Profile Changes in Modified Functional Regulator Therapy

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Comparison of lateral cephalometric radiographs of treatment and control groups finds the changes achieved with a modified functional regulator are limited to improvement in dental and lip relations. No effects are found on mandibular growth or position in relation to the profile.

KEY WORDS: • FUNCTIONAL APPLIANCE • PROFILE • • MALOCCLUSION, CLASS II DIVISION 1 •

The Fränkel functional regulator is of relatively recent origin, and the theoretical concept and clinical results following treatment have aroused considerable interest and controversy. FRÄNKEL (1969A, 1969B) considers that the main changes which are induced by the appliance in the treatment of Class II[1] malocclusion are:

a. An increase in the width of the dental arches.

b. A favorable change in the anteroposterior mandibular-maxillary relationship, which may be located within the articular tissues.

c. An increase in the length of the mandible (i.e. condyle-menton distance), which may exceed the growth expectation for the individual.

d. Correction of associated physiological disturbances of the orofacio-pharyngeal muscles, and an improvement in their functional "performance."

The concept of promoting additional mandibular growth, increasing the length of the mandible in conjunction with orthodontic treatment, is also supported by MOSS (1969), PETROVIC, STUTZMAN, AND GASSON (1981) and PETROVIC, STUTZMAN, OZEROVIC AND VIDOVIC (1983). These authors all state that, contrary to popular belief, there is no genetically predetermined final length of the mandible.

The present study is a continuation of earlier investigations (HAYNES 1983, 1986), and relates to the profile changes associated with the use of the functional regulator. Since this particular aspect of treatment has not been previously investigated and compared with a control group, the present findings cannot be related to similar independent studies. Such information on the clinical response

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to functional regulator treatment is desirable for many reasons, (EDITORIAL AMERICAN JOURNAL OF ORTHODONTICS, NOVEMBER 1982), and the findings described may be of value to orthodontists and research workers with an interest in functional appliance therapy.

— Material and Method —

The children involved in this study were all aged between 6–10 years at the commencement of the investigation. The group receiving modified functional regulator treatment consisted of 15 boys and 16 girls, with a mean age of 109.8 months (standard deviation 13.0mo). The mean duration of treatment was 41.3 months, S.D. 12.9mo. The untreated control group was composed of 9 boys and 19 girls, mean age 104.3mo (S.D. 21.0mo), and the period of observation was 37.9 months.

The modifications incorporated in the design and construction of the functional regulator used in this treatment are fully described in HAYNES (1986). These consist primarily of consolidation and extension of the lower vestibular pads, incorporating them into the labial shield to provide continuous coverage across the lower cuspids and incisors (Fig. 2).

Cephalometric radiographs were obtained for each child at the beginning and end of the treatment or observation period. These were traced in the conventional manner to identify the cephalometric points and reference planes shown in Fig. 1.

Measurements used in the investigation were obtained from the initial and final tracings for each child along coordinates parallel with the maxillary plane, extending from the anterior nasal plane to the previously identified cephalometric points. Each variable was measured from the tracing to the nearest 0.5mm, and the values were corrected for the magnification factor of the cephalostat.

The differences between the initial and final values of each variable were determined, and the profile changes during the period of investigation were compared utilizing the data for the treatment and control groups.

— Findings —

Mean Values and Changes (Table 1)

The initial measurements of each variable were similar in both groups of children. The mean value of the smallest dimension, from the anterior nasal plane (anp) to ula, was 9.2mm in the treatment group and 8.4mm in the controls. The largest measurement, anp–PBR, averaged 95.3mm in both the treatment group and the controls. Comparison of other measurements in Fig. 1 establishes the overall similarity of the experimental and control groups.

The final mean values were also similar in both groups. The lowest values in the control group were 10.1mm (anp–ula) and 13.3mm (anp–ssp), compared with corresponding values of 12.2 and 14.5mm respectively in treated patients. The highest values observed were for the variables anp–S, and anp–PBR, which were 91.3 and 102.1mm in the control group, and 90.6 and 102.2mm in the treated patients.

Comparison of the initial and final measurements in the treatment group shows that the mean values from the anterior nasal plane to points LI, lls, lla, sm and M *decreased* during the observation period within the range of 0.3mm to 1.1mm, whereas the data relating to all other cephalometric points increased from 1.3–6.9mm.

In the control group, *increases* ranging from 1.6mm to 6.7mm were found for the variables studied.

