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Original Article

Comparison Between Roof of Glenoid Fossa Roof in Temporomandibular Joint Disorders and Non-TMD Patients: A Cone-Beam Computed Tomography Study

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ABSTRACT

Objective: To study variations in the thickness of the roof of the glenoid fossa (RGF) in a group of patients with temporomandibular disorder (TMD) compared to a non-TMD group using Cone Beam Computed Tomography (CBCT).
Study Design: Comparative cross-sectional study.
Place and Duration of Study: Department of Prosthodontics, Armed Forces Institute of Dentistry (AFID), Rawalpindi Pakistan, from Jul 2024 to Jan 2025
Methodology: Based on inclusion criteria, 60 patients with complaints of TMD for the last two years were included in the study. After obtaining informed consent, the patients with temporomandibular joint pain (Group-A) were subjected to a full clinical evaluation and CBCT of the affected TMJ and the normal TMJ were requested from the Department of Radiology. Patients undergoing dental implant placement and those with orofacial pain unrelated to TMJ, like caries and sinusitis, requiring CBCT as part of their workup were included as controls (Group-B). CBCT reporting on all individuals was performed by a single investigator. Chi-square test and t-test were used to analyze data.
Results: Mean thickness of the RGF in patients with TMD was 1.850±1.096 mm which is significantly increased compared to 1.006±0.265 mm in non-TMD patients (*p*-value <0.001). Only one case of discontinuity of the RGF was recorded. The age and gender distribution matched closely in the two groups.
Conclusion: The study demonstrates a significant increase in Roof of Glenoid Fossa thickness in Temporomandibular Disorder (TMD) patients, suggesting its potential role as a diagnostic criterion in TMD.

Keywords: Cone Beam Computed Tomography, Glenoid Fossa, Temporomandibular Disorders.

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INTRODUCTION

The temporomandibular joint (TMJ) is a ginglymoarthrodial synovial joint. It is formed between the glenoid fossa of temporal bone and the condyle of mandible.[1] Pain in the craniofacial/ orofacial region may be due to a dental problem or some non-dental issue. Temporomandibular Disorder (TMD) accounts for a majority of cases of non-dental pain in craniofacial/orofacial region including headaches.[2]

The etiology of TMD is complicated. It may be due to intra articular or extra-articular cause. Some of the variables that are considered to contribute to the TMD are masticatory muscular dysfunction causing localized pain/referred pain, disc displacement, bone destruction (degenerative joint disease), malocclusion, partial edentulism, faulty prosthesis, trauma to TMJ, postural deviation and psychological factors.[3,4] The most common intra-articular factor that contributes to TMD is the malalignment of the articular disc in condyle-disc relationship.[5,6]

The significance of imaging is crucial in diagnosing TMD, particularly when the history and physical examination results are inconclusive. Various advanced imaging modalities like ultrasonography (USG), computed tomography (CT), magnetic resonance imaging, arthrography and cone beam computed tomography (CBCT) are now available for the assessment of TMJ.[7]

A number of alterations involving TMJ have been studied in cases of TMD like joint space, condylar erosion, condylar flattening, subcortical sclerosis, osteophyte formation and subcondylar pseudocyst formations.[8,9] Studies, however, have also shown an association between TMD and thickness of the RGF.[10] CBCT is considered to be a highly efficient and low-cost technique producing images of bony changes of high diagnostic quality using lower radiation doses when investigation of the thickness of the RGF is required.

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This study aimed to evaluate the thickness of the roof of the glenoid fossa (RGF) in individuals with temporomandibular disorders (TMD) compared to those without TMD.

METHODOLOGY

This comparative cross-sectional study was carried out at the Department of Prosthodontics, Armed Forces Institute of Dentistry (AFID), Rawalpindi Pakistan, from July 2024 to January 2025. An approval was obtained from the Ethical Committee/ Institutional Ethics Review Board (IERB) of the Armed Forces Institute of Dentistry (AFID) (Ref. No. 918/Trg/008/Jan/2023).

Inclusion Criteria: Patients of either gender with an age range of 18-65 years, classified on Helkimo's Clinical Dysfunction Index with TMD lasting for the last two years were included.[11]

Exclusion Criteria: All patients who had undergone TMJ surgery, exhibited any congenital TMJ abnormalities, suffered from musculoskeletal or neurological disorders, or had any systemic diseases, were excluded.

WHO calculator was utilized to determine the sample size using standard prevalence of Temporomandibular disorders at 50%, resulting in a total of 385.[11] Non-probability convenience sampling was used to collect data.

