Section: Dentistry

Original Research Article

REVERSE PANORAMIC IMAGING AN ASSESSMENT FOR TMJ: A NOVEL APPROACH

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ABSTRACT

Background: The essence of oral and maxillofacial radiology is not only to an important tool in the diagnostic assessment of dental patients but also to equip the clinician with the ability to interpret images of certain maxillocraniofacial structures of importance to dental, medical and surgical practices. One of the most important and unique joints in the body is the Temporomandibular Joint (TMJ). TMJ is a freely movable articulation between the condyle of the mandible and squamous portion of the temporal bone at the base of the skull. The appearance of mandibular condyle & variability in the shapes and sizes among different age groups and individuals should be an important factor in diagnosing the disorders of TMJ. Though OPG provides us with bilateral view of condyle but is not much clearly appreciated except its central & lateral part as there is superimposition of certain structures, so we worked on new modified technique i.e Reverse Panoramic Imaging in which condylar head is better appreciated than conventional/standard Panoramic Imaging. The aim & objective is to Compare the reliability of Reverse Panoramic Imaging over standard/conventional Panoramic Imaging for bilateral imaging of the condyle.
Materials and Methods: Total of 30 subjects (30 OPG & 30 Reverse OPG) visiting our college will comprise the study group. Both OPG & Reverse OPG will be taken for the same patient & the image will be analyzed for following parameters i.e Condylar Head, Condylar Neck, Articular Eminence, Mandibular Fossa, Sigmoid Notch.
Results: Data was statistically analysed by Chi Square test.
Conclusion: Study concludes that Reverse Panoramic Imaging can be a BETTER approach to assess the TMJ than standard Panoramic Imaging as there is no superimposition of any associated structure.
Keywords: Reverse Panoramic Imaging, Mandibular condyle, Temporomandibular joint.

INTRODUCTION

Temporomandibular Joint (TMJ) is one of the most important and unique joints in the body. TMJ is a freely movable articulation between the condyle of the mandible and squamous portion of the temporal bone at the base of the skull.[1]
The functions of the temporomandibular joint, is to provide smooth, efficient movement of the mandible during mastication, swallowing and speech and to provide stability of mandibular position and prevent dislocation from external or unusual forces.[2]
The condyle is very special because expression of the mandibular growth is provided by mandibular condyle. The appearance of mandibular condyle varies greatly among different age groups and individuals. Human mandibular condyles may be categorized into five basic types: flattened, convex, angled, rounded and concave. Morphologic changes of condyle occur due to developmental variations,

remodeling, various diseases, trauma, endocrine disturbances and radiation therapy.[3,4]

Thus variability in the shapes and sizes of condyles should be an important factor in diagnosing the disorders of temporomandibular joint. Among various imaging modalities used for TMJ imaging panoramic radiographs still remains the main screening modality for TMJ abnormalities but still condylar head anatomy is superimposed by some of the anatomical structures of the skull and is not clearly appreciated in Panoramic Imaging, so slight modification was done in the "Modified Reverse Panoramic Technique" described by Chandra et al.[5] In a reverse panoramic radiograph (RPRg), condylar head is better appreciated than conventional panoramic radiographs because lesser radioopaque mastoid air cells superimpose the condylar head in comparison to the more radiopaque cranial base and zygomatic arch seen in conventional panoramic radiographs.[6]

Aim & Objective: To Compare the reliability of Reverse Panoramic Imaging over standard/conventional Panoramic Imaging for bilateral imaging of the condyle.

MATERIALS AND METHODS

Figure 1

Study was conducted on 30 randomly selected healthy subjects between the age of 20 to 40 years keeping in consideration that the development of condyle is completed and no pathological conditions are present in this age group. The 30 Panoramic Imaging and Reverse panoramic imaging was taken of same patient. Approval was taken from IHEC and IRDC. Written informed consent was obtained from each subject after explaining the purpose and nature of the study. Dental and clinical records of the patients were recorded in a prescribed performa. Subjects with history of disorders related to temporomandibular joint or mandible, history of temporomandibular joint surgery, clinical characteristics of endocrine disturbances, presence of any radiographic error, nutritional diseases or hereditary facial asymmetries were excluded from study. First the OPG was taken in Kodak 8000C Digital Panoramic and Cephalometric machine operating with Kodak Dental Imaging Software and Cephalometric Acquisition Interface Module at standard exposure parameters and adequate radiation protection measures [Figure 1] and image was obtained with superimposition of normal anatomic structures on condylar head [Figure 5].

