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Morphological and Functional Changes Dynamics in the Treatment of Combined Forms of Distal Occlusion and Deep Bite

Marina Anatolyevna Danilova, Pavel Valeryevich Ishmurzin,
Maria Lvovna Ponomareva, Andriana Victorovna Agaki and Olga Borisovna Goreva

The State Budget Educational Institution of Higher Professional Education
"Perm state medical academy named after Academician Eugenie Anatoljevich Vagner"
of Health's Ministry of Russian Federation, Perm, Russia

Abstract: The aim of this study was to investigate functional and morphological mechanisms of craniofacial complex compensation during the treatment of patients with combined forms of distal occlusion and deep bite. The article covers the results of orthodontic treatment of 26 patients, who have a combined form of distal occlusion and deep bite in the period of a complete growth of maxillofacial complex. We present a structural analysis of pharyngeal tube architectonics and a tongue position change during the orthodontic treatment. We have discovered the correlation between inclination of mandible, tongue volume and oropharynx airspace. The article shows the fact of enlargement of tissue frame of oropharynx during orthodontic treatment of combined forms of distal occlusion and deep bite soft. As a consequence of inclination and position of mandible normalization the oral cavity volume is increased and position of a tongue is normalized, that is proved by a change of X-ray length and the height of a tongue.

Key words: Distal occlusion · Deep bite · Oropharynx · Position of tongue

INTRODUCTION

Mutual conditionality of morphology and functions of human organism is without any doubt. Choosing a principle and a method of orthodontic correction malocclusion's, a doctor should answer the question "Will normalization of teeth position, teeth relations and improvement of aesthetic of macro- and micro parameters of maxillofacial system lead to its optimal function?" Only in the case of a positive answer conducted treatment can be successful [1-3].

A tongue being a might muscular organ is one of the main factors, of valuable development of maxillary bones. In the process of formation of distal occlusion and deep bite's combined anomaly tongue position changes as a result of mandible counter clockwise rotation. The tongue starts to take a forced distal position in the oral cavity adapting to hyperdivergent type of maxillary bones and to reduction of oral cavity volume. As a rule it leads to progression of distal position of mandible and to worsening of occlusion pathology [4].

The aim of this study was to investigate functional and morphological mechanisms of dentomaxillary complex compensation during the treatment of patients with combined forms of distal occlusion and deep bite.

MATERIALS AND METHODS

We've carried out clinical study and treatment of 26 patients aged from 17 up to 25 with a skeletal form of distal occlusion (ANB-5,82±0,73°). All patients had a deep overbite in front area caused by retroinclination of mandible (NSL-ML-22,47±0,54°). Position and inclination of maxilla related to cranium were determined as normal (NSL-NL-6,08±0,53°, SNA-81,88±0,31°). Besides the definition of main lateral cephalograms' landmarks before and after orthodontic treatment X-ray markers were studied. These markers characterized the sagittal dimensions of parynx and tongue according to the criteria described by E.K.Pae et. al, presented in picture 1 [5-7].

In the pharyngeal analysis, muscular carcass of pharynx of was categorized into naso-, oro- and hypopharynx:

Corresponding Author: Danilova, Bauman Street, 11-73, Perm, 614 066, Russia.

