The Size of the Tongue and the Intermaxillary Space

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Introduction

The position of the dentoalveolar structures in an individual is generally accepted as being an expression of the interaction between inherited skeletal and neuromuscular characteristics.

The significance of the soft tissues in determining the position of the dento-alveolar structures has long been recognized.[1,2,3]

Although the skeletal changes due to growth have received considerable attention, the consequent alteration in the interplay between skeletal morphology and specific aspects of the linguofacial musculature remain relatively obscure. For this reason, treatment planning in orthodontics all too often tends to be focused on the more easily assessed skeletal variations whilst ignoring the role of the muscular environment of the teeth in the aetiology and prognosis of the malocclusion.

Any relative change between skeletal and soft tissue components would be expected to alter the equilibrium affecting the dento-alveolar structures. An understanding of such changes is essential for the prediction of the long-term stability of both treated and untreated occlusions.

It has been stated that the tongue undergoes a relative change in size, decreasing from childhood to maturity compared with those structures which enclose it.[4,5,6] Quantitative data on such changes are not available.

The aim of this study was to compare the size of the tongue and the intermaxillary space in the child with that of the adult.

Materials and Methods

Seventy-five children who had been referred for orthodontic consultation were compared with a group of 26 adults previously described by Vig.[7]

Lateral skull radiographs were taken with the teeth in occlusion and traced. The tongue shadow was only sufficiently clear to trace in 36 of the radiographs. Intermaxillary space dimensions were recorded for all 75, while the tongue was traced in only those 36 in which it was obvious. The landmarks used in tracing were those used by Vig and were as follows (Fig. 1).

Anterior Intermaxillary Space Height: The length of a perpendicular

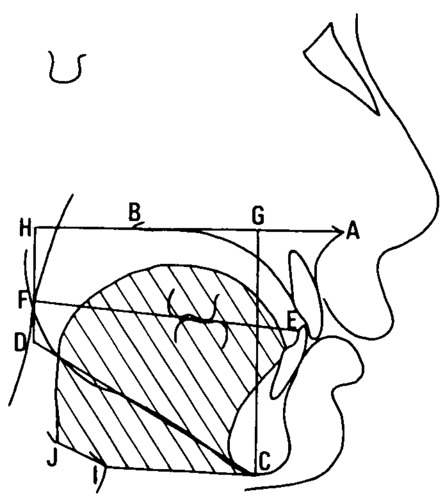

Fig. 1 A-B and C-D represent the maxillary and mandibular planes, respectively. E-F is the occlusal plane. G-C and H-D represent anterior and posterior intermaxillary space heights. These are perpendicular to the maxillary plane. The shaded area above C-I and I-J is the tongue shadow.

from the maxillary plane to menton.

Posterior Intermaxillary Space Height: The length of a perpendicular from the maxillary plane to the mandibular plane which passes through the point where the occlusal plane intersects the posterior pharyngeal wall.

Occlusal Plane: Joins the point midway between the tips of the upper and lower incisors to the point midway between the mesiobuccal cusps of the upper and lower first permanent molars.

Length of the Intermaxillary Space: Measured along the occlusal plane from the point where it intersects with the lingual shadow of the upper or lower incisor anteriorly, to where it cuts the pharyngeal wall posteriorly.

$$\textit{Intermaxillary Area Index} = \frac{\text{Ant. I.M. Ht.} + \text{Post. I.M. Ht.}}{2} \times \text{I.M. Length}$$

Tongue Area: The area enclosed by the outline of the tongue shadow, above a line extending from the vallecula to the most anterior point on the hyoid body, and above a line from the most anterior point on the hyoid body to the menton. This area will, of course, include some other suprahyoid structures as well as the tongue, but for the purpose of this study it was considered preferable to do this rather than to omit musculature which is directly related to the tongue (Fig. 1).

Linear measurements were made to the nearest 0.5 mm while the tongue size was estimated from the area of its shadow which was determined using a fixed index planimeter.

Results

Reliability of the Method

Tracing errors were assessed in the following way: thirteen radiographs, selected at random from the group in which the tongue was clear, were each traced twice. The second of each pair of tracings was produced on a different day to the first. Dahlberg's[8] method of double determination was then applied to the measurements of the tracings to establish the standard error of the method (Table 1).

