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RESEARCH ARTICLE

Correlation between posterior teeth loss and temporomandibular joint disorder symptoms in adult patients

[version 1; peer review: 2 approved]

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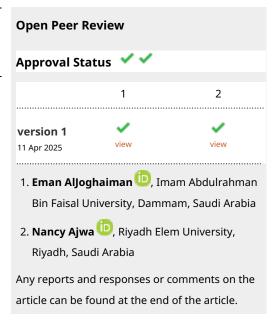## Abstract

Background/Objectives

The relation between TMD and posterior tooth loss is still up for debate and is a topic of constant discussion. The present study aimed to find a correlation between posterior teeth loss and TMJ disorder symptoms in adult patients.

Methods

A total of fifty patients were selected for the study. First, intra-oral dental examination recorded all missing posterior teeth, the teeth numbers, type of missing teeth (except third molars). All existing teeth are examined during the clinical examination to identify any odontogenic causes for pain if present. Second, patients were asked to fill in the Arabic-translated form of the DC/TMD Axis I symptom questionnaire. Third, the DC/TMD Axis II protocol was applied to each patient and the examination form was completed by the examiner during the clinical examination.

Results

Disc displacement with reduction is more likely to cause headache, pain, and clicking. A statistically significant positive correlation was found between age and the number of missing teeth. Furthermore, a statistically significant negative correlation was found between age and maximum unassisted mouth opening, and the number of missing teeth and maximum unassisted mouth opening. Logistics regression

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Approval Status ✓✓

	1	2
version 1 11 Apr 2025	✓ view	✓ view

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analysis showed clicking was significantly associated and 13.8 (OR) times more likely to have TMD.

Conclusions

The current study reported that patients with TMD are more likely to have pain, headache, clicking, and a decrease in maximum mouth opening. There was a correlation between clicking and TMJ disorder, and the number of tooth loss and TMJ disorder.

Keywords
temporomandibular joint disorder; tooth loss; posterior teeth

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Author roles: Ayaz BH: Conceptualization, Data Curation, Formal Analysis, Investigation, Methodology, Software, Supervision, Validation, Writing – Original Draft Preparation, Writing – Review & Editing; **Al-Khudhairy MW**: Conceptualization, Formal Analysis, Investigation, Methodology, Project Administration, Resources, Software, Validation, Writing – Original Draft Preparation, Writing – Review & Editing

Introduction

A variety of clinical symptoms affecting the temporomandibular joint (TMJ), the muscles of mastication, or the related orofacial tissues are grouped under the name "temporomandibular disorders" (TMD). Specific symptoms, including headaches, neck pain, abnormal noises during jaw movements, pain or sensitivity in the chewing muscles or TMJ region, limited or incoherent movements, and an inappropriate relationship between jaw positions characterize it.[1] It is currently unclear what causes TMD.[2] TMD has been linked to several conditions, including bruxism, tooth grinding or clenching,[3] osteoarthrosis, abnormal occlusion,[4] tooth wear,[5] non-working-side occlusal interferences,[6] limited mandibular movements,[7] partial loss of teeth,[8] masseter muscle activity,[9] osteoarthritis,[10] and reduced maximum bite force.[11] The connection between TMD and posterior tooth loss is still up for debate and is a topic of constant discussion.

TMD is more common in people who lose their posterior teeth, particularly young women, with less missing posterior teeth in more quadrants.[12] However, TMD is not associated with malocclusion or the loss of five or more posterior teeth,[13] and there is no relation between the number of lost teeth and TMD.[14] There is inconsistency in the literature because some research found no relation between TMD and the number of absent posterior teeth.[15–17] Other authors, however, have claimed that losing molar support was associated with the presence and severity of osteoarthrosis[18–20] or with TMD.[21–24] The current study aimed to find a correlation between posterior teeth loss and symptoms of TMJ disorder in adult patients.

