ABSTRACT

Introduction: The present study evaluated the condylar position, pre and post deprogrammer splint, in 18 subjects who showed pain in their temporomandibular joint (TMJ). Methods: A sample of 72 transcranial radiographs of the TMJ was used, being 4 radiographs for each subject (an initial and another post-splint, on the right and left sides). It was outlined in the marking-out, the external acoustic meatus, the outline of the mandibular fossae and the condyle. Aiming to evaluate the condylar position, it was obtained an initial marking-out, and another one, post-splint, measuring the superior, the anterior, and the posterior joint spaces, with the purpose of determining the condylar concentricity and displacement level. Data were analyzed using the analysis of variance method (ANOVA), with a confidence interval of 95%. Results and Conclusion: According to the results, it was not observed any statistically significant difference between the condylar positions pre and post deprogrammer splint.

DESCRIPTORS: Temporomandibular joint disorders – Temporomandibular joint/radiography - Orthodontics.

RESUMO

Introdução: O presente estudo avaliou a posição condilar, pré e pós-placa desprogramadora, em 18 indivíduos que apresentavam dor na articulação temporomandibular (ATM). Métodos: Utilizou-se uma amostra de 72 radiografias transcranianas da ATM, sendo 4 radiografias por indivíduo (uma inicial e outra pós-placa, dos lados direito e esquerdo). No traçado, foram delineados o meato acústico externo, o contorno da fossa mandibular e o cóndilo. Com a finalidade de avaliar a posição condilar, obteve-se um traçado inicial e outro pós-placa, mensurando os espaços articulares superior, anterior e posterior, para se determinar o grau de concentricidade e de deslocamento condilar. Os dados foram analisados pelo método de análise de variância (ANOVA), com intervalo de confiança de 95%. Resultados e Conclusão: De acordo com os resultados, não se observou diferença estatisticamente significante entre as posições condilares pré e pós-placa desprogramadora.

INTRODUCTION

Initially, the diagnosis of alterations in the temporomandibular joints (TMJ) is based on the patient’s clinical evaluation. When required, other procedures, such as radiography, magnetic resonance imaging (MRI) and tomography of the TMJ can be requested. Transcranial radiography is the most frequently asked exam when intrajoint disorder is suspected, or to verify condylar translation capacity, because is it low cost and requires no sophisticated apparatuses (Gonçalves, 2000; Moraes et al., 2001/2002).

Pullinger and Hollender (1985) conducted a comparative study between transcranial radiography and the linear tomography. A statistically significant correlation was shown (p < 0.05) between pairs of transcranial radiographs and linear tomographs of condylar position for the same TMJ. When assessing the posterior concentricity and anterior position, it was found a qualitative agreement in 80% of the pairs, and complete agreement for the degree of condylar displacement in 60% of the cases. It was concluded that transcranial radiographs were clinically useful for monitoring small changes in the condylar position in comparison with tomography. A comparative analysis between two transcranial radiography techniques was made by Almeida, Bóscolo and Pereira (1997), with the aid of an ACCURAD-200 cephalostat, in the standard and corrected positions. These authors developed a template that helps the professional to measure the anterior and posterior joint spaces, providing information about the condylar position. Radiographs were taken of 59 patients, ranging between 18 and 35 years of age, who voluntarily participated in the study. There was no statistically significant difference between the radiographic techniques used, or between the studied sides, but there was a predominance of a more posterior position of the condyle in both techniques.

In patients with signs and symptoms of Temporomandibular Dysfunction (TMD), the reliable recording of the centric relationship (CR) demands a previous neuromuscular deprogramming period of the mandible. Among the interocclusal devices adopted for this purpose, the deprogrammer splint has been considered the most effective method (Roth, 1981; Roth and Rolfs, 1981; Weinberg, 1991). Oke son (2000) affirmed that the deprogrammer splint tends to normalize the painful pulses generated by the occlusal condition. Santos, Cerqueira and Fantini (2004) evaluated the electromyographic activity (EMG) of the masseter and anterior temporal muscles at mandibular rest in a group of 16 asymptomatic individuals, with Angle Class II malocclusion and mean age of 17 years and 4 months. There was statistically significant diminishment of the EMG activities of the mas seter and anterior temporal muscles after the neuromuscular deprogramming period with the use of the deprogrammer splint.

