Research Journal of Medical Sciences 9 (4): 193-196, 2015
ISSN: 1815-9346

Distant Response of the Visual Analyzer Function (Visual Fields) to the Reduction of Occlusal Vertical Dimension in Dental Patients

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Abstract: This study deals with information on the distant response of the visual analyzer function occurring upon restoration of the occlusal vertical dimension in patients with major dental diseases of different origin. The study describes a Computer Automated Perimetry (CAP) "white-on-white" for the analysis of the visual fields which used the program 30-2 and evaluated a fovea function (macular region). CAP is used in ophthalmic practice for registering the changes of the light sensitivity of the retina which value is one of the most important characteristics of the visual analyzer condition.

Key words: Stomatology, function of the visual analyzer, field of vision, electrogenesis retina, change of interalveolar distance

INTRODUCTION

One of the current problems the orthopedic dentistry faces is unclear mechanisms of formation of pathological processes in the maxillofacial region, developing under the influence of various etiological factors and leading to both secondary changes in the jaw relationships and indirect impact on the various systems of the human body. The number of studies aimed at understanding the neurophysiological mechanisms increases in nowadays. The results of these studies gradually fill the gaps in knowledge related to the activities of the main physiological systems that control the functions of the masticatory apparatus (Bulycheva, 2010; Bumann and Lotzmann, 2002).

In case of impairment of the occlusal relationships of various etiology an imbalance of contractile activity of masticatory muscles occurs that affects, directly or indirectly, the muscles of the neck and other parts of the spine. Functional impairments associated with dysfunction of the musculo-articular complex of the dentoalveolar apparatus, can lead to a change in the innervation and hemodynamics of maxillofacial region (Potapov, 2010; Chessa, 2002). There is information that the correction of occlusal relation in various pathological conditions of dental system results not only in the restoration of chewing function, reduced intensity of clinical manifestation of dysfunctional states of the Temporomandibular Joint (TMJ) but also allows eliminating the pain in joints and muscles and changing the posture of the patient (Bugrovetskaia, 2008; Abrahamsson, 2013). Upon normalization of the occlusal relation there is a change in the neurological status which manifests itself as the decreased intensity of headaches and dizziness and improvement of sleep. The phenomena observed are the results of either eliminated or reduced influence of the regional elements of dentoalveolar apparatus on the hemodynamics of vascular regions of dental and brain components (Bugrovetskaia, 2008; Feu *et al*., 2013).

Analysis of dental literature allows making a conclusion that a complete rehabilitation of patients with secondary changes in the jaw relationships is not only dental but also an interdisciplinary issue (Barnard *et al*., 2005).

Objective of the study is to identify the distant response of visual analyzer by recording visual fields with the use of the computer-automated perimetry in dental patients with signs of deep occlusion.

MATERIALS AND METHODS

We examined 395 people aged from 32-68 years with major dental diseases of a dento-facial system. The 293 (74.2%) patients of the total examined persons had signs of deep occlusion and formed the main group and 102 (25.8%) patients with no signs of deep occlusion formed the control group. The main group included 228 (77.8%) women and 65 (22.8%) men. The main dental diseases having resulted in a change in the jaw relatioships were: increased abrasion of hardtissues of teeth in 138 (47.1%) patients, a generalized periodontitis in 125 (42.6%) patients and partial loss of teeth in 260 (88.7%) patients. The 174 (59.4%) patients had a combination of major dental diseases

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revealed. We performed the determination of diseases by using international classification of diseases, 10th edition (ICD-10). Exclusion criteria:

- Moderate and severe dysfunction of the temporomandibular joint as per Helcimo classification (1974)
- Somatic diseases in the decompensation phase
- A concomitant ophthalmic pathology (glaucoma, cataracts, diabetic and hypertensive retinopathy, acute vascular disorders, macular pathology, etc.)

