The Role of Dental Compensations in the Orthodontic Treatment of Mandibular Prognathism

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The compensatory effect of tooth positions in specific skeletal growth dysplasias has been described by many investigators. Robinson et al.[15] noted the anteroposterior dental compensations present with mandibular prognathism. These compensations include tendencies toward proclination of the maxillary incisors, retroclination of mandibular incisors, and negative overjet (Fig. 1). Others have subsequently reported similar findings.[1,16,17]

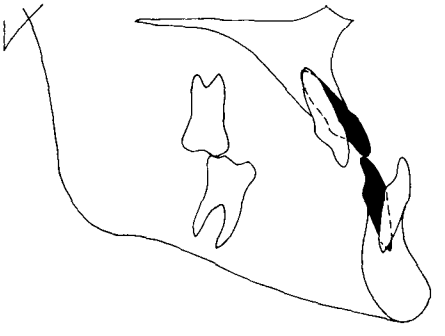

Fig. 1 Class III molar relationship with uncompensated incisor axial inclination (white) and compensated incisor axial inclination (black). Compensated incisors (black) may mask or confuse proper treatment planning.

Vertical dental compensations have also been described in vertical skeletal growth dysplasias. These compensations include greater vertical dentoalveolar growth with anterior open bites and lesser dentoalveolar vertical growth with deep bites.[7]

No consistent relationships have been established between anteroposterior or vertical incisor position and such sequelae as traumatic occlusion or periodontal disease.[4,5] More recently, Geiger and Wasserman studied the relationship between incisor inclination and periodontal status in nontreated adults and noted an association between labial gingival recession of the mandibular incisors and linguoversion.[3]

Although no definite correlations have been established, the role of occlusal malrelationships and symptoms of temporomandibular joint dysfunction have been studied.[6,8]

The purpose of this paper is to document the magnitude of dental compensations incorporated and retained in a group of orthodontically treated cases of mandibular prognathism.

In addition, postretention periodontal status and tooth mobility in functional jaw positions are examined and compared with a non-Class III group of orthodontically treated cases. Examples of physiologic and esthetic morbidity are demonstrated.

METHODS AND MATERIALS

Patients were selected for recall from records in the Division of Orthodontics, University of Minnesota, based on the following criteria:

1) Original examination indicated a preliminary diagnosis of Class III malocclusion.

2) Original examination did not note a significant anterior mandibular slide from initial tooth contact (centric relation) to maximum intercuspation (centric occlusion).

3) Treatment was performed without surgical intervention.

4) Treatment records were complete and included pretreatment and posttreatment films.

5) Patient retention period was completed.

Thirty-six patients were selected for the study group. Postretention records obtained for this group included a standardized cephalometric film, 35 mm color intraoral slides, and a clinical analysis of periodontal structures and tooth mobility in functional jaw positions. The average age was 26.7 years with an average of 9.2 years postretention.

A study sample of thirty-two Class I and II orthodontically treated patients was randomly selected from the retention files for the comparison group. These patients' averaged age was 17.1 years and were 2.1 years postretention. Extraction and nonextraction treatments were approximately equally divided in both the study and comparison groups. All observations in both groups were made by the same investigator.

Both groups were recalled and clinically examined for periodontal status and tooth mobility in functional jaw positions.

Periodontal status

Maxillary and mandibular anterior teeth from canine to canine were evaluated. Gingival tissue was recorded as recessive if the labial cementoenamel junction was exposed, but the curve of the epithelial cuff was smooth and unbroken. If the curve of the epithelial cuff was broken, the tooth was counted as having a gingival cleft. Liberal use of the air syringe and explorer aided the examination. Color 35 mm slides were made of each patient and evaluated under enlargement. Results of this second independent evaluation correlated well with results of the primary clinical examination. Gross inflammatory periodontal disease was not present in any of the patients in either group.

Tooth mobility

Maxillary and mandibular anterior teeth from canine to canine were evaluated. Notations were made for the presence of tooth mobility in centric, balancing, working, and protrusive occlusions.

Several instruments and techniques have been proposed to quantitatively measure tooth mobility.[12] However, for a clinical survey, a digital examination and a decision of presence or absence had been recommended[9] and followed in the study. A forefinger was placed on the labial surface of the crown and the patient asked to firmly tap in centric occlusion or other excursive occlusal positions. If vibrations felt by the investigator for any particular tooth were excessive, a positive response was marked in the analysis for occlusal mobility in functional jaw positions. This inferred occlusal trauma.