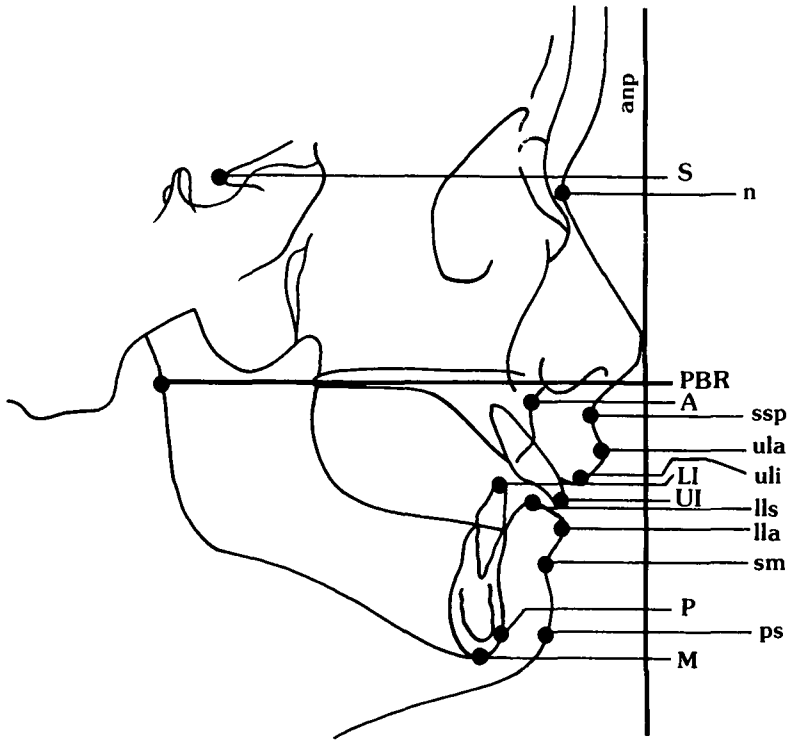

Fig. 1 Landmarks and reference planes

The horizontal reference plane is the maxillary plane established by the the anterior and posterior nasal spines ANS and PNS. The intersection of the maxillary plane with the posterior border of the ramus defines the point PBR.

The vertical reference plane is the anterior nasal plane (anp). This is drawn perpendicular to the maxillary plane, tangent to the the anterior surface of the nose.

Mean Changes and Statistical Findings (Table 2)

The differences derived from the initial and final observations in the treatment and control groups respectively, together with the statistical findings, are shown in Table 2.

In the treated patients, negative differences (i.e. lower final values) were observed for certain variables. The decreases observed were 0.3mm for anp–LI, 0.6mm for anp-sm, 0.8mm foranp–11a, 1.1mm for anp-ps, and 1.2mm for anp–lls.

The highest positive changes in the treatment group were found in the variables anp–S (6.8mm); anp–PBR (6.9mm), and anp–UI (5.9mm). Similar values were observed in the control patients for anp–

Table 1

Mean Values of Linear Distances from Anterior Nasal Plane (mm ± Standard deviation)

	FR Treatment		Control	
	Before	After	Before	After
S	83.8±3.5	90.6±6.3	84.7±5.1	91.3±7.1
n	15.8±3.0	19.2±3.8	16.4±2.5	19.7±3.5
PBR	95.3±4.2	102.2±5.7	95.3±5.0	102.1±5.8
ssp	12.3±1.4	14.5±2.1	11.7±2.2	13.4±2.5
ula	9.3±2.4	12.2±2.9	8.5±2.7	10.2±2.8
uli	14.9±2.4	18.5±3.1	14.4±2.9	16.2±3.8
A	23.8±2.2	27.2±2.6	24.0±2.8	26.7±3.3
LI	29.4±3.3	29.2±2.9	29.0±4.8	31.2±5.2
UI	20.3±2.8	26.1±3.0	20.0±3.6	21.8±3.6
lls	23.5±3.7	22.3±3.4	22.2±4.8	25.1±4.9
lla	17.6±3.7	16.8±3.1	16.4±4.4	18.3±3.8
sm	26.0±3.7	25.4±3.5	24.4±4.3	26.9±4.5
ps	24.6±5.1	23.6±4.0	22.7±4.3	24.2±4.6
M	38.0±4.4	39.2±6.2	38.2±4.9	39.9±5.3
P	33.6±4.7	34.5±4.9	33.5±4.9	34.8±5.3

Table2

Mean Differences (mm) Between Initial and Final Observations

	FR Treatment Mean±SD	Control Mean±SD	t	p[1]	Treatment Effect[2]	
S	6.8±4.6	6.6+3.7	−0.3	0.8	+0.2	No change
n	3.5±2.8	3.3±2.3	0.2	0.9	+0.2	No change
PBR	6.9±4.2	6.8±3.3	0.1	1.0	+0.1	No change
ssp	2.3±1.4	1.7±1.5	0.6	0.6	+0.6	Favorable
ula	3.0±1.8	1.7±1.7	1.9	0.1	+1.3	Favorable
uli	3.6±2.1	1.8±2.3	2.4	0.0	+1.8	Favorable
A	3.5±1.8	2.7±1.9	1.4	0.2	+0.7	Favorable
LI	−0.3±1.2	2.2±2.0	−1.4	0.2	−2.4	Favorable
UI	5.9±2.3	1.8±2.0	6.4	0.0	+4.1	Favorable
lls	−1.2±2.2	2.9±2.3	−0.7	0.5	−4.1	Favorable
lla	−0.8±2.1	1.9±2.2	−0.2	0.8	−2.6	Favorable
sm	−0.6±1.5	2.5±2.2	−1.4	0.2	−3.1	Favorable
ps	−1.1±1.7	1.5±2.1	−0.2	0.8	−2.6	Favorable
M	1.3±1.9	1.7±2.5	0.6	0.5	−0.4	No change
P	0.9±1.5	1.3±2.4	−0.1	0.9	−0.4	No change

