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Impact of Temporomandibular Joint Ankylosis on Dentition and Ramus Height: A Clinical Perspective

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ABSTRACT

Objective: Temporomandibular joint (TMJ) ankylosis is a debilitating disorder that affects jaw movement, facial symmetry, and general well-being. This study evaluates the impact of TMJ ankylosis on dentition, ramus height, and functional limitations, while also examining treatment trends among affected individuals.

Study Design: A cross-sectional study

Place and Duration of Study: Department of Oral and Maxillofacial Surgery, Khyber College of Dentistry, Peshawar, Khyber Pakhtunkhwa, Pakistan; from January 2023 to June 2023.

Materials and Methods: 40 patients with a diagnosis of TMJ ankylosis were evaluated for demographic details, impacts on dentition, differences in ramus height, functional limitations, and treatment records. Distributions of frequencies and percentages were used to analyze the data.

Results: The majority of patients (30%) were aged 20-29 years, with 50% presenting with bilateral ankylosis. The condition was equally divided between fibrous and bony ankylosis (50% each). Dental issues included malocclusion (62.5%), crowding (37.5%), and mandibular hypoplasia (30%). A ramus height drop of 11-15 mm was most common (37.5%). Functional deficits included difficulty in chewing (75%) and reduced mouth opening (70%). 25% had never received treatment, while 30% had undergone gap arthroplasty.

Conclusion: TMJ ankylosis causes malocclusion, reduced height of the ramus, and functional disability with a significant impact on the dentition and oral functionality. Surgical intervention is the main treatment, although there are a lot of untreated cases. This requires early detection and intervention to ensure that the long-term effects are minimal.

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Key Words
TMJ Ankylosis, Dentition, Ramus Height, Malocclusion, Functional Impairment, Surgical Treatment

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INTRODUCTION

Temporomandibular joint (TMJ) ankylosis is a debilitating condition in which the mandibular condyle fuses to the glenoid fossa, maxilla, zygomatic bone, or base of the skull, resulting in a non-functional TMJ. The TMJ ankylosis may be examined at unilateral, one joint, or bilateral, two joints. Further classification can be made based on location (intra- or extracapsular), tissue type (fibrous, bony, or fibro-osseous), and degree of fusion (full or partial) [1, 2].The majority of patients with TMJ ankylosis are caused by trauma, and other traumatic injuries have been reported in one in every five people who have the condition. Although in 3.6 percent of cases, the cause is unknown, the syndrome is significantly disabling in everyday tasks such as the movement of the jaws, eating, talking, and maintaining oral hygiene [3–5]. Due to its interference with the growth of the craniofacial structure, TMJ ankylosis is a severe condition when it appears in the stage of growth. In children, it may affect the formation of the mandible in the so-called younger children, resulting in dental, craniofacial deformities and consequential difficulties like obstructive sleep apnea. All the stages of proper mandibular development are critical to the eruption of permanent teeth, and any interference in the process may result in tooth crowding, rotated teeth, larger

overjet, and tooth decay because of a lack of oral hygiene [6, 7].

The development of teeth can be impacted by condyle trauma in children at an earlier age. This is because the mandibular body does not grow as much, which reduces the space required for teeth to emerge. The loss of space in the jaw joint (TMJ) can lead to a variety of problems, such as teeth that don't erupt properly, deciduous teeth that stay in the mouth after they should have fallen out, crowding, teeth that are crooked or misaligned, increased overjet due to proclaimed front teeth, many decaying or carious teeth caused by periodontal disease, and poor oral hygiene.Time of onset and extent of damage determine the full extent to which TMJ ankylosis impacts dentition. There is a tradeoff with aesthetics in addition to functional impairment [8- 11].