Then the reverse Panoramic radiograph was taken for the same patient with standardization of radiographic technique was done Subjects were positioned in reverse manner in Kodak 8000 Digital Panoramic system at standard exposure parameters (80 kVp, 10 mA, and 13.9 s). Adequate radiation protection measures were taken, maintaining the mid sagittal plane centered within the image layer of the X-ray unit. Chin rest was so adjusted in order to place condylar region close to lateral centre of rotation bilaterally equal making an angle of 15 degree upward from ala-tragus line with slightly mouth open, to disocclude the dentition. [Figure 2,3]. Patients head was stabilized centrally with the assistance of central head stabilizer. Patient was instructed to slightly open the mouth to attain the position of non occlusion and avoid overlapping of adjacent anatomical structures. The resultant image obtained gave a clear undistorted, non overlapped image of lateral (anterio- posterior border) aspect of mandibular condyle bilaterally along with mastoid air cells, occipital bone and cervical vertebrae [Figure 6].

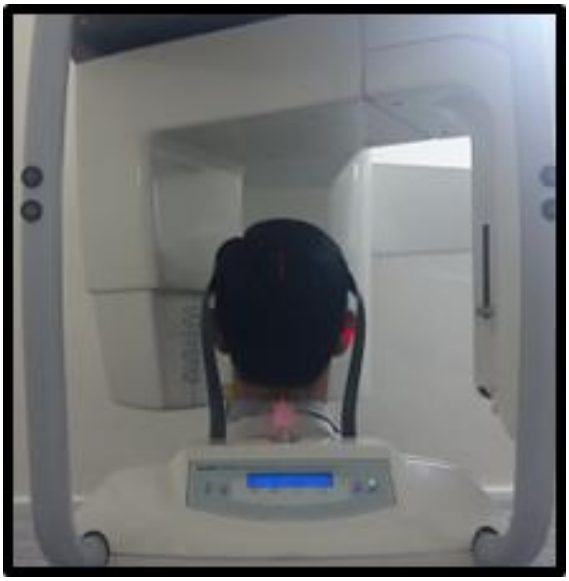


Figure 2

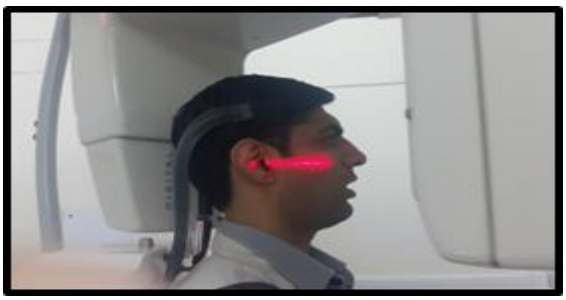


Figure 3

Figure 4: OPG

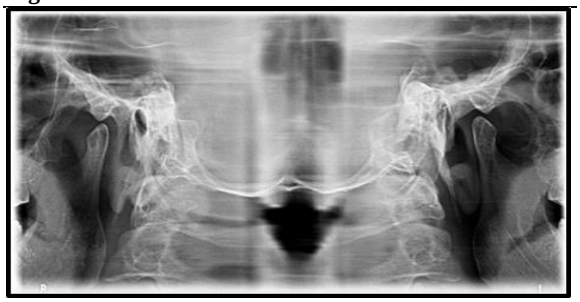
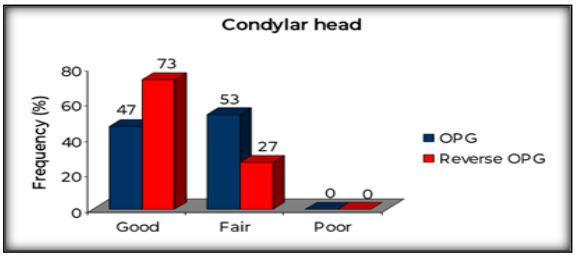
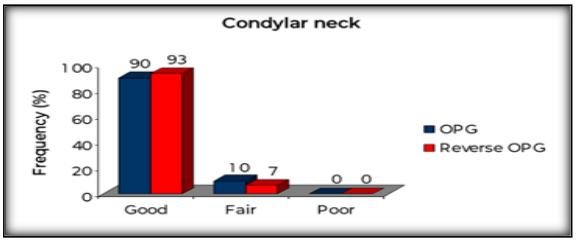
