ORIGINAL ARTICLE

Association of condylar angle with incisal wear and myofunctional therapy – Original Research

Ajit V Parihar\textsuperscript{1}, Naresh Kumar\textsuperscript{2}, Atul Bhatnagar\textsuperscript{3}, Sarita Parihar\textsuperscript{4}

ABSTRACT

Introduction: In any normal dentition there is stable relationship between the morphology of the occlusal facets and the movement of the condyles. Change in one of these are compensated by reactive adaptation of another. In the present study, the relation between the incisal wear facets and the condylar inclination were evaluated by checking the changes in condylar angle measurements in patients with incisal wear and those without it. The effect of myofunctional therapy on condylar angle and its correlation pre and post treatment was also established. Materials and Methods: The case group included 50 patients with incisal wear (attrited mandibular incisors) and the control group included 50 patients without incisal wear. 44 samples were taken to evaluate the changes in condylar angle pre and post myofunctional therapy. The posterior slope of articular eminence was marked in the lateral cephalogram and the horizontal condylar angle was drawn by tangent method. Results and Conclusion: The steepness of the condylar angle was found, directly proportional to the mandibular incisal wear. There was decrease in the values of condylar angle in patients after treatment with myofunctional therapy when compared with the pre-treatment values.

Introduction

Normal movements of the jaws are mainly controlled by muscles. However, when the teeth are held in firm tight contact, the morphology of occlusal facets may result in displacement of the jaw from its normal position. This directional guidance is subjected to continual modification\textsuperscript{1}. There is always an existence of functional harmony of occlusal facets with its attached musculature and the bilateral condylar guidances\textsuperscript{2}. Changes in one of these are compensated by reactive adaptation of another. Therefore, in any normal dentition there is stable relationship between the morphology of the occlusal facets (the occlusal guidance) and the movement of the condyles (the condylar guidance)\textsuperscript{3,4}.

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This relationship was first proposed by Hanau as early as 1926. The wear facets that may be observed on the occlusal surfaces of the teeth of a worn dentition are generated by milling movements of the jaws. These movements occur both in the final phases of food comminution and also during habitual and parafunctional grinding activities when opposing teeth make sliding contact.

The condylar guidance is measured by the angle formed between the inclination of a condylar guide control surface of an articulator and a specified reference plane. Radiographically, the angle formed in the horizontal plane between the Frankfurt horizontal plane and a line connecting a point on the head of the condyle, in centric and protrusive position is referred to as the horizontal condylar angle. The determination of this angle is important when planning a restoration which alters the occlusal morphology of the teeth. Steepness of this angle determines the steepness of the cusps of the posterior teeth as well as the lingual inclines of the anterior teeth. Age related changes in the condyle and glenoid fossa can affect the steepness of this angle which if not taken into consideration may result in unfavourable premature contacts during centric and eccentric jaw movements. This can be studied clinically by comparing the condylar inclination values obtained in an articulator for individuals with different age groups. A radiographic evaluation using lateral cephalogram provide an accurate morphology of condyle and anatomic structures to register the reference planes.

In the present study, the relation between the occlusal wear facets and the condylar inclination were evaluated by checking the changes in condylar angle measurements in patients with incisal wear and those without it. The effect of myofunctional therapy on condylar angle and its correlation pre and post after treatment was also established.

**Materials and Methods**

The sample size for the study was calculated using G*Power 3.1.9.2 software which was 50 samples for case group and 50 samples for control group. The case group included patients with incisal wear (attrited mandibular incisors) and the control group included patients without incisal wear. 44 samples were taken to evaluate the changes in condylar angle pre and post myofunctional therapy. The screenings of the samples were done at the outpatient department, Faculty of Dental Sciences, Institute of Medical Sciences, Banaras Hindu University. Samples were also collected from the dental practitioners of Varanasi cities and adjoining areas. Subjects were selected for inclusion in the study based on the following criteria:

1. Pre-treatment stone dental casts available with wax bite, free of any obvious distortion and accurately showing the incisal surface of the mandibular incisors,
2. Pre-treatment lateral cephalometric radiograph available, and
3. Complete eruption of maxillary and mandibular permanent anterior teeth. Subjects were excluded from the study based on the following criteria:
   - History of previous orthodontic treatment,
   - Any missing permanent mandibular anterior tooth, and
   - Any restorative manipulation involving the incisal edge of a permanent mandibular incisor.
Collection of records:

Stone cast made from alginate impressions and a lateral cephalometric radiograph taken at the subject’s initial orthodontic records appointment was used. Bite registration made from baseplate wax taken at the initial records appointment was used to confirm the subject’s occlusion. All lateral cephalometric radiographs were digitized using Viewbox 4 (dHAL Software, version 4.0.1.7).

All the subjects were examined by a team of dentists after obtaining the informed consent from the subjects and their parents. The patients were examined using sterile mouth mirror and flash light. All Occlusal relationships were evaluated at a centric occlusal position, which was achieved by asking the subject to swallow and then to bite on his or her teeth together. The occlusion was then classified into normal occlusion or malocclusion using the first permanent molars as described by Angle. The cheeks were fully retracted to obtain a direct lateral view of the dentition on each side.