An additional variable considered was the status of the temporomandibular joints. At the clinical examination a history of joint limitations or pain was taken in addition to any crepitus or temporomandibular joint symptoms.

Skeletal-dental and interdental relationships were measured from cephalometric films. Four parameters were recorded: maxillary incisor to sella-nasion, mandibular incisor to mandibular plane, overbite, and overjet.

Results

Table I summarizes pretreatment to postretention net changes in dental compensation variables which were documented for the study group. In this group the maxillary incisor incorporated more dental compensation than the mandibular incisor. During the pretreatment to postretention period the mean advancement of the maxillary incisor was 4.9 degrees. The mean retrac-

TABLE I

Variable	Mean Net Change	SD	Range
UI to SN°	+4.9	6.8	— 8 to 19
LI to MP°	—3.5	5.2	— 13 to 6
OB (mm)	—0.5	2.8	—8.0 to 5.5
OJ (mm)	+2.0	2.3	—3.2 to 6.2

tion of the mandibular incisor was 3.5 degrees. This resulted in a mean overjet reduction of 2 mm with a mean overbite decrease of 0.5 mm from pretreatment to postretention.

Table II compares mean dental compensation variables of the study group with the comparison group during the postretention period. All mean differences between the groups were significant at the 0.01 level using a "t" test.

The study group had a mean of 1.9 teeth with labial gingival recession per patient. The comparison group had a mean of 0.6 teeth with labial gingival recession per patient. This difference was significant at the 0.01 level using a "t" test.

Of the 77 teeth recorded as having labial gingival recession in the study group, 24 were in the maxilla and 53 were in the mandible. Of the 18 teeth in the comparison group recorded as having labial gingival recession, 8 were in the maxilla and 10 were in the mandible (Table III).

Three patients in the study group had a combined total of 7 gingival clefts. Teeth showing clefts were maxillary lateral incisor (1), maxillary canines (2), mandibular canines (2), and maxillary central incisors (2). One patient (maxillary lateral incisor) had received treatment for the defect. No gingival clefts were observed in the comparison group.

The mean number of mobile teeth in functional jaw positions per patient for the study group was 2.5. The mean number of functionally mobile teeth per patient for the comparison group was 1.5. This difference was significant at the 0.05 level using a "t" test.

Of the 89 mobile teeth observed in this study group, 73 were maxillary anterior teeth and 16 were mandibular teeth. All 50 mobile teeth observed in the comparison group were maxillary teeth. The distribution of the observations on tooth mobility by tooth is tabulated in Table IV.

The distribution of tooth mobility by excursion was also recorded (Table V). Forty-one of 89 teeth in the study group and 21 of 50 teeth in the comparison group were functionally mobile in centric occlusion.

None of the patients in either group revealed any contributory history or presence of clinical symptoms in the region of the temporomandibular joint.

TABLE II

	Mean UI-SN°	SD	Range	Mean LI-MP°	SD	Range
Study	112.1	7.3	95-132	82.4	7.3	65-100
Comparison	100.1	6.2	88-115	93.2	7.2	81-113
	OB (mm)	SD	Range	OJ (mm)	SD	Range
Study	0.9	1.6	—2.7-3.4	—0.1	1.3	—3.8-2.0
Comparison	2.0	1.1	0.0-4.5	1.6	0.8	0.0-3.5

TABLE III

Distribution by Teeth of Labial Gingival Recession

	Total	Max	Mand	3/	/3	2/	/2	1/	/1
Study	77	24	53	10	16	9	18	5	19
Comparison	18	8	10	1	2	5	3	2	5

TABLE IV
Distribution of Tooth Mobility During Functional Jaw Positions

	Total	Max	Mand	3/	/3	2/	/2	1/	/1
Study	89	73	16	0	0	27	0	46	16
Comparison	50	50	0	0	0	13	0	37	0

Discussion

The essence of an orthodontic correction of a malocclusion involving skeletal base discrepancies is the incorporation of dental compensations to provide maximum intercuspation and proper overbite and overjet relationships. If balanced and proportional maxillary and mandibular skeletal relationships exist, there is ordinarily little difficulty in establishing the proper skeletal-dental relationships. However, the presence of a skeletal dysplasia progressively increases the necessity for the incorporation of additional dental compensation to establish proper interdigitation, overbite and overjet. As the skeletal dysplasia becomes more severe, proper skeletal-dental relationships become more difficult to establish.