TABLE I

Ant. Intermax. Height	0.5 mm nearest 0.5 mm
Post. Intermax. Height	1.5 mm nearest 0.5 mm
Intermaxillary Length	0.5 mm nearest 0.5 mm
Tongue Shadow area	0.5 sq cm nearest 0.1 sq cm

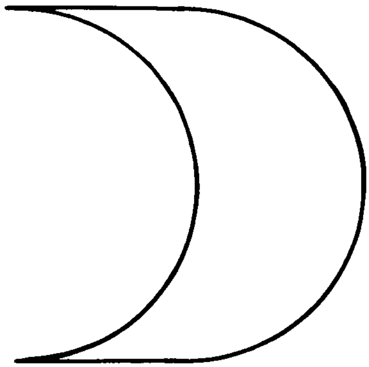

Fig. 2 The standard shape which was measured 50 times with the planimeter in order to find the magnitude of errors in the use of this instrument. The curved sides were also parallel, and were semicircles of diameter 6.6 cms.

Each of the paired tongue area measurements from which the standard error was determined for tongue areas was the mean of three consecutive planimeter readings.

The reliability of the use of the planimeter was assessed by tracing a standard shape (Fig. 2) fifty times. The results of these repeated measurements are shown in Table II. Using the method quoted by Moroney,[9] it was calculated that if one takes the mean of three planimeter readings of the same area, the results so obtained will be within ± 1.24 per cent of the true

TABLE II

Mean	21.79 sq cm to nearest .01 sq cm
Range	2.60 sq cm to nearest .01 sq cm
S.D.	0.23 sq cm to nearest .01 sq cm
S.E.	0.03 sq cm to nearest .01 sq cm

value in 95 per cent of cases (i.e., p = .045).

The present child sample (75) had a mean age of 10 years with a range of 7, the 36 usable record children had a mean age of 9.9 years, range 5 years. The adult sample was 28.2 years, range 10 years.

Although only 36 radiographs were usable for tongue area measurements, it does not seem likely that this has introduced bias due to selection since the linear measurements of the 36 relating to intermaxillary space dimensions are very similar to those of the child group as a whole (Table III).

The ratio of the tongue area to the intermaxillary space area in the child sample was 0.74, the adult ratio being 0.67.

Discussion

A pilot study has been carried out which has provided a comparison between the size of the intermaxillary space and the tongue at the age of 10 years and in the adult.

It has been shown in the material studied that, while both the tongue and the intermaxillary space undergo considerable growth changes between the age of 10 years and adulthood, the tongue becomes relatively smaller when compared with the intermaxillary space.

It seems likely that this relative decrease in the size of the tongue within the oral cavity is partly due to differential rates of maturation of the skeletodental and muscular elements, and partly due to the descent of the

TABLE III

	CHILD SAMPLE								ADULT SAMPLE			
	75				36							
	Mean	Range	S.D.	C. of V.	Mean	Range	S.D.	C. of V.	Mean	Range	S.D.	C. of V.
Ant. Intermax. Ht. mm	59.6	20.2	5.2	8.7	60.6	19.5	5.1	8.4	69.9	22.0	4.8	6.9
Post. Intermax. Ht. mm	27.1	15.5	3.6	13.3	27.8	14.5	4.0	14.4	40.6	19.0	4.4	10.9
Intermax. Length mm	70.9	23.5	5.1	7.2	70.7	18.5	4.6	6.5	80.5	26.0	5.7	7.0
Intermax. Area sq cm	30.7	17.7	3.5	11.4	31.3	15.6	3.5	11.2	45.7	17.8	5.3	11.6
Tongue Area sq cm					23.2	10.3	2.7	11.6	30.4	12.4	2.5	8.2

The intermaxillary space and tongue dimensions of the child sample, compared with the adult sample. The child sample is subdivided into the whole group (75), and those 36 in which the tongue shadow was clear. It is apparent that the characteristics of the 36 are very similar to the entire child sample of 75 and that the morphological characteristics of both child and adult sample are similar (to the nearest 0.1 unit).

tongue and associated structures which occurs with growth of the cervical spine.

The interplay of neuromuscular patterns within the rigid environment of the stomatognathic system is of obvious relevance to orthodontics.

Such relative changes in the morphology of the intermaxillary space and the musculature of the tongue may also play a part in the acquisition and development of speech.[6,10,11]

The clinical significance of such an approach to analysis of growth changes can therefore also be seen as a necessary prerequisite for establishing significant diagnostic criteria in the fields of speech pathology and therapy.

The present study was cross-sectional and so provides information on mean growth trends and the changing association between the growth of the tongue and its rigid confines.

To observe individual variations which are, of course, clinically more significant, it is necessary to conduct longitudinal studies of these parameters.

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