Methods

The present cross-sectional analytical study was carried out at Riyadh Elm University's prosthodontics department in Riyadh, Kingdom of Saudi Arabia. The Institutional Review Board of Riyadh Elm University in Riyadh, Kingdom of Saudi Arabia, gave its approval to the study (FPGRP/2021/574/527) in December 2021. The study was carried out between January and April of 2022. Participants had to be older than eighteen, have maxillary and mandibular front teeth, and have two or more posterior teeth (molars and premolars) missing for longer than six months, with the exception of the third molars. Subjects wearing removable partial dentures who had experienced traumatic tooth loss (e.g., a car accident, gunshot, maxillofacial surgery, etc.), those with a history of diagnosed and treated symptomatic TMD, and those currently diagnosed with fibromyalgia, trigeminal neuralgia, or on medication were excluded. Samples were chosen using convenience sampling. For the investigation, 50 samples in total that satisfied the inclusion requirements were chosen. Before the trial started, each participant gave their informed consent.

Since DC/TMD Axis-I and Axis-II protocols have a high dependability index value and are regarded as the gold standard, all relevant data pertaining to TMD was collected using them.[25] An international version of the clinical examination and a symptom questionnaire are part of the Axis-I protocol. Psychosocial state and pain-related impairment are assessed as part of the Axis II methodology. The decision tree and diagnostic criteria were used to make the diagnosis.[26]

Clinical examination

An intraoral dental examination was conducted first, and all missing posterior teeth were noted along with their numbers and kind (molar, premolar, except third molars). During the clinical examination, every tooth that was in place was inspected to determine whether there were any odontogenic reasons for pain. Second, the Arabic-translated version of the DC/TMD Axis I symptom questionnaire (www.rdc-tmdinternational.org) was given to the patients. This questionnaire covered symptoms such as headache, pain, jaw joint sounds, closed locking of the jaw, and open locking of the jaw. Third, during the clinical examination, the examiner filled out the examination forms and administered the DC/TMD Axis II procedure to each patient.

The examiner examined both TMJ simultaneously on both sides of the face using fingertips, by touching the joints (lateral pole) and adjacent area at 5 to 6 points spaced approximately .5 cm apart (around lateral pole). 0.5 kg pressure was applied on the lateral pole, and 1 kg pressure was applied around the lateral pole. Since too much pressure applied during the examination leads to unreliable results, the force applied by the examiner during palpation is measured using a device called a pressure Algometer.

All the clinical examinations were done by only one examiner who is trained in DC/TMD clinical examination by an orofacial pain specialist to avoid inter-examiner variation. Intra- examiner variability was done for every 5 cases and one case was repeated by the examiner to see if there is any variation. To avoid the improper diagnosis all the diagnosis was done by an orofacial pain specialist. While assessing the pain of muscles and joints. DC/TMD protocol was used to assess TMD symptoms following the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD), according to guidelines of the International Network for Orofacial Pain and Related Disorders (https://ubwp.buffalo.edu/rdc-tmdinternational/tmd-assessment diagnosis/dc-tmd/).

Statistical analysis

The Statistical Package for Social Science (SPSS), version 20 (IBM SPSS Statistics for Windows, IBM Corp., Armonk, NY, USA), was used for all statistical analyses. The mean, standard deviation, frequency, and percentage were among the descriptive statistics that were computed. The Mann-Whitney U test was used for comparison, while the Pearson Chi-Square and Fisher's Exact tests were used for association. We used Spearman's rho to perform correlations. Logistics regression analysis was used for multivariate analysis. Statistical significance was set as p-value of less than 0.05.

Results

The mean age of the subject was 41.5±6.3 years. The mean number of missing teeth, duration of missing teeth, and maximum unassisted opening of mouth were 3.4±1.3, 5±2.9, and 49.2±5.0, respectively.

The mean maximum mouth opening was higher with no headache (*50.8±4.2*) (p<0.05). On the other hand, the mean age (*42.8±7.5*) (p>0.05), number of missing teeth (*3.8±1.4*)(p>0.05), and duration of tooth loss (*6.6±3.5*)(p<0.05) were higher with the headache (Table 1). Disc displacement with reduction is more likely to cause a headache (p<0.05) (Table 2). The maximum mouth opening was higher with no pain (*50.0±4.5*) (p<0.05). On the other hand, the mean age (*42.8±5.9*) (p>0.05), number of missing teeth (*4.4±1.5*) (p>0.05), and duration of tooth loss (*9.2±3.7*) (p<0.05) were higher with pain (Table 3). Displacement with reduction is more likely to cause pain (p<0.05) (Table 4). The maximum mouth opening was higher with no clicking (*51.8±2.4*) (p<0.05). On the other hand, the mean age clicking (*46.2±5.6*)

Table 1. Comparison of maximum mouth opening, age, number of missing teeth, and duration of tooth loss with headache.

