Computerized Biophotogrammetry Evaluation of Asymmetry Facial in Patients with Temporomandibular Disorders

Avaliação biofotogramétrica da assimetria facial em pacientes com disfunção temporomandibular

RESUMO
Introdução: os protocolos de avaliação das assimetrias faciais em pacientes com disfunção temporomandibular são, em grande parte, realizados por meio da avaliação cefalométrica, que possibilita a visualização, mensuração e análise apenas do tecido duro. A análise facial pela biofotogrametria computadorizada tem sido utilizada como meio auxiliar diagnóstico, não expondo o indivíduo a radiação nociva, promovendo avaliação das estruturas craniofaciais, musculares e a disposição do tecido adiposo.

Objetivo: avaliar a assimetria facial em pacientes com disfunção temporomandibular por meio da biofotogrametria computadorizada.

Material e métodos: a amostra consistiu de 36 pacientes com disfunção temporomandibular (31 mulheres e 05 homens), e 11 indivíduos controles (06 mulheres e 05 homens). Para a seleção e classificação da amostra foi utilizado o Índice Clínico de Fonseca (1994), seguido do exame físico, odontológico e fisioterapêutico.

Resultados: foram encontradas diferenças significativas \((p=0,041)\) quando comparados o ângulo referente à boca, entre os lados direito e esquerdo, nos pacientes com disfunção temporomandibular.

Conclusão: alterações na simetria facial podem estar presentes em pacientes com disfunção temporomandibular, e que a mesma se encontra localizada no terço inferior da face, principalmente na região da maxila, mandíbula e mento.

Palavras-chave: Assimetria Facial; Transtornos da Articulação Temporomandibular; Fotografia; Dor.

ABSTRACT
Introduction: the protocols of evaluation of the asymmetry facial in patients with temporomandibular disorders are, in general, realized by using cephalometric analysis, which provide the visualization, measurement and analysis of the hard tissue only. The facial analysis by computerized biophotogrammetry has been used as an auxiliary manner of diagnostic, not exposing the patient to harmful radiation, promoting the evaluation of craniofacial and muscular structures and fat layer disposition.

Aim: evaluate the facial asymmetry in patients with temporomandibular disorders by computerized biophotogrammetry.

Material and methods: the sample was 36 patients (31 women and 05 men) and 11 controls (06 women and 05 men) with temporomandibular disorders. For selection and classification of the sample, the Clinical Index of Fonseca (1994) was used, according to physical, dentistry and physiotherapeutic examination.

Results: significant differences \((p=0,041)\) were found between the mouth angle and the right and left sides in patients with temporomandibular disorders.

Conclusion: alteration in facial symmetry can be observed in patients with temporomandibular disorders and it is located in lower portion of face, mainly in maxillary, mandibular and menton regions.

Keywords: Facial Asymmetry; Temporomandibular Joint Disorders; Photography; Pain.

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INTRODUCTION

The Temporomandibular Disorders (TMD) are considered as one suborder of musculoskeletal disorders, involving a number of clinical problems in stomatognathic system. It is characterized by pain in masticatory and craniocervical muscles, in Temporomandibular Joints (TMJ) and ear, migraine, limitation and asymmetries in mandibular movements, joint sounds, muscular hyperactivity and occlusal trauma. The etiology of TMD is multifactorial, not being possible to determine one only factor etiologic that initiates it. The symptoms can happen of the teeth tightness caused by parafunctional activity from stress physical or emotional, occlusal interferences and alterations of the postural standard. The functional overload proceeding of hyperactivity muscular associated a bad occlusion, doesn’t permit that mandibular condyles enter in a stable position inside mandibular fossa, promoting adverse effects in TMJ.

The high incidence of facial asymmetry in patients with TMD seems to indicate that an occlusal problem brings disequilibrium of the mandibular function and a disturbance in the mandibular posture, therefore, taking an antisymmetrical growth of the jaw and TMD. These aspects demonstrate the importance of symmetry evaluation of hard and soft tissues in patients with masticatory disorders and a necessity of early care and prevention of dysfunction symptoms.

