Tooth Migration Subsequent to Surgical Treatment of Mandibular Protrusion

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The distalization of the mandible in surgical correction of mandibular protrusion represents a unique opportunity for studying whether changes in its position and function influence the position of the teeth.

Previous studies do not agree about the stability of the anterior teeth postoperatively. Some find an uprighting of the upper incisors,[10] whereas others have observed a stable position.[5,14] The stability of the lower incisors is also controversial, as some have observed a labial protrusion postoperatively,[3,5,6] while others find the incisors remain stable in relation to the mandibular body.[2,14] Most investigators agree that there is an anterior shift of the mandible postoperatively, [1,11,13,14,15] whereas there is only little information about migration of the teeth, especially in the lateral segments. The purpose of the present study was to compare the tooth positions preoperatively, and six months postoperatively, and two years postoperatively to determine whether there was any tooth migration in the first six months after the removal of the intermaxillary fixation, whether these changes were stable, or continued even up to two years after the operation.

MATERIAL AND METHOD

The material comprised preoperative, six months postoperative and two years postoperative records of 37 patients who had been operated for mandibular prognathism. Only patients having received no pre- or postoperative orthodontic treatment were included in the material. The sexes were evenly distributed (20 females and 17 males). The age varied from 18 years to 43 years.

The arch length measurements were taken with an Engh Dental Arch Gauge to the nearest 0.5 mm; the other measurements were performed with a sliding caliper with the same accuracy.

The variables measured are described in Figures 1 and 2.

The measurement error based on double recordings of each variable did not exceed 0.3 mm.

RESULTS

The comparison between the preoperative and the six months postoperative measurements (Table I) showed small differences and only a few were significant. Among those were the changes in overjet and overbite which are a result of the surgical set-back of the mandible. The mandibular molar width increased about 0.3 mm ($p<0.05$), and the maxillary anterior dental arch length decreased about 0.3 mm ($p<0.01$). The maxillary overall dental arch length decreased approximately 0.4 mm ($p<0.05$). The space conditions were approximately the same as on the preoperative models.

The comparison between the preoperative models and those taken two years postoperatively (Table II) showed a significant decrease in the mandibular intercanine width of 0.6 mm ($p<0.01$), whereas the mandibular intermolar width had increased about the same amount ($p<0.05$). The overbite no longer differed from the preoperative recording. The spaces between the teeth remained unchanged except for a 0.4 mm increase in the mandibular posterior segments ($p<0.01$).

A comparison between the changes occurring from six months postoperatively to two years postoperatively displayed significant changes only for the continuous decrease (0.3 mm) in the mandibular intercanine distance ($p<0.05$) and a small in-

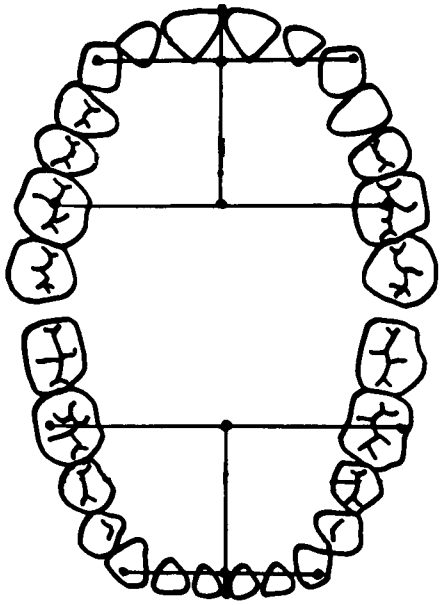

Fig. 1 Maxillary and mandibular intercanine width, between the cusps of the upper and lower canines. Maxillary intermolar width, between the midpoints of the central fissures of the upper first molars. Mandibular intermolar width, between the midpoints of the middle buccal cusps of the lower first molars. Maxillary and mandibular anterior arch lengths, the distance from the tangents to the labial surfaces of the most anterior upper and lower central incisors to the connecting lines between the cusps of the upper and lower canines. Maxillary and mandibular overall arch lengths, from the tangents to the labial surfaces of the most anterior upper and lower central incisors to the connecting lines between the central fissure of the upper molars, and the middle buccal cusps of the lower molars.

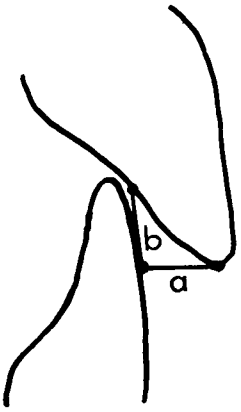

Fig. 2 OVERJET (a) Distance from the incisal edge of the most protruded upper incisor to the labial surface of the lower incisor on the same side measured along the upper occlusal plane. Anterior crossbite gives negative values. OVERBITE (b) Distance from the incisal edge of the most protruded lower incisor to the upper occlusal plane. Open bite gives negative values.

crease throughout the period (0.2 mm) for the spaces in the mandibular posterior segments ($p<0.05$).

Discussion

The surgical set-back of the mandible, a routine treatment procedure, makes the most drastic changes of face morphology and functional conditions. It offers an excellent opportunity for study of various changes of the face, denture and muscular activity.

It is likely that any changes in the position of the teeth postoperatively will be the result of the changed stimuli exerted by the muscular activity and the soft tissue. During the period of intermaxillary fixation these forces will be evenly transmitted to both dental arches. The chewing muscles are stretched by the distalization. Their contractive force results in an elevation of the gonial angle and an extrusion of the maxillary and mandibular anterior teeth[7]. Thus, the dental changes shown during the first six months of this study might be the result of both changes during the intermaxillary fixation period and may have been caused from functional stimuli in the postretention period. The changes between six months and two years postoperatively should be a reflection of functional changes.

