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A Study to Check Correlation between Panoramic Radiographic Image and Protrusive Inter-Occlusal Record in Male and Female Dentulous Patients for Depicting Condylar Guidance Angle: A Pilot Study

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Authors' contributions

This work was carried out in collaboration between all authors. Author PK designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors KKP and MA managed the analyses of the study. Authors AG and FT managed the literature searches. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

Purpose: To study and compare the sagittal condylar angles set on a Hanau articulator using intra-oral protrusive records to angles found using a panoramic radiographic image in male and female dentulous patients.

Materials and Methods: A total of 20 subjects (10 male and 10 female) Aged between 21 to 30 years, free of signs and symptoms of temporomandibular joint disorders and with intact dentition were selected. Impressions were made using irreversible hydrocolloid and all dental stone casts (type- III), were mounted on a Hanau articulator using a spring bow type of face bow. For all patients, the protrusive records were made with polyether bite registration paste when the mandible was moved forward by approximately 4- 6 mm, using compound jig. All procedures for

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recording, mounting, and setting were done on the same day and the obtained condylar guidance angles were tabulated.
A panoramic radiographic image of each patient was made with the Frankfurt horizontal plane parallel to the floor of the mouth and the horizontal reference lines were marked by joining the orbitale and porion after tracings of the radiographic images. The most superior and most inferior points of the curvatures were identified. These two points were connected by a straight line representing the mean curvature line and the Angles made by the intersection of the mean curvature line and the horizontal reference lines were then measured. The results were subjected to statistical analysis using Independent Student's t-Test, ANOVA.
Results: values obtained, using panographic method were on average 5.51° greater than the values obtained by protrusive interocclusal record method. The mean condylar guidance angles between the right and left side using both the methods were not statistically significant.
Conclusion: Within the limitations of this study, it was concluded that the protrusive condylar guidance angles obtained by panoramic radiograph may be used for the programming of semi-adjustable articulators.

Keywords: Condylar guidance; protrusive interocclusal record; panoramic radiograph.

1. INRODUCTION

Condylar guidance is defined as the mandibular guidance generated by the condyle and articular disk traversing the contour of the articular eminence and or it can be defined as the mechanical form located in the posterior region of an articulator that controls movement of its mobile member (GPT-9) [1].

The goal of a prosthodontic rehabilitation is to fabricate a prosthesis which is in harmony with the patient's stomatognathic system. The most essential consideration in the oral rehabilitation of any patient is the inclination of the condylar path. It enables the clinician to estimate the correlation between the path traced by the condyle during mandibular movements and the morphology of the occlusal surfaces which in turn aids in restoring the occlusion without interferences [2].

The guidance inclination in semi-adjustable articulators is set either by individual protrusive or lateral inter-occlusal registrations. Varying inclinations have been reported with consecutive registrations, between operators, between recording materials, and between articulators [3].

A protrusive inter-occlusal record can register the influence of condylar paths over the movements of the mandible. It enables the condylar guidance of the articulator to be set to an approximation of the paths of the condylar movements in patients. Several studies have shown an unreliability in recording and reproducing the condylar guidance on semi-adjustable articulator using inter-occlusal record. Consecutive condylar guidance angles recorded showed variation between operators, recording materials, and articulators [4].

Panoramic radiography is a widely used method to represent the outline of articular eminence and may be aid in setting the condylar guidance inclination of a semi adjustable articulator and if the panoramic radiographic image accurately represents the outline of the articular eminence, it may be used as an aid in setting the condylar guidance inclination of a semiadjustable articulator [5].

Hence, this pilot study has been planned to evaluate and compare the correlation between a protrusive inter-occlusal record and panoramic radiographic image method in male and female dentulous patients for setting condylar guidance on an articulator.

2. MATERIALS AND METHODS

Twenty subjects (10 male & 10 female) with angles class 1 occlusion and having sound periodontal health with no signs or symptoms of temporomandibular disorders were selected for the study. Impressions of each patient was made using irreversible hydrocolloid (DPI Imprint) and immediately poured in Type-III dental stone (gypstone, privest dental). The casts were mounted on an articulator (Hanau articulator Wide-Vue, Teledyne/Water Pik, Fort Collins, CO) with a springbow (Teledyne/Water Pik) after making interocclusal records using polyether bite registration material (Ramitec™ material from 3M).

