https://doi.org/10.35630/2199-885X/2019/9/3.26

DEPENDENCE OF FACIAL MORPHOMETRIC PARAMETERS FROM MASTICATORY MUSCLES TONE IN PEOPLE WITH HORIZONTAL TYPE OF INCREASED DENTAL ABRASION

Andrey Kondratyuk[1], Roman Subbotin[2], Margarita Puzdyreva[2], Sergey Fischev[2]✉, Alexander Lepilin[3], Arkady Sevastyanov[1], Dmitry Domenyuk[4], Mariya Rozhkova[2]

[1] Department of Dentistry Saint-Petersburg State Pediatric Medical University, Saint-Petersburg
[2] Department of Pediatric Dentistry and Orthodontics Saint-Petersburg State Pediatric Medical University, Saint-Petersburg
[3] Department of Surgical Dentistry and Maxillofacial Surgery, Saratov State Medical University, Saratov
[4] Department of General Practice dentistry and Child Dentistry, Stavropol State Medical University, Stavropol, Russia

✉ *spb@gpma.ru*

ABSTRACT — The work offers qualitative indicators of masticatory muscles myotonometry, which were recorded in patients in their second mature age with a compensated and decompensated type of increased dental abrasion. The obtained results are compared with similar parameters of patients with physiological occlusion. A characteristic feature of patients with a compensated type of increased dental abrasion is the absence or a slight decrease in the height of the gnathic part of the skull due to false hypertrophy (an increase in the jaw bone porosity). This category features an increased tone of the masticatory muscles, both at rest and during tension. In patients with a compensated type of increased dental abrasion, the parafunction of the masticatory muscles and tongue are combined with symptoms of temporomandibular joint damage. A decompensated type of increased dental abrasion combines clinical and functional symptoms with a decrease in the lower face height. The study outcomes are of an applied focus in terms of selecting the tactics and principles of reasonable treatment when dealing with patients revealing a horizontal type of increased dental abrasion.

KEYWORDS — increased dental abrasion, face morphometric study, interalveolar height, intergnathic distance, myotonometry

INTRODUCTION

Increased dental abrasion (IDA) is quite common in dental practice. This is less common among young people (6.3%) compared to people of middle age (32.7%), as well as to those belonging to older age groups (11.8–20.6%) [1, 2, 19, 22].

IDA occurrence may be associated with the teeth functional overload, harmful professional factors, impaired development of hard dental tissues, the functional status of the masticatory muscles, etc. [3, 9–13, 17, 30].

A decompensated abrasion reveals a decrease in the interalveolar height, while a compensated abrasion shows a slight decrease in the height of the gnathic part due to the jaws alveolar parts hypertrophy. This hypertrophy may disappear or decrease when the alveolar ridge gets proper strain, since bone tissue false hypertrophy develops through increased bone porosity [18, 20].

The following affects a decrease in the lower face height: the dental abrasion degree, abnormal occlusion; changes occurring through loss of antagonist teeth; the functional status of the masticatory muscles [4–8, 14–16, 21, 23–29]. The purpose of this study can be explained with the lack of systematic data available in the respective research literature focusing on the masticatory muscles tone in patients with IDA.

Aim of study

to identify the masticatory muscles tone status and its effect on the face vertical parameters in patients with horizontal IDA.

MATERIALS AND METHODS

A morphometric study of the face and masticatory muscles myotonometry was carried out involving 66 patients (27 males and 39 females) in their second mature age (35–60) with a horizontal type of increased dental abrasion, where 30 patients (14 males and 16 females) had a decompensated type with another 36 (13 men and 23 women) featuring a compensated type of dental abrasion. The comparison group included 64 people in their second half of adulthood (27 males and 37 females) with physiological occlusion. Cefalometric measurements were done subject to the generally accepted method by Ya.Ya. Roginsky (1968), F.Ya. Khoroshilkina (1991) using a caliper with a scale unit value of 0.01 mm. The generally accepted measuring points were used through the cephalometry (Fig. 1).