It has been shown that the set-back of the mandible results in a distalization and

TABLE I

Differences between Measurements on the Preoperative and 6 Months Postoperative Models

n = 37

Variables	$\bar{d}$	s_d	t
Maxillary-intercanine width	0.24	0.77	1.19
Maxillary-intermolar width	-0.18	1.97	-0.43
Mandibular-intercanine width	-0.30	0.70	-1.86
Mandibular-intermolar width	0.31	0.49	2.43*
Maxillary-anterior arch length	-0.28	0.32	-3.18**
Maxillary-overall arch length	-0.46	0.71	-2.64*
Mandibular-anterior arch length	0.07	0.37	0.60
Mandibular-overall arch length	0.12	0.52	0.98
Overjet	7.31	2.40	12.56**
Overbite	-1.27	2.41	-2.19*
Spaces in the maxillary anterior segment	-0.06	0.12	-1.48
" " " " posterior segment	-0.49	1.16	-1.68
" " " mandibular anterior segment	0.03	0.06	1.11
" " " " posterior segment	0.19	0.43	1.71

* $p<0.05$

** $p<0.01$

TABLE II

Differences between the Measurements on the Preoperative and two Years Postoperative Models

n = 37

Variables	$\bar{d}$	S_d	t
Maxillary intercanine width	0.30	0.91	1.18
Maxillary intermolar width	-0.15	1.74	-0.33
Mandibular intercanine width	-0.66	0.77	-3.49**
Mandibular intermolar width	0.61	0.97	2.49*
Maxillary anterior arch length	-0.32	0.38	-3.36**
Maxillary overall arch length	-0.33	1.07	-1.17
Mandibular anterior arch length	0.23	0.49	1.78
Mandibular overall arch length	-0.04	0.72	-0.17
Overjet	6.97	2.63	11.03**
Overbite	-0.87	2.44	-1.53
Spaces in the maxillary anterior segment	-0.07	0.19	-1.46
" " " " posterior segment	-0.23	2.32	-0.35
" " " mandibular anterior segment	0.03	0.13	0.99
" " " " posterior segment	0.41	0.53	3.07**

* $p<0.05$

** $p<0.01$

lowering of the upper lip,[4,12,14] and electromyographic studies have shown a temporary increase of the muscle activity of the upper lip postoperatively.[14] It is likely that these changes would affect the position of the maxillary incisors by uprighting them, thereby resulting in a reduction of the maxillary dental arch length, as was really observed. The situation seemed to be stable six months postoperatively as no further reduction was observed from six months to two years postoperatively. The reduction of the overall maxillary arch length was somewhat greater than the reduction of the anterior arch length, which indicates that the molars have migrated mesially, probably as a result of the mesial relapse of the mandible which by the intercuspidation will affect also the maxillary lateral segments.[11,14,15]

A corresponding increase of the mandibular arch length as could be anticipated from changed tongue pressure and a reduced lower lip tension was not observed.

The dimensions of the mandibular dentition were remarkably stable, as the only significant changes were a reduction of the intercanine width and an increase of the intermolar width. A possible explanation for the change of the intercanine width is that the canines are often in a cross-bite position preoperatively and are enclosed within the maxillary dentition postoperatively. This hypothesis is sustained by a small though not significant increase of the maxillary intercanine width.

The mandibular intermolar width increased significantly during the period studied, a fact which has been observed previously by others.[5] The reason for this increase might be an altered tongue position and tongue pressure postoperatively, or it might be caused by the changed occlusion and cusp interdigitation which will improve the functional ability of the posterior part of the dentition. This is sustained by the findings of Åstrand[15] who found a "normal" chewing pattern postoperatively with less participation of the incisors and a higher activity in the molar region during the chewing circle. Both the decrease in the intercanine width and the increase in intermolar width displayed higher values two years postoperatively than six months postoperatively, indicating that the functional stimuli were still active even that long after the operation. The observed increase of the spaces in the mandibular posterior segments is probably also an effect from the changed width dimensions of the dentition, or it might be created by tooth movements resulting from a somewhat changed tongue function.

The change of the overjet was small between six months and two years postoperatively, indicating that the sagittal position was rather stable. Other studies have also shown that the sagittal relapse is greatest during the first period after the operation.[14]

Previous works have reported some bite-opening postoperatively as a result of a backward rotation of the mandible.[1,2,8,9,14,16] This tendency is strongest during the first period after the operation. In this material there was a small though insignificant increase in the overbite from six months to two years postoperatively showing that the tendency to bite-opening had been overcome, or even reversed, probably as a result of a slight extrusion of the anterior teeth which often follows the uprighting of the upper incisors.

It should be noted, however, that other studies have indicated that both the mandibular and maxillary incisal teeth extrude during the intermaxillary fixation period.[7] The intermaxillary fixation should, therefore, be supplemented by a chin cap with occipital traction.

Conclusion

Changes of the dental arch dimensions after surgical correction of mandibular prognathism are very limited. Except for a decrease of the mandibular intercanine

width, an increase of the mandibular intermolar width, and a decrease of the maxillary dental arch length, the dentition remains remarkably stable. It thus seems that the changed function postoperatively does not result in great changes in the position of the teeth within the jaws.

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