The jaw exerts a dominant contribution for relation teeth and facial asymmetry because it works as skeletal support of soft tissues of the lower face. The facial asymmetry with divergence of the median line and menton for the same side occurs when the growth of the jaw is bigger when compared with the opposing side. The causes can vary and asymmetry can be congenital or acquired. The anterior displacement of articular disc with non-reduction can cause asymetry of the mandibular length with the line deviating for the same side.

The analysis of the facial expression permits the visualization of the soft tissue of the individual. A fundamental factor to be considered in the harmony of the profile is the soft tissue covering of the face therefore could exert effect in facial esthetic and dentition. The muscles, passive and active, would produce forces that may affect the teeth position, causing bad occlusion and facial disharmony.

Angle (1907) emphasized the importance of soft tissue, considering the mouth like the most powerful factor in the determination of the beauty and face characteristics, as well its form and elegance depended basically on the occlusal relation of the teeth. The soft tissues profile close relationship with skeletal and dental structures.

The cephalometric analysis can compromise the quantification of asymmetries, since this technique is efficient only in the measurement and study hard tissues of face. The soft tissue that recovers teeth and bones doesn’t follow the hard tissues necessarily, varying so greatly that
the standard dental and skeletical can be inadequate in disharmony evaluation\textsuperscript{22-23}.

In this way, a study of soft structures of face show extreme importance in asymmetry analyses. The soft profile evaluation is of fundamental importance in diagnosis and planning orthodontic or surgical treatments\textsuperscript{7}. Thus, the aim of this work was evaluated the presence of facial asymmetry by computerized biophotogrammetry soft profile in TMD patients and control group, bilaterally.

**MATERIAL AND METHODS**

**Sample Selection**

In this study, the experimental group consisted of 36 patients with TMD, being 31 (86.1\%) women and 05 (13.9\%) men, with average of age of 27 years old (± 8.1), proceeding from the Program of Shelter, Treatment and Control of Patients with Temporomandibular Disorders and Orofacial Pain (PRODAE), of the Dentistry School of Federal University of Uberlândia (UFU). The control group consisted of 11 healthy individuals, being 06 (54.5\%) women and 05 (45.5\%) men, with average of age of 25.2 years old (± 5.1 years old).

The patients were diagnosed with temporomandibular disorders by means of the physiotherapy, dentistry evaluation and physical examination, guided for the norms proposals by American Academy of Orofacial Pain (AAOP), and anamnesis guided by the Clinical Index of Fonseca (1994)\textsuperscript{5}. It was composition for 10 questions about the signals and symptoms of the TMD. The project was previously approved by ethical research committee of University Center of Triângulo (number 594459/06).

Both the groups did not tell history of successfully orthodontic treatment and maxillofacial trauma. They presented clinically normal occlusion, with presence of upper and lower permanent teeth in both dental arcs until the second molar teeth, being able to have absence of only one tooth for quadrant, however with posterior bilateral occlusion. All the volunteers had been informed of the intention of the study, and requested the fulfilling of the term of free and clarified assent.

**Asymmetry Facial Analysis**

For the asymmetry facial analysis by means of the computerized biophotogrammetry, had been used frontals photographs of the face of the individuals gotten for an only examiner. The frontals photographs of the face had been made with a photographic machine Sony® Cyber-shot 6 mega pixels (DSC- W50), mounted on a leveled tripod, to a height of 80 cm of the ground and with a distance of 2.55 meters of the analyzed individual, using only the surrounding light and excusing to the flash and zoom of the machine.