Unilateral TMJ ankylosis in patients can result in midline deviations, mandible asymmetry, or chin deviation, whereas bilateral ankylosisresults in retrognathia and convex facial contour, harming both means and looks. The affected individuals are likely to have a decrease in the height of the mandibular ramus and a decrease in mandibular length, and this causes additional functional liabilities [12–15]. The objectives of the study are to evaluate the impact of TMJ ankylosis on the dentition, ramus height, and cosmetic issues, and to find ways to ensure positive outcomes in patients with early diagnosis and management.

MATERIAL & METHODS

This cross-sectional study was conducted at the Department of Oral and Maxillofacial Surgery, Khyber College of Dentistry (KCD), Peshawar, Pakistan, from January 2023 to June 2023. The study aimed to evaluate the effects of temporomandibular joint (TMJ) ankylosis on dentition and ramus height. Ethical approval was obtained from the Research and Ethics Committee of KCD **(Approval No: KCD-REC/2023/78)**. All patient data were anonymized to ensure confidentiality. As this was a record-based study, the ethics committee granted a waiver of written informed consent.

Study Design and Sampling

All available patient records and corresponding Cone Beam Computed Tomography (CBCT) scans from the study period were screened consecutively. A total of 52 patient records were reviewed, of which 12 were excluded due to incomplete data or poor-quality CBCT images. The final sample comprised 40 eligible cases, which were included in the analysis.

This exploratory study used consecutive non-probability sampling, where every eligible case presenting during the study period was included without randomization.

Sample Size Justification

A minimum required sample size was estimated using the single population proportion formula with a conservative prevalence (p = 0.50), 95% confidence level (Z = 1.96), and 15% margin of error (d = 0.15):

n=Z2×p×(1−p)d2=1.962×0.5×0.50.152=42.68≈43 n = \frac{Z^2 \times p \times (1 - p)}{d^2} = \frac{1.96^2 \times 0.5 \times 0.5}{0.15^2} = 42.68 \approx 43n=d2Z2×p×(1−p)=0.1521.962×0.5×0.5 =42.68≈43

Although the calculated minimum sample was 43, only 40 complete cases were available during the study period due to the rare nature of TMJ ankylosis. This was acknowledged as a limitation in terms of statistical power.

Inclusion and Exclusion Criteria

Inclusion Criteria

- Patients of either gender aged ≥10 years with a confirmed diagnosis of TMJ ankylosis.
- Availability of complete medical records and high-quality pre-treatment CBCT scans.

Exclusion Criteria

- Patients with incomplete or missing CBCT data.
- Syndromic craniofacial anomalies or systemic bone disorders.
- Previous mandibular surgery unrelated to TMJ ankylosis.
- Third-molar impactions interfering with ramus measurements.

Data Collection

Demographic and clinical variables were extracted from the medical records, including age, gender, type of ankylosis (fibrous or bony), laterality (unilateral or bilateral), and duration of ankylosis. Dentition variables included malocclusion, crowding, open bite, crossbite, mandibular hypoplasia, impacted teeth, and retained deciduous teeth.

Treatment history was documented, including gap arthroplasty, interpositional arthroplasty, total joint reconstruction, conservative therapy, or no previous treatment.

Functional outcomes assessed included mouth opening (maximum inter-incisal distance), difficulty in

chewing, speech impairment, facial asymmetry, and pain.

Ramus Height Measurement

Ramus height was measured on pre-treatment CBCT scans using standardized anatomical landmarks. The Frankfort Horizontal (FH) plane was used as the reference line. A perpendicular vertical line was drawn to the most inferior point of the gonion. The distance between the condylion and gonion was recorded as the ramus height. For unilateral cases, the difference between affected and unaffected sides was calculated. For bilateral cases, both sides were compared to normative values based on age- and gender-matched data. All measurements were performed by a single calibrated examiner to avoid inter-observer variability.