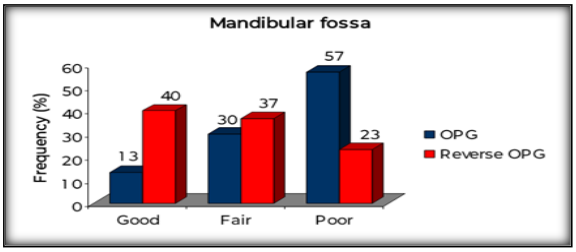
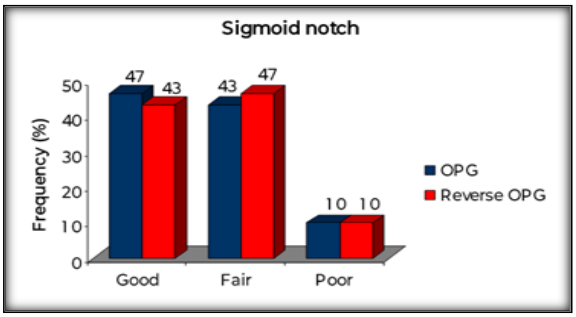


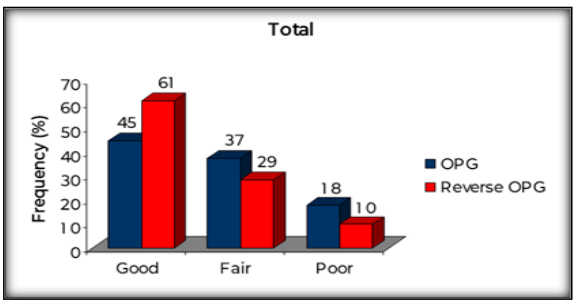
Figure 6: Reverse OPG











RESULTS

Now both the radiographs were compared, In overall assessment of TMJ Reverse Panoramic Imaging showed 61 % better result as compared to OPG in almost all the parameters or significantly the same.

- Categorical groups were compared by chi-square ($\chi 2$) test.
- A two-tailed $p<0.05$ was considered statistically significant.
- Analyses were performed on SPSS software (windows version 17.0).

Table 1: Distribution and comparisons of condylar head & neck mandibular fossa, articular eminence, sigmoid notch in panoramic image and reverse panoramic imaging.

Parameters	Outcome	OPG (n=30) (%)	Reverse OPG(n= 30) (%)	$\chi 2$ value	p value
Condylar head	Good	14 (47)	22 (73)	4.44	0.035
	Fair	16 (53)	8 (27)		
	Poor	0 (0)	0 (0)		
Condylar neck	Good	27 (90)	28 (93)	0.22	0.640
	Fair	3 (10)	2 (7)		
	Poor	0 (0)	0 (0)		
Mandibular fossa	Good	4 (13)	12 (40)	8.37	0.015
	Fair	9 (30)	11 (37)		
	Poor	17 (57)	7 (23)		
Articular eminence	Good	8 (27)	17 (57)	5.70	0.058
	Fair	15 (50)	8 (27)		
	Poor	7 (23)	5 (17)		

Sigmoid notch	Good	14 (47)	13 (43)	0.07	0.964
	Fair	13 (43)	14 (47)		
	Poor	3 (10)	3 (10)		
Total	Good	67 (45)	92 (61)	9.07	0.011
	Fair	56 (37)	43 (29)		
	Poor	27 (18)	15 (10)		

