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ORIGINAL RESEARCH

A Tomographic Study of the Mandibular Condyle Position in Partially Edentulous Population

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ABSTRACT

Background and objectives: The influence of the loss of teeth on the condylar position and on temporomandibular joint (TMJ) dysfunction syndrome remains a controversial issue. This study analyses the condylar position by means of a tomogram in partially dentate subjects which serves as a guide to predict which of the partially dentate statuses is prone to develop TMJ dysfunction syndrome in personnel without symptoms of the same.

Methodology: Eighty personnel were enrolled in this study consisting of Kennedy's class I, II, III, IV and control to analyze the condylar position by means of a tomogram. In all the five groups TMJ sectional tomogram programmed in a panoramic radiographic machine (PLANMECA PM 2002 CC PROLINE) was taken with the subjects at maximal intercuspal position and rest position. Tomograms were evaluated using linear measurements of the anterior and posterior intra-articular joint spaces on the basis of drawings and tracings.

Results: The results of the study revealed a predominance of reduced posterior condylar space in Kennedy's class I and II. A disparity was seen between the maximum intercuspal position and rest position, where the posterior joint space was reduced in the rest position.

Conclusion: Within the limitations of this study, it has been revealed that in Kennedy's classes I and II, for partially dentate personnel, a posterior displacement of the condyles was seen. This predisposition would suggest towards the necessity of restoring the missing dentition in order to maintain the harmony of the stomatognathic system.

Keywords: Condylar position, Intra-articular joint spaces, Reduced condylar space, Temporomandibular joint dysfunction syndrome, Tomogram.

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INTRODUCTION

The anatomy and physiology of the temporomandibular joint (TMJ) are intimately related to each component of the masticatory apparatus.[1] In a natural dentition, harmony exists between the function and position of the dental elements and the condyles. The TMJ is under a certain load during function. Therefore, theoretically, the load balance between the dentition and the TMJ could be disturbed especially when the posterior teeth are removed.[1]

Loss of teeth or tooth wear may compromise the occlusion and condylar position at TMJ in partially edentate patients. Tooth loss also results in shifting of the remaining adjacent and opposing teeth which causes premature contacts in centric and eccentric movements. This alteration in condylar position in time can result in structural changes of the TMJ surfaces and can initiate temporomandibular disorders and pain dysfunction symptoms.

In shortened dental arches where molar support is absent, Applegate[2] considered it to be a prime etiologic factor in mandibular dysfunction. Mandibular overclosure and the consequent change in the position of the condyles and an increased load to the TMJ are some considerations for the TMJ dysfunction syndrome.

Various methods have been used to determine the condylar position according to the relative dimensions of anterior and posterior joint spaces between the fossa and the condyle, and three types of condylar positions have been identified which are:

1. Condylar concentricity, in which the anterior and posterior joint spaces are equal.
2. Posterior condylar position, in which the posterior joint space is smaller than the anterior joint space.
3. Anterior condylar position, in which the posterior joint space is greater than the anterior joint space.[3]

Radiographic investigations have shown that patients with TMJ pain presented a higher ratio of posterior condylar positions than in symptom-free subjects. This

posterior displacement of the condyle has frequently been associated with loss of posterior teeth. Many patients can adapt to occlusion or condylar positions that are not ideal.[4-7]

The influence of condylar position and loss of posterior teeth on temporomandibular disorders remains a controversial issue[1] and with the available literature not much is known on the influence of loss of anterior teeth and condylar position.

Partially dentate patients wearing upper and lower removable partial denture had a significantly higher prevalence of temporomandibular disorder signs than edentulous patients wearing complete dentures.

The aim of this study was to analyze the status of condylar positions in partially dentate subjects by means of a tomogram and to analyze the influence of partially dentate status on the TMJ dysfunction syndrome.

Tomography enables accurate superimposition and repeatable visualization of the TMJ. It is capable of recording a radiographic slice through an anatomic area at a predetermined level.[8] The results obtained will help analyze which of the Kennedy's classification for partial edentulism is prone to develop TMJ dysfunction syndrome.

The objectives of the study:

1. To analyze the condylar position by means of a tomogram in partially dentate subjects (grouping as per Kennedy's classification).
2. To compare the condylar position of partially dentate with completely dentate subjects.
3. To analyze which of partially dentate status as per Kennedy's classification is prone to develop TMJ dysfunction syndrome.