Reports in the literature indicate that clinicians have made a maximum effort to utilize dental compensations in the orthodontic correction of mandibular prognathism.[10,14] It is reasonable to assume that there is some limitation to the magnitude of dental compensations to attain a dental correction in a skeletal dysplasia. The sequelae of such an attempt may be examined from both physiologic and esthetic viewpoints.

The mean study patient had over three times as many teeth with labial gingival recession as the mean comparison patient. Most of the teeth recorded as having labial gingival recession were in the mandible, a site of active dental compensation during both the treatment and posttreatment period. These data concur with the observations of Geiger and Wasserman.

In three patients, representing seven teeth, labial gingival recession had progressed to clefting. Figure 2 (upper left) illustrates that a possible sequela of labial gingival recession may be progression to a cleft by the interruption of the continuity of the gingival cuff. This particular maxillary lateral incisor was functionally mobile in centric occlusion. The patient has received treatment (equilibration and hygiene instruction) for the gingival deformity.

Figure 2 (upper right) illustrates the results of a case that was dentally, functionally, and esthetically acceptable. Lingual crown movement of the mandibular incisors was accompanied by labial movement of the roots. Root prominence was apparent on clinical examination. Thinning of the labial cortical plate may be postulated. Figure 2 (lower left) illustrates maxillary and mandibular labial cortical plates and dentition of a prognathic dry skull with excessive incisor compensation. Root prominence and thin cortical plates are apparent in the maxillary and mandibular dentitions.

The patient in Figure 2 (lower right) was 24 years posttreatment at the time of recall. Anteroposterior dysplasia was too severe for dental compensation and negative overjet was present. Incisor teeth were compensated excessively in the effort to obtain a dental correction. The patient did not have inflammatory periodontal disease or history of abrasive habits. Although no data exist to directly support a cause and effect relationship in this case, one might specu-

TABLE V
Functional Tooth Mobility by Excursion B (Balancing), W (Working), P (Protrusive), CO (Centric Occlusion)

	B	W	P	CO
Study	16	16	16	41
Comparison	4	6	19	21

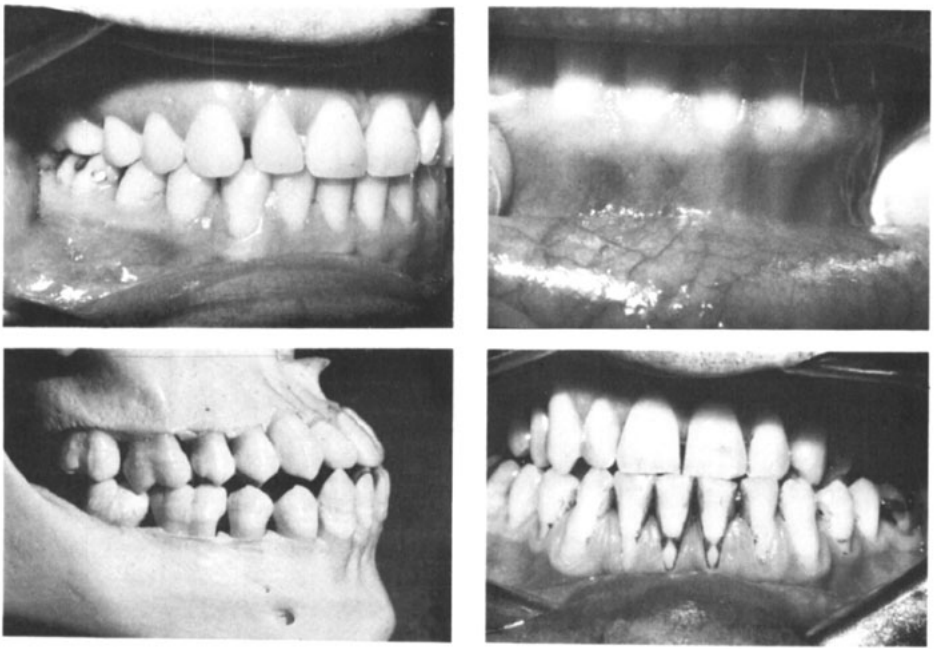

Fig. 2 Nonphysiologic sequelae of dental compensations. Upper left, the gingival cleft is present on the labial aspect of the right maxillary lateral incisor. The tooth was also mobile in centric occlusion. Upper right, the root prominence of the mandibular incisors is apparent. The occlusal and esthetic results in this study patient were good. Lower left, dry skull with mandibular prognathism. The excessive compensation of the maxillary and mandibular incisors and the effect on root prominence or labial bone thickness is apparent. Lower right, this study patient was 24 years posttreatment. No inflammatory periodontal disease was observed and there was no history of an abrasive habit. It may be suggested that excessive dental compensations contributed to the violation of the alveolar complex.

late that excessive tooth inclinations in the alveolar complex may have contributed to the current periodontal situation.

