Recent Findings In Myometric Research*

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The quantitative and qualitative appreciation of the pressures exerted on the dentition by the perioral and lingual musculature is of vital interest to every orthodontist in planning the proper treatment for his patient. The degree to which he accurately assesses these forces may well decide the ultimate success of an orthodontic result, regardless of his technical skill.

For these are continual forces, difficult to measure, hard to alter and at present, not well defined. They further appear to be intimately associated with "facial pattern" and the morphological variation of the skeletal parts. They represent one component of the overall neuromuscular mechanism of the "Stomatognathic System".

But since an appreciation of the normal must precede a consideration of the abnormal, a definite picture as to what these pressures are, and are not, must emerge. This means measurement, with all its problems of instrumentation, sampling and interpretation.

Galileo was reported to have pointed out, substantially, that the aim of science is —

> "to measure that which can be measured; to make measurable that which cannot yet be measured."

Oral myometrology is very young, but considerable information has already been obtained. Studies in which pressure recordings have been made during swallowing, speaking, maximum efforts and, more recently, resting pressures have provided a good estimate of the ranges and nature of myometric forces acting on the dentition.[1,2,3]

INSTRUMENTATION

As instrumentation has been refined using strain gauges as the transducer element for registering these intraoral myometric pressures, it has become apparent a particular feature in design is worth noting.

Figure 1 illustrates two designs in which the pressure platforms are of different sizes. When the pressure platform becomes too small, as in Fig. 1 (A), the insulating material which covers the transducer can transmit pressure and thereby increase the effective size of the pressure platform. This can be overcome by increasing the size of the platform and thereby decreasing the unsupported area of the insulating material, as in Fig. 1 (B). However, care must be taken not to make the platform too large to cause a reversal in the action of the active beam. These considerations become important features in later converting myometrograms (deflections) into pressure units or force per unit area.

PRESSURE ESTIMATES

Further investigations using refinements in instrumentation in which pressures were recorded during swallowing would seem to indicate that some revision of earlier estimates is indicated.

These values, Table I, appear to be more consistent with those obtained by Kydd[4] using a different recording apparatus, and previous questioning of his

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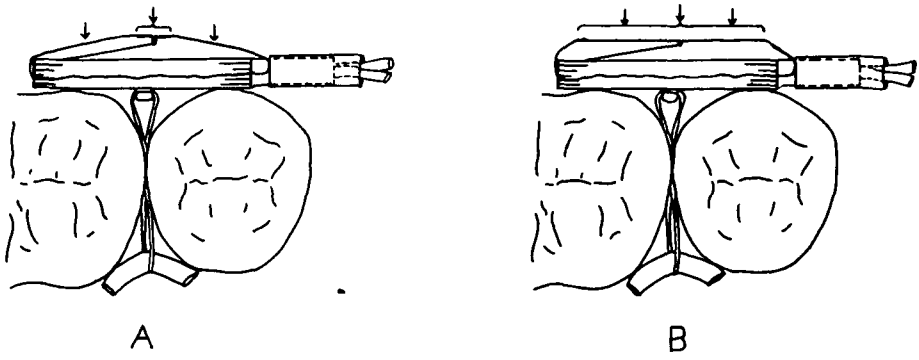

Fig. 1 Note difference in effect by varying the size of the pressure platform A-B.

method by this author[2] would now appear to be unjustified.

Table I indicates peak swallowing pressures recorded in three areas, and comparisons are made between Class I subjects and Class II subjects. Group comparisons made between the Class I (excellent group) and Class II (malocclusion group) disclose no statistically significant difference. When all subjects are pooled including those with abnormal swallowing reflexes, a range of pressures from .208 to 3.593 pounds per square inch (14.624 to 252.616 grams per square centimeter) was obtained. However, it is interesting that the higher values of this range are contributed by those subjects with abnormal swallowing reflexes. This seems to indicate group comparisons should be made on the basis of swallowing patterns rather than occlusion classifications. In reviewing the findings of myometric pressures on various subjects with different types of occlusion there appears to be little difference, myometrographically, between Class I excellent occlusions and some of those of the Class II malocclusion group. An abnormal swallowing reflex is not necessarily restricted to any one type of occlusion. It can, however, be superimposed on any type of occlusion.

Myometric research has well established that during a normal type of swallowing reflex there is neither con-

TABLE I

COMPARISON OF SWALLOWING PRESSURES BETWEEN GROUPS

	Class I Excellent Group			Class II Div. 1 Group		
	Mean	Standard Deviation	Standard Error	Mean	Standard Deviation	Standard Error
Lingual-Mandibular Central Incisor...	1.040	.757	.228	1.312	.393	.124
Lingual-Maxillary Molar Area.....	.960	.384	.116	1.481	1.117	.353
Lingual-Mandibular Molar Area.....	1.218	.337	.102	1.065	.346	.109

(Pressures in pounds per square inch)

traction of the perioral musculature nor an increase in buccal pressures bearing on the dentition. Further, it has shown that only in those cases of open bites or a lack of normal or adequate overbite does an increase in perioral pressures become apparent. It would seem, therefore, that in certain types of malocclusions, as well as in excellent dentitions, a normal swallowing reflex can and does occur.