MATERIALS AND METHODS

The study was conducted on personnel reporting for treatment of partially dentate status to the department of prosthodontics including crown and bridge and Implantology in AB Shetty Memorial Institute of Dental Sciences, Deralakatte, Mangalore - 575018.

A sample size of 80 subjects, divided into 5 groups was taken.

Group I: Control group (20 subjects) individuals with full complement of natural teeth.

Group II: Kennedy class I (15 subjects) individuals with bilateral edentulous area located posterior to the remaining natural teeth.

Group III: Kennedy class II (15 subjects) individuals with unilateral edentulous area located posterior to the remaining natural teeth.

Group IV: Kennedy class III (15 subjects) individuals with unilateral edentulous area with remaining natural teeth both anterior and posterior to it.

Group V: Kennedy class IV (15 subjects) individuals with a single, but bilateral (crossing the midline) edentulous area located anterior to the remaining natural teeth.

CRITERIA FOR SELECTION

Group I: Control Group

1. Subject with full complement of sound natural teeth (with the exception of third molars).
2. Subjects with Angle's class I molar relationship bilaterally.
3. Subjects with no history of TMJ dysfunction syndrome.

Groups II, III, IV, V

1. Subjects with no symptoms of TMJ dysfunction syndrome.

Groups II, III, IV, V and Control

1. Subjects with no history of orthodontic treatment
2. Subjects with no history of orthognathic surgery.
3. Should be free of coronal/radicular restorations of any form, crowns, fixed or removable partial dentures, etc. in the dental arch.
4. Subjects with no malocclusion.

PROCEDURE

TMJ sectional tomogram programmed in a panoramic radiographic machine (PLANMECA PM 2002 CC PROLINE) was taken with the subjects in maximal intercuspal position and at rest, at 66 KVP, 08 mA, exposure time of 6.3 seconds (Fig. 1).

Tomograms were evaluated using linear measurements of the anterior and posterior intra-articular joint spaces on the basis of drawings and tracings.

Tracings of the radiographs were made on acetate matte tracing paper, and the outlines of both right and left condyles were traced (Fig. 2).

- The following structures were identified and traced.
- The outline of the mandibular condyle
- The outline of the glenoid fossa including the articular eminence.
- The post glenoid spine, which is the junction of the squamotympanic fissure and the outline of the posterior surface of the glenoid fossa.

Condylar positions were analyzed as follows:

- X and Y coordinates was taken; X being parallel to the Frankfort horizontal plane and tangent to the highest point on the temporal fossa.

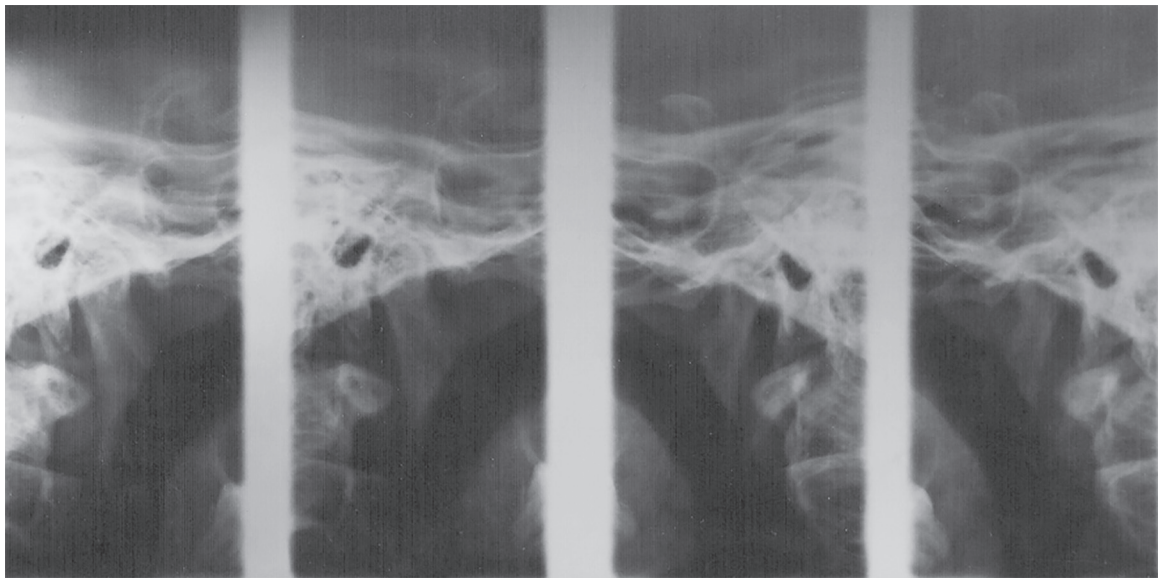


Fig. 1: Lateral tomogram of the right and the left condyle at rest and at maximum intercuspation