The measurements between the cephalometric points allowed evaluating the gnathic parameters. The

functional status of the masticatory muscles was evaluated through myotonometric measurements for which purpose a SZIRMA myotonometer (Hungary, METRIMPEX) was used. We involved the motor points (the most prominent areas of the masticatory and temporal muscles, at the maximum teeth compression), and then, using the device's submersible probe we measured the rest tone (Tr) and the stress tone (Ts) in grams (Fig. 2).

The study outcomes were statistically processed using the SPSS 17.0 software package at a 0.05 significance level. When performing quantitative description, the mean value (M) and the standard mean error (m) were used. The statistical processing was carried out using descriptive statistics, analysis of variance (Student's t-test), correlation analysis (Pearson and Spearman's paired correlation coefficients), and with nonparametric statistics methods (Mann-Whitney and Wilcoxon).

RESULTS AND DISCUSSION

The relationship between individual morphometric head and face parameters in patients with physiological occlusion of permanent teeth was identified. Table 1 shows the results of studying the head and face parameters in patients with permanent teeth physiological occlusion.

In females, the morphometric head and face parameters had lower values than in males. The height of the nasal part and the height of the face in males exceeded that of females, while the height of the gnathic part revealed no significant difference between the two genders. The face height (n–me) in males was 125.64±6.3 mm, while in females it was 111.87±2.26 mm ($p < 0.05$). The gnathic part of the face was 55.84±4.5 mm in males vs. 53.16±1.54 mm in females. The mean value of the interocclusal gap was 3.2±0.85 mm. The sum of the dentoalveolar parts height, maxillary and mandibular, corresponded to the size of the mandible height and, according to these signs, no gender dimorphism was identified.

Myotonometry was performed with the rest tone (Tr) and the stress tone (Ts) of the masticatory muscles. Table 2 offers a view on the respective outcomes.

Compared with the temporal muscles in people of both genders, the rest tone of the masticatory muscles exceeded it (by 4.2±0.3 grams, $p < 0.05$), thus being 52.3±3.5 grams in

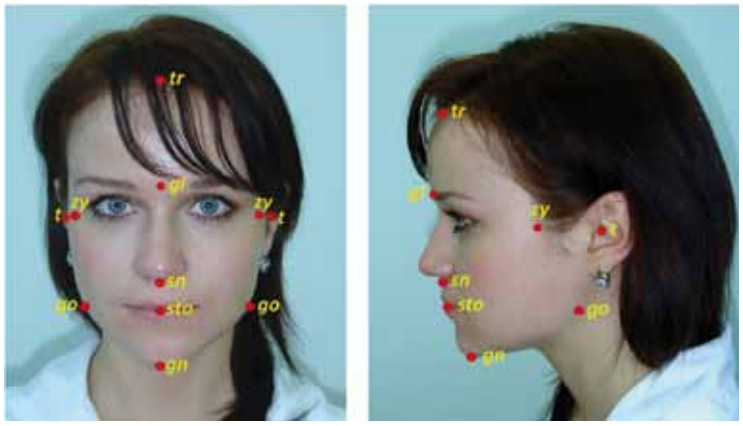

Fig. 1. *Location of cephalometric points in the frontal (a) and sagittal (b) planes.*

Fig. 2. *Mechanical myotonometer Szirmai "Metrimpex" (Hungary).*

males and 43.1 ± 4.2 grams ($p < 0.05$) in females. The stress tone of the masticatory muscles in males was 155.4±18.0 grams. The masticatory muscles stress tone in females was 19.2±2.5 grams ($p < 0.05$) lower than in men. The measurement values for the facial skeleton in patients with decompensated horizontal IDA can be seen from Table 3.

The height of the nasal face part (n–sn) exceeded the height of the lower face part (sn – gn) and the difference in this case was 8.2±1.2 mm ($p < 0.05$). The intergnathic part (sn–spm) decreased by 6.5±0.7 mm ($p < 0.05$). A typical feature for the patients was a decrease in the height of the gnathic part of the face, namely, the intergnathic distance and the mandible height. The interocclusal gap was 7.5±0.95 mm. The study showed that the patients had a normal maxilla position, while the mandible had a slight sagittal shift. The measurement results for the masticatory muscles tone (in grams) in patients with decompensated horizontal IDA are shown in Table 4.