To obtain a protrusive record, each subject was instructed to move his/her mandible directly forward by approximately 4-6 mm or in edge to edge relationship using compound jig (Fig. 1). The condylar guidance angles recorded on the articulator were then tabulated.

Fig. 1. Making of protrusive record

A panoramic radiographic image of each patient was made with the Frankfurt horizontal plane parallel to the floor of the mouth using cephalostat to align the head in the same position for all subjects (2). All radiographs were made by the same operator with the same panoramic radiographic unit (Satelac X Mind Pano ceph digital x-ray machine).

Fig. 2. Subject position in OPG machine

The images were acquired at 74 kVp and 10 Ma. The panoramic radiographic unit comes with a light aligned along the anatomic planes, Two radio-opaque lines are consistently visible on the panoramic radiographs in the region of the temporal bone. The upper line depicts the outline of the articular eminence and fossa, the lower depicts the border of the zygomatic arch (Fig. 3).

After tracing of the radiographic images, a horizontal reference line was marked by joining the orbitale and porion. The most superior and the most inferior points on the curvatures were identified and these two points were connected by a straight line representing the mean curvature line (Fig. 3). Angles made by the intersection of the mean curvature line and the horizontal reference line were then measured (Fig. 3) and data were subjected to statistical analysis by using Independent Student's t-Test and ANOVA. Approval for this study was first obtained from the institution ethical committee. Informed consent was obtained from all subjects included in this study.

3. RESULTS

Table 1 shows the angles of the condylar guidance and standard deviations measured by the protrusive interocclusal record and panoramic radiographic methods. Table 2 shows the correlation between condylar guidance angle of all subjects at right and left sides between two methods. The radiographic values were on average 5.5 [10] greater than the values obtained by the protrusive interocclusal record method.

The comparison of mean condylar guidance angles between both methods in all subjects (male + female) were not statistically significant ($p > 0.05$). The values obtained were, ($p = 0.967$ and $p = 0.954$, respectively) in male and ($p = 0.640$ and $p = 0.8222$, respectively) in female subjects.

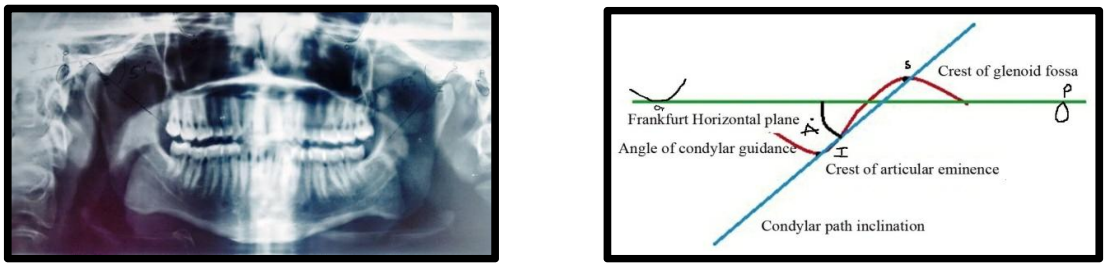

Fig. 3. Tracing of Frankfurt horizontal plane (OP) and SI line joining height of superior curvature and inferior curvature. A is the angle made by the intersection of the mean curvature line and horizontal reference line