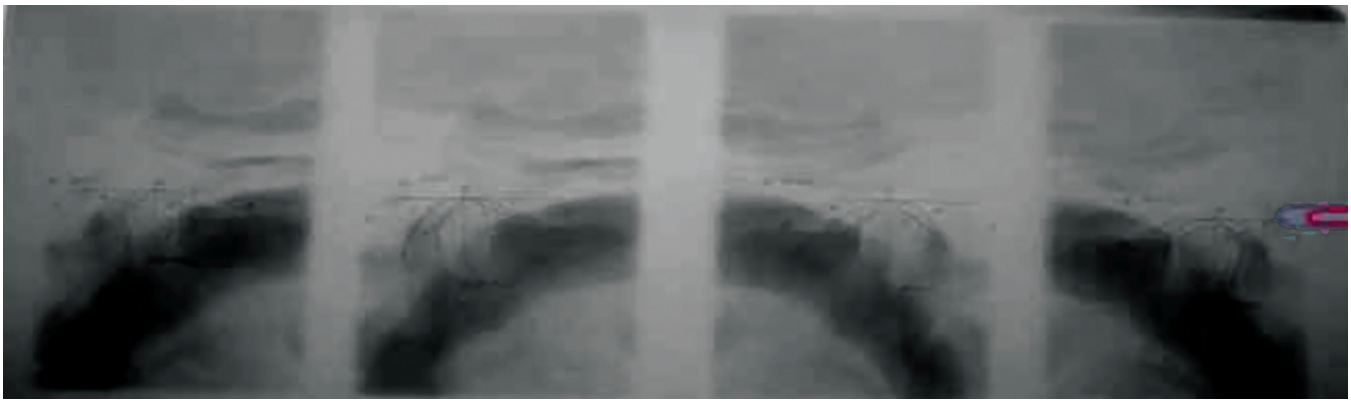
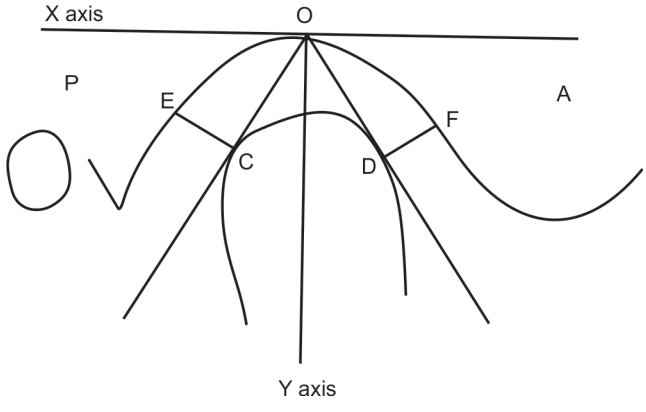


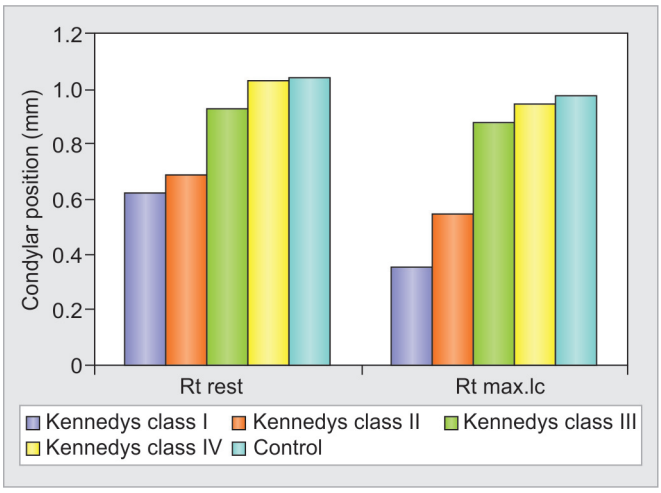
Fig. 2: Tracing showing the anterior and posterior joint space of the right and the left condyle at maximal intercuspal position and rest position