[1] — Statistical tests based on distribution of differences, utilizing pooled and separate variance estimates and 2-tail probablities

[2] — Determined from overall Differences between Treatment and control groups relative to Anterior Nasal plane

S (6.6mm) and anp–PBR (6.8mm), but the difference for the dimension anp–UI in the controls was only 1.8mm.

The difference found for variable anp–UI is highly significant statistically ($P < 0.000$), and for dimension anp–uli it is moderately significant ($P. < 0.05$).

— Discussion —

The findings of this investigation are of special interest in view of the controversy concerning the clinical effects of functional regulator treatment. The changes found to occur in the treated group are all favorable. The clinical improvement appears to be associated with profile changes involving the positions and interrelationships of the lips, maxillary and mandibular incisors, subspinale, submentale, and superficial pogonion (ps) in relation to to the anterior nasal plane.

Of the fifteen anteroposterior relationships studied, it can be seen that the greatest single effect of treatment is an increase in the distance anp–UI. This dimension increased 5.9mm in the treatment group, compared to 1.8mm in the control children, and this difference was found to be highly statistically significant.

The increase in the dimension anp–uli was also significantly greater in the treatment group.

No other statistically significant differences were found, although the change affecting the dimension anp–ula approached the accepted level of statistical significance with a value of $P < 0.06$.

In the control group, distances increased between the anterior nasal plane and all of the cephalometric points investigated. In contrast, a number of corresponding values in the treatment group decreased, while others showed a greater increase relative to those observed in untreated children.

Thus, in the treated children, the mean values of the variables outlining the mandibular soft tissue profile and mandibular incisal edge were reduced, and the measurements relating to the upper lip contour and the maxillary incisal edge increased to a greater extent than in control patients.

If the anteroposterior changes in the treatment group are visualized and compared with the direction and degree of change in the control group, it is possible to account for the nature of the clinical improvement which occurs in the treatment of Class II, division 1 malocclusion with the functional regulator. In mean value terms, the lower incisor (point LI) moved 0.3mm toward the anterior nasal plane in the treatment group, whereas there was a movement in the opposite direction amounting to 2.2mm in the control children. Thus, the effect achieved by functional regulator treatment is a mean relative anterior movement of point LI of 2.5mm compared to the untreated control children.

Similarly, the profile points, lls, lla, sm and ps are all relocated more anteriorly in the treated children, the observed changes being 4.1, 2.6, 3.1 and 2.6mm respectively.

The change in the anteroposterior relationship of the lips (mean value differences) is also of clinical significance. The anterior point of the lower lip (lla) was initially 8.3mm posterior to the anterior point of the upper lip (ula) in the treatment group, and the corresponding value in the control children was 8.0mm. On completion of the investigation, these values were 4.6 and 8.0mm respectively, which clearly shows the extent of the improvement in the interrelationship of the lips with treatment.

The change in incisor occlusion is also demonstrated in the findings. The respective distances anp–UI and anp–LI were almost identical in the treatment

and control groups at the commencement of the investigation, 20.2 and 20.0mm, and 29.4 and 29.0mm respectively. The corresponding final values were 26.1 and 21.8mm, and 29.1 and 31.1mm.

While the initial overjet value was approximately 9.0mm in both groups, the final values showed a reduction of 6.2mm in the treatment group and a relatively unchanged overjet of 9.3mm in the control children.

Other important findings concern the stability of the mandibular position relative to the anterior nasal plane, as determined by the parameters anp–M, anp–PBR, and anp–P. The distance anp–PBR was initially identical in the treatment and control groups (95.3mm) and the changes observed during the investigation were very similar (final measurements 102.2mm and 102.0mm). Nearly identical values were also observed for the distance anp–M (37.9 and 38.2mm initially and 39.2 nd 39.8mm respectively on completion). Similarly, there were no significant differences between the treatment and control groups in the variable anp–P.

— Conclusions —

It may be concluded from the findings of this investigation that there are clinically significant anteroposterior changes associated with functional regulator treatment.

However, these changes are limited to the interrelationships of the incisor teeth of both dental arches, and their associated soft tissues.

These findings do not support the view that the functional regulator influences the spatial position of the mandible, and hence its anteroposterior relationship to the maxilla, as no clinical or statistically significant differences were found between the treated and control children for the variables relating the mandibular skeletal landmarks to the anterior nasal plane. A/O

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