

Original Research

Accuracy of horizontal condylar guidance values in edentulous patients using preprosthetic diagnostic radiographs: An original research

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ABSTRACT:

Introduction: In this study we aim to evaluate accuracy of horizontal condylar guidance values in edentulous patients using preprosthetic diagnostic radiographs. **Materials and Methods:** A total of 100 CD individuals were considered. HCG angles were determined clinically using protrusive interocclusal records and semi-adjustable articulator after intraoral gothic arch tracing. Radiographically, it was taken by cephalometric tracing of OPG and lateral cephalogram. **Results:** In our study shows mean HCG \pm standard deviation (SD) of $28.17^\circ \pm 5.99^\circ$ for interocclusal protrusive record while cephalometric tracing method yielded HCG \pm SD of $38.95^\circ \pm 4.77^\circ$ and $35.2^\circ \pm 4.94^\circ$ for lateral cephalogram and orthopantomogram, respectively. A statistically significant positive correlation was seen among these three methods. **Conclusion:** HCG values from cephalometric tracing of diagnostic radiographs can be used as an aid to the clinical method but cannot be used independently for programming a semi-adjustable articulator.

Key words: Horizontal Condylar Guidance, Preprosthetic Diagnostic Radiographs, Edentulous Patients.

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INTRODUCTION

Condylar guidance if not detailed correctly, might lead to an increased clinical adjustment time due to trimming which can be difficult.[1] Horizontal condylar inclination can be established by different methods including interocclusal records, pantographic tracings, electronic jaw tracking devices, radiographic methods, etc., but programming semi-adjustable articulator with protrusive interocclusal record is still the most prevalent method in clinical practice.[2-4] Intraoral registrations may compromise the accuracy because of dimensional instability of registration materials.

The radiographic method is simpler, with the angles being read directly on the radiographs. On lateral cephalogram and panoramic radiograph, various angles of temporomandibular joint (TMJ) are usually supposed to be related to the HCG angle. Frankfurt horizontal plane is taken as a reference plane when HCG is determined. If a correlation between HCG values using lateral cephalometry or panoramic radiograph tracing and protrusive interocclusal records can be established in an edentulous population, the necessity of performing elaborate recording procedures can be removed. An precise HCG value can be determined each time from

diagnostic radiographs only.[5-10] Hence, In this study we aim to evaluate accuracy of horizontal condylar guidance values in edentulous patients using preprosthetic diagnostic radiographs.

MATERIALS AND METHODS

After obtaining the institutional Ethical Clearance 100 complete edentulous subjects were selected. For the radiographic determination of HCG, one OPG and a lateral cephalogram were made for each participant using a digital cephalostat. All the radiographs were made in an open mouth position using one standardized bite block. Two bite blocks were made from cold cure acrylic.

Both the OPGs and lateral cephalograms were manually traced using the guidelines as given by Gilboa *et al.*[7] The Frankfurt's horizontal plane (FH plane) was drawn by joining the "orbitale" (lowest point on the infraorbital margin of the orbit) and "porion" (highest point on the margin of the bony auditory meatus).[8] The most superior point on the glenoid fossa and most inferior point of articular eminence were identified, and the mean curvature line was obtained by joining the two points. A third reference line passing through the same points was extended to intersect the Frankfurt's Horizontal Plane. This angle was measured with a protractor and was

considered as HCG angle.[9]

For the clinical HCG registration, maxillary and mandibular primary impressions were registered with impression compound and casts were poured. Custom trays were fabricated by cold-cure acrylic resin and the final impressions made with ZOE impression paste after proper border molding with green stick compound. Master casts were made with Type III dental stone. Occlusal rims of proper dimension were made on trial denture base (DPI RR cold cure, Mumbai) of 2- mm thickness.[10] Facebow records were made to mount the maxillary cast on the Hanau™ Wide- Vue Articulator. The Hanau™ Wide- Vue articulator had a condylar track of numerical scale with increments of 5°. To take the readings with accuracy up to 1°, a protractor modified to have angulations from -20° to +60° along with a movable pointer was fixed on to the condylar shaft. If the pointer was at 0.5 or more decimals on the protractor, the greater value was considered for the reading. After taking tentative vertical jaw relation, an intraoral gothic arch tracing was done to make centric and 6- mm protrusive plaster interocclusal records. The protrusive check bite was used to register the right and left HCG values on the Hanau™ Wide- Vue articulator. The data recordings were recorded and compared keeping $p < 0.05$ as significant

RESULTS

From our study, HCG values range from 21° to 43° in the right sides and 17°–45° in the left sides recorded by the clinical protrusive interocclusal method, whereas 28°–47° in the right sides and 27°–46° in left sides were recorded by the panoramic radiographic method. Lateral cephalogram tracing produced HCG values ranging from 31° to 50° at right sides. Three different results of mean HCG \pm SD were obtained by three different methods. HCG \pm SD was 28.17° \pm 5.99° for interocclusal protrusive record, while cephalometric tracing and OPG method yielded 38.95° \pm 4.77° and 35.2° \pm 4.94°, respectively. A statistically significant positive correlation ($P < 0.0001$) was seen between three methods rejecting the null hypothesis [Table 1].