Figure 2 illustrates the areas and directions of pressures occurring at least in the initial stages of the swallowing reflex as recorded by the "myometrograph". It would seem that, when the subject uses the muscles of mastication to bring the teeth into occlusion and an adequate anterior and lateral seal can be effected, a normal swallowing reflex can occur. However, when the patient does not close his teeth together upon the initiation of swallowing, and the tongue is used to seal off the anterior and lateral areas of the mouth by protruding, this necessitates, or is associated with, perioral muscular contraction.

One of the diagnostic points which has long been recognized as associated with a "tongue thrust" is the open bite. It would seem that tongue thrusting or abnormal swallowing reflexes are characterized not so much by a tremendous increase of pressure in any one area, but rather that increased pressures are brought to bear upon the dentition in areas in which normally they would not be found. This can be demonstrated by a graphic presentation of myometric pressures obtained from excellent occlusion groups (Fig. 3).

This graph places in perspective the pressures obtained during rest, swallowing and maximum efforts. The pressures range from 0 to 2,000 g/cm^2. The increments are not continuous but have been

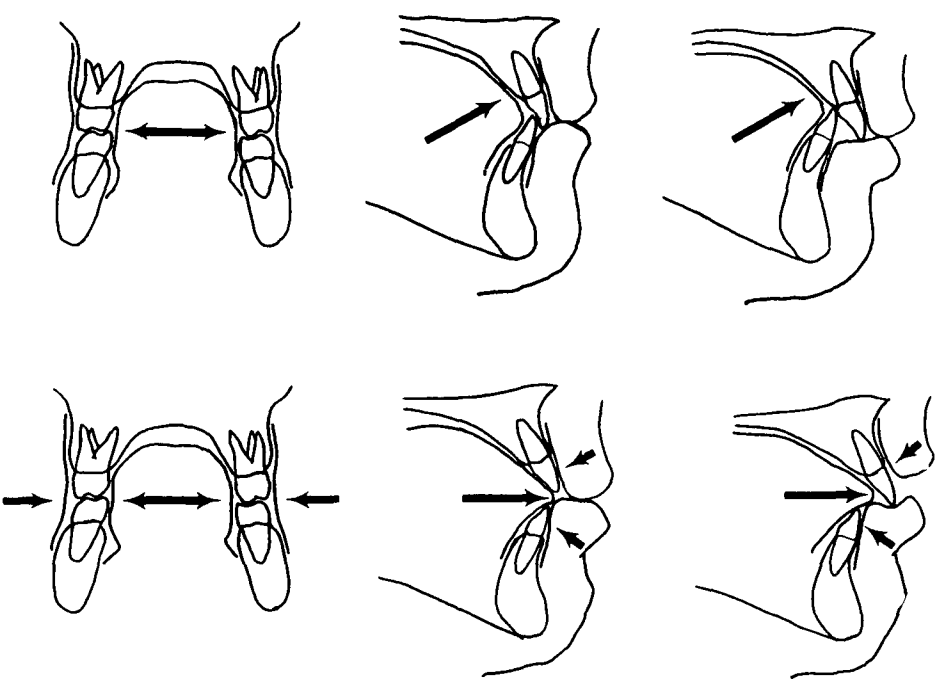

Fig. 2 Arrows indicate direction and locations where increases in pressure occur. Above, normal swallow: left, posterior; center, Class I; right, Class II. Lower, abnormal swallow: left, posterior; center, Class I; right, Class II.

divided into three ranges for ease of presentation.

Various areas of the mouth are indicated at the bottom of the graph, and for each area there are three bars which indicate the various pressure ranges (mean, ± one standard deviation). The solid bars represent resting pressures and are small in magnitude (ranging from 0 to 15 g/cm^2). This range is marked "Resting Pressures".[3]

The cross bars represent swallowing pressures. These values are naturally of greater magnitude than the resting pressures and rise to the middle section of the graph (10 to 150 g/cm^2), marked "Swallowing Pressures". It should be noted that only lingual pressures in-