Statistical Analysis

All analyses were performed using IBM SPSS Statistics version 26. Descriptive statistics: Frequencies and percentages were calculated for categorical variables. Continuous variables (e.g., ramus height) were presented as mean ± standard deviation (SD). Normality check: Shapiro–Wilk test and visual histogram inspection were used to assess normality of continuous variables. Comparisons: Independent t-test was used to compare mean ramus height between unilateral and bilateral ankylosis groups (if normally distributed); Mann–Whitney U test was used for non-normal data. Chi-square or Fisher's exact test was used for associations between categorical variables, such as type of ankylosis and presence of malocclusion. Significance threshold: p-value <0.05 was considered statistically significant.

Handling of missing data: Records with missing primary outcome measurements were excluded via listwise deletion.

Variable Coding and Reference Categories

- Type of ankylosis: Fibrous = 0 (reference), Bony = 1.
- Laterality: Unilateral = 0 (reference), Bilateral = 1.
- Functional limitations: 0 = Absent, 1 = Present.
- Ramus height difference: Continuous variable in millimeters (positive value indicates reduced height on affected side).

Participant Flow Summary

- Records screened: 52
- Excluded due to incomplete CBCT or missing data: 12
- Final included and analyzed: 40

Ethical Considerations

Ethical approval was obtained from the Research and Ethics Committee of Khyber College of Dentistry (Approval No: KCD-REC/2024/78). The study was conducted in compliance with the Declaration of Helsinki. As a retrospective study based on anonymized patient data, the requirement for individual informed consent was waived by the ethics committee.

RESULTS

The study sample consisted of 40 patients, with an equal gender distribution of males (50%) and females (50%). The majority of participants were in the 20–29 years age group (30%), followed by 30–39 years (25%) and 40–49 years (25%), while the remaining 20% were aged 10–19 years. Both fibrous and bony types of ankylosis were equally represented, each accounting for 50% of cases. Regarding laterality, bilateral ankylosis was the most common presentation (50%), while right and left unilateral cases were observed in 25% each. The duration of ankylosis varied, with 30% of cases persisting for 6–10 years, 20% each for 0–5 years and 11–15 years, and 15% each for 16–20 years and more than 20 years. This indicates a balanced distribution across gender, type, and laterality, with a notable proportion of cases persisting for more than a decade.

Table 1: Demographic and Clinical Characteristics of Patients with TMJ Ankylosis (n = 40)

Variable	Frequency (n)	Percentage (%)
Gender		
Male	20	50%
Female	20	50%
Age Group (years)		
10–19	8	20%
20–29	12	30%
30–39	10	25%
40–49	10	25%
Type of Ankylosis		
Fibrous	20	50%
Bony	20	50%
Laterality		
Right unilateral	10	25%
Left unilateral	10	25%
Bilateral	20	50%
Duration of Ankylosis		
0–5 years	8	20%
6–10 years	12	30%
11–15 years	8	20%
16–20 years	6	15%
>20 years	6	15%

The analysis of dentition findings among patients with ankylosis revealed that malocclusion was the most frequent feature, observed in 62.5% of cases, with a significantly higher prevalence in the bony ankylosis group (75%) compared to the fibrous group (50%) (*p = 0.042). Crowding was present in 37.5% of patients, distributed relatively evenly between fibrous (35%) and bony (40%) cases, showing no significant association (p = 0.68). Mandibular hypoplasia (30%), open bite (25%), and crossbite (20%) were moderately prevalent findings, again more common in the bony group but without statistical significance (p > 0.05). Normal dentition was observed in 12.5% of patients, slightly higher in fibrous ankylosis (15%) than bony (10%), with no meaningful difference (p = 0.64). Overall, the findings suggest that while most dentition abnormalities were present across both types of ankylosis, malocclusion showed a significant association with bony ankylosis.

Table 2: Dentition Findings and Association with Type of Ankylosis

Dentition Finding	Frequency (n)	Percentage (%)	Fibrous (%)	Bony (%)	p-value
Malocclusion	25	62.5%	50%	75%	*0.042
Crowding	15	37.5%	35%	40%	0.68
Mandibular Hypoplasia	12	30%	25%	35%	0.41
Open Bite	10	25%	20%	30%	0.50
Crossbite	8	20%	15%	25%	0.43
Normal Dentition	5	12.5%	15%	10%	0.64

Chi-square test used for categorical comparisons. $p < 0.05$ = statistically significant.