Table 1: Comparison of the three variables

Methods	Clinical right side	Clinical left side	Clinical total	OPG right side	OPG left side	OPG total	Lateral cephalogram right side
Clinical right side							
<i>r</i>		0.846**	0.952**	0.940**	0.869**	0.927**	0.899**
<i>P</i>		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Remarks		Positive	Positive	Positive	Positive	Positive	Positive
Clinical left side							
<i>r</i>	0.846**		0.968**	0.816**	0.936**	0.900**	0.877**
<i>P</i>	<0.0001		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Remarks	Positive		Positive	Positive	Positive	Positive	Positive
Clinical total							
<i>r</i>	0.952**	0.968**		0.907**	0.943**	0.949**	0.923**
<i>P</i>	<0.0001	<0.0001		<0.0001	<0.0001	<0.0001	<0.0001
Remarks	Positive	Positive		Positive	Positive	Positive	Positive
OPG right side							
<i>r</i>	0.940**	0.816**	0.907**		0.899**	0.974**	0.945**
<i>P</i>	<0.0001	<0.0001	<0.0001		<0.0001	<0.0001	<0.0001
Remarks	Positive	Positive	Positive		Positive	Positive	Positive
OPG left side							
<i>r</i>	0.869**	0.936**	0.943**	0.899**		0.976**	0.962**

<i>P</i>	<0.0001	<0.0001	<0.0001	<0.0001		<0.0001	<0.0001
Remarks	Positive	Positive	Positive	Positive		Positive	Positive
OPG total							
<i>r</i>	0.927**	0.900**	0.949**	0.974**	0.976**		0.979**
<i>P</i>	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		<0.0001
Remarks	Positive	Positive	Positive	Positive	Positive		Positive
Lateral cephalogram right side							
<i>r</i>	0.899**	0.877**	0.923**	0.945**	0.962**		0.979**
<i>P</i>	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		<0.0001
Remarks	Positive	Positive	Positive	Positive	Positive		Positive

**Denotes statistically significant result. OPG: Orthopantomogra

DISCUSSION

The present study was attempted to evaluate accuracy of horizontal condylar guidance values in edentulous patients using preprosthetic diagnostic radiographs. In our study, a statistically significant positive correlation was formed between mean HCG angles obtained from protrusive interocclusal record and panoramic radiographic tracing, but the mean HCG difference between panoramic radiographic tracing and protrusive interocclusal records was 7.03°. Gilboa *et al.* seensame mean difference of 7°; Kumari *et al.* claimed the radiographic values were on average 4° and 13° greater, respectively.[7,8] Without using any accessory aid, it is difficult to distinguish between these two closely approached radiopaque lines, one depicting the outline of the articular eminence and fossa, the second one indicating the inferior border of the zygomatic arch.[11-15]

Mean HCG angle values were seen to be greater in lateral cephalogram tracing when comparing with panoramic radiograph and clinical method and they were 3.75° and 10.78° greater respectively. This is in contrast to the findings of Galagali *et al.*, where they seen that panoramic radiographs showed a greater HCG value than that of lateral cephalogram.[16] From our study, HCG values determined by protrusive method were 17°–45°, whereas cephalometric tracing of panoramic radiographs and lateral cephalogram yielded HCG values ranging from 27° to 47° and 31°–50°, respectively. Zamacona where they seen HCG angulations ranging from 5° to 55° was in unison with present study.[18]

In the present study, mean HCG values obtained from panoramic radiographic tracing and interocclusal protrusive records for the right side were 35.6° and 28.35° with a mean difference of 7.25°; 28.0° and 34.8° for left side with a mean difference of 6.80°, respectively, showing statistically and clinically significant results. These results were in accordance to the study by Patil *et al.*[4] However, values from radiographic technique were seen to be lower in the study by Patil *et al.*[4] This inconsistency may be explained by the fact that quantitative measurements on OPG or lateral cephalogram are difficult because of magnification differences, image distortions and are dependent on operator's perception.

Christensen and Slabbert mentioned this discrepancy

of radiographic method comparing with the intraoral clinical method of HCG determination where radiographic method is always greater.[3]

Inaccuracies of manual cephalometric tracing might arise at tracing stage, during landmarks identifications and misreading of measurements as cephalometric analyses are dependent to human judgment. Clinical protrusive technique for each individual is mandatory to determine accurate HCG values. Cephalometric tracing of diagnostic radiographs can define an idea about HCG angle before any clinical step, that help the operative to select the type of articulator and select posterior teeth. It cannot be used independently for programming articulator due to its inability of soft-tissues imaging, unreliability of determining landmarks, image distortion, and structural superimposition.

We had some limitations like the Manual cephalometric tracing method was used instead of digital imaging software.

CONCLUSION

HCG values from cephalometric tracing of diagnostic radiographs can be used as an aid to the clinical method but cannot be used independently for programming a semi-adjustable articulator. Further studies with larger sample size, different articulator systems, are advised.

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