Janson (1986) evaluated 20 orthodontic patients treated at the Department of FOB-USP, completed in a period of one year. The results demonstrated that, in 85% of the cases, the maximal habitual intercuspation (MHI) did not coincide with the CR, and 10% of these cases had TMD.

Crawford (1999) conducted a study with the purpose of determining the existence of a relationship between the condylar position, as determined by the occlusion, and signs and symptoms of TMD due to the condylar displacement, using the condylar position indicator (CPI). The sample consisted of 30 individuals (43% being men and 57%, women) and a control group of 30 individuals (47% being men and 53%, women) without previous treatment, matched by the distribution of genders. It was concluded that there is a relationship between the condylar position, determined by the occlusion with the measurement in the three planes of space using the CPI, and signs and symptoms of TMD.

Fantini et al. (2005) evaluated condylar displacements between MHI and CR, recorded after the use of the deprogrammer splint for a mean period of 7.8 months before the orthodontic treatment. The sample consisted of 22 individuals, with Class II malocclusion, without apparent signs and symptoms of TMD. The comparison of the values with those observed in non-deprogrammed groups, published in the literature, indicates that the use of the mentioned splints resulted in larger condylar displacements, especially in the vertical direction, between the positions of CR and MHI, which contributed to a more precise orthodontic diagnosis, with benefits for the studied patients. Cordray (2006) evaluated models in the three planes of space to determine possible alterations in the interarch relationships and condylar position between the positions of CR and MHI. The recordings of 596 patients without symptoms of TMD were used. The entire sample underwent neuromuscular deprogramming. The most frequent condylar displacements were in the lower direction in 97%, and in the posterior direction in 67% of the sample, when the mandible was moved to CR.
This study aimed at evaluating the condylar position, pre and post deprogrammer splint, in patients with painful TMJ.

MATERIALS AND METHODS

The sample comprised 18 individuals of both genders, with ages ranging between 13 and 44 years, mean age of 24 years. In total, 72 transcranial radiographs were assessed: the initial one and the final radiograph after use of the deprogrammer splint, taken of the right and left TMJs. The radiographs were obtained from a private clinic collection, taken of individuals who presented clicking and joint pain before orthodontic treatment. The individuals in the sample agreed to participate in the research, and signed the term of free and informed consent, after the project had been approved by the UNICID Research Ethics Committee (Protocol # 13234674).

The initial MHI recording was obtained in 7 NewWax® that was heated until it reached a plastic consistency. The excess of wax in the upper vestibular cusps was removed, and immediately afterwards, it was cooled with jet of air to prevent distortions (Figure 1).

For each individual, a pair of plaster stone models was obtained, and set up in a Bio-Art® semi-adjustable articulator with the aid of the respective facial arch and wax MHI recording. The models were fixed in the articulator with plaster stone. These models served to construct the deprogrammer splint plate in the maxillary arch and for the initial documentation. Neuromuscular deprogramming was obtained with the continuous use of the deprogrammer splint fabricated of acrylic resin. The splint was adjusted to meet the criteria recommended by Roth and Rolfs (1981). So that the objectives of using the splint could be satisfactorily attained, the individuals in the sample were instructed:

1 - To use the deprogrammer splint continuously, 24 hours a day, removing it only to eat, perform oral hygiene and to clean the splint. The total time of deprogrammer splint use varied from 4 to 6 months.

2 - Not to clench the teeth against the deprogrammer splint, or to slide the mandible forward frequently, in order to avoid inappropriate muscle tension.

For each individual, two transcranial radiographs of the right and left TMJs were obtained by the same operator, using a Panoura - 10 CSU (Yoshida Kaykor®) X-Ray unit with a coupled cephalostat, set at 70 to 80 kVp, 7 mA and exposure time of 1 second. The initial radiograph was taken in the MHI position and the other after the mandible neuromuscular deprogramming period (Figure 2).