The comparative analysis between unilateral and bilateral ankylosis revealed a statistically significant difference in ramus height, with bilateral ankylosis cases showing a greater mean ramus height difference (13.9 ± 5.2 mm) compared to unilateral cases (10.8 ± 3.9 mm) (t = 2.11, *p = 0.041). In contrast, maximum mouth opening was slightly lower in bilateral ankylosis (12.7 ± 4.9 mm) than in unilateral ankylosis (14.5 ± 4.7 mm), but this difference was not statistically significant (t = 1.19, p = 0.24). These findings indicate that bilateral ankylosis is more strongly associated with ramus height discrepancy, while functional limitation in mouth opening does not differ significantly between the two groups.

Table 3: Ramus Height Differences and Mouth Opening by Laterality

Variable	Unilateral Ankylosis (n = 20)	Bilateral Ankylosis (n = 20)	t-value	p-value
Ramus Height Difference (mm)	10.8 ± 3.9	13.9 ± 5.2	2.11	*0.041
Maximum Mouth Opening (mm)	14.5 ± 4.7	12.7 ± 4.9	1.19	0.24

Independent t-test applied. $p < 0.05$ = statistically significant.

The majority of patients with ankylosis reported notable functional limitations, with difficulty in chewing being the most common (75%), followed closely by reduced mouth opening (70%). Pain or discomfort was present in half of the patients (50%), while facial asymmetry (45%) and speech impairment (30%) were also observed. Only a small proportion (12.5%) maintained normal function. Regarding treatment history, gap arthroplasty was the most frequently performed procedure (30%), followed by conservative therapy (20%) and interpositional arthroplasty (15%). Total joint reconstruction was less common (10%), while a considerable proportion of patients (25%) had not received any treatment. These findings highlight the significant functional burden of ankylosis and the varied treatment approaches, with many patients remaining untreated or inadequately managed.

Table 4: Functional Limitations and Treatment History (n = 40)

Variable	Frequency (n)	Percentage (%)
Functional Limitations		
Difficulty in Chewing	30	75%
Reduced Mouth Opening	28	70%
Pain or Discomfort	20	50%
Facial Asymmetry	18	45%
Speech Impairment	12	30%
Normal Function	5	12.5%
Treatment History		
Gap Arthroplasty	12	30%
Conservative Therapy	8	20%
Interpositional Arthroplasty	6	15%
Total Joint Reconstruction	4	10%
No Treatment	10	25%