- Y axis was taken perpendicular to X-axis intersecting it at point O (highest point of glenoid fossa).
- From point O tangents to the posterior and anterior condylar outlines were drawn at point C and D respectively.
- Perpendiculars to the anterior and posterior segments of the glenoid fossa (E and F) were drawn from points C and D.
- Lines CE and DF were measured to determine the P/A (CE/DF) ratio and condylar positioning the fossa based on posterior and anterior joint space.
- Letters A and P indicate anterior and posterior joint segment respectively.
- If P/A = 1; condyle was considered centrally located
- If P/A > 1; condyle was considered anteriorly located
- If P/A < 1; condyle was considered posteriorly located[8]

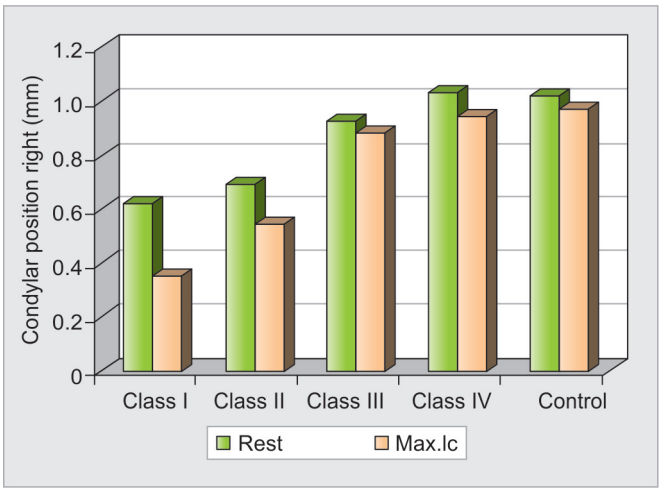


RESULTS

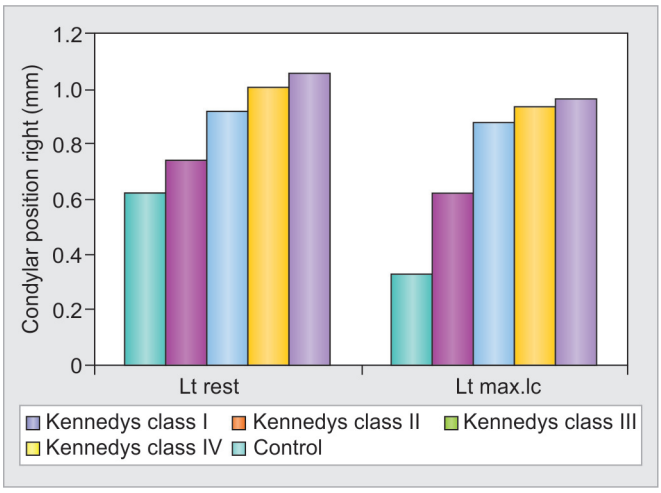
The values obtained was be tabulated and subjected to statistical analysis using an unpaired t-test, ANOVA-analysis of variance with Tukey's post hoc test and paired samples statistics. The distribution of the condylar positions on the right and the left sides in various Kennedy's classification and in control, at rest and at maximum intercuspation are given in Graphs 1 and 3, one way ANOVA showed a statistically significant difference between them ($p < 0.005$). The comparison of mean of the right and left condylar position in various Kennedy's classification and in control at rest and at maximum intercuspation showed a statistically significant decrease



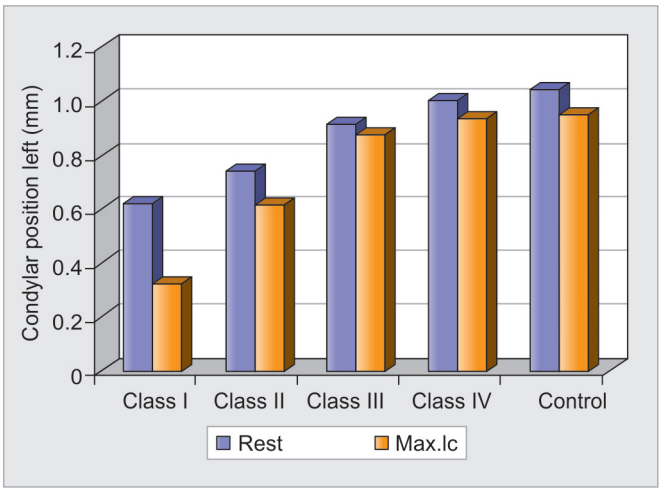
Graph 1: Mean position of the right condyle in various Kennedy's classification and in control at rest and at maximum intercuspation