Table 1. Condylar guidance angle in male and female subjects

Sl no	Subjects	Age	Sex	Angles measured on panaromic with jig (in degree)		Angles measured on articulator with protrusive inter-occlusal records(in degree)	
				R	L	R	L
1.	Subject	26	F	25	33	58	40
2.	Subject	22	F	35	37	43	49.5
3.	Subject	22	F	35	39	47	40
4.	Subject	27	F	35	37	29	29
5.	Subject	24	F	30	40	18	22
6.	Subject	23	F	45	50	18.5	13
7.	Subject	23	F	45	32	37	52
8.	Subject	22	F	05	16	21	33
9.	Subject	24	F	41	39	31	40.5
10.	Subject	24	F	51	54	50	46
11.	Subject	28	M	30°	24°	45°	45°
12.	Subject	24	M	46	44	46.5	50
13.	Subject	25	M	45	55	54	63
14.	Subject	23	M	20	28	15.5	23.5
15.	Subject	30	M	39	25	14	9
16.	Subject	22	M	34	39	36	44.5
17.	Subject	28	M	36	25	29	47
18.	Subject	20	M	16	29	24	22
19.	Subject	29	M	59	59	17	30
20.	Subject	21	M	24	34	47.5	48

Table 2. Condylar guidance angle (Mean ± SE, n=20) of all subjects at right and left sides using both the methods

Sex	Articulator	Panoramic	Mean difference	Mean difference (%)
Female	67.38 ± 7.54	68.75 ± 9.17	1.38	2.00
Male	66.88 ± 6.96	71.00 ± 11.34	4.13	5.81

4. DISCUSSION

Accurately measuring condylar guidance is, important correctly simulate mandibular movements on the articulator and to fabricate well-functioning prosthesis for restoring the patient's lost oral form, function, appearance and health [6].

Panoramic imaging (also called pantomography) is a technique for producing a single tomographic image of the facial structures that includes both the maxillary and mandibular dental arches and their supporting structures. The panoramic radiograph is a widely used method for diagnosis and it gives an accurate representation of equivalent outlines in the skull and can be of value in determining the condyler guidance angle but the image magnification and distortion limits accuracy in panographic radiography [7].

Musawi et al investgated the condylar path angle (CPAs) in Malay subjects to compare the measurements with average values, (25° -35° Camper's based on caucasian studies), and to compare the right and left CPAs. In that study, thirty subjects aged 21-23 years were recruited. A wash technique impression was made, casts were poured, and face-bow transfers were taken. The casts were mounted to their centric position on a semi-adjustable articulator. Protrusive guides were constructed to allow the mandible to be protruded for 5 mm, and then the angles were measured using the protrusive record method. They found that the right CPA was within the normal range for 43% (13/30) of participants and out of the normal range for 57% (17/30). The left CPA was within the normal range for 33% (10/30) of participants and out of the normal range for 67% (19/30). There was no statistically significant difference between the left and right CPAs ($p = 0.72$), but there was a strong linear