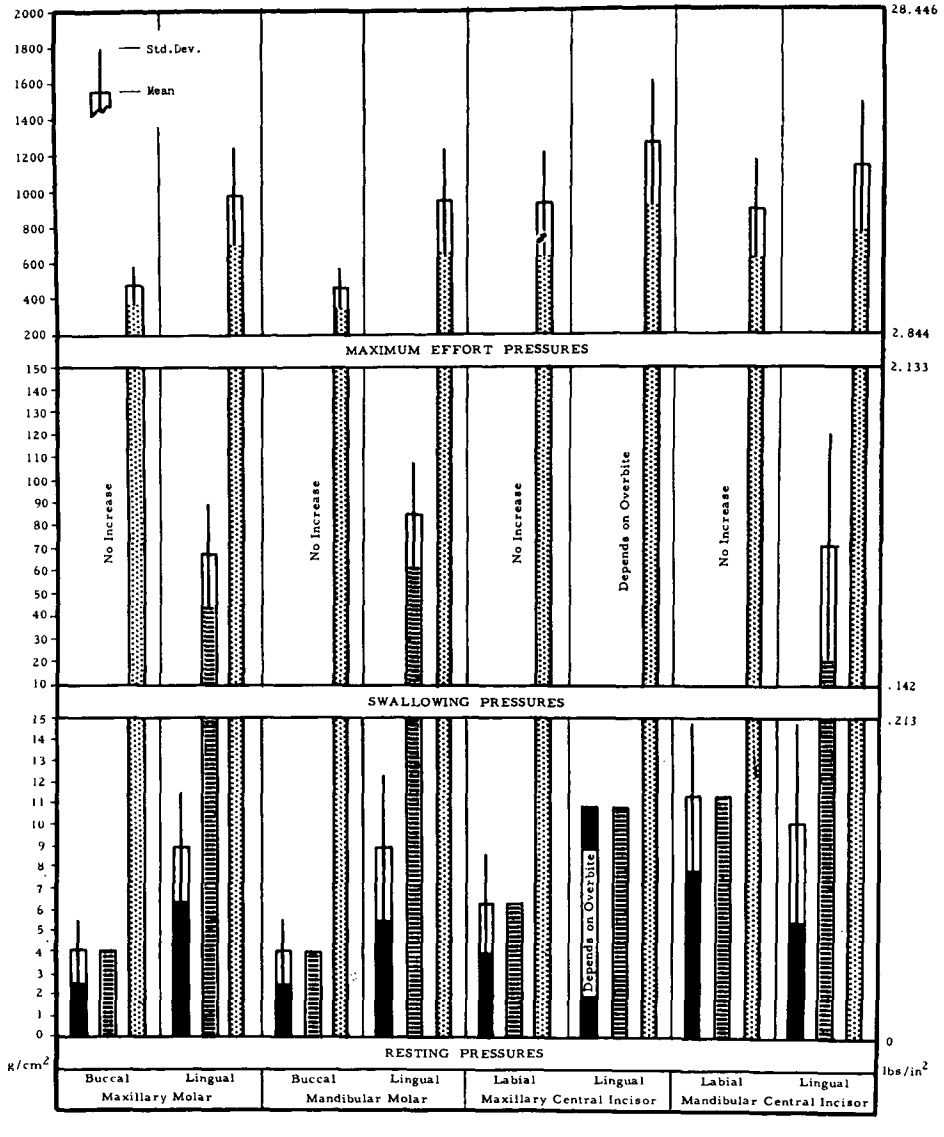

Fig. 3 Pressure ranges obtained on subjects with excellent dentition.

crease during swallowing. The perioral musculature shows no increase and remains at the level of the solid bars (resting pressures). This pattern does not obtain during abnormal swallowing reflexes.

Also, this pressure increase is for the most part missing on the lingual surface of the maxillary central incisor, due to the overbite present, or the degree to which the lower incisors keep the tongue from reaching the lingual surface of the maxillary central incisors.

The dotted bars indicate maximum efforts in the various areas of the mouth. These values are obtained by the subject exerting maximum pressure against the mouthpiece of the myometrograph in the various areas. The discipline for subject management has been described in detail previously[1,2]. These values may be said to represent the maximum potential of the particular muscle group.

Lingual pressures on the maxillary central incisors have been recorded as high as 207.62 grams per square centimeter on subjects who exhibit a tongue thrusting habit. Force of this magnitude, compounded by the frequency of swallowing, applied to an area which normally receives only slight pressure, if any, does reflect itself in some protrusion of the anterior teeth. The same can be said for the lower incisor area in which a significant lingual pressure is registered when the tip of the tongue is protruded forward rather than positioned palatally. Also the presence of the tongue being thrust, and in some instances constantly carried, between the incisal and occlusal surfaces of the teeth prevents their full eruption causing an open bite to varying degrees.

Myometric research has disclosed such a high degree of association between the incidence of an open-bite tendency and tongue thrusting that one is tempted to reject the probability of one existing without the other. It must also be kept in mind, however, that not every case of open bite is due to tongue thrusting. Certainly a large percentage of subjects with various types of malocclusion apparently have a normal swallowing reflex. Care must be exercised not to attribute too much importance to the swallowing reflex in the absence of definite clinical signs. The perioral and lingual musculature must have considerable adaptability which is so characteristic of every other tissue in the body.

When the myometric pressure ranges are considered during static and functional states in the various areas of the mouth, the imbalance of perioral versus lingual forces becomes apparent. Lingual forces continually predominate over perioral forces. This is apparently independent of the fact that the tongue is more dense tissue than the rather soft, loose, easily deflected tissue of the cheeks and lips. The mouth pieces are miniaturized and measure about three millimeters in thickness. Even though the tissues are distended necessarily this slight amount, recordings made in edentulous areas with no distention of tissues still show the same relationship, the actual pressures being only slightly smaller.

The problem facing myometric research today is to attribute the correct importance to the perioral and lingual musculature — to understand more fully the degree of its adaptability — to recognize under what precise circumstances its influence becomes paramount in the equation of tooth position.

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