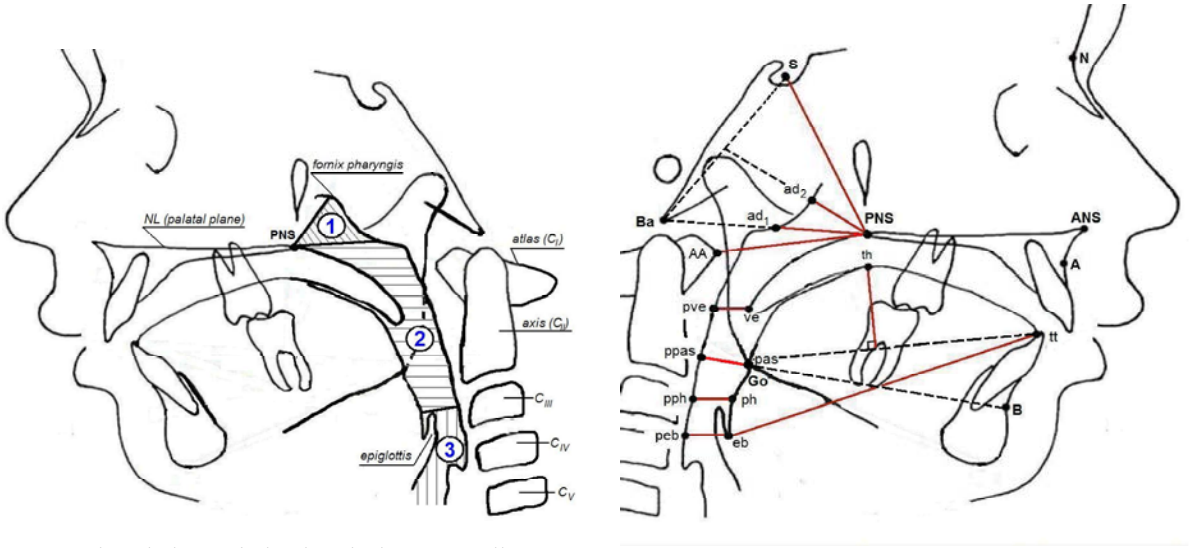

Fig. 1: Used cephalometric landmarks by Pae et.all.
1-nasopharynx, 2-oropharynx, 3-hypopharynx;
ad$_1$ is the intersection point of posterior pharyngeal wall and the line from posterior nasal spine (PNS) to basion (Ba);
ad$_2$ is the intersection point of posterior pharyngeal wall and the line from the midpoint of the line from sella (S) to basion (Ba) to posterior nasal spine;
AA is the most anterior point of atlas vertebra;
ve-pve is the distance of the closest point of soft palate to the posterior pharyngeal wall (velum palatinum, ve) to the horizontal counterpoint on the posterior pharyngeal wall (pve);
ppas-pas is the distance of the intersectionpoints on anterior and posterior pharyngeal wall of the line from supramentale (B) to gonion (Go);
ph-pph is the distance of horizontal counterpoints on anterior and posterior pharyngeal wall in oropharynx at its narrowest area;
eb-peb is the distance from vallecula of epiglottis (eb) to horizontal counterpoint on the posterior pharyngeal wall (peb);
tt-eb is the distance from anterior point of tip of tongue (tt) to the base of epiglottis (eb)
th is the perpendicular distance of superior point of tongue (th) bellow posterior nasal spine (PNS) to line from the tongue tip (tt) to the intersection point of tongue and mandibular border (tg)

- Nasopharynx - the area outlined by a line between roof of the pharynx and posterior nasal spine (PNS), an extension of the palatal plane to the posterior pharyngeal wall and the posterior pharyngeal wall (S-PNS; ad$_1$-PNS; ad$_2$-PNS distances);
- Oropharynx - the area outlined by the inferior border of the nasopharynx, the posterior surface of the soft palate and tongue, a line parallel to the palatal plane trough the tip of epiglottis and the posterior pharyngeal wall (AA-PNS; ve-pve; ppas-pas; ph-pph distances);
- Hypopharynx - The area outlined by the inferior border of the oropharynx, the posterior surface of the epiglottis, a line parallel to the palatal plane through the point C4ai and the posterior pharyngeal wall (eb-peb distance).

Treatment of patients was made using Damon system by straight-wire technique without teeth extraction as wits was 4,15±0,79 mm. Correction of sagittal discrepancies was reached by using of Class II mechanics [2].

Statistical analyses were calculated using BioStat 2009 (AnalystSoft Inc). Describtion qualitative sings we used the form of mean (M) ± standard deviation (m). For comparison of two dependent groups by a qualitative sign. Wilcoxon test was used. Also we took correlation analysis by Spearman. Estimation of statistic hypothesis consisted in comparing of received level of significance with threshold level 0,05.

RESULTS AND DISCUSSION

In the process of distal occlusion and deep bite treatment ANB decreased for certain (3,11±0,21°, p<0,05), divergation of facial skull enlargement because of changing of mandible inclination in vertical plane (NSL-ML-26,57±1,29°, p<0,05). Combination of cephalometrical landmarks of position and inclination of maxillary bones after orthodontic correction approached to the super harmony line of harmony box by A.Hasund and D.Segner (Table 1, Figure 2) [8].

