

Cephalometric Investigation of Class III Malocclusion According to McNamara Method

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Abstract – Lateral telerradiography represents an indispensable paraclinical investigation in dento-maxillary anomalies. McNamara's cephalometric analysis method is one of the most suitable in this case. The purpose of this study was to identify the most informative parameters according to McNamara method, that are specific for Class III malocclusion. The study sample consists of 6 lateral cephalometric radiograms that were examined according to principles described by McNamara. After cephalometric evaluation we detected a range of modifications characteristic for Class III. The mandible is positioned more antero-inferior than the normal values suggested by McNamara, which is confirmed by an average deviation of 6.7mm of the index Pg-Nasion perpendicular. There was detected a significant antero-posterior skeletal disharmony, proven by increased values (15.6mm) of the variable maxillomandibular difference. The maxilla has a retropositioned location compared to the cranial base expressed by the parameter A-Nasion perpendicular that is deviated 4.2mm posterior from the position considered normal. The goniac angle is more obtuse than the standard values. The increased value (+3.2°) of the angle between Frankfurt and mandibular plane confirms this modification. Mandibular length was excessive for all the patients with a medium exceed of the normal values of 13.1mm. As a result of this research we determined that the most important informative value in class III diagnosis is possessed by the following parameters: the mandibular and maxillary length, maxillomandibular difference, the relation between the mandible and cranial base and the goniac angle value.

Index Terms — Lateral telerradiography, cephalometric analysis, McNamara, Class III malocclusion.

I. INTRODUCTION

Among all the paraclinical investigation methods available in orthodontics, the lateral telerradiography has the most important value for diagnosis, treatment planning and the outcome evaluation in dento-maxillary anomalies. The aim of the telerradiographical examination is to determine the relationship between teeth, maxillaries and cranial base. To this end, with the help of skeletal and soft tissue landmarks, planes and angles are formed. Their values were analyzed in multiple researches. One of the most recent is McNamara's cephalometric analysis method [2]. This method combines the anterior reference plane described by Burstone [10] and a description of the length of the jaws and their relationship as given by Harvold [12]. This approach makes this analysis method one of the most suitable for diagnosis, treatment plan developing and treatment evolution assessment.

Increased interest regarding this method and its advantages determined us to use it in the cephalometric evaluation for Class III patients.

The purpose of this study was to emphasize the most informative parameters according to McNamara method which are specific for Class III malocclusion.

II. MATERIALS AND METHODS

This study has been performed on 6 lateral cephalometric radiograms (Fig.1), made at 1.5 m distance,

in centric occlusion. All the patients were diagnosed with

skeletal Angle class III malocclusion. After clinical examination, study models were fabricated and analyzed via classical methods. Depending on necessity, orthopantomography and photometric investigation were performed. Lateral cephalometric radiographs were evaluated according to McNamara method.

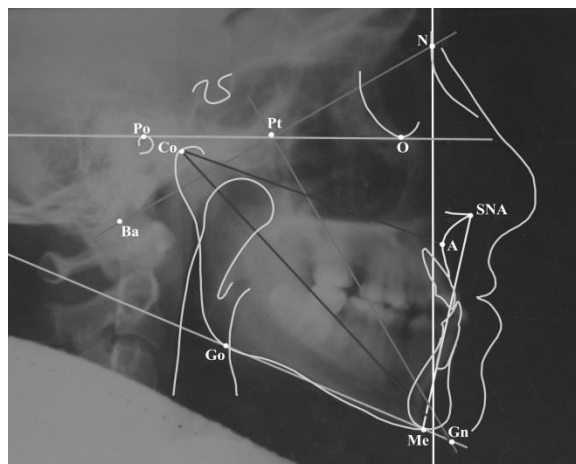


Fig.1 Example of lateral telerradiogram analyzed according to McNamara method.

McNamara analysis method consists of 5 main directions:

- Maxilla - cranial base relationship evaluation

- Maxilla - mandible relation assessment
- Mandible - cranial base rapport determination
- Dentition assessment
- Evaluation of the morphological parameters of the respiratory segment

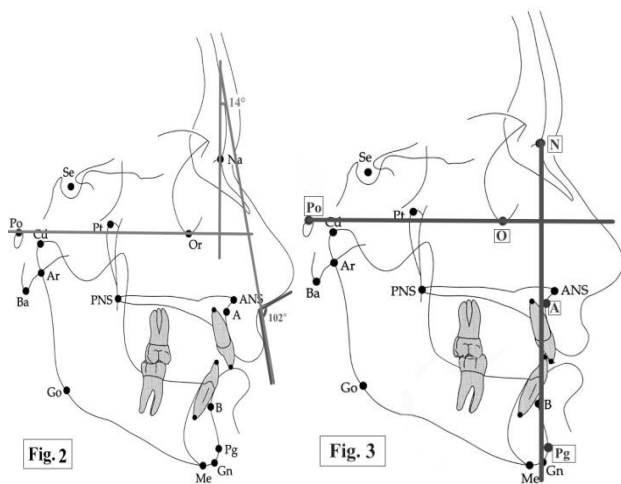
1. To determine the maxilla-cranial base relationship 2 steps are required: soft tissue evaluation and bone structure evaluation.