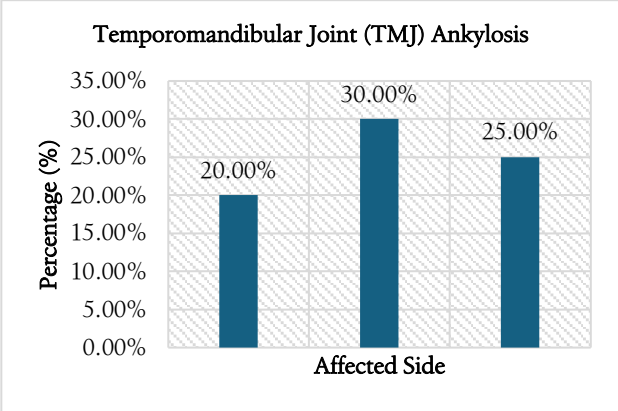

Figure 1: Affected Side (TMJ) Ankylosis

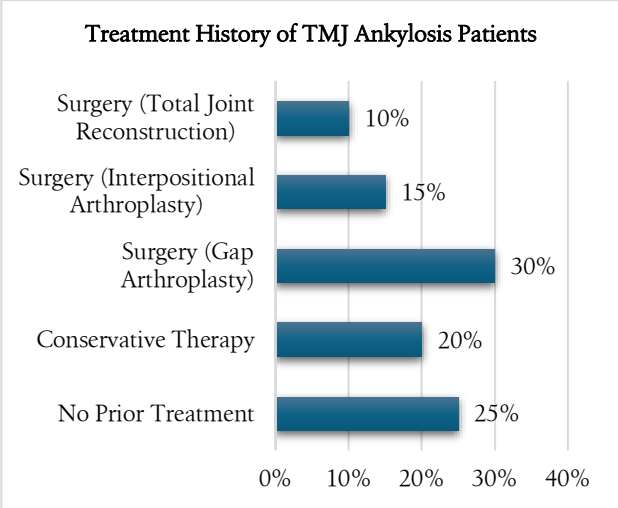

Figure 2: Treatment History of TMJ Ankylosis Patients

DISCUSSION

This study highlights the significant impact of temporomandibular joint (TMJ) ankylosis on dentition, ramus height, and oral function. The high prevalence of malocclusion (62.5%), crowding (37.5%), and mandibular hypoplasia (30%) demonstrates the condition's effect on dental development and facial growth. These findings are consistent with earlier research reporting similar dentofacial abnormalities in TMJ ankylosis patients [16–19]

The mean ramus height difference in our study was 12.4 ± 4.6 mm, with bilateral ankylosis showing significantly greater discrepancies than unilateral cases ($p = 0.041$). This aligns with studies suggesting that ankylosis disrupts normal mandibular growth due to altered bone deposition and resorption patterns in the ramus [20]. Such structural changes contribute to functional limitations, including restricted mouth opening, difficulty chewing, and facial asymmetry, which were highly prevalent among our participants.

This study found an equal distribution of unilateral and bilateral ankylosis (50% each). Previous studies have reported higher rates of unilateral ankylosis, particularly on the left side, but our findings are closer to those reported in recent Chinese studies, suggesting possible regional variations [21–23]. This indicates that there must be further research into genetic and environmental factors influencing laterality.

Approximately 25% of patients had never received any treatment, despite severe functional impairment. While specific socioeconomic data were not collected, previous studies have documented that rural populations and low-income groups face barriers to timely care, including limited surgical expertise and financial constraints [24]. Our findings support these concerns and emphasize the importance of improving access to specialized maxillofacial services.

Strengths and Limitations

The study provides clinical and radiographic evidence linking TMJ ankylosis to dentition changes and ramus height reduction. However, its cross-sectional design limits causal inferences. The relatively small sample size ($n = 40$) may not represent the broader population. Additionally, oral hygiene and socioeconomic status data were not collected, restricting our ability to directly analyze access-to-care factors.

Clinical Implications

Early detection of TMJ ankylosis is critical for preventing long-term complications such as severe malocclusion and facial asymmetry. Surgical interventions, particularly gap arthroplasty and interpositional arthroplasty, remain essential in management. To reduce treatment delays, we need public health initiatives that aim to increase awareness and encourage early referral, particularly in underserved regions.

CONCLUSION

This study analysis shows that TMJ ankylosis has severe negative effects on dentition and ramus height, which are highly unfavorable in functional and cosmetic aspects. These findings are indicative of to require for early age diagnosis and surgical intervention to prevent adverse consequences of the dental and skeletal complications long-term. Future research should focus on incorporating larger sample sizes, longitudinal follow-up, and control group participation in order to make a better assessment ofthe long-term effects of TMJ ankylosis and how effective various courses of treatment can be. There is

a need to enhance access to healthcare and oral health management among these patients to reduce the negative outcomes of this debilitating disorder.

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AUTHOR'S CONTRIBUTION

SM: Contributed to the study design and literature review, and critically revised and finalized the manuscript for submission.
SW: Was responsible for data collection and organization.
MM: Conducted data analysis and interpretation.
SM: Assisted in drafting the manuscript and preparing figures or tables.
All authors reviewed and approved the final manuscript.

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