X-ray parameters of pharynx during treatment had the following changes (Table 1):

- Distance S-PNS showing the most of air space of nasopharynx didn't have significant differences in landmarks (before treatment-43,46±0,39 mm, after treatment-43,38±0,13 mm, p>0,05);
- Sagittal dimensions of middle and low parts of oropharynx increased for certain in the process of correction of anomaly of occlusion (ppas–pas before treatment was 6,46±1,18 mm, after treatment-7,76±0,53 mm, p=0,05; ph-pph before treatment was 6,38±1,27 mm, after-7,96±0,27mm, p<0,05).

Distance tt-eb describing X-ray tongue length increased for certain (before treatment-60,26±2,07 mm, after-61,23±0,37 mm) and distance th reflecting tongue height in oral cavity lessened for certain (before treatment-21,73±0,44 mm, after-20,42±0,82 mm). These changes are connected with the process of mandible clockwise rotation, during Class II correction oral cavity volume increases and creates favorable condition for tongue position (Figure 3).

Correlation analysis allowed us to find out the next dependences (Figure 4):

- Between mandible rotation and dimensions of low parts of oropharinx (ph-pph and ppas-pas) a direct strong correlation;
- Strong direct correlation connection is determined between X-ray tongue length and width of a low part of orohparynx (ph-pph).

These dependences are corroborated by anatomical preconditions of the form of maxillaryfacial area structures. It's known that muscular carcass of a pharynx is formed by three muscular-constrictors: upper, middle and low. An upper constrictor starts from lateral parts of a tongue root [9]. So, gradual adaptive mesialization of a tongue in an oral cavity in the correction process of an occlusion anomaly leads to the change of a pharynx tube's form in its low parts by small muscular tension of low parts of a pharynx and increasing of its gap.

Table 1: Change of parameters of soft tissues structures of maxillary facial area in the process of combined form of distal occlusion and deep bite treatment

Variables	Before treatment (n=26)	After treatment (n=26)
SNA, °	81,88±0,31	82,03±0,27
SNB, °	78,34±0,92	80,57±0,83*
ANB, °	5,82±0,73	3,11±0,21*
NSL-NL, °	6,08±0,53	6,18±0,77
NSL-ML, °	22,47±0,54	26,57±1,29*
NL-ML, °	15,73±1,12	20,15±0,79*
The landmarks of nasopharynx:		
- S-PNS, mm	43,46±0,39	43,38±0,13
- ad_1-PNS, mm	18,80±1,03	18,38±1,73
- ad_2-PNS, mm	13,03±0,35	13,15±1,09
The landmarks of oropharynx:		
- AA-PNS, mm	32,65±0,87	32,34±1,48
- ve-pve, mm	4,42±0,88	4,26±1,87
- ppas-pas, mm	6,46±1,18	7,76±0,53*
- ph-pph, mm	6,38±1,27	7,96±0,27*
The landmark of hypopharynx:		
- eb-peb, mm	8,92±0,23	8,19±1,14
The landmarks of a tongue:		
- lendth (tt-eb), mm	60,26±2,07	61,23±0,37*
- heidht (th), mm	21,73±0,44	20,42±0,82*

Note: * - difference of landmarks before and after orthodontic treatment is statistically significant (p≤0,05).

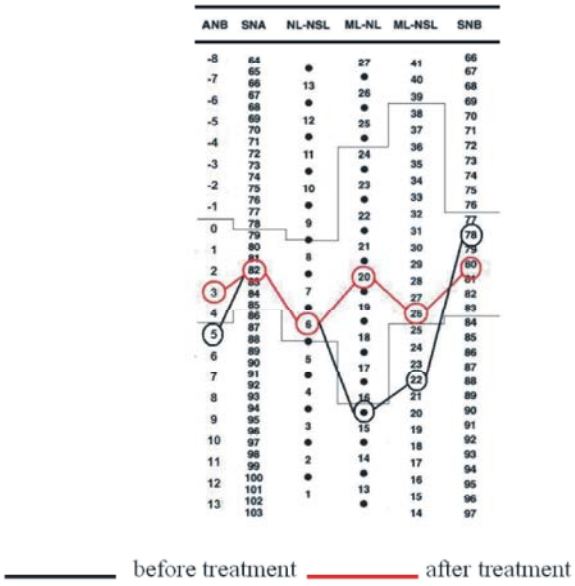

Fig. 2: Change of patient's cephalometrical landmarks with combined form of deep bite and distal occlusion during treatment (zone of angle's harmonious combination is limited by the frame)