Soft tissue assessment is performed by calculating 2 indices:

- Naso-labial angle, which is formed between the tangent of the nose and the tangent of the upper lip (fig.2, red). According to McNamara, this index average value is 102°.

- Upper lip orientation, which is determined by measuring the angle between the tangent of the upper lip and the perpendicular from N to Frankfurt horizontal plane (the line from O to P) (fig.2, blue). According to McNamara, normally this angle represents 14°.

The evaluation of skeletal relationships consists in determination of maxilla's antero-posterior orientation towards cranial base. This is performed by measuring the distance between the perpendicular from the Nasion (N) to Frankfurt's horizontal plane and A point (fig.3). In an esthetic facial balance this distance is 0 in temporary dentition and represents 1 mm in adult dentition.



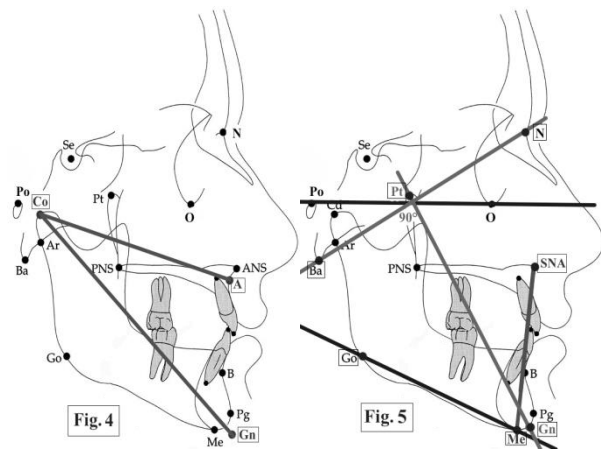
2. In order to determine the relationship between the maxilla and mandible we use the modified Harvold method. The effective midface length is measured from the point Condilion (Co) to the point A. Effective mandibular length is measured from the Co point to the point Gnathion(Gn) (fig.4). To determine the maxillomandibular difference we have to decrease the midface length from the mandibular length. According to McNamara this difference has a mean value of 20-23mm in mixed dentition and 27-30mm in permanent.

Maxillomandibular relationship is described also by the anterior lower face height. In this order, the anterior face height is expressed by 3 parameters:

- the distance between the point SNA (Spina Nasalis Anterior) to the Menton (Me) (fig.5, red). The medium value McNamara suggested is 62.4mm.

- the angle between the Frankfurt plane (O-Po) and the mandibular plane (Me - Go) (fig.5, blue), the mean value is 22°.
- the angle between the Ricketts facial axis (Pt - Gn) and Ricketts cranial plane (Ba - Na) (fig.5, green), that has a medium value of 90°.

3. The assessment of the relationship between the superior facial structures and the mandible is determined from the point Pogonion (Pg) to the Nasion perpendicular (fig.3). According to McNamara, this value is from 6 to 8 mm (Pg posterior to perpendicular) in temporary dentition and varies from 2mm posterior to 4mm anterior in adults.



4. Dentition assessment consists of the appreciation of the central incisors relationship. In order to determine the antero-posterior position of the superior incisors we measured the distance from the vestibular surface to the N-A line (fig.6). The mean value of this parameter is 4-6mm. As a vertical position, the incisal edge is situated 2-3mm under the superior lip margin.

To evaluate the position of the inferior incisors we calculate the distance between the incisal edge and the A-Pg line (fig.6). In a facial balance this index value is 1-3mm

5. We performed cephalometric measurements characteristic for respiratory function evaluation. For this purpose we determined SPW (Superior Pharyngeal Width) and IPW (Inferior Pharyngeal Width). For SPW, we appraised the distance between the most posterior point on the soft palate and the nearest point on the pharynx (fig.7, blue), the mean value for this index is 15-20mm. In order to determine the IPW variable, we measured the space from the intersection point of the mandibular edge and the tongue's root posterior margin to the nearest point on the pharynx (fig.7, red). The medium value is 11-14mm, regardless of the age.

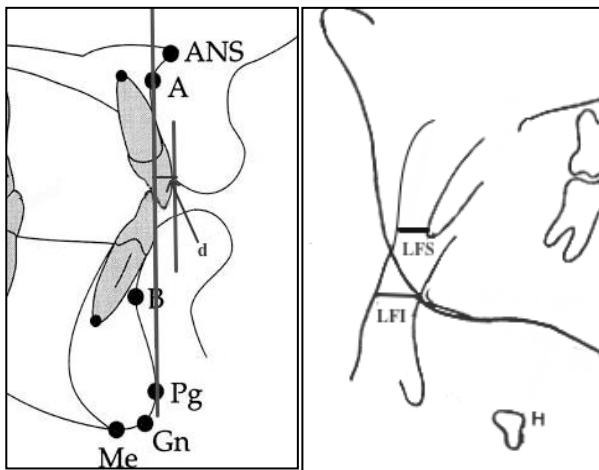


Fig.5

Fig.6

After the cephalometric analysis according to McNamara method, a mathematical calculation was performed, that expresses the deviation from the mean values of every individual variable, for every examined patient. Finally, a statistical computation was performed that expresses the mean deviation for every parameter, represented by the arithmetic average between the previously determined deviations for each clinical case.

