Dental Arch Space and Facial Type

A. Hasund, D.D.S., Dr. Odont.

R. Sivertsen, D.D.S.

In clinical orthodontics the assessment of space in the dental arches is of importance in the diagnosis and treatment planning. There are a number of factors, intrinsic and extrinsic in origin, that may influence the space conditions, as a discrepancy between tooth size and the size of the jaw, the width of the dental arches, the inclination of the teeth, muscle function and occlusal relationships.

This complexity frequently makes it difficult for the orthodontist in planning adequate treatment. It is therefore relevant to ask if the basal parts of the facial cranium may form the basis for differentiating types of lack of space, and if this relationship will manifest itself in spite of the influence of local factors.

In an earlier investigation Hasund[3] has shown a tendency for better space conditions in the dental arches in women in the prognathic than in the retrognathic types in a Norwegian material from the Middle Ages. In the lower jaw there was no definite connection, though the tendency was the same. In a study of Norwegian children three to seven years of age, Hasund and Remme[4] found the same tendency, with a greater degree of manifestation in girls than in boys.

The materials in both these studies are different from the actual clinical cases. In the collection from the Middle Ages there are few cases with a typical horizontal overbite. In the material from the child study the two classical types in the deciduous dentition with spacing or lack of spacing are found. The spacing/crowding situation seems to be little influenced by extrinsic factors according to Baume.[1] The question then will be if the relationship between space and type of face also is recognizable in a modern material with various types of overbite, with different muscle function and where such local factors as loss of the deciduous teeth and dental restorations have upset the space conditions in the front.

The aim of this study is to investigate whether or not modern material shows any relationship between the space conditions of the lower anterior teeth and the facial type.

Material and Method

The material consists of 165 adult Norwegian individuals, 72 women and 93 men, and has been previously described.[5]

The study is based on cephalometric headplates and plaster models. Standard measuring technique was used. Both the cephalometric measurements and the relevant variables on the models were measured by two men. After correction for possible faults, the mean for the corresponding measurements was used.

On the basis of tooth and space measurements, a space-index for the lower anterior segment has been calculated:[3]

$$\text{Space-index (SI)} = \frac{\text{Teeth mesiodistal diameter (3-3)}}{\text{Available arch space of segment}} \cdot 100$$

SI>100 indicates lack of space

SI<100 indicates excess of space.

Cephalometric headplates and models were used to decide whether the lower third molars were present.

From the University of Bergen, Orthodontic Department, Norway. The study has been supported by the Norwegian Research Council, Grant E-51.73-0.

The data were punched and the usual statistical parametres calculated by the University of Bergen Computer Centre by cand. mag. Erna Ramm.

The cephalometric measurements and the arch width between the mandibular first premolars were used as independent variables. The data were arranged in increasing order for each variable and were divided into three approximately equal groups (Group I, II and III) with increasing values from Group I to Group III. The number in each group varied in women from 22 to 27 and for men from 29 to 34.

For the variables s-n-ss, s-n-sm and s-n-pg, Group I will represent the retrognathic face, Group II the orthognathic face and Group III the prognathic face. Correspondingly, Group I for the variables NL-NSL and ML-NSL will indicate an anterior inclination and Group III a posterior inclination, while Group II is an in-between group.

Variance analysis has been used to show the covariation between the variables. Fischer's F-test is used in the variance analysis with the following values: $P=0.05$ for $F=3.12$ for men and for $F=3.15$ for women, $P=0.01$ for $F=4.88$ for men and for $F=5.00$ for women.

The mean of the dependent variables for each group has been used in the graphical representation. These means have been plotted and form the basis for the constructed curves.

In the analysis of error, Student's t-test is used to test for systematic deviation between measurements and control measurements.[2,8]

Results

Analysis of error and the distribution of the material.

Both for the tooth measurements and the cephalometric variables the error of measurements is at the same level as in earlier works.

None of the cephalometric variables in this study showed significant deviation when tested for kurtosis and skewness of the distribution.