DISCUSSION

TMJ is a freely movable articulation between the condyle of the mandible and squamous portion of the temporal bone at the base of the skull.[1] The function and health of TMJ is vital to life. Panoramic radiograph is curved surface tomogram, and popular radiographic technique in dentistry.[7] It is based on the principle of reciprocal movement of an x-ray source and image receptor around a central plane while the patient remains stationary. This central plane of the object is not blurred on the radiographs called as plane image layer. Panoramic radiography was first described by Numata and Paatero,[8,9] later by Hudson and Blackman.[10,11] Panoramic Radigraphy is an invaluable aid in orofacial diagnosis because of the broad coverage of the facial bones and teeth. It also serve diagnostic modalities for hard tissue imaging of the temporomandibular joint. Some panoramic units have provision o take TMJ Tomogram. The unit must have adjustable focal trough. Some other technique are also there to show the lateral aspect of the condyle but all has its own limitations.[7] Trancranial joint shows lateral joint contours, ipsilatral petrous ridge may superimpose over the condylar neck.[12] on other aspect Transpharyngeal view shows medial surface of condyle but patient is asked to open mouth widely and radiation dose is also high.[13] Linear tomography and Computed Tomography is not recommended for general screening purpose. Even a standard Panoramic view shows some distoration and magnification in the region of the ramus. So Reverse Panoramic Imaging provides clearer view and less distorted view of the ascending mandibular ramus condylar head and other adjacent structures and the better assessment of the temporomandibular joint especially in case of restricted mouth opening. Reverse panoramic imaging was first tried by Markus et al in 1986.[6] who demonstrated significant improvement in visualization of temporomandibular joint (TMJ) and associated structures.[7] In a standard panoramic radiograph, TMJ interpretation can be done generally only in the lateral and central aspects of the condylar head because of the oblique orientation of the beam with respect to the long axis of the condyle.[6] In a reverse panoramic radiograph (RPRg), condylar head is better appreciated than conventional panoramic radiographs because lesser radioopaque mastoid air cells superimpose the condylar head in comparison to the more radiopaque cranial base and zygomatic arch seen in conventional panoramic radiograph. So in present study, the condylar head, condylar neck, mandibular fossa, articular eminence and signmoid notch outcome (good/fair/poor) of two groups is summarised in [Table 1]

Comparing the outcome of two groups, $\chi 2$ test showed significantly different and higher 'good" outcome of condylar head (26%) (47% vs. 73%, $\chi 2=4.44$, $p=0.035$) and mandibular fossa (27%) (13% vs. 30%, $\chi 2=8.37$, $p=0.015$) in reverse OPG as compared to OPG.

However, the outcomes of condylar neck, articular eminence and sigmoid notch not differed ($p>0.05$) between the two groups i.e. found to be statistically the same. Further, among these, the findings (outcome) of sigmoid notch were the most similar between OPG and reverse OPG followed by condylar neck and Articular eminence.

Moreover, the overall or total (condylar head + condylar neck + mandibular fossa + articular eminence + signmoid notch) "good" outcome was also found to be significantly different and higher (16%) in reverse OPG as compared to OPG (45% vs. 61%, $\chi 2=9.07$, $p=0.011$). Similar study was done C.Pravda, D. Koteeswaran "Reverse opg – A Revival" were they concluded that position should be critical and needs to be accurate such that condylar region is close to the lateral center of rotation. Less distoration and clarity depends on the limited opening of the mouth during the exposure. Errors can occur with improper postioning of the patient in the machine.[6]

Advantages

- Shows the condyle and its neighbouring structures with the ascending ramus that is usually overlapped by the soft tissue shadows in the OPG.
- Lesser cooperation from the patient .
- Restricted mouth opening in case of fracture of condylar region.
- No provision to take a TMJ tomogram.
- Assessment of posterio-lateral surface of mandible.
- To view the head of the condyle, mandibular fossa, sigmoid notch, Articular Eminences

Limitation

- Sensitive technique and any error in positioning of the subject or x-ray source can result in diagnostically unacceptable radiographs. To achieve maximum advantage, it is not only important for the clinician to follow the correct technique, but also to understand the limitations as well as the capabilities.
- It is further suggested to incorporate new softwares and programmes in the panoramic machines which can aid in improved reverse panoramic tomography.
- Reverse Panoramic imaging is not without problems. Positioning of the patient is more critical than for the standard view.

CONCLUSION

This Study concludes that to assess the temporomandibular joint or its associated structures Reverse Panoramic Imaging can be a better approach than standard Panoramic Imaging as the superimposition of normal anatomic structures is negligible. It can be also be better approach in case of limited mouth opening.

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