These values give us the opportunity to detect which variables, determined according to MnNamara method, recorded the most increased deviations from the mean values. Respectively, these parameters will be the most significant for the diagnosis of Class III malocclusions.

III. RESULTS

The index values obtained after the measurements and calculus are showed in the Table 1.

After the intendment of the achieved results, we detected the following significant modifications characteristic for Class III malocclusion:

The mandible is positioned more antero-inferior than the normal values suggested by McNamara. This is confirmed by a medium deviation of 6.7mm of the index *Pg-Nasion perpendicular*.

- Significant antero-posterior skeletal disharmony proven by increased values (15.6mm) of the variable *maxillomandibular difference*.
- Maxilla has a retropositioned location compared to the cranial base, expressed by the parameter *A-Nasion perpendicular* that is deviated 4.2mm posterior from the position considered normal.
- The goniac angle is more obtuse than the standard values. The increased value (+3.2°) of the *angle between Frankfurt and mandibular plane* confirms this modification
- *Mandibular length* was excessive for all the patients, with a medium exceed of the normal value of 13.1mm.
- Superior lip shows a posterior position, as a result of retropositioned maxillary parameters. *Upper lip orientation angle* showed a medium decrease of 1.83° and *the naso-labial angle* a 9.17° increase in comparison with the normal values.

The specific modifications described by us were confirmed in previous similar researches [4,5] with small exceptions related to ethnical differences.

Table 1

Parameter	Average value	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	Patient 6	Mean deviation
Maxilla-cranial base relationship								
<i>Naso-labial angle</i>	102°	97°	104°	125°	114°	107°	120°	+9.17°
		-5°	+2°	+23°	+12°	+5°	+18°	
<i>Upper lip orientation angle</i>	14°	12°	15°	20°	13°	7°	6°	-1.83°
		-2°	+1°	+6°	-1°	-7°	-8°	
<i>A-Nasion perpendicular (mm)</i>	1	-2	-3.5	-3.9	+2.8	-6	-7	-4.2
		-3	-4.5	-4.9	+1.8	-7	-8	
Maxillomandibular relation								
<i>Maxillary length (mm)</i>	90	84	86	73	98.5	91	86	- 3.58
		-6	-4	-17	+8.5	+1	-4	
<i>Mandibular length (mm)</i>	110	111.5	117	108	143	128	131	+13.1
		+1.5	+7	-2	+33	+18	+21	
<i>Maxillomandibular difference. (mm)</i>	21.1	27.5	31	35	44.5	37	45	+15.6
		+6.4	+9.9	+13.9	+23.4	+15.9	+23.9	
<i>Anterior face height (SNA-Me) (mm)</i>	62.4	60	57	63	80	64	73	+3.77
		-2.4	-5.4	+0.6	+17.6	+1.6	+10.6	
<i>(O-Po) ∠ (Go-Me)</i>	22°	20°	23°	32°	28°	15°	33°	+ 3.2°
		-2°	+1°	+10°	+6°	-7°	+11°	
<i>(Ba-Na) ∠ (Pt-Gn)</i>	90°	94°	87°	96°	91°	80°	97°	+0.84°
		+4°	-3°	+6°	+1°	-10°	+7°	
Mandible - cranial base relation								
<i>Pg-Nasion perpendicular (mm)</i>	- 6-8	-3	1	-1	4.5	+1.5	-5	+ 6.7
		+4	+8	+6	+11.5	+8.5	+2	
Dentition evaluation								

Superior incisor (mm)	4-6	5	5.5	2	3.2	4.5	5.5	- 0.6
		0	+0.5	-3	-1.8	-0.5	+0.5	
Inferior incisor (mm)	1-3	4	3.3	3.1	6.1	2	5.5	+1.6
		+2	+1.3	+1.1	+4.1	0	+3.5	
Respiratory segment								
SPW (Superior Pharyngeal Width) (mm)	15-20	16	17.5	16	11	13	7.5	-3.5
		-1	+0.5	-1	-6	-4	-9.5	
IPW (Inferior Pharyngeal Width) (mm)	11-14	12	12.5	12	16	21	9	+1.75
		0	+0.5	0	+4	+9	-3	

IV. CONCLUSION

Lateral telerradiography represents a mandatory step in the diagnosis and treatment of dento-maxillary anomalies, as long as this method provides certain details that cannot be obtained via clinical examination or model analysis.

With the aid of cephalometric investigation according to McNamara and statistical computation, we found the indexes that recorded the most important deviations in Class III malocclusion. The most significant values in this research have the following variables: the mandibular and maxillary length, maxillomandibular difference, the relation between the mandible and cranial base and the goniac angle value. McNamara's method provided objective values and data that allowed us to come up with the most correct treatment plan, based also on other known cephalometric analysis methods.

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