Before the photographic taking, face anatomical points and the extremities of the acromial prominences had been demarcated with adhesives.
The used anatomical points had been: glabella, nasal apex, soft tissue subnasale, upper lip, lower lip, menton, supraorbital foramen, infraorbital foramen, infraorbital margin and tragus. The others two anatomical points analyzed, the orbicular muscle corresponding to exocanthion of the eyes and commissural labiorum, had been directly computerized. After the landmark of the points was realized the photographic taking being the individuals located in place previously delimited, remaining in orthostatic position, with the parallel feet, the head located in the Frankfurt horizontal plane being parallel to the ground, habitual occlusion and relaxed labial position.

The digital photographic registers had been transferred to a computer, being analyzed by computerized biophotogrammetry method associated to AutoCAD® 2007, that transforms points of images into cartesian coordinate axles and quantifies them angularly.

To eliminate any possibility of error between asymmetries of a side and another one of the face, was opted to comparing the degrees gotten in both face sides (right and left), by means of the angles formed from the median line, more necessarily of the anatomical point of glabella. The face angles used to verify the asymmetry facial had been: eyes angle (GER/GEL) that correspond to the orbicular region; mouth angle (GMR/GML) that correspond to the maxillary, dentoalveolar and mandibular region; acromial prominences angle (GAR/GAL); asymmetry angle (AA) that corresponds to the positioning of the menton in relation to the reference line; and finally the side of the mandibular displacement (MDS) (Fig. 1).

Figure 1. Frontal view of facial angles used to calculate the facial asymmetry. Legend: GER: glabella/eye angle – right side; GEL: glabella/eye angle – left side; GMR: glabella/mouth angle – right side; GML: glabella/mouth angle – left side; GAR: glabella/acromial – right side; GAL: glabella/acromial – left side; AA: asymmetry angle; MDS: mandibular displacement side.
The values of asymmetry facial angles analyzed had been compared between the right and left side for each group, except the asymmetry angle that were compared between the patient and control group, using test $t$ of Student as statistical analysis.

RESULTS

In the facial analysis carried through by means of frontal photographs, in this work, it was observed significant statistically difference ($p = 0.041$) (Tab. 1), between the measurements of GMR and GML angles variables, in the patient group, being that the more raised values had been the values gotten with GMR measurements. In the comparison of the asymmetry angle (AA) values gotten between the two analyzed groups, no statically significant differences was found ($p=0.814$) (Tab. 2).

Table 1. Comparison between the right and left sides of facial angles measurements in patient and control groups.

<table>
<thead>
<tr>
<th>Analyzed Variable</th>
<th>Probabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient Group</td>
<td></td>
</tr>
<tr>
<td>GER x GEL</td>
<td>0.295</td>
</tr>
<tr>
<td>GMR x GML</td>
<td>0.041*</td>
</tr>
<tr>
<td>GAR x GAL</td>
<td>0.137</td>
</tr>
<tr>
<td>Control Group</td>
<td></td>
</tr>
<tr>
<td>GER x GEL</td>
<td>0.387</td>
</tr>
<tr>
<td>GMR x GML</td>
<td>0.633</td>
</tr>
<tr>
<td>GAR x GAL</td>
<td>0.406</td>
</tr>
</tbody>
</table>

$p < 0.05$

* Significant statistically difference.

Table 2. Comparison of the facial asymmetry angle measurements (AA) between patient and control groups.

<table>
<thead>
<tr>
<th>Analyzed Variable</th>
<th>Probabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA</td>
<td>0.814</td>
</tr>
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</table>

$p < 0.05$
The percentages distribution gotten in the facial analysis in relation to mandibular displacement side (MDS) was evaluated with the aim to verify for which side (right, centered or left) would occur the mandibular displacement in the patient and control groups. Thus, it was observed that the menton met deviated for the left side in 61.11% of the individuals pertaining to the patient group and in 45.45% for control group (Fig. 2).