The study was conducted in accordance with the Declaration of Helsinki. The instrumental methods used were as follows:

- Functional and physiological method of building constructive jaw relationships
- Extracranial and transcranial Doppler sonography (ultrasound diagnostics) of vascular regions of the head and neck
- Computer automated perimetry "white-on-white" for visual field investigation

Functional and physiological method allows taking into account the individual functionalities of a patient regardless of the severity level and degree of disease of dental components and identifying the response features of masticatory force. We used the obtained information to develop an algorithm of therapeutic measures.

The 293 (74.2%) patients with jaw relationships disorders of different origin had a decreased occlusal vertical dimension which varied from 0.5-5.5 mm. The 102 (25.8%) patients of control group had no reduction in the occlusal vertical dimension.

The study of cerebral hemodynamics with the use of ultrasound diagnostics revealed a dependence of the linear velocity of blood flow in *A. ofthalmica* on the separation rate of the jaws in 231 (78.8%) patients. To exclude ophthalmic pathology we carried out an assessment of the visual analyzer function by traditional methods of ophthalmological examination which included visometry, biomicroscopy and indirect binocular ophthalmoscopy (Balashevich, 2004; Shamshinova, 2004).

We have examined 198 patients which indicators met the criteria for inclusion and exclusion after undergoing the traditional ophthalmic practices. We carried out an integrated assessment of the visual analyzer function by using techniques of computer aided perimetry and electrophysiological study of the retina (pattern ERG and EFI as per ISCEV standards).

We have applied the method of Computer Automated Perimetry (CAP) "white-on-white" for the analysis of the visual fields which used the program 30-2 and evaluated a fovea function (macular region). CAP allowed us to determine the center of a visual field, i.e, to assess the light sensitivity of the retina which value is one of the most important characteristics of the visual analyzer condition. We have performed a computer-automated perimetry by using Humphrey Field Analyzer, 745i (Carl Zeiss Jena, Germany).

We have assessed the status of the central vision field upon application of computer perimetry by using the following indices:

- MD: mean deviation-describes an average reduction of light sensitivity (dB). Its increase indicated the positive effect of treatment
- PSD: pattern standard deviation (sigma, dB) (central visual field) characterizes the severity of local defects. Its decrease indicated the positive effect of treatment
- Fovea-light sensitivity in the macular region. Its increase indicated the positive effect of treatment

In addition to the above indices, the test protocol contains large amount of information that characterizes the state of the central field of vision. The most informative are "total deviation" and "pattern deviation" schemes. These schemes show the probability of the existence of any deviation from the norm; the lower the probability of deviation is the more intensive a corresponding symbol is hatched. A "pattern deviation" index is of great importance, since it excludes the effect of overall diffuse reduction of light sensitivity which occurs, for example, at the initial cataract or other opacities of the optical eye media. As a result of the study, we have revealed even small local defects.

The Humphrey perimeter also periodically checks the regularity of fixation, giving the stimulus to the blind spot and recording the fixation losses when a patient responds to the stimulus which he/she was not supposed to see; the share of fixation losses must not exceed 20%. In addition, we have constantly registered and recorded the deviations of gaze direction. We have carried out an assessment of visual fields as follows:

- In habitual occlusion with signs of reduced interalveolar distance
- with silicone occlusion recorders that fix the constructive relationship of jaws
- After reconstructing the jaw relationship by various designs of dentures in optimal occlusion position

Computer automated perimetry was conducted in a separate room in silence. The patient was sitting in front of the device. During the test, the patient's head was fixed on a special Humphrey chin table (HFAII). Each eye is examined alternately (the other eye is closed with an occluder) with optical correction for a distance of 33 cm. The patient holds in his/her hand a remote with button by clicking which he/she informs about light signal he/she sees. The study began with fixing his/her eye on a point in the center of the hemisphere. A luminous lamp located in the center of the hemisphere serves as a fixing object ensuring the patient's eye immobility during the test. After fixing the glaze of the studied eye on the bright point, a computer-assisted alignment is performed. Further, light stimuli of different intensity appear in different segments of the field and at this time when the patient sees stimulus within a hemisphere, he must respond by pressing the device button.