Occlusal wear was also recorded using the method by Hugoson et al.

0 = No or minimal wear (uncertain wear)
1 = Occlusal/Incisal Wear of enamel down to dentin spots
2 = Wear of dentin down to one third of the crown height
3 = Wear of the dentin more than one third of the crown height or excessive wear on dental materials.

Factors other than the malocclusion were also taken into consideration and recorded for further reference and its statistical significance in relation to Occlusal/Incisal wear.

The association of condylar angle with incisal wear was evaluated. Patients with incisal wear were treated as subjects while those without incisal wear served as controls. Condylar angle was measured in both the groups and values were compared statistically by unpaired ‘t’ test. The posterior slope of articular eminence was marked in the lateral cephalogram and the horizontal condylar guidance (HCG) was drawn by tangent method (Figure-1,2). The angle between the

Figure-1: Measurement of Condylar angle
Figure-2: Measurement of Condylar Angle (Radiographic)
Frankfort horizontal plane and the HCG line gives the condylar angle (Figure 1,2). The condylar angle was re-verified clinically, by recording the centric relation using bimanual palpation (Dawson hold) method and registering the protrusive mandibular position there after transferring them to the articulator. By this, we were able to evaluate whether association of condylar angle with incisal wear (Anterior Guidance) was statistically significant or not.

Figure-3: Pre-treatment and Post-treatment comparison of condylar angle in myofunctional therapy

The effect of myofunctional therapy on condylar angle was assessed. Patients planned for myofunctional therapy were selected from OPD and their condylar angles were measured. After myofunctional treatment of these patients, the condylar angle of same patients was measured again post treatment. Previous cases of myofunctional therapy who had both pre and post treatment lateral cephalograms were also included in the study (Figure 3). Finally, paired ‘t’ test was done to find the statistical correlation, if any, of myofunctional therapy on condylar angle in patients pre and post treatment.

Results

A major revelation that this study brought was a significant association between condylar angle and attrited lower incisors. Cases with incisal wear were treated as subjects while those without incisal wear served as controls. Their condylar angles were measured and the unpaired t test was done to establish the relationship of condylar angle with incisal wear.

Table-1: Effects of Condylar angle on Incisal Wear

<table>
<thead>
<tr>
<th>Condylar Angle</th>
<th>Mean ± SD</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>35.80 ± 2.01</td>
<td>t = 11.955, p = 0.000(HS)</td>
</tr>
<tr>
<td>Cases</td>
<td>42.74 ± 3.57</td>
<td></td>
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</tbody>
</table>

The results showed that Mean ± SD value (in degrees) of Condylar angle in patients with incisal wear (subjects) was 42.74±3.57 which was significantly higher than Condylar angle in patients without incisal wear (controls) which came out to be 35.80±2.01 (Table-1, Graph 1, 2).
This difference was highly statistically significant (p = 0.000) thereby indicating that incisal attrition leads to an increase in condylar angle of the patient. Such relationship of condylar angle with incisal wear in patients has not been established previously.

Another insight that this study brought was the effect of myofunctional therapy on the condylar angle. Patients with class II div 1 malocclusion planned for myofunctional therapy were included in the study.

<table>
<thead>
<tr>
<th>Condylar Angle</th>
<th>Mean ± SD</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre treatment</td>
<td>46.36 ± 2.85</td>
<td>t = 21.97, p = 0.000 (HS)</td>
</tr>
<tr>
<td>Post treatment</td>
<td>37.13 ± 2.26</td>
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</table>

Their condylar angle pre and post treatment were measured. Paired 't' test was done to find out the correlation of Condylar angle before and after treatment. Results showed that Mean ± SD value (in degrees) of Condylar angle before and after myofunctional therapy was 46.36 ± 2.85 and 37.13 ± 2.26 respectively (Table 2, Graph 3, 4).
This correlation of Condylar angle in the patient before and after treatment was statistically significant (Pearson’s correlation: r=0.427; p= 0.000). Thus, the study led us to the conclusion that condylar angle decreases in patients after myofunctional therapy. Such a correlation of condylar angle in an individual pre and post myofunctional therapy has not been reported in literature.

Discussion

Tooth wear, being a continual process, can lead to significant long-term effect on one’s dental health\(^1\). Previous authors have investigated various relationships between a number of possible etiologic factors and tooth wear. Although a number of studies have previously investigated the relationship between tooth wear and occlusal and cephalometric factors, none to date have analyzed as many factors while focusing on mandibular incisal wear as this current study. The focus of the current study was limited to mandibular incisal wear. This study detected a number of skeletal and occlusal characteristics associated with an increase in mandibular incisal wear. The present study is aimed at finding the relation of mandibular incisal wear with the condylar angle.
and the changes in condylar angle values before and after myofunctional therapy. There were numerous studies regarding the condylar angle which were discussed as follows:

Claudia Reicheneder et al.\textsuperscript{12} in 2009 conducted a study to test the null hypothesis that there are no differences between children and adults in the condylar path inclination angle on the right and left sides. A group of 80 children aged 6 to 10 years was compared with an adult group with regard to the condylar path inclination angle (CPIA) on the right and left sides. A significant difference was found in the CPIA between the groups of adults and children. In the group with the oldest children (mean age: 10.3 years) the condylar path inclination angle had reached 81.87\% on the right side and 78.85\% on the left side compared with the adult group at a 5 mm protrusive path. In the pooled group of children the CPIA amounted to 73.08\% on the right side and 72.13\% on the left side compared with the values for the adults. No significant difference was found between the right and left CPIA in any group. Hence, the hypothesis is rejected that the CPIA on the right and left sides increased with age in the group of children and was significantly smaller in the group of children compared with the group of adults.

Mehrdad Panjnoosh et al.\textsuperscript{13} in 2014 conducted a cross-sectional study to find a relationship between condylar angles and type of malocclusion. The study was conducted on 81 patients aged 15-25 years randomly selected from those presenting to the Orthodontics Department of School of Dentistry, Tehran University of Medical Sciences from 2001 to 2008. Lateral cephalograms of patients were obtained and type of malocclusion was determined using Wits analysis and measurement of ANB angle. The angle between the condylar head, condylar neck and articular eminence slope and the angle between the bisector of the fore-mentioned angle and the articular slope were measured on the cephalograms. The correlation between the right and left angles was 0.459 in patients with class I malocclusion (p=0), 0.276 in patients with class II malocclusion (p=0.011) and 0.334 in patients with class III malocclusion (p=0.02). There were no significant associations between these measurements and age, gender or type of malocclusion. There was no correlation between the type of malocclusion and the angle between the articular eminence slope and the horizontal line, the angle between the condylar head and condylar neck or the angle between the bisector of the fore-mentioned angle and the articular slope.

In general, this study supports the conclusions of a number of previous studies, while also clarifying conflicting results that had been reported in studies evaluating whole-mouth tooth wear. The long awaited answer to the question, “does orthodontic treatment have a protective effect on tooth wear?” has also been answered in this study but future studies need to be done in order to establish a final correlation. The importance of this question is significant to a treating clinician who is able to identify the characteristics associated with increased tooth wear reported in this study.

Sweta Singh et al.\textsuperscript{4} in 2017 conducted a study to determine and correlate the HCG in individuals with Angle’s Class I, Class II, and Class III malocclusion using radiographic and clinical methods. Horizontal condylar angle was recorded for thirty individuals (Class I-10, class II-10, class III-10). For each individual, the angle was recorded clinically as well as radiographically. Clinically, HCG was recorded using protrusive check bites and a semi-adjustable articulator. Radiographically, two methods were employed. First, a “tangent method” wherein the angle made
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by a tangent to the posterior slope of articular eminence with the Frankfurt Horizontal (FH) plane was considered as the HCG, and second, a "protrusive method" where the position of the condyle at maximum intercuspation and 6 mm protrusion were traced, and the angle this path made with the FH plane was recorded as the HCG. Among the three skeletal classes, a significant difference was seen in the HCG values. In general, Class II group yielded higher values and Class III group had less steep condylar inclination as compared to Class I group.

The present study reveals that there is associations of increase in the condylar angle with the mandibular incisal wear when compared with the normal people. There is decrease in the condylar angle after myofunctional therapy which showed that the myofunctional therapy may result in decrease in the condylar angle in the patients. Both the results were obtained by using radiographic method of measuring condylar angle as the radiographic method provided greater value of HCG than the clinical method. In general, this study supports the conclusions of a number of previous studies, while also clarifying conflicting results that had been reported in studies evaluating whole-mouth tooth wear. The long awaited answer to the question, "does orthodontic treatment have a protective effect on tooth wear?" has also been answered in this study but future studies need to be done in order to establish a final correlation. The importance of this question is significant to a treating clinician who is able to identify the characteristics associated with increased tooth wear reported in this study. Further studies could investigate the effect of orthodontic treatment on the progression of tooth wear. If future studies are able to show that orthodontic treatment does have a protective effect on tooth wear, then alert clinicians will be able to inform patients and parents of the benefit of timely orthodontic treatment in reducing the progression of incisal wear.

Conclusion

Within the limitations of the study, the following conclusions can be drawn:

1. Steepness of the condylar angle is directly proportional to the mandibular incisal wear.

2. There is decrease in the values of condylar angle in patients after treatment with myofunctional therapy when compared with the pre-treatment values thereby useful in preventing future incised wear.

The present study was an effort to find the correlation of condylar angle changes with the mandibular incisal wear and myofunctional therapy. It is the beginning to rule out the importance of condylar angle with morphological variations of the tooth as well as the orthodontic treatment procedures. Due to limitations of the study, it was focused only on the functional orthodontic treatment procedures. Further efforts should be taken to find the importance of changes in condylar angle with various orthodontic treatment procedures as well as various morphological variations of the tooth and its significance in treatment outcome and joint morphology of the patients.

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