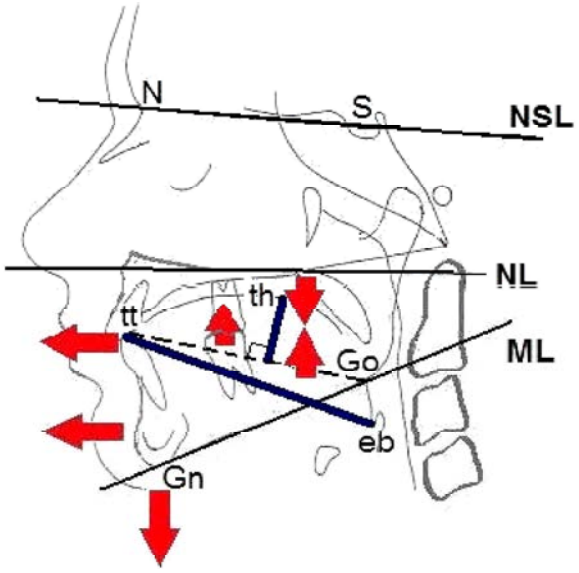

Fig. 3: Mechanism of morphological and functional changes in the process of orthodontic treatment of combined forms of distal occlusion and deep bite

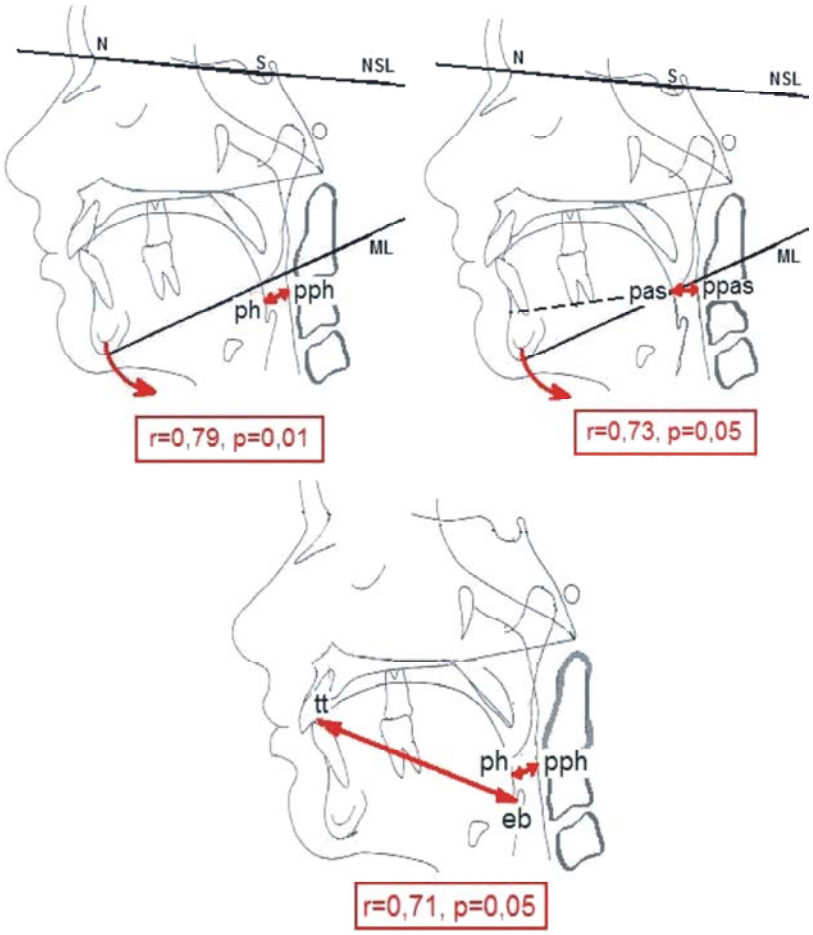

Fig. 4: Correlation dependences of mandible inclination, X-ray dimensions of an oropharynx and a tongue (explanation in the text)

Besides, an act of mastication of food is being normalized and its swallowing is being facilitated. Full value of mastication function in a retention period influences positively the stability of achieved occlusion contacts during the treatment [10].

CONCLUSION

This study showed that a positive dynamics of changes of sagittal mandible position and its counter clockwise rotation in the process of the correction of distal discrepancy of maxillary bones will be followed by a physical one. Activities directed to the treatment of an occlusion anomaly should be planned in the focus of myofunctional correction. Detailed cephalometric estimation of peculiarities soft tissue structures of a facial part is expedient and important while planning of a treatment and a prognosis of its results.

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