Patients coming to the Out-Patient-Department (OPD) with complaints of any orofacial pain in temporomandibular region were registered in hospital information system (HIS), and demographic details were recorded. Patients, after initial triage in OPD clinics, were referred to the Department of Prosthodontics for consultation and management of the chief complaints. After clinical evaluation, necessary management and informed consent, patients with suspected TMD (TMD group) were referred to the radiology department for CBCT of the affected TMJ and the normal TMJ. Sixty patients with TMD were placed in Group-A, while 70 of those undergoing dental implant placement and those with orofacial pain unrelated to TMJ, like caries and sinusitis, requiring CBCT as part of their workup were included as controls (Group-B), as seen in Figure-1.

CBCT examination was performed using a NewTom Vgi scanner (Figure-2). Several factors affect the quality of CBCT images such as voltage, current (amperage), scanning field and voxel. Depending upon the individual patient requirements the images were obtained with specific parameter settings, as: voltage 60-120 kVp, current 2-15 mA, exposure time 5-40 sec, scanning field 5x5 cm to 13x17cm, voxel size 0.075 to 0.4 mm and minimum thickness size of 0.2 mm. During the CBCT scanning, patients were instructed to maintain a standing position in a naturally relaxed state, ensuring that the Frankfort Horizontal (FH) plane was parallel to the floor, and that the intraoral occlusion was in the intercuspal position. All patients underwent CBCT imaging on the same scanner and by the same technician.

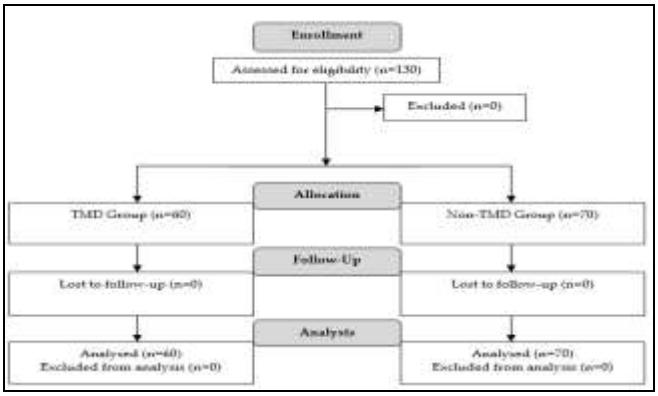

Figure-1: Patient Flow Diagram

Figure-2: NewTom Vgi scanner for Cone Beam Computerized Tomography

Thickness of RGF was assessed as the minimum perpendicular distance between the 'glenoid fossa line' and the 'middle cranial fossa line' in the frontal (coronal) plane (Figure-3). The thickness of RGF was measured by one of the authors (WP) at the narrowest section of glenoid fossa, as identified on the monitor across various slices, and the average of two measurements was computed for statistical analysis. Data regarding thickness of RGF and any discontinuities were gathered accordingly.

Figure-3: Measurement of Roof of Glenoid Fossa in Frontal Section showing the distance between Inferior Cortex and the Superior Cortex

Data was analyzed using Statistical Package for Social Sciences (SPSS) version 22. Quantitative data was represented using mean ± standard deviation and qualitative data was represented by using percentage and frequency. Chi square test (for qualitative variables) and independent Samples t-test (for normally distributed variables). The *p*-value of ≤0.05 was considered as significant.

RESULTS

A total of 130 patients participated in the study. There were 60 patients in Group-A including 42(70%) females and 18(30%) males with mean age of 29.35±5.69 years. There were 70 controls in Group-B including 43 females (61.4%) and 27 (38.9%) males with mean age of 29.33±5.71 years. The study shows that the two groups closely match and are not significantly different for age (*p*-value 0.983) and the gender distribution (*p*-value 0.305). Baseline characteristics are shown in Table-I.

Table-I: Age and Gender Distribution across Groups (n=130)

Variables		Group-A (n=60)	Group-B (n=70)	*p*-value
Age (years) Mean±SD		29.35±5.69	29.33±5.71	0.983
Gender	Female	42(70%)	43(61.4%)	0.305
	Male	18(30%)	27(38.6%)	

Table-II shows comparison of the measurements of RGF thickness between non-TMD patients and the TMD patients. Mean thickness of the RGF is significantly more in TMD patients (*p*-value <0.001).