RESULTS AND DISCUSSION

Analysis of the data presented in Table 1 shows that the orthopedic treatment conducted in patients of the main group has resulted in a statistically significant improvement of both MD and PSD of the computer assisted perimetry ($p<0.05$). MD values show increase from 1.57±0.25-0.62±0.15 dB, PSD values show decrease from 2.96±0.25-2.51±0.1 dB which indicates an improvement of the central field of vision. Fovea values, expressing the light sensitivity in the macular region, increase insignificantly.

We should note that sensitivity values in most patients became more symmetrical during the CAP. Alignment of performances of the retina sensitivity occurred in response to a decrease in the variability of blood flow rate which was confirmed by Doppler ultrasound obtained after optimizing the relationships of the jaws.

The results of computer automated perimetry of both right and left eyes in habitual occlusion with signs of reduced occlusal vertical dimension before and after treatment in the patient P are presented in Fig. 1 and 2.

As we can see from Table 2, patient P underwent the registration of visual fields with the use of computer automated perimetry "white-on-white" after dental treatment in optimal occlusion which further led to

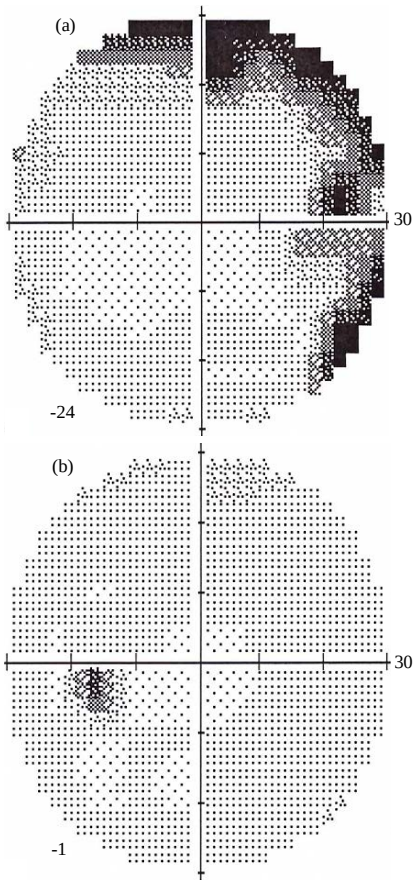

Fig. 1: The results of computer automated perimetry in habitual occlusion with signs of reduced occlusal vertical dimension in the patient P: a) right eye; MD: 4.05 dB, PSD: 8.89 dB, Fovea: 36 dB and b) left eye; MD: 1.35 dB, PSD: 2.53 dB, Fovea: 36 dB

Table 1: Assessment of functional parameters of light sensitivity of the central field of vision in dental patients with signs of reduced occlusal vertical dimension of different origin before and after treatment (n = 198)

Computer perimetry indices	In habitual occlusion before treatment	In optimal occlusion after treatment	p-values
MD (mean deviation) of light sensitivity (dB)	1.57±0.25	0.62±0.15	<0.01
PSD (standard deviation) of a pattern of the central vision field (dB)	2.96±0.25	2.51±0.11	<0.05
Fovea (light sensitivity in the macular region) (dB)	33.27±2.73	34.87±3.41	>0.05

Table 2: Assessment of functional parameters of light sensitivity of the central field of vision before treatment and after restoring the occlusion in patient P

	In habitual occlusion before treatment		In optimal occlusion after treatment	
Computer perimetry indices	Right eye	Left eye	Right eye	Left eye
MD (mean deviation) of light sensitivity (dB)	-4.05	-1.35	-0.78	-0.53
PSD (standard deviation) of a pattern of the central vision field (dB)	8.89	2.53	1.49	1.86
Fovea (light sensitivity in the macular region) (dB)	36.0	36.0	37.0	37.0