The rest tone and the stress tone in all the patients with decompensated horizontal IDA was 4.5±0.6 grams ($p < 0.05$)

Table 1. *Morphometric head and face parameters in patients with physiological occlusion of permanent teeth, (mm), (M±m), (p≤0,05)*

Morphometric parameters	Face sizes	
	Male face sizes	Female face sizes
n–me (face height)	125,64 ± 6,3	111,87 ± 2,26
gl–me	136,75 ± 3,29	122,34 ± 2,34
n–sn	61,19 ± 2,7	58,57 ± 2,29
sn–spm (intergnathic height)	55,84 ± 4,5	53,16 ± 1,54
gn–me	6,52 ± 1,29	6,02 ± 1,19
gl–n	12,38 ± 2,62	10,38 ± 2,42
zy–zy	143,57 ± 5,1	138,41 ± 3,72
sn–gn	65,46 ± 1,43	63,28 ± 2,16

Table 2. *Masticatory muscles tone in patients with physiological occlusion of permanent teeth, (gramme), (M±m), (p≤0,05)*

Muscle	Patients	Muscle tone	
		Resting tone, (Tr)	Voltage tone, (Ts)
Chewing muscles proper	Women	46,3 ± 1,4	159,0 ± 4,8
	Men	55,4 ± 2,5	175,6 ± 3,7
Temporal muscles	Women	44,3 ± 1,2	145,2 ± 4,1
	Men	52,7 ± 2,3	166,5 ± 3,9

Table 3. *Morphometric head and face parameters in patients with decompensated horizontal IDA, (mm), (M±m), (p≤0,05)*

Morphometric parameters	Face sizes	
	Male face sizes	Female face sizes
n–me (face height)	112,5 ± 3,13	108,96 ± 2,26
gl–me	123,88 ± 3,29	118,34 ± 2,34
n–sn	55,18 ± 3,39	54,22 ± 3,29
sn–spm (intergnathic height)	46,35 ± 3,45	43,41 ± 2,14
gn–me	6,12 ± 1,54	5,24 ± 1,31
gl–n	12,38 ± 2,62	10,38 ± 2,42
zy–zy	136,57 ± 6,39	132,57 ± 6,76
sn - gn	57,30 ± 2,06	54,76 ± 1,59

lower compared with the norm, and the stress tone was 31.1±3.3 grams lower ($p < 0.05$) in males and females. Table 5 offers a view on the head and face morphometric parameters in patients with compensated horizontal IDA.

The face nasal area (n–sn), taken vertically, corresponded to the height of the lower part of the face (sn–gn) and the difference in these values was 1.75±0.2 mm ($p < 0.05$). The intergnathic part (sn–spm) decreased by 2.1±0.12 mm ($p < 0.05$). The interocclusal gap was 1.5±0.3 mm. This group of patients had a slight decrease in the interalveolar height, especially the height of the mandible and the intergnathic distance. An analysis of indicators showed that the patients had the mandible and maxilla positions corresponding to the normal values. The values for the masticatory muscles tone (in grams) in patients with compensated horizontal IDA are listed in Table 6.

The study revealed that the rest tone and the stress tone in almost all the patients with compensated horizontal IDA was elevated. The patients showed an increase in the rest tone as compared with normal values, by 21.2±1.8 grams ($p < 0.05$), and the stress

Table 4. *Myotonometry results in patients with decompensated horizontal IDA, (gramme), (M±m), (p≤0,05)*

Muscle	Patients	Muscle tone	
		Resting tone, (Tr)	Voltage tone, (Ts)
Chewing muscles proper	Women	42,7 ± 1,3	134,6 ± 3,8
	Men	51,3 ± 1,1	155,4 ± 2,7
Temporal muscles	Women	39,7 ± 2,5	118,8 ± 4,7
	Men	42,3 ± 2,4	126,3 ± 4,7

