

Assessment of Sagittal Condylar Guidance with Protrusive Inter-occlusal Method, Panoramic Radiographs, and Lateral Cephalogram: A Comparative Study

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ABSTRACT

Background: Condylar guidance can be determined using the clinical and radiographic methods. The present study was conducted to determine condylar guidance using the protrusive interocclusal wax method, panoramic radiographs, and lateral cephalogram.

Aims: The aim of the study was to compare the correlation between sagittal condylar guidance with protrusive interocclusal method, panoramic radiographs, and lateral cephalogram.

Materials and methods: The present study was conducted on 82 dentulous subjects (males 41, females 41). In all subjects, interocclusal registration values and condylar guidance values were measured using panoramic radiographs and lateral cephalograms.

Results: The mean \pm SD protrusive interocclusal registration value on the left side was 34.01 ± 1.2 mm and 34.08 ± 1.4 mm on the right side. The panoramic radiographs showed 35.12 ± 1.6 mm on the left side and 35.16 ± 1.7 mm on the right side. The mean \pm SD protrusive interocclusal registration values on the left side was 34.01 ± 1.2 mm on the left side and 34.08 ± 1.4 mm on the right side. Lateral cephalogram showed 34.35 ± 1.3 mm on the left side and 34.67 ± 1.6 mm on the right side. There was a significant difference between the methods ($p < 0.05$).

Conclusion: Sagittal condylar guidance can be evaluated using protrusive interocclusal method. Along with it, other methods such as panoramic radiographs and lateral cephalogram may also be used for recording condylar guidance.

Clinical significance: Lateral cephalogram and panoramic radiographs may be reliable in determining condylar guidance, which can be used in orthodontic treatment planning.

Keywords: Condylar guidance, Lateral cephalogram, Panoramic radiographs.

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INTRODUCTION

The management of missing few or multiple teeth with removable or fixed partial denture is considered successful only when the prostheses is capable of performing all functions such as mastication, biting, and phonetics. It should be in harmony with the patient's stomatognathic system.¹ Condylar path plays an important role in rehabilitation of patient. Accurate simulation of the condylar path on an articulator ensures success and survival of prostheses. Condylar path helps in deciding the future occlusal surfaces of teeth in prostheses based on the movement and the path of condyle during the movement of mandible.²

Condylar guidance is the mandibular guidance generated by the condyle and articular disc traversing the contour of the glenoid fossa. The efficacy of condylar guidance can be judged by the fact that there may be occlusal interferences if there is failure in the recording of condylar guidance accurately. The right and left lateral mandibular as well as protrusive movements are of paramount importance and important to establish accurate recording. It is essential to set the condylar elements of the articulator so that they will reproduce inclinations, which are analogous to that of the patient's temporomandibular articulation.³

Various studies have recorded condylar guidance which includes intraoral and extraoral methods. Both clinical and radiographic methods provide useful information.⁴ Tannamala et al.⁵ in their study assessed condylar guidance using protrusive interocclusal record and panoramic radiographic images. In the

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radiographic method, lateral cephalogram, computed tomography, and panoramic radiographs are routinely used. The present study was conducted to determine condylar guidance using protrusive interocclusal wax method, panoramic radiographs, and lateral cephalogram.

MATERIALS AND METHODS

The present study was conducted in the Department of Prosthodontics. It comprised of 82 dentulous subjects (males 41, females 41). The study protocol was approved by the institutional ethical committee. All the subjects were informed regarding the study, and written consent was obtained.

Inclusion Criteria

Age ranged from 20 to 45 and with at least three posterior teeth in all quadrants.

Exclusive Criteria

TMJ disease and muscular disorder, malocclusion, and craniofacial anomalies.

Method

All subjects both maxillary and mandibular impression was made using alginate impression materials and casts were poured with dental stone. Protrusive relation was recorded by allowing the subjects to move their mandible forward preferably edge-to-edge position. The maxillary cast was mounted on Hanau semi-adjustable articulator, and the mandibular cast was mounted using the patient's maximum intercuspation record.