The tooth measurements also show strong conformity with the normal distribution. For men there are no significant deviations. For women only the left lower lateral deviates with kurtosis ($P<0.01$) and the left lower canine shows skewness in the distribution ($P<0.05$).

The arch length, that is measured for each tooth, shows a strong tendency to leptokurtosis, and there is significant deviation for skewness for most measurements. This condition generally indicates small perimeter distances, but with a few large values which affect the mean.

This, of course, affects the distribution of the space-index in this study. For both men and women there is leptokurtosis in the distribution with definite skewness. The space index shows positive displacement indicating that in this study there are more individuals with a lack of space than with excess of space ($P<0.01$). Here the material of adults departs markedly from the child material in the study of Hasund and Remme[4] where $\sqrt{b_1}=0$ for the space conditions of the lower incisors. This indicates that the space conditions in the adult material have been more influenced by extrinsic factors than has the deciduous dentition.

The width of the lower dental arch between the first premolars shows normal distribution.

The relation of this material to the general pattern of craniofacial associations has been assessed in an earlier work.[5]

Conditions of space in relation to facial type.

The conditions of space in the anterior region show no relationship with the degree of prognathism in men. For

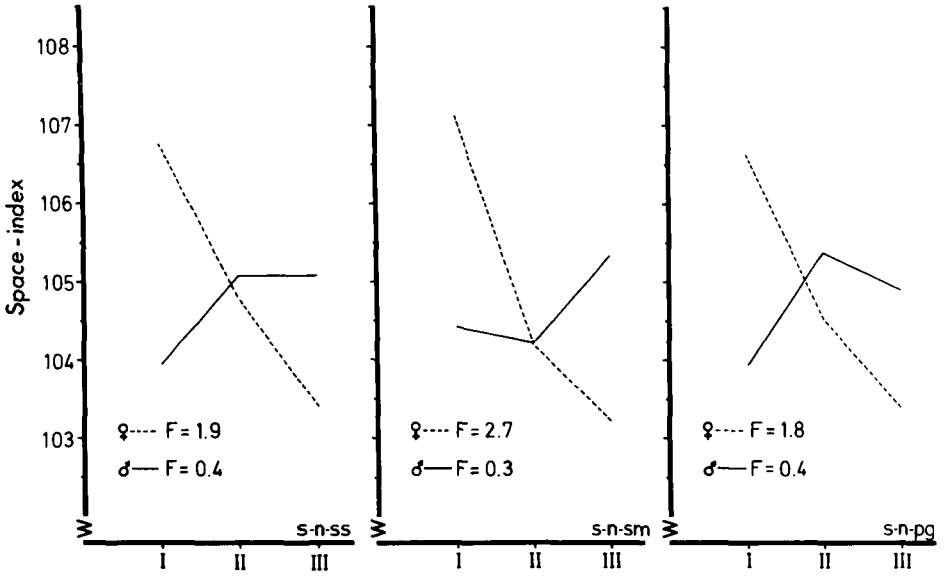

Fig. 1 Space-index in relation to the degree of prognathism of the maxilla and the mandible. Increasing prognathism from I to III. High values of the space-index indicate lack of space.