Table 5. *Morphometric head and face parameters in patients with compensated horizontal IDA, (mm), (M±m), (p≤0,05)*

Morphometric parameters	Face sizes	
	Male face sizes	Female face sizes
n–me (face height)	123,34 ± 6,2	110,57 ± 2,16
gl–me	134,65 ± 3,27	121,36 ± 2,14
n–sn	59,69 ± 2,5	55,27 ± 2,26
sn–spm (intergnathic height)	52,81 ± 4,5	52,15 ± 1,64
zy–zy	142,57 ± 6,1	137,51 ± 3,82
sn–gn	62,45 ± 1,23	53,27 ± 2,36

Table 6. *Myotonometry results in patients with compensated horizontal IDA, (gramme), (M±m), (p≤0,05)*

Muscle	Patients	Muscle tone	
		Resting tone, (Tr)	Voltage tone, (Ts)
Chewing muscles proper	Women	66,3 ± 2,5	168,3 ± 3,8
	Men	73,7 ± 1.8	186,3 ± 3,4
Temporal muscles	Women	56,5 ± 2,6	158,8 ± 4,8
	Men	65,7 ± 3,4	176,6 ± 4,5

tone was higher by 12.5±1.15 grams (p <0.05), both in males and females. This can be viewed as a compensatory response that the maxillofacial area had to hypertrophy of the jaws alveolar ridges. The stress tone in males was 21.6±2.1 grams (p <0.05) higher than in females. The interocclusal gap was an average of 1.5±0.3 mm

CONCLUSIONS

1. The specific feature in the patients with decompensated horizontal IDA was a decrease of 6.5± 0.7 mm (p <0.05) in the interalveolar height with changes in the face vertical parameters. The interocclusal gap was within 7.5±0.95 mm. At the same time, the rest tone in these patients was 4.5±0.6 grams (p <0.05) lower if compared with the normal values, while the stress tone — by 31.1±3.3 grams (p <0.05) in patients of both genders.

2. The patients with compensated horizontal IDA had an insignificant decrease in the height of the gnathic part, as compared with the norm, by 2.1±0.12 mm (p <0.05). The interocclusal gap in the patients was within 7.5±0.95 mm. However, an increase in the rest tone was observed, as compared to the normal values, by an average of 21.2±1.8 g (p <0.05), while the stress tone was an average 12.5±1.15 g higher (p <0.05), both in males and females.

3. The data obtained from the examination of the patients with horizontal IDA will facilitate the selection of reasonable tactics for orthopedic treatment. Patients with decompensated horizontal IDA are recommended treatment with a simultaneous increase in the interalveolar distance with the interocclusal gap maintained within 2–3 mm. As for patients with compensated horizontal IDA, treatment should be delivered in stages with a gradual disintegration of the occlusion, and introduction of teeth under the masticatory muscles tone control.