Graph 2: Comparison of mean of the right condylar position in various Kennedy's classification and in control at rest and at maximum intercuspation



Graph 3: Mean position of the left condyle in various Kennedy's classification and in control at rest and at maximum intercuspation



Graph 4: Comparison of mean of the left condylar position in various Kennedy's classification and in control at rest and at maximum intercuspation

in the posterior condylar space in Kennedy's classes I and II ($p < 0.005$), given in Graph 2 and 4 and when a comparison with in each Kennedy's classification at rest and at maximum intercuspation on the right and the left mandibular condyle (Graph 5) was done, a statistically significant difference among all the pairs was noted ($p < 0.001$).

DISCUSSION

The TMJ is a complex articulation that shows great variability from one individual to another and also within each individual, indicating that the normal range of the condyle morphology; angulation and position are fairly large.[8] The significance of condylar position in TMJ dysfunction syndrome is a persistent controversy, which is partly due to the difficulties in establishing the truly asymptomatic control populations that are needed if normal condylar position is to be adequately defined.[14] However, many clinical studies have associated posteriorly positioned condyles with TMJ internal derangement and pain.[4, 6,10,11,15]

The evaluation of the TMJ space is used to determine the condylar position in the fossa. The superior portion of the temporomandibular fossa is usually symmetrical. The anterior and posterior portions are used for orientation of the radiograph. Condylar position is determined by the relative dimensions of the anterior and posterior joint spaces between the fossa and the condylar surface.[3]

Ireland V E4 in 1953 stated that loss of posterior teeth may allow the bite to close and cause the mandible, as a whole, to be forced in a backward direction by the action of the inclined planes of the incisors. Since the rest position of the mandible is virtually constant, this closing of the bite results in an increase in the free way space, and the movement of the mandible from the rest position to the occlusal position is no longer a pure hinge movement. The condyles are driven into a position

above and behind their normal position in relation to the articular eminence. Only one condyle is affected when a unilateral cause is responsible, but, when the bite has closed, both are affected.

In this study, personnel who had lost posterior support showed a predominance of posterior condylar positions where the condyle/fossa relationship, i.e., P/A ratio is less than one namely in Kennedy's class I and II. This reduction of the posterior intra-articular space may represent a compression on the bilaminar zone, which is responsible for the blood supply and the nutrition of the TMJ and may also be related to the anterior displacement of the joint disk.[6,7,16] It has been concluded by Weinberg that condylar position in the fossa (especially retrusion) is a significant factor in the etiology of TMJ pains and dysfunction.[3,9] Reduction in posterior joint space is far more prevalent than an increased posterior joint space.[17]

It is considered that certain positions, especially posterior positions, may be less stable and predispose to disk displacement.[12] Posterior condylar position might predispose biomechanically to anterior displacement of the articular disk, whereas a concentric or anterior position permits the disk to remain in a more stable position against the slope of the articular eminence.[13] Caution must be exercised in determining the clinical significance of radiographic condylar retrusion. Distinction must be made between true condylar retrusion and retrusion as seen radiographically as a result of mandibular over closure.[10]

This study showed a significant reduction in the posterior condylar space in Kennedy's class I and II when compared with Kennedy's class III and IV and the control. A variation was seen between the rest position and maximum intercuspation, where the posterior joint space was reduced at rest position.

The high incidence of condylar retrusion in Kennedy's class I and II personnel indicates that condylar displacement in general, and posterior displacement in particular are one of the etiologic factors in TMJ dysfunction-pain syndrome. Since, the proportion of unilateral (Kennedy's class II) to bilateral (Kennedy's class I) condylar displacement in both groups is 1.1:0.7, it would seem on the basis of this evidence, that the occurrence of condylar retrusion itself is the significant factor, rather than if it is unilateral or bilateral.

