Effects of Altered Anterior Occlusal Relationship on Perioral Muscular Forces

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Recent cross-sectional investigation of perioral muscular tensions conducted by means of strain gauge transducers[1] revealed characteristic patterns of tonic and contractile forces in various classes of malocclusion. Integration of these forces in form of an Index of Muscular Accommodation (IMA)* disclosed high mean IMA scores (6.59) in Class II, Division 1 malocclusion, while small IMA values were found in Class III and Class I anterior open-bite cases (0.97 and 0.65, respectively).[1]

The adaptation of electrodynamographic methods to longitudinal studies was found to be quite difficult because of considerable error of measurement connected with reattachment of transducers for repeated serial recordings. The current investigation represents an effort to overcome some of these obstacles and to test longitudinal effects of an altered occlusion upon perioral muscular behavior.

MATERIAL AND METHODS

Subject of the study was a white male, age 28, who because of rampant caries and other diagnostic considerations was facing extraction of all natural teeth. Orthodontic examination of the patient revealed Class II, Division 1 malocclusion with a moderate anteroposterior discrepancy between maxillary and mandibular skeletal bases (SNA-SNB difference of 4.5°), 6 mm anterior vertical overbite, 9 mm horizontal overjet, inadequate lip morphology[2] and patent nasal passages.

$$*\text{IMA} = \frac{\text{Mandibular } \dfrac{\text{Contractile Forces}}{\text{Tonic Forces}}}{\text{Maxillary } \dfrac{\text{Contractile Forces}}{\text{Tonic Forces}}}$$

All posterior teeth except the right maxillary and mandibular first premolars were extracted and, after a postsurgical period of three months, partial dentures were constructed to serve as transducer-carrying devices (Fig. 1). Prebonded, weldable SR-4 resistance strain gauges were employed for measuring perioral tensions, and the output current induced by deflection of cantilever beams was registered on a strip chart recorder.[3] The mounting assembly for transducer attachment consisted of: (1) Russel lock welded to a perforated stainless steel retention band which was embedded in the denture acrylic, and (2) edgewise stainless steel wire welded to the stainless steel cantilever beam carrier (Fig. 1).

Following the insertion of appliances, standard prosthodontic measures were employed to avert discomfort due to denture wear and to eliminate any occlusal disharmonies which might elicit proprioceptive instability.[4] Two weeks after placement of prostheses perioral tonic and contractile forces were recorded by employing force-measuring procedures which involve passive tissue retraction and a broad range of standardized volitional movement exercises, as described fully elsewhere.[1]

Subsequently, the remaining teeth were extracted and immediate prostheses were constructed by adding denture material to the partial appliances. This method of change-over from partial to complete dentures was adopted