REFERENCES

1. **Berdin V. V., Dmitrienko S. V. , Sevastyanov A.V., Fishchev B. S., Lepilin A.V.** The main linear parameters of dental arches for the permanent teeth nurmatovtitle // Stomatology of children's age and prevention. 2012. Vol. XI. №3 (48). P. 38–42.
2. **Berdin V. V., Sevastyanov A.V., Fishchev S. B., Dmitrienko D. S., Lepilin A.V.** To the question of determining the size of dental arches in the sagittal and transversal directions // Pediatric dentistry and prevention. 2013. Vol. 12. No. 3. p. 43.
3. **BalakhnichevD.N., Subbotin R.S., Fischev S.B. et al.** Normalization of occlusion in patients with increased dental abrasion // European journal of natural history. 2018. № 4. P. 37–45.
4. **Dmitrienko S.V., Fomin I.V., Domenyuk D.A., Kondratyuk A.A., Subbotin R.S.** Enhancement of research method for spatial location of temporo-mandibular elements and maxillary and mandibular medial incisors // Archiv EuroMedica. 2019. T. 9. № 1. P. 38–44. https://doi.org/10.35630/2199-885X/2019/9/1/38
5. **Dmitrienko S.V., Domenyuk D.A., Fischev S.B., Subbotin R.S.** Dynamics of periodontal fixing capacity through orthodontic treatment employing edgewise technique // Archiv EuroMedica. 2019. Vol. 9; 1: 151–152. https://doi.org/10.35630/2199-885X/2019/9/1/151
6. **Dmitrienko S.V., Domenyuk D.A., Puzdyryova M.N.** Manufacturing methods for individual aligners and trainers from thermoplasts fnd clinical indications for their application // Archiv EuroMedica. 2019. Vol. 9; 1: 153–154. https://doi.org/10.35630/2199-885X/2019/9/1/153
7. **Dmitrienko S.V., Lepilin A.V., Domenyuk D.A., Kondratyuk A.A.** Clinical meaning of methods for identifying variability of mental prominence location // Archiv EuroMedica. 2019. Vol. 9; 1: 45–46. https://doi.org/10.35630/2199-885X/2019/9/1/45
8. **Dmitrienko T.D., Domenyuk D.A., Porfyriadis M.P., Arutyunova A.G., Kondratyuk A.A., Subbotin R.S.** Connection between clinical and radiological torque of medial incisor at physiological occlusion // Archiv EuroMedica. 2019. Vol. 9. № 1. P. 29–37. https://doi.org/10.35630/2199-885X/2019/9/1/29
9. **Fishchev S. B., Orlova I. V., Sevastyanov A. V.** Morphometric parameters of the facial skeleton in humans with a reduced height of gnatichesky part of the person // Pediatr. – 2014. Vol. V. № 3. P. 67–70.
10. **Fishchev B. S., Lepilin A.V., Sevastyanov A.V.,Orlov V. I., Balakhnichev D. N.** The results of treatment of patients with defects of dentition in combination with cross bite with the use of computer modeling // Stomatology of children's age and prevention. 2015. Vol. XIV. No. 3 (46). P. 55–58.
11. **Fishchev B. S., Lepilin A.V., Sevastyanov A.V., Balakhnichev D.N., Agashina M.A.** Prediction of the results of orthopedic treatment of patients with vertical-mesial form of increased teeth abrasion // Parodontologia. 2017. Vol. XXII. №1(82). P. 31–37.
12. **Fischev S.B., Puzdyryova M.N., Dmitrienko S.V., Domenyuk D.A., Kondratyuk A.A.** Morphological features of dentofacial area in peoples with dental arch issues combined with occlusion anomalies // Archiv EuroMedica. 2019. Vol. 9; 1: 162–163. https://doi.org/10.35630/2199-885X/2019/9/1/162
13. **Jacobson A.** Retrospective cephalometric investigation of the effects of soldered transpalatal arches on the maxillary first molars during orthodontic treatment involving extraction of maxillary first bicuspids // American Journal Of Orthodontics add Dentofacial Orthopedics. 2006. № 1. P. 81.
14. **Korobkeev A. A., Domenyuk D. A., Shkarin V. V., Dmitrienko S. V., Mazharov V. N.** Variability of odontometric indices in the aspect of sexual dimorphism. Medical News of North Caucasus. 2019;14(1.1):103-107. DOI – https://doi.org/10.14300/mnnc.2019.14062 (In Russ.)
15. **Lepilin A.V., Fomin I.V., Domenyuk D.A., Dmitrienko S.V., Budaychiev G.M-A.** Diagnostic value of cephalometric parameters at graphic reproduction of tooth dental arches in primary teeth occlusion // Archiv EuroMedica, 2018. Vol. 8. № 1. P. 37–38.
16. **Lepilin A.V., Dmitrienko S.V., Domenyuk D.A., Puzdyryova M.N., Subbotin R.S.** Dependence of stress strain of dental hard tissues and periodontal on horizontal deformation degree // Archiv EuroMedica. 2019. Vol. 9; 1: 173–174. https://doi.org/10.35630/2199-885X/2019/9/1/173
17. **Lepilin A.V., Rajgorodskij Yu.M., Grigoryeva D.A., Erokina N.L., Bakhteeva G.R., Domenyuk D.A.** Reasoning for the application of violet laser physiotherapy device following surgeries in the oral cavity. Archiv EuroMedica, 2018; 8(2): P. 111–114.
18. **Mercado J.** Jefferson skeletal classification system (JSCS) and how it helps in extraction and non-extraction orthodontic cases // Int. J. Orthod. Milwaukee. 2007. № 18(4). P. 31–34.
19. **Porfyriadis M.P., Domenyuk D.A., Arutyunova A.G., Dmitrienko S.V.** Scanning electron microscopy and X-ray spectral microanalysis in dental tissue resistance // Archiv EuroMedica. 2019. Vol. 9; 1: 177–185. https://doi.org/10.35630/2199-885X/2019/9/1/177
20. **Proffit W.R., Fields H. W.** Contemporary Orthodontics, 4rd Edition. Mosby. 2007. 751 p.
21. **Pullinger A. G., Seligman D. A.** Multifactorial analysis of differences in temporomandibular joint hard tissue anatomic relationships between disk displacement with and without reduction in women. / The journal of prosthetic dentistry. 2001. Vol. 86. № 4. P. 407–419.
22. **Sevastyanov A.V., Dmitrienko D. S., Fishchev S. B., Egorova A. V., Rtishcheva S. S.** Match the size of the permanent teeth, dental arch parameters