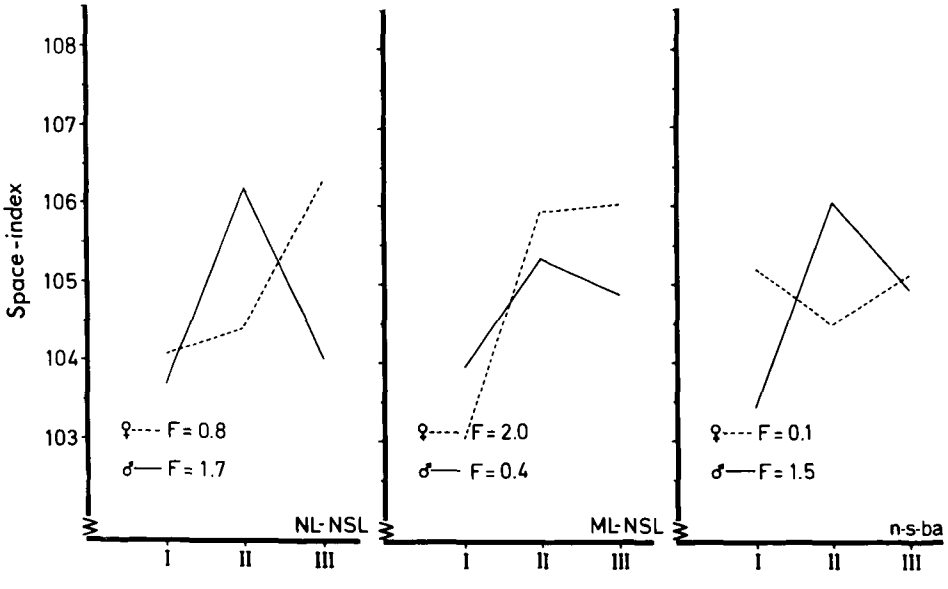

Fig. 2 Space-index in relation to the inclination of the maxilla, the mandible and clivus. Increasing values of the angles from I to III. It should be noted that the high values usually follow the retrognathic faces.

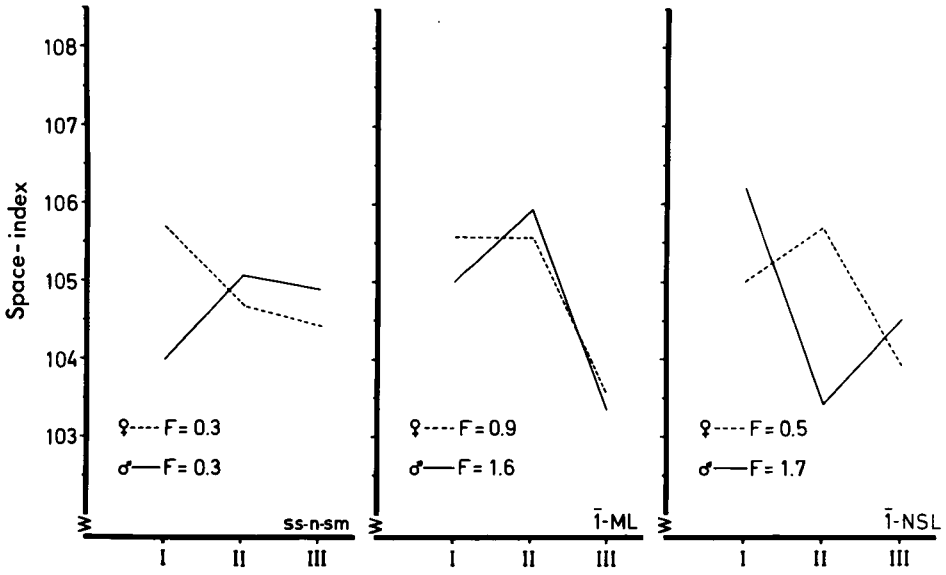

Fig. 3 The space-index in relation to the sagittal basal deviation and to the inclination of the lower incisors.

women there is a tendency to greater lack of space in the retrognathic than in the prognathic face. Figure 1 shows the connection between the space index and angle s-n-ss, ($F=1.9$ $P>0.1$); s-n-sm, ($F=2.7$ $P>0.07$) and s-n-pg, ($F=1.8$ $P>0.1$).

The relationship between the inclination of the maxilla (NL-NSL), the mandible (ML-NSL), the cranial base (n-s-ba) and the space-index for women is less pronounced than for the degree of prognathism (Fig. 2). The best connection is found for the relation to ML-NSL, but the relationship is not statistically significant ($F=2.0$ and $P>0.1$). The group of men gives no significant correlation.

The sagittal jaw relationship (ss-n-sm), the position of the incisors on the base ($\bar{1}$-ML) and further, its position in space ($\bar{1}$-NSL) show no covariation with the space-index, Fig. 3.

There is a positive relationship between the space condition in the lower anterior segment and the distance between the lower first premolars. This shows that a great width is accompanied by better conditions of space in the front of the lower jaw than when this width is small ($F=6.5$ for women and $F=7.8$ for men, $P<0.01$), Fig. 4.