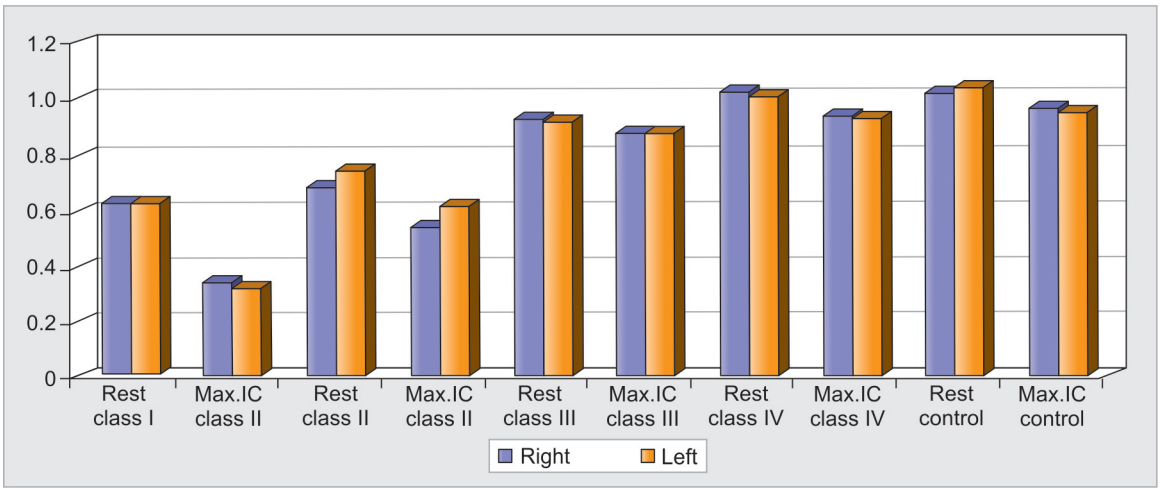
Reider's[17] lateral transcranial radiographic study stated that there was a significant correlation of condylar position, joint space variations, and condylar morphology with mandibular dysfunction profile scores. TMJ changes serves as an important adjunct in the examination and diagnosis of mandibular dysfunction.

This work confirms the importance and validity of radiography in the diagnosis of TMJ dysfunction-pain syndrome. When correctly performed, tomography gives an accurate view of the bony structures of the entire TMJ.[11]

Various studies have been conducted on the significance of sex and age predilection on the position of the condyle which revealed an increase in the incidence of posterior condylar position in women than in men[12] and the likelihood of reduced joint space increases with age,[17] which has not been evaluated in this study. Further studies need to be conducted to evaluate the same.

Further studies are to be under taken with a larger sample size to obtain a more conclusive data and to study the relationship between various Kennedy's classification and its significance in the exact diagnosis of TMJ dysfunction syndrome.

When Kennedy's class I and II were compared with control, class III and IV, a reduced posterior condylar space in class I and II situations was noted. This might act as a factor predisposing to TMJ dysfunction syndrome. Furthermore, the clinical significance of this study would suggest replacement of the missing dentition, which



Graph 5: Comparison of means of the right and left condylar position in various Kennedy's classification and in control at rest and at maximum intercuspation

would help to prevent a TMJ dysfunction syndrome. However, further studies on the actual benefits of a restoration in preventing have to be conducted to authenticate this claim.

CONCLUSION

From the foregoing study, the following conclusions were drawn:

1. In Kennedy's class I and II a predominance of reduced posterior condylar space, where the condyle/fossa relationship (i.e. P/A ratio) is less than one, was noted.
2. There was a variation seen between the rest position and maximum intercuspation, where the posterior joint space was reduced in the rest position.
3. When comparing the various Kennedy's classes with the control, it was noted that only class I and II showed a significant decrease in posterior condylar space in comparison with the control.
4. The changed condylar position in Kennedy's classes I and II might act as a predisposing factor resulting in TMJ dysfunction syndrome.

Through the findings of this study, it has been revealed that in Kennedy's classes I and II, for partially dentate personnel, a posterior displacement of the condyles was seen (either unilaterally or bilaterally). This predisposition would suggest toward the necessity of restoring the missing dentition in order to maintain the harmony of the stomatognathic system.

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