and the craniofacial complex (the literature review) // Parodontologia. 2010. Vol. XV. No. 2 (55). P. 18-20.

23. **Shkarin V., Domenyuk D., Lepilin A., Fomin I., Dmitrienko S.** Odontometric indices fluctuation in people with physiological occlusion. Archiv EuroMedica, 2018; Vol. 8; 1: 12–18.

24. **Shkarin V.V., Ivanov S.Yu., Dmitrienko S.V., Domenyuk D.A., Lepilin A.V., Domenyuk S.D.** Morphological specifics of craniofacial complex in people with varioustypes of facial skeleton growth in case of transversal occlusion anomalie // Archiv EuroMedica. 2019. Vol. 9; 2: 5–16. https://doi.org/10.35630/2199-885X/2019/9/2/5

25. **Shkarin V.V., Grinin V.M., Khalfin R.A., Dmitrienko S.V., Domenyuk D.A.** Specific features of transversal and vertical parameters in lower molars crowns at various dental types of arches // Archiv EuroMedica. 2019. Vol. 9; 2: 174–181. https://doi.org/10.35630/2199-885X/2019/9/2/174

26. **Shkarin V.V., Grinin V.M., Khalfin R.A., Dmitrienko S.V., Domenyuk D.A.** Specific features of grinder teeth rotation at physiological occlusion of various gnathic dental arches // Archiv EuroMedica. 2019. Vol. 9; 2: 168–173. https://doi.org/10.35630/2199-885X/2019/9/2/168

27. **Shkarin V.V., Grinin V.M., Khalfin R.A., Dmitrienko S.V., Domenyuk D.A.** Specific features of joint space in patients with physiological occlusion on computed tomogram head image // Archiv EuroMedica. 2019. Vol. 9; 2: 182–183. https://doi.org/10.35630/2199-885X/2019/9/2/182

28. **Shkarin V.V., Grinin V.M., Khalfin R.A., Dmitrienko S.V., Domenyuk D.A.** Specific features of central point location between incisors in people with physiological occlusions // Archiv EuroMedica. 2019. Vol. 9; 2: 165–167. https://doi.org/10.35630/2199-885X/2019/9/2/165

29. **Shkarin V.V., Grinin V.M., Khalfin R.A., Dmitrienko T.D., Domenyuk D.A., Fomin I.V.** Craniofacial line of teleradiography and its meaning at cephalometry // Archiv EuroMedica. 2019. Vol. 9; 2: 84–85. https://doi.org/10.35630/2199-885X/2019/9/2/84

30. **Subbotin R.S., Puzdyreva M.N., Fishchev S.B. et al.** Morphometric parameters of the face in patients with decompensated vertical-anterior form of incrised adrasion of teeth // European journal of natural history. 2018. № 5. P. 27–30.