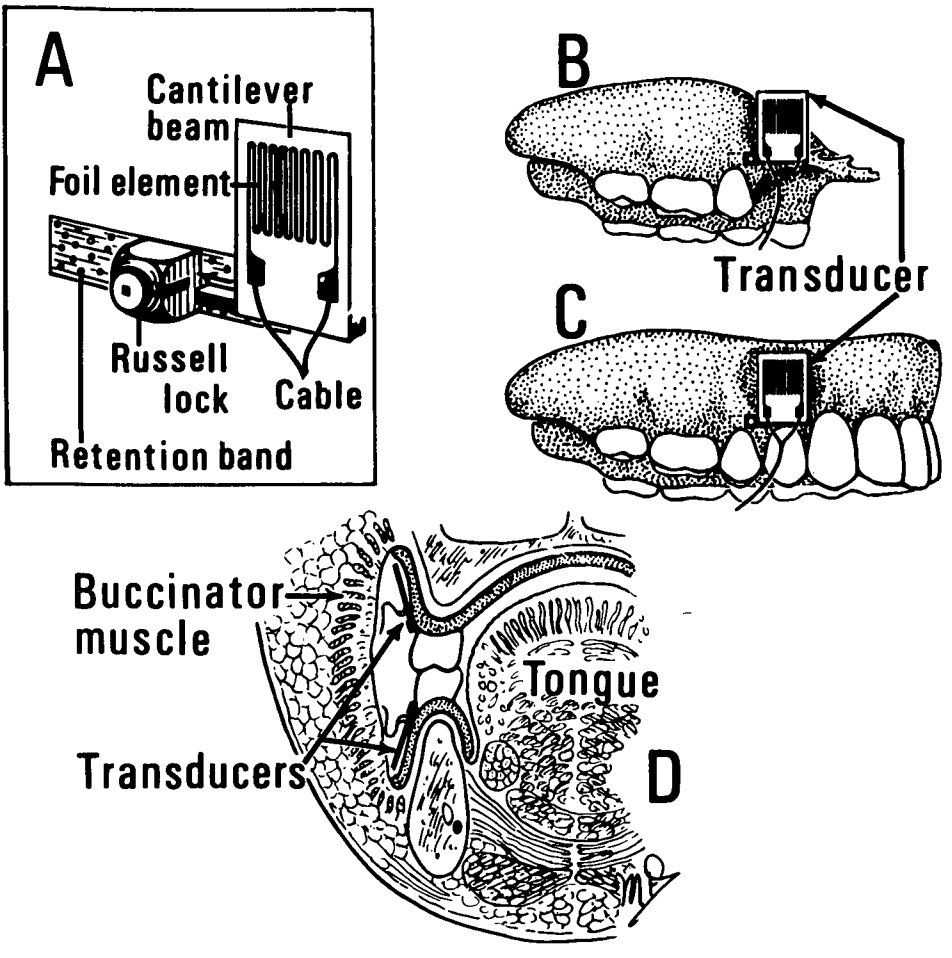

Fig. 1 Placement of transducers: A. Mounting assembly. B. Lateral view of partial denture with transducer in place. C. Lateral view of full immediate denture with transducer in place. D. Transverse view of transducer—carrying dentures *in situ*.

in order to maintain an unaltered position of mounting assemblies and constant orientation of transducers throughout the duration of study. Excessive overbite and overjet, present in the natural dentition, were reduced to 1 and 2 mm, respectively, in the immediate dentures, and the effect of altered anterior occlusal relationship on the behavior of perioral tissues was measured at biweekly intervals. Then, anterior teeth were reset according to the original study casts, *i.e.*, excessive overjet and overbite were restored, and two more recordings of perioral forces were taken at weekly intervals. Denture adhesive was used sparingly during all operations to increase denture stability and retention.

Results and Discussion

Summary of collected data, presented in Table 1, seems to indicate that high IMA values, associated with excessive overjet and overbite, were dramatically affected by repositioning of anterior

TABLE 1. MEANS AND STANDARD DEVIATIONS OF RECORDED PERIORAL FORCES*

Schedule of recordings +	Anterior occlusal relationship	Mandibular forces		Maxillary forces		IMA Score
		Contractile	Tonic	Contractile	Tonic	
0	Overbite: 6 mm Overjet: 9 mm	184.5±17.2	19.7±1.7	125.5±11.1	108.3±11.9	7.8
1		192.8±24.1	29.0±3.9	119.3±18.3	61.0± 8.4	3.3
3		161.5±18.4	29.3±2.1	134.5±15.2	56.1± 5.1	2.3
5	Overbite: 1 mm	162.4±16.0	22.7±2.8	148.6±14.0	50.5± 4.5	2.3
7	Overjet 2 mm	139.2±13.8	26.5±2.0	143.6±16.3	54.2± 4.5	1.9
9		124.4±10.5	24.3±1.8	151.0±13.9	48.7± 4.6	1.7
10	Overbite: 6 mm	173.4±21.2	21.2±3.0	160.0±18.5	116.2±13.1	5.9
11	Overjet: 9 mm	189.9±19.0	22.2±2.4	130.9±15.2	98.7± 8.4	6.6

* Presented in g/sec and based upon ten replications of each measurement.

\+ In weeks after the initial recording.

teeth. The observed decline of IMA scores from 7.8 to 1.7 was produced primarily by a significant decrease of maxillary tonic and mandibular contractile forces. In like manner, "relapse" of the anterior occlusal configuration to its original Class II, Division 1 relationship was reflected by recurrence of the characteristic pattern of perioral muscular behavior and, correspondingly, large IMA scores (Table 1). It is noteworthy that similar rapid and reversible adaptation of soft tissues to altered skeletodental environment has also been observed electromyographically[5] and cinefluorographically.[6]

Results of this study seem to be compatible with current theories of muscle mechanics[7] and may be viewed as further pragmatic validation of IMA as a useful and sensitive indicator of soft tissue behavior. It is hoped that future refinement of electrodynamographic methods may justify their serial employment in a large sample of population. Such studies may supply valuable data about the nature of ontogenetic interaction between "form" and "function" and its effect on developing occlusion.

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