The patients were subjected to panoramic radiographs (Fig. 1) and lateral cephalograms (Fig. 2). The panoramic radiographs were obtained using the digital Planmeca extraoral panoramic unit operating at 100 kVp, 12 mA, and 17 mA s. The lateral cephalograms were taken using digital Planmeca lateral cephalogram unit operating at 90 kVp and 10 mA. All tracings were done on digital images. Points orbitale and porion were joined to delineate Frankfurt's horizontal plane. Sagittal condylar path inclination was obtained. The angle between both the reference planes showed the angle of sagittal condylar guidance. All the tracings were performed using two independent radiographers, and means of them were considered to overcome the bias.

The obtained data were tabulated and subjected to statistical analysis using SPSS version 21.0. The results were expressed as mean \pm SD. Mann-Whitney *U* test and Chi-squared test were applied. *p* value less than 0.05 was considered significant.

RESULTS

Table 1 and Figure 3 show that mean \pm SD protrusive interocclusal registration value on the left side was 34.01 ± 1.2 mm and 34.08 ± 1.4 mm on the right side. Panoramic radiographs showed 35.12 ± 1.6 mm on the left side and 35.16 ± 1.7 mm on the right side. Mann-Whitney *U* test showed a significant difference between both the methods ($p < 0.05$).

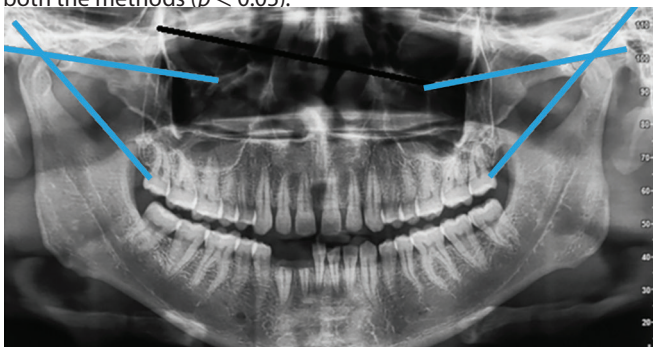


Fig. 1: Panoramic radiographs showing sagittal condylar guidance angle

Group I: Condylar guidance values obtained with protrusive interocclusal record and panoramic radiographic tracings.

Group II: Condylar guidance values obtained with protrusive interocclusal record and lateral cephalogram tracings on both right and left sides separately.

Table 2 and Figure 4 show that mean \pm SD protrusive interocclusal registration value on the left side was 34.01 ± 1.2 mm and 34.08 ± 1.4 mm on the right side. Lateral cephalogram showed 34.35 ± 1.3 mm on the left side and 34.67 ± 1.6 mm on the right side. Mann-Whitney *U* test showed a significant difference between both the methods ($p < 0.05$).

DISCUSSION

In literature methods such as interocclusal protrusive wax, records, Lucia jig, leaf gauge, and intraoral tracers are the most commonly used intraoral methods.^{6,7} However, extraoral methods are usually employed in edentulous patients. Aull AE⁸ in their study found average condylar guidance value that ranged from 22° to 65° . All the methods have advantages as well as disadvantages. Laboratory methods may result in errors due to polymerization shrinkage of materials or instability of materials. Similarly, in clinical methods, there can be a change in registration of condyle if the patient moves either left or right lateral movements during protrusion.⁹ Condylar guidance is described as the mandibular guidance generated by the condyle and articular disc traversing the contour of the glenoid fossae or synonymously region of an articulator that controls the movement of the mobile member.¹⁰ The present study was conducted to determine the condylar guidance using protrusive interocclusal wax method, panoramic radiographs, and lateral cephalogram.