Discussion

The study shows that in this material there is no definite connection between the facial type and the space condition of the lower anterior teeth. For the male group this is in accordance with Solow's investigation on a Danish male material.[9]

For women there is a tendency for better space condition when the angle s-n-sm is larger than when this angle is small, but the relationship is not significant. This difference between the two sexes was also apparent in Hasund's material from the Middle Ages[3] and in the Norwegian child sample.[4]

The material from the Middle Ages showed better space condition where the lower third molars were congenitally missing. It is then a question whether these molars may affect the results of

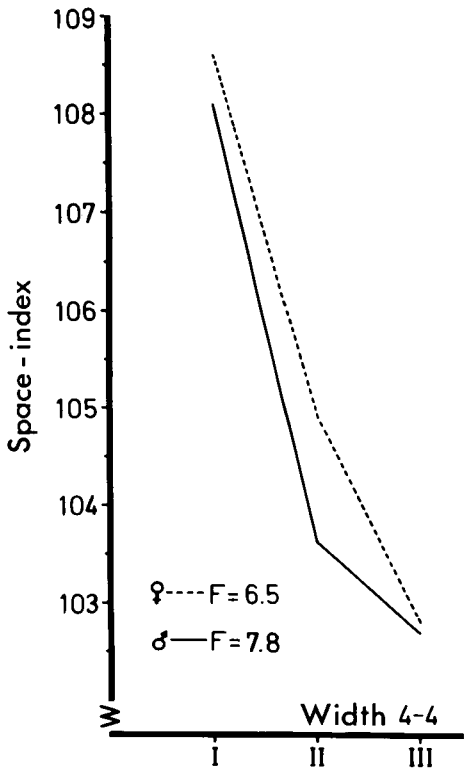

Fig. 4 Space-index in relation to width of dental arch between the lower first premolars. Increasing width from I to III. Note that decreasing values for the space-index denote better space conditions.

this study by an uneven distribution according to the facial type.

Out of 69 women 27 did not have wisdom teeth in the lower jaw, and of 91 men 35 were missing the same teeth. This is a much greater percentage of missing third molars than has been described in earlier studies. In the material from the Middle Ages there were 22 per cent lacking one or more third molars, the usual frequency for Northern European material. It is therefore reasonable to suppose that not all the missing third molar teeth in our living material are congenitally lacking. Some must be ascribed to extractions, and this may be the reason that the group with all their teeth does not differ with worse conditions of space in this study as was found in the Middle Ages material.

The study showed, however, that for the men the group with third molars present had more protruded incisors, both in relation to the mandibular base ($\bar{1}$-ML) and in relation to NSL ($\bar{1}$-NSL) than the group without these teeth. This situation may interfere with the relationship between space conditions and axial inclination.

In a multiple variance analysis the elimination of the effect of the third molars on this connection has been attempted. It is revealed that they do not affect the covariation between the space-index and the incisal inclination on the mandibular base. For the remaining variables in the facial cranium there are no differences when the groups with and without these teeth are compared. In this study one may therefore disregard the presence of lower third molars when discussing space conditions and the facial cranium.

The study shows strong covariation between the space conditions of the lower anterior teeth and the width of the dental arch. This is in accordance with earlier studies.[3,6,7]

In this material there is definite connection between the degree of prognathism and lower arch width, so that prognathic faces have wider dental arches than retrognathic, for s-n-ss, $F=3.8$ for women and 3.5 for men, and for s-n-sm $F=2.6$ for women and 1.9 for men.

On this background it is interesting to investigate the reciprocal covariation the degree of prognathism and dental arch width has on the space conditions. The multiple variance analysis shows that the significance levels are unchanged from the simple analysis.

Conclusion

For women there appears to be a space complex where both arch width

and degree of prognathism are relevant factors so that the basal space conditions appear to be better in the prognathic face with wide dental arches than in a retrognathic face with narrow arches.

For men there is no connection between degree of prognathism and space conditions.

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