables within the pairs, of monozygotes (rM) and dizygotes (rD), the levels of the significance of correlation (P) and indices of inheritance (h,H^2)*

Tablica 1. *Koeficijenti korelacija varijabli unutar blizanačkih parova, stupanj značajnosti i indeksi nasljednosti*

Variable	rM	P	rD	P	h	H^2
UAW	0.887	0.000	0.541	0.000	075	0.69*
LAW	0.911	0.000	0.868	0.000	0.32	0.31
UPW	0.810	0.000	0.421	0.003	0,67	0.58*
LPW	0.875	0.000	0.857	0.000	0.12	0.11
AL	0.957	0.000	0.826	0.000	0.75	0.73*
PH	0.669	0.000	0.612	0.000	0.14	0.11
OB	0.696	0.000	0.205	0.166	0.62	0.46
OJ	0.872	0.000	−0.033	0.821	0.86	0.76
CL	0.635	0.000	0.246	0.063	0.51	0.56
SCL	0.830	0.000	0.104	0.682	0.81	0.68
AN	0.980	0.000	0.058	0.046	0.97	0.96*
SAN	0.691	0.000	−0,107	0.006	0.65	0.47

* Significance of correlation.

kedly higher in the group of monozygotes for most variables examined. Correlations were also found to be statistically significant (P not exceeding 0.05) (Table 1). Among dizygotes, coefficients of correlation (rD) were lower, while the correlations were insignificant for AO (anterior over bite), OJ (overjet), CL (class) and CLS (class severity) variables.

The assessment of indices of inheritance resulting from intra-correlations, the AN (anomaly) and maxilla-related gnathometric variables (i.e. UAW – upper anterior width, UPW upper posterior width and AL – anterior lenght) were found to be highly genetically determined. It would be quite difficult to explein why lower indices of inheritance were associated with mandible-related variables. One of the possible hypotheses might involve the dynamics of mandibular movement, allowing oral nad exogenous factors to influence its growth and development to a greater extent.

Conclusions

The following conclusions can be made on the basis of the study results:

- No substantial differences were recorded in the distribution of various types of anomalies either in the sample of twin pairs as compared to the rest of the population or between the monozygotes and dizygotes;
- Class I was most frequently observed, followed by classes II and III; no significant differences according to zygosity were recorded;
- The second stage class (severity) was most frequent in the sample as a whole, as well as in monozygotes and dizygotes separately;
- Compatibility of the types and severity of anomalies within individual twin pairs was significantly hihger in the subgroup of monozygotes;
- Correlation of the same variables was found to be considerably higher within individual monozygotic pairs of twins; and
- Indices of inheritance pointed to a high genetic determination of the type of anomaly as well as of the gnathometric related to the maxilla. The findings obtained for the mandible may have been more strongly influenced by various oral and exogenous factors.

ORTODONTSKE ANOMALIJE I RAZLIKE U GNATOMETRIJSKIM VARIJABLAMA BLIZANACA

Sažetak

Uvodno je naglašena i današnja aktualnost gnatometrije na sadrenim odljevima, te su navedena najvažnija dosadašnja istraživanja ove vrste u blizanaca.

Ispitivanjem je obuhvaćeno 96 pari blizanaca obaju spolova (36 monozigotnih i 60 dizigotnih).

Kvalitativni i kvantitativni parametri su nakon evaluacije kompjutorski obrađeni. Za većinu parametara je uočena značajno veća podudarnost u monozigota u usporedbi s dizigotima. To je osobito izraženo za vrstu i intenzitet anomalija, kao i za sve kvalitativne varijable osim dubine zagriza, preklopa fronte, klase i intenziteta klase.

Varijable povezane s maksilom pokazale su jaču genetsku determiniranost, što se može objasniti dinamikom mandibule i, možda jačim utjecajem vanjskih faktora na njezin rast i razvoj.