We found that mean \pm SD protrusive interocclusal registration value on the left side was 34.01 ± 1.2 mm and 34.08 ± 1.4 mm on the right side. The panoramic radiographs showed 35.12 ± 1.6 mm on the left side and 35.16 ± 1.7 mm on the right side. The mean \pm SD protrusive interocclusal registration value on the left side was 34.01 ± 1.2 mm and 34.08 ± 1.4 mm on the right side. The lateral cephalogram showed 34.35 ± 1.3 mm on the left side and 34.67 ± 1.6 mm on the right side. Shreshta et al.¹¹ conducted a comparative study to measure the condylar guidance by the radiographic and clinical methods. Four methods such as clinical methods which comprised of the wax protrusive records, Lucia jig record, and

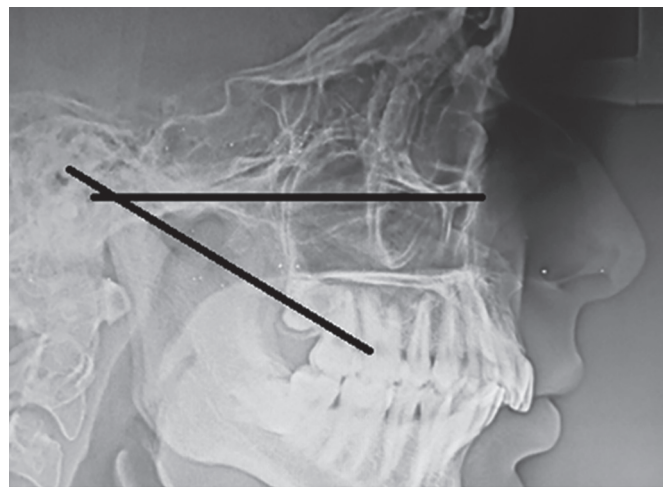


Fig. 2: Lateral cephalogram showing sagittal condylar guidance angle

Table 1: Mean condylar guidance values obtained with protrusive interocclusal registration and panoramic radiographic tracings

Method	Left side		Right side		p value
	Mean	SD	Mean	SD	
Protrusive interocclusal registration	34.01	1.2	34.08	1.4	0.01
Panoramic radiographs	35.12	1.6	35.16	1.7	

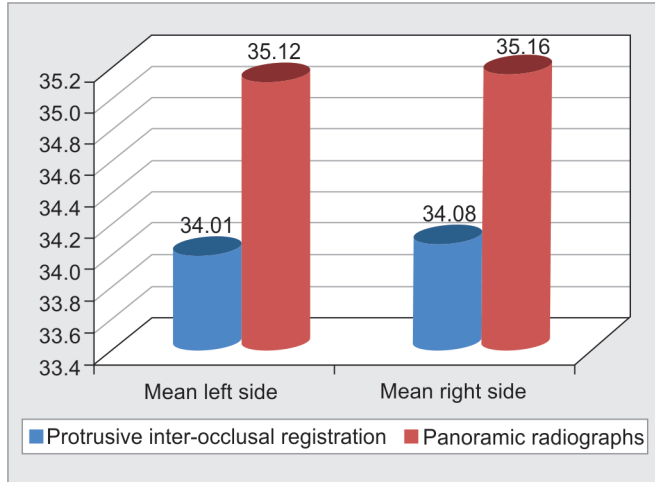


Fig. 3: Comparison of protrusive interocclusal registration and panoramic radiograph

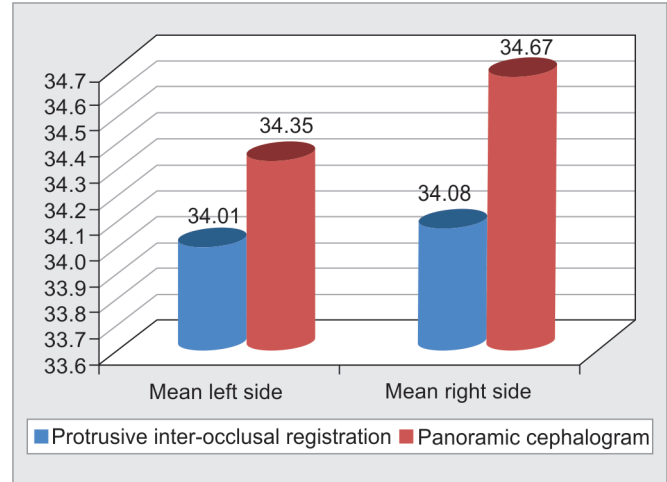


Fig. 4: Comparison of protrusive interocclusal registration and panoramic cephalogram