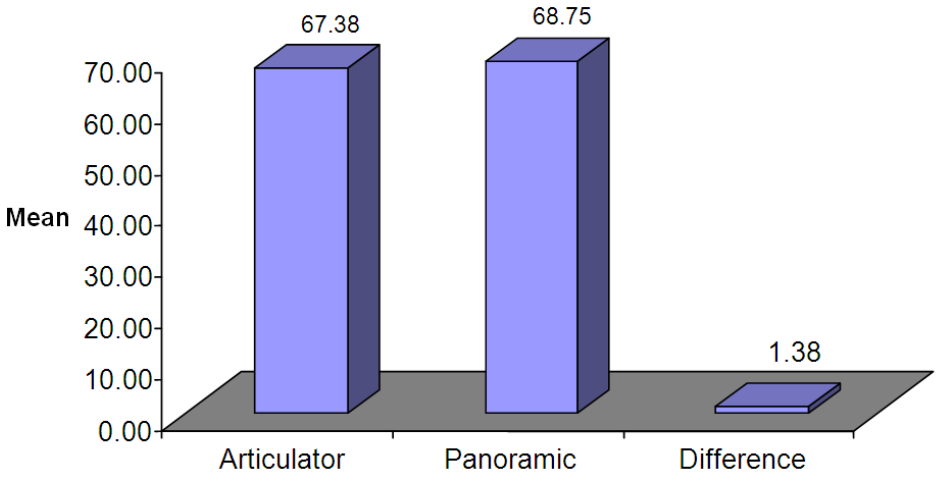

Fig. 4. Condylar guidance angle (degree)- Female

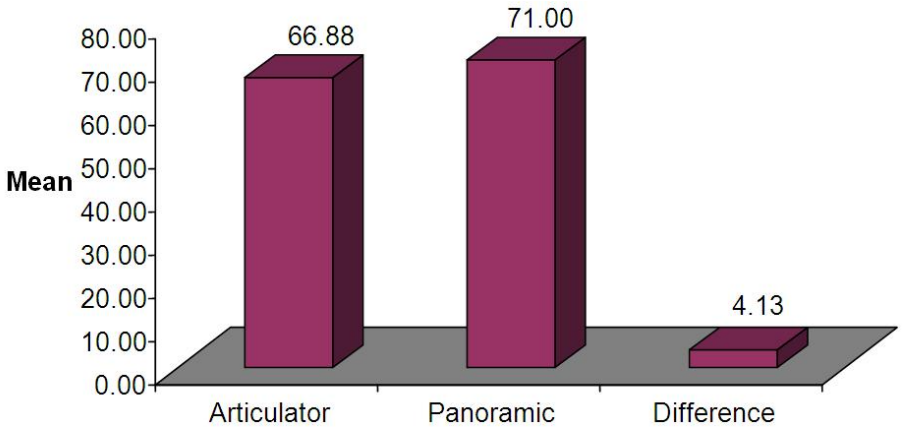

Fig. 5. Condylar guidance angle (degree) - Male

relationship between left and right CPAs (p = 0.001). They concluded that, Malay subjects had measurable variations in the CPA, suggesting this population has an ethnic variation in the CPA [8].

Kwon et al studied the correlation between sagittal condylar guidance angles (SCGAs) obtained using radiographic and protrusive occlusal record methods. They concluded that Strong correlations were detected between the SCGAs obtained using radiographic images and the protrusive occlusal record [9].

Krishna et al in a clinical-radiographic study of sagittal condylar guidance compared using protrusive inter-occlusal registration and panoramic radiographic imaging and found that Condylar guidance inclination determined by those methods cannot be compared when obtained by different planes of reference [5].

Other studies that evaluated the feasibility of using panoramic radiographs as an alternative to an interocclusal recording method for determining the condylar guidance in dentate and edentulous conditions concluded that panoramic radiograph can be used as an alternative to interocclusal technique in edentulous patients 5,9,10].

In the present study the panoramic machines used to obtain all radiographs were equipped with a light source and a cephalostate that helps in accurately positioning the patients and to minimize errors. The mean curvature of the articular eminence in the panoramic radiographic image was recorded as the condylar guidance angle [1].

In the protrusive method, inter-occlusal records are used to set the condylar guides to approximate the anatomical limit of temporomandibular joint. This allows the maximum benefit from using an articulator and facilitates in the fabrication of accurate restorations with a minimal time required for intraoral adjustment. The inclination of condylar path during protrusive movement may vary from steep to shallow and differ among patients By looking at the condylar guidance of the individual patieny using inter-occlusal method the panoramic radiographic image may be a value to program the semi adjustable articulator [11,12,13].

5. LIMITATIONS OF THE STUDY

- Structures were flattened out radiographically (OPG) which becomes more apparent when the subject is improperly positioned.
- Ghost images were formed which appeared more blurred than the real images.
- A panoramic radiograph gives a two dimensional representation of the glenoid fossa and the articular eminence, so the curvature seen on the radiograph may not give the exact inclination of the condylar guidance value [14].

Further studies on the variations in the sagittal condylar path inclination values in the panoramic radiographs are required to obtain normative data for our population.

6. CONCLUSION

Considering the inaccuracies of the interocclusal record technique, the alternative method of recording protrusive condylar guidance angle by panoramic radiograph is not difficult to perform and appears to have useful clinical application. The right and left horizontal condylar guidance values were comparable to each other and were not statistically significant when compared with the angles obtained by protrusive inter-occlusal record method. The values obtained by panoramic method may be used to program the semi-adjustable articulator to obtain clinically acceptable restorations.

CONSENT

Informed consent to participate was obtained from each patient prior to their enrollment in the study.

ETHICAL APPROVAL

Ethical approval was obtained from institutional ethical research cell committee.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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