Ključne riječi: *gnatometrijske varijable, blizanci.*

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References

1. PONT A. Der Zahnindex in der Orthodontie. Zschr Zahnärztl Orthop 1909; 3:306–318.
2. LYSELL L, MYRBERG N. Mesiodistal Tooth Size in The Deciduos and Permanent Dentitions. Eur J Orthod 1982; 4:113–122.
3. SINCLAIR PM, LITTLE RM. Maturation of Untreated Normal Occlusions. Amer J Orthod 1983; 83:114–123.
4. HOWE RP, McNAMARA JA, O'CONNOR KA. An Examination of Dental Crowding and Its Relationship to Tooth Size and Arch Dimensions. Amer J Orthod 1983; 84:363–373.
5. SCHENK HJ, FUCHS G, WIEMANN C, SCHENK D. Orientierungsgerät für die dreidimensionale Vermessung von Gebissmodellen. Fortschr Kieferorthop 1985; 46:461–464.
6. BROOK H, PITTS NB, YAU F, SANDOR PK. An Image Analysis System for The Determination of Tooth Dimension with Mannal Measurements of Mesio-distal Diametar. J Dent Res 1986; 65:482–431.
7. SCHENK HJ, FUCHS G, WIEMANN C, SCHRÖTER R. Kieferorthopädische Modellanalyse mit Hilfe vershiedener Verfahren der Koordinatenmesstechnik. Fortshr Kieferorthop 1986; 47:67–75.
8. SADOWSKY C, POLSON A. Temporomandibular Disorders and Functional Occlusion After Orthodontic Treatment results at Two Long – Term Studies. Am J Orthod 1984; 86:386–390.
9. JANSON M. Die Reproduzierbarkeit okklusaler Befundevergleich zwischen Artikulator und Klinischer Analyse. Fortschr Kieferorthop 1986; 47:133–140.
10. LUNDSTRÖM A. Tooth Size and Occlusion in Twins. New York: S. Karger, 1948.
11. LUNDSTRÖM A. Nature Versus Nurture in Dento-facial Variation. Europ J Orthod 1984; 6:77–91.
12. CHRISTIAN JC, KANG KW, NORTON JA Jr. Choice of an Estimate of Genetic Variance from Twin Data. Amer J Hum Gen 1974; 26:154–161.
13. CHRISTIAN JC. Testing Twin Means and Estimating Genetic Variance – Basic Methodology for The Analysis of Quantitative Twin Data. Acta Genet Med Gemellol 1979; 28:35–40.
14. CORRUCCINI RS, POTTER RHY. Genetic Analysis of Occlusal Variation in Twins. Amer J Orthod 1980; 78:140–146.
15. POTTER RHY, CORRUCCINI RS, GREEN LJ. Variance of Occlusion Traits in Twins. J Craniofac Gen Dev Biol 1981. 1:217–227.
16. SHARMA K, CORRUCCINI RS. Genetic Basis of Dental Occlusal Variation in North – West Indian Twins. Europ J Orthodont 1986; 8:91–97.
17. LUNDSTRÖM A, McWILLIAM JS. A Comparison of Vertical and Horisontal Cephalometric Variables with Regard to Heritability. Europ J Orthodont 1987; 9:104–108.
18. ANTOLIČ I. Najpogostejše okluzijske anomalije mlečnega zobovja pri šestletniki. Zobozdrav Vest 1965; 20:65–72.
19. CERANIĆ I. Učestalost ortodonskih anomalija kod predškolske i školske djece u Slavonskoj Požegi. Bilten UOJ 1982; 15:117–121.
20. EJDUS POPOVIĆ B, KRESO-KNEŽEVIĆ D. Zapažanja vezana uz ortodontske nepravilnosti u sarajevske djece do 6 godina starosti. Stom Glas Srb 1984; 5:323–29.
21. GRABER T M, SWAIN B F. Orthodontics, Current Principles and Techniques. St. Louis: Mosby, 1985, p. 18.
22. MILIČIĆ A, GAŽI-ČOKLICA V, HUNSKI M. Analiza incidencije ortodontskih anomalija i karijesa mliječnih zubi kod zagrebačke djece. Acta Stom Croat 1984; 18:95–102.
23. SOLBERG WK, BIBB CA, NORDSTRÖM BB, HANSSON TL. Mallocclusion Associated With Temporomandibular Joint Changes in Joung Adults of Autopsy. Amer J Orthod 1986; 89:326–30.
24. WILLIAMS S, ANDERSEN CE. The Morphology of The Potential Class III Skeletal Patern in The Growing Child. Amer J Orthod 1986; 89:302–10.