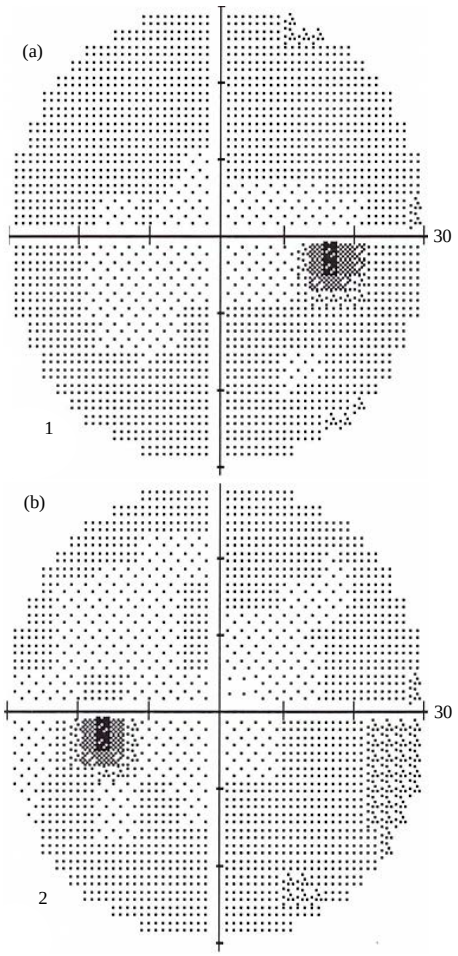

Fig. 2: Results of computer automated perimetry in optimal occlusion after treatment in the patient P: a) right eye; MD: 0.78 dB, PSD: 1.49 dB, Fovea: 37 dB and b) left eye; MD: 0.53 dB, PSD: 1.86 dB, Fovea: 37

positive dynamics and more symmetric MD and PSD values in both eyes. Fovea-light sensitivity in the macular region also had a positive dynamics (increase in values).

This fact indicates that the results of the computer automated perimetry "white-on-white" allows suggesting the distant response of light sensitivity of the visual analyzer to the restoration of occlusal vertical dimension in dental patients with signs of secondary reduction in the vertical dimension of occlusion of various origin.

CONCLUSION

- Restoration of the occlusal relationship with changing the occlusal vertical dimension resulted in significant improvement ($p<0.05$) of central visual field: MD value increased and PSD value decreased. Fovea value changed insignificantly
- Both MD and PSD values became more balanced after restoring the occlusal vertical dimension which may indicate the influence of changes of dental elements on the function of the visual analyzer
- A clinical situation resulting in the reduced jaw relationships must be considered as a part of complex of interrelated pathological processes rather than an individual problem
- A comprehensive approach to the treatment of dental patients with signs of impaired jaw relationship of various origin will ensure a full range of diagnostic measures and adequate dental treatment based on somatic symptoms in this group of patients

REFERENCES

Abrahamsson, C., 2013. Masticatory function and temporomandibular disorders in patients with dentofacial deformities: Studies before and after orthodontic and orthognathic treatment. Swedish Dent. J.

Balashevich, L.I., 2004. Methods of Studying the Vision Fields: Study Guide. Publishing House MAPO, St. Petersburg, Russia, Pages: 54.

Barnard, J.C., A.J. Williams, B. Rabier, O. Chassande and J. Samarut *et al.*, 2005. Thyroid hormones regulate fibroblast growth factor receptor signaling during chondrogenesis. Endocrinol., 146: 5568-5580.

Bugrovetskaia, E.A., 2008. Postural balance and dental occlusion. The role of occlusion disorders in postural imbalance at neuro-dental diseases. Manual Therapy, 2: 40-48.

Bumann, A. and U. Lotzmann, 2002. TMJ Disorders and Orofacial Pain: The Role of Dentisitry in a Multidisciplinary Diagnostic Approach. Thieme, New York, USA., Pages: 360.

Feu, D., F. Catharino, C.C.A. Quintao and M.A.D.O. Almeida, 2013. A systematic review of etiological and risk factors associated with bruxism. J. Orthodontics, 40: 163-171.

Shamshinova, A.M., 2004. Functional Studies in Ophthalmology. Medicine Publishers, Moscow, Russia, Pages: 465.