The condylar displacements between the pre- and post-splint positions were measured in the transcranial radiography of TMJ. The transcranial radiographs of the TMJ were digitized at a resolution of 200% at 75 dpi, in order to maintain their original size without distortions. This definition was demanded by the program CDT CEF X 2.1.38 to prepare the tracing, which was printed by an Epson Stylus® Color 880 printer on high resolution transparency paper (Jet Polien® TR 1440). In the tracing, the outlines of the external acoustic meatus, mandibular fossae and condyle were delineated (Figure 3). Condylar displacement was measured by the comparison between the pre- and post-splint tracings, measuring the superior (SS), anterior (AS) and posterior (PS) joint spaces. After the TMJ joint structures were determined, a line was drawn tangential to the uppermost point of the glenoid fossae (SF) and parallel to the top edge of the tracing, denominated Line 1 (L1). Line 2 (L2) was drawn parallel to Line 1 and tangential to the uppermost point of the condyle (SC). Two lines were traced from point SF passing tangentially anterior (AC) and posterior (PC) to the condyle. Perpendicular to these tangents of points AC and PC they intersected at the glenoid fossae in the anterior fossae (AF) and posterior fossae (PF), respectively (Cohnfria et al., 1996).

To measure the condylar position, the TMJs were divided into quadrants, using the location method by percentage based on the measurements of the posterior space (PS) obtained between points PC and PF and the anterior space (AS) obtained between points AC and AF. The condylar position was evaluated for concentricity by the formula described as follows, which indicated the percentage of condylar displacement. A value equal to zero shows condyle concentricity at the joint fossae (Pullinger and Hollender, 1985).

\[
\frac{PS - AS}{PS + AS} \times 100
\]

A positive value indicated anterior condylar position and a negative value indicated a posterior condylar position. Condylar displacement was defined when a value higher than 12% in the deviation from concentricity was obtained.

All the variables were descriptively analyzed. The mean values and standard deviations were calculated, observing the minimum and maximum values. To test
hypothesis of equality among the pre- and post-neuromuscular deprogramming periods of the individuals in the sample, analysis of variance (ANOVA) for paired samples was used. The level of significance was set at 5%.

RESULTS

Table 1 shows the mean values of the condylar positions, considering standard deviation (sd), maximum (Max) and minimum (Min) values, as well as the percentage represented by letter A in the pre- and post-splint condition.

The statistical significance of the comparisons made in the present study was tested by analysis of variance (ANOVA). No statistically significant differences were found between pre- and post-splint condylar positions (Table 2).

DISCUSSION

The condylar position can be assessed by different types of images. In this research, 72 transcranial radiographs of the TMJ were used to measure the condylar position in relation to the mandibular fossae. Wood17 (1980) had used transcranial radiography to obtain a tracing with the objective of measuring the joint spaces and concluded that it was a suitable technique for TMJ assessment. Since then, different studies have used this radiography to evaluate the TMJ (Almeida, Bóscolo and Pereira1, 1997; Cohlmia et al.3, 1996).

Although there are now other more efficient imaging methods than the transcranial radiography, Pullinger and Hollender12 (1985) conducted a comparative study between transcranial radiography and linear tomography of the TMJ and concluded that the radiographs were clinically useful to monitor small changes in the condylar position. With the prescription of the transcranial radiography to assess the condylar position, some researchers decided to quantify the position of the condyle by means of template (Almeida, Bóscolo and Pereira1, 1997), tracing (Cohlmia et al.3, 1996) or formula (Pullinger and Hollender12, 1985).

In this study, the tracing used to assess the condylar position can be assessed by different types of images. In this research, 72 transcranial radiographs of the TMJ were used to measure the condylar position in relation to the mandibular fossae. Wood17 (1980) had used transcranial radiography to obtain a tracing with the objective of measuring the joint spaces and concluded that it was a suitable technique for TMJ assessment. Since then, different studies have used this radiography to evaluate the TMJ (Almeida, Bóscolo and Pereira1, 1997; Cohlmia et al.3, 1996).