Table 2: Mean condylar guidance values obtained with protrusive interocclusal registration and lateral cephalogram tracings

Method	Left side		Right side		p value
	Mean	SD	Mean	SD	
Protrusive interocclusal registration	34.01	1.2	34.08	1.4	0.02
Lateral cephalogram	34.35	1.3	34.67	1.6	

intraoral central bearing device whereas radiographic method included CT scan. Authors found non-significant differences in the horizontal condylar guidance (HCG) values between the right and left sides [($p = 0.589$ (CT), $p = 0.928$ (wax), $p = 0.625$ (jig), $p = 0.886$ (tracer)]. The clinical methods provided low Pearson's correlation values [($R = 0.423$ (wax), $R = 0.354$ (jig), $R = 0.265$ (tracer))] for the right as well as the left sides when compared with the CT values. Jig and wax methods showed a strong level of association which is statistically significant whereas the intra-oral tracer showed weak association compared with the other two methods.

Galagali et al.¹² in their study assessed sagittal condylar guidance obtained by protrusive interocclusal records mounted on semi-adjustable articulator with panoramic and lateral cephalogram on 120 dentulous subjects age ranged from 20 to 40 years of both genders. The mean difference between the condylar guidance values was 0.13° and 0.67° on the right side obtained using panoramic and lateral cephalogram radiographs, respectively, and was 1.0° and 1.54° on the left side using panoramic and lateral cephalogram radiographs, respectively. The authors found a significant positive correlation observed in the left and right sides.

We used lateral cephalogram and panoramic radiographs for recording the condylar guidance. Both the radiographs are useful in providing the outline of the articular eminence and the glenoid fossa of the temporal bone. Davis and Mackay¹³ in their study

suggested that lateral cephalogram is better in terms of patient exposure which is 4–5 times less than as compared to panoramic radiographs. Image quality was improved, and there were fewer faults in the images and high speed of application is applicable.

We used panoramic radiographs as another radiographic tool for determining the condylar guidance. The biggest advantage of these images is that both left and right sides can be compared side by side. There is no need to expose the patient twice as in case of lateral cephalogram. The digital radiographs provide high-quality images.

Bhandari et al.¹⁴ conducted a study on 25 completely edentulous patients and measured the HCG by protrusive interocclusal records using zinc oxide–eugenol paste through a face bow transfer to a semi-adjustable articulator. HCG was traced in the panoramic radiograph. The mean difference between the HCG angle values obtained using protrusive interocclusal record and panoramic radiograph was 2.68° and 3.40° for the right and the left sides, respectively. This difference between the values was found to be highly significant between the two methods for the right left sides. A significant positive correlation was found between the HCG obtained from protrusive interocclusal record and panoramic radiograph for the right and left sides separately.

Salemi et al.¹⁵ assessed cone beam computed tomography (CBCT) and panoramic radiographs for determining the condylar

ramp in comparison with interocclusal protrusive record on 28 dentulous patients. The mean difference between the condylar guidance obtained using interocclusal recording and CBCT was $0.73 \pm 0.8^\circ$ for the right side and $0.48 \pm 0.1^\circ$ for the left side. The differences between interocclusal recording and panoramic were $2.79 \pm 0.30^\circ$ and $2.49 \pm 0.9^\circ$ for the right and the left sides, respectively. The CBCT had a narrower Bland–Altman graph than panoramic radiography.

CONCLUSION

Sagittal condylar guidance can be evaluated using protrusive interocclusal method. Along with it, the other methods such as panoramic radiographs and lateral cephalogram may also be used for recording the condylar guidance.

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