Table-II: Comparison of Roof of Glenoid Fossa thickness across Groups (n=130)

Groups	RGF thickness (mm) (Mean± SD)	Range (mm)	*p*-value
TMD patients	1.850±1.096	0.6-4.9	<0.001
Non-TMD patients	1.006±0.265	0.6-1.7	

**TMD: Temporomandibular Disorder*

DISCUSSION

In our study, sixty patients with clinically diagnosed TMD (Group-A) had their CBCT performed for assessment of the thickness of RGF. Seventy patients undergoing CBCT for non-TMD conditions were included as controls for comparison (Group-B). There was no significant difference in mean ages of the patients in the two groups; thus, age is unlikely to influence observed differences in RGF thickness. The mean age in the two groups, however, showed that the patients undergoing CBCT for TMD evaluation or for other reasons were relatively young. In our study there were 70% females and 30% males in TMD group while in non-TMD group 61.4% were females and 38.6% were males. This shows that the gender distribution is not significantly different, indicating that gender-related differences are unlikely to bias the outcome. There is a statistically significant increase in RGF thickness in patients with TMD compared to those without. The mean difference suggests that this could be a potential morphological indicator or consequence of TMD.

Similar age and gender distribution has been reported in other studies also. However it has been observed, in a study, by Yap *et al.,* and in a meta-analysis by Zielinski *et al.,* that TMD is more common in women than men with a female to male (F: M) ratio of 1.09 to 1.56.[11,12] This has been attributed to the

effects of hormonal influences on the TMJ and Gender has been suggested as a notable risk factor for TMJ disorders, in addition to parafunctional habits.[13]

In our study the mean thickness of the RGF was 1.006 mm (Range: 0.6–1.7) in non-TMD group and 1.850 mm (Range: 0.6–4.9) in those with TMD. A study conducted by Greene *et al.,* on autopsies revealed that the minimum thickness of glenoid fossa roof ranged from 0.5 to 1.5 mm, with a mean measurement of 0.9 mm.[14]

Park *et al.,* reported average thickness of RGF in asymptomatic adult patients from Korea as 0.75 mm.[7] Ejima *et al.,* reported average thickness of RGF as 0.97 in asymptomatic Europeans while Khojastepour et al. in a study carried out in Iranian population, reported thickness of RGF as 1.12 in non-TMD patients.[15,16]

Our results in non-TMD patients are similar to those for asymptomatic patients as reported in the literature. In our study the mean thickness of RGF was significantly higher in TMD patients as compared to non-TMD patients. The two groups are significantly different for thickness of RGF (p-value <0.0001). Other studies have also reported similar results with significantly higher RGF thickness in TMD patients.[16]

There are varying reports on the RGF thickness in TMD, with some studies reporting an increase in thickness of RGF while others report no change in the thickness. Thickness of RGF has been studied in various scenarios. Chandran *et al.,* studied thickness of RGF in dentate, edentulous, and partially edentulous individuals using CBCT and did not find any statistically significant difference among the three groups of patients.[10] Altun *et al.,* found no significant difference between TMD and non-TMD patients although they reported a difference in RGF thickness between patients with degeneration findings and those without it and the mean RGF thickness was higher in patients with degeneration.[17]

In our study, however, the RGF thickness demonstrated a strong association with TMD compared to those with non-TMD patients undergoing CBCT for TMJ. International studies have shown that certain conditions like osteoarthritis (OA) of TMJ lead to an increase in the thickness of the RGF. It was, however, discovered that thickness of RGF is not influenced by morphology of condylar head or quantity of the remaining teeth.[15,18]

Increase in thickness of RGF, observed in our study, aligns with findings from other studies. Our impression, similar to other studies, is that this thickening of RGF in symptomatic TMD patients results from heightened mechanical stress on the cortical bone of RGF.

Studies have demonstrated cases of discontinuity of RGF among patients undergoing CBCT of TMJ. The presence of discontinuity has been reported in both the TMD group and non-TMD group. One study reported presence of discontinuity of RGF on CBCT in 8.6% of TMD patients and 1.4% in non-TMD group. In our study there was only one case of discontinuity in the RGF in non-TMD group.[16] Discontinuity of the RGF has been considered as a risk factor for displacement of mandibular condyle into intracranial fossa in cases of trauma. It has been considered as a risk factor for the intra-cranial abscess drain into the TMJ or an ear infection spreading intra-cranially through the TMJ.[19]

However, in a case report of discontinuity of RGF by Al-Ekrish *et al.,* no clinical significance of a thin RGF was reported.[20]

LIMITATION OF STUDY

The main constraint of the study is the limited sample size.

CONCLUSION

A significant increase in Root of Glenoid Fossa (RGF) thickness among Temporomandibular Disorder (TMD) patients as observed through Cone Beam Computerized Tomography, when compared to individuals without TMD, suggesting that RGF thickness could be a useful diagnostic criterion for TMD.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

WP & SK: Data acquisition, data analysis, critical review, approval of the final version to be published.

MMB & MS: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

SS & MS: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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