Table 1 - Values of the pre- and post-splint condylar positions

<table>
<thead>
<tr>
<th></th>
<th>AS (mm)</th>
<th>PS (mm)</th>
<th>SS (mm)</th>
<th>A (%)</th>
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<tr>
<td>Pre</td>
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<tr>
<td>Mean</td>
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<td>2.2</td>
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<tr>
<td>sd</td>
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<td>Post</td>
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<tr>
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<td>2.3</td>
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<tr>
<td>Mean</td>
<td>0.2</td>
<td>-0.1</td>
<td>0.3</td>
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<tr>
<td>sd</td>
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<td>Min</td>
<td>2.0</td>
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</table>
position was developed by Cohlmia et al.\(^3\) (1996), who quantified the condylar position in its anterior, posterior and superior spaces, and informed the condylar position inside the mandibular fossae. The formula used in this study to determine the condylar position was developed by Pullinger and Hollender\(^{12}\) (1985), which consisted of posterior space less anterior space, divided by the posterior space added to the anterior space, multiplied by 100, to obtain the percentage value.

When comparing the pre- and post-splint condylar position, no statistically significant difference was observed (Table 2). The total sample result, quantified in millimeters, presented a variation of -3.00 mm to 2.50 mm between the positions from MHI to CR. The higher percentage was around 28.5% of 0.50 mm, a finding that corroborates the studies of Calagna, Silverman and Garfinkel\(^2\) (1973), who obtained CR 0.70 mm more posterior than the position from MHI, as well as that of Karl and Foley\(^9\) (1999), who obtained a value of 0.57 mm.

In this study sample, there were 5 of the 18 individuals with differences greater than 1.00 mm; another finding that corroborates those of Calagna, Silverman and Garfinkel\(^2\) (1973), who obtained 4 out of 15 individuals with differences greater than 1.00 mm. The finding of 61.5% for posterior displacement is similar to that of Cordray\(^4\) (2006), who observed 67% of the sample with posterior displacement from MHI to RC.

In this group, there were part of the individuals who presented displacement ≤ 1.00 mm, another part with displacement of 0.50 mm and yet a third part with displacement greater than 2.00 mm, which were very similar to the values observed in the study of Crawford\(^5\) (1999), who found displacement in 70% of the sample that was divided into four groups: the first, with displacement equal to or less than 1.00 mm, the second and third had displacements that increased by 0.50 mm, and the fourth had displacement greater than 2.00 mm. The results of 61.5% of cases in which the MHI did not coincide with the RC are in agreement with those of Janson\(^8\) (1986), in which MHI and RC did not coincide in 85% of the sample. The finding relative to approximately 11% of displacement greater than 2.00 mm are in disagreement with the study of Karl and Foley\(^9\) (1999), who recorded that 40% of the cases presented displacements greater than 2.00 mm when using a deprogrammer splint.

Condylar displacement from 0.50 mm to 2.00 mm

![Figure 1 - MHI recording](image1.png)

![Figure 2 - Radiographic image of the left TMJ](image2.png)

![Figure 3 - Tracing of the TMJ](image3.png)

\[\text{Line 1} \hspace{1cm} \text{SF} \hspace{1cm} \text{Line 2} \]

\[\text{PF} \hspace{1cm} \text{SC} \hspace{1cm} \text{AC} \hspace{1cm} \text{AF} \]

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produces an increase in TMJ symptomatology. Based on the results of the present study, it was noted that the difference between the positions of MHI and RC is relatively common, however, should be evidenced mainly in cases in which this discrepancy occults some malocclusion.

The use of deprogrammer splint benefited orthodontic planning in patients with painful symptomatology related to the TMJ. The neuromuscular deprogrammation provided pain relief and made it possible to visualize the true occlusion of the patient. Although the differences in condylar position showed no statistical significance, they were present, even if discreetly, and they made it possible to plan more appropriate treatments.

**CONCLUSION**

It was possible to conclude that there was no statistically significant difference between the pre- and post-deprogrammer splint positions.

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