![Figure 2. Percentages distribution of mandibular displacement side (MDS) in the patient and control groups.](image)

**DISCUSSION**

Patients with TMD display several of signal and symptoms, which contribute to generate modifications in hard and soft oral tissues. In the present research, to applying the Clinical Index of Fonseca (1994)\(^5\), was observed a bigger prevalence relative to the presence of parafunctional habits, presences of articulate noises and sensation of teeth are not articulated well. Diverse publications also stand out the prevalence of these complains\(^{11,15,18}\).

The parafunctional habits constitute one of the main factors of the etiology of the TMD\(^{7,19}\) and may produce changes in lubrication mechanism of articulate structures, decurrent of the overload of articulate surfaces, mainly for changes in the TMJ biomechanics\(^{16}\). The biomechanics insane is expressed for the craniocervicofacial structures asymmetry, where any alteration in articlar position will affect the movement of one TMJ, implying in a compensatory position of another one, thus breaching the symmetry\(^2\).

The facial asymmetry may be attributed to facial bone asymmetry or even by asymmetrical activity of masticatory and mimical muscles\(^{14}\). The soft structures in the face may present asymmetry between the both antimeres, being common in dysfunctional patients. The results of this study showed significant differences between the right and left side for
mouth angle, in experimental group, demonstrating that the TMD may influence the behavior of oral tissues.

The analyses done by mouth angle correspond to the maxillary, dentoalveolar and mandibular region, representing the lower face, region of interest in dentistry care. In this way, the facial asymmetry, in accord of the data analyses, is a common characteristic found in the patients with TMD. Some studies also observed the facial asymmetry due to mandibular asymmetry is a relatively common finding in dysfunctional patients, since the patient group presented a bigger degree of lateral mandibular displacement for the left side and the frontal oclusal plan was inclined upper following the displacement side, being significant when comparing with control group\textsuperscript{6,9}.

The mandibular displacement side (MDS) in this research wasn’t statistically significant, but presented bigger for the left side in the patient group, what it can contribute positively for the facial asymmetry. Some authors observed that the dental asymmetry caused by lateral deviation of lower midline and difference of molar relation significantly had been correlated with the degree of lateral displacement of the jaw for the left side\textsuperscript{6,9}.

The corporal and facial posture were evaluated in 51 patients with TMD and 28 controls, by means of lateral and frontals photographs. The authors observed significant difference in shoulder line angle, being larger in patient group, but the mouth angle wasn’t significant in frontal photographs\textsuperscript{21}. In this study when compared the experimental group with control no statistical differences were observed. Thus, research conducted in order to clarify this aspect, with a more homogeneous methodology, are necessary.

The facial asymmetry was analyzed in 23 patients with cervico-brachial pain and migraine, by means of frontal photographs and cephalometric, and comparing with 22 healthful individuals. It was observed that facial skeleton asymmetry didn’t present significant difference between the groups, and the index values of facial expression asymmetry in photographic analysis, had tended to be bigger for the patient group when compared with controls in all variable analyzed, being statistically significant for the lateral eyes angle, mandibular length and lower face linear contour length\textsuperscript{14}.

In this work, also were noted a biggest prevalence of facial expression asymmetry in patient group, however no statistically difference were found for the lateral eyes angle. This fact can occur because of type of sample formed for patients without TMD diagnosis and for the referential point used to calculation eyes angle. The reference was the pupils\textsuperscript{14}, not fixed structures that can already be presented asymmetrical due to the positioning of the ocular globe. Thus, the referential point for analyze the eye angle wasn’t the same, justifying a necessity of standard of asymmetry evaluation.
CONCLUSIONS

- the computerized biophotogrammetry method may be used in evaluation and diagnosis of facial asymmetry, consisting in a cheaper and easier application method than cephalometry;
- the facial asymmetry may be found in patients with temporomandibular disorders and may be present between the both antimeres of the face in dysfunctional individuals and occurs mainly in lower portion of face;
- the facial asymmetry found in patients with TMD is concentrated in the mouth, possibly for occlusal problems or alterations in articulate biomechanics of TMJ and chewing muscles.

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