In recording functionally mobile teeth it was found that, for all excursions, there were nearly twice as many mobile teeth in the study group than the comparison group. Although no direct relationship between this functionally traumatic occlusion and periodontal disease has been established, it might be postulated that this is an undesirable sequela of treatment.

Based on the data for labial gingival recession and tooth mobility, it may be suspected that the incidence of physiologic morbidity was greater in orthodontic treatment of mandibular prognathism than that of nonprognathic treatments. When comparing the variables most associated with the anterior dentition, UI to SN, LI to MP, and overbite and overjet, increased morbidity was significantly related to increased dental compensations. However, it should be noted that the comparison group of patients was considerably younger (17.1 years to 26.7 years) and was postretained for a shorter time (2.1 years to 9.2 years).

One should be cautious in incorporating major dental compensations in the maxillary and mandibular dentition in an attempt to gain an occlusal correction of mandibular prognathism. Increased morbidity in long-term evaluations measured by labial gingival reces-

sion may be related to increased dental compensations and Class III orthodontic treatment. There is the suggestion that increased dental compensations associated with the orthodontic treatment of mandibular prognathism may contribute to traumatic occlusion.

The clinician is faced with the question, "How much dental compensation can be placed in the anterior dentition before nonphysiologic sequelae occur"? The answer was not clarified by the data. A continuum of dental compensations was associated with a continuum of nonphysiologic sequelae. The best treatment for each patient rests in careful individual case analysis with an acute sense of dentoalveolar physiologic limitations.

Failure to remove naturally incorporated dental compensations prior to surgical correction of mandibular prognathism also results in improper facial esthetic balance.[16] If the option of orthodontic care only is elected for the correction of mandibular prognathism, pretreatment dental compensations will have to be increased. This may result in an unsatisfactory facial balance.

Figure 3 (left) is a patient from the study group who has what may be considered a straight profile with a facial contour angle of —1°. An acceptable balance between nose, lips and chin is present. Figure 3 (right), however, is another patient from the study group on whom every effort was made to obtain a dental correction. She shows a facial profile angle of + 8°. The relative prominence of soft tissue pogonion and the resulting nose-lips-chin positive facial contour angle result in a less desirable profile.

To avoid undesirable facial esthetic sequelae resulting from incorporation of excessive dental compensations the orthodontist should establish, with the patient, definite treatment objectives. Objectives which are attainable by orthodontic care only, and objectives that will require an orthognathic surgical treatment approach must be identified for formulation of the appropriate treatment plan.

Fig. 3 Esthetic compromise in the orthodontic treatment of mandibular prognathism. Left, a patient from the study group with good facial balance between nose-lips-chin. Right, a study patient with compromised facial esthetics.

Dental compensations have an integral role in the treatment of mandibular prognathism. To avoid undesirable sequelae in orthodontic treatment it must be recognized that a limitation inherent in conventional orthodontic treatment is the physiological limitations of the alveolar complex. Proper skeletal-dental relationships should be established to avoid undesirable facial esthetic compromises. Based on these principles, it may be possible that a surgical phase of treatment in tandem with orthodontic treatment may actually be a more desirable treatment plan to meet predetermined objectives.

Summary and Conclusions

Thirty-six patients with orthodontically treated mandibular prognathism were recalled for cephalometric and clinical evaluation. A comparison group of 32 non-Class III patients was similarly examined.

Analysis of variables associated with the anterior dentition and documenta-

tion of labial gingival recession and tooth mobility led to the following conclusions concerning the role of dental compensations in the orthodontic treatment of mandibular prognathism.

1. Vertical and horizontal dental compensations were quantitated in the dentition of the study group (pretreatment to postretention).

2. Increased labial gingival recession and increased tooth mobility in functional jaw positions were present in anterior maxillary and mandibular teeth of the study group relative to the comparison group.

3. Proper diagnosis and the establishment of realistic treatment objectives by clinician and patient are necessary to avoid undesirable sequelae and/or undesirable facial esthetics in the treatment of mandibular prognathism.

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