	Headache Mean±SD		p-value
	Yes	No	
Maximum mouth opening	45.8±5.1	50.8±4.2	0.001*
Age	42.8±7.5	40.8±5.7	0.306
Number of missing teeth	3.8±1.4	3.2±1.2	0.192
Duration of tooth loss	6.6±3.5	4.3±2.3	0.029*

*Statistical significance at p<0.05.

Table 2. Association between TMJ disorders and headache.

		Headache frequency (Percent)		p-value
		Yes	No	
TMJ disorder	*None*	8 (22.9)	27 (77.1)	0.049*
	Disc displacement with reduction	8 (53.3)	7 (46.7)	
Reported TMJ click	*Yes*	2 (33.3)	4 (66.7)	1.000
	No	14 (31.8)	30 (68.2)	

*Statistical significance at p<0.05.

Table 3. Comparison of maximum mouth opening, age, number of missing teeth, and duration of tooth loss with pain.

	Pain Mean±SD		p-value
	Yes	No	
Maximum mouth opening	41.4±1.9	50.0±4.5	0.000*
Age	42.8±5.9	41.3±6.4	0.624
Number of missing teeth	4.4±1.5	3.3±1.2	0.068
Duration of tooth loss	9.2±3.7	4.6±2.5	0.000*

*Statistical significance at p<0.05.

Table 4. Association between TMJ disorders and pain.

		Pain Frequency (Percent)		p-value
		Yes	No	
TMJ disorder	*None*	1 (2.9)	34 (97.1)	0.024*
	Disc displacement with reduction	4 (26.7)	11 (73.3)	
Reported TMJ click	*Yes*	1 (16.7)	5 (83.3)	1.000
	No	7 (15.9)	37 (84.1)	

*Statistical significance at p<0.05.

(p<0.05), number of missing teeth clicking (*4.8±1.0*) (p<0.05), and duration of tooth loss (*8.4±2.5*) were higher with clicking (p<0.05) (Table 5). Disc displacement with reduction and reported TMJ click (p<0.05) is more likely to have clicking (p<0.05) (Table 6).

A statistically significant positive correlation was found between age and the number of missing teeth (r=0.607) (p<0.05). Furthermore, a statistically significant negative correlation was found between age and maximum unassisted mouth opening (r=-0.402) (p<0.05); and the number of missing teeth and maximum unassisted mouth opening (r=-0.502) (p<0.05) (Table 7). The mean number of missing teeth was statistically significantly higher in TMJ disorder (Disc displacement with reduction) (4.7 ± 1.0) (p<0.05) (Table 8).

Table 5. Comparison of maximum mouth opening, age, number of missing teeth, and duration of tooth loss with clicking.

	Clicking Mean±SD		p-value
	Yes	No	
Maximum mouth opening	43.9±4.8	51.8±2.4	0.000*
Age	46.2±5.6	39.0±5.3	0.000*
Number of missing teeth	4.8±1.0	2.7±0..7	0.000*
Duration of tooth loss	8.4±2.5	3.3±1.0	0.000*

*Statistical significance at p<0.05.

Table 6. Association between TMJ disorders and clicking.

		Clicking Frequency (Percent)		p-value
		Yes	No	
TMJ disorder	*None*	3 (8.6)	32 (91.4)	0.000*
	Disc displacement with reduction	14 (93.3)	1 (6.7)	
Reported TMJ click	*Yes*	6 (54.5)	5 (45.5)	0.000*
	No	0 (0.0)	39 (100.0)	

*Statistical significance at p<0.05.

Table 7. Correlation between various variables.

Variables	Correlation coefficient	p-value
Age-Number of missing teeth	0.607	0.000*
Age-Maximum unassisted mouth opening	-0.402	0.004*
Number of missing teeth-Maximum unassisted mouth opening	-0.502	0.000*

*Statistical significance at p<0.05.

Table 8. Comparison of mean (sd) number of missing teeth with TMJ disorder.

TMJ Disorder	Mean±SD number of missing teeth	p-value
None	2.8 (0.9)	0.000*
Disc displacement with reduction	4.7 (1.0)	

*Statistical significance at p<0.05.

Table 9. Logistics regression analysis of the number of missing teeth with the TMD.

Model variables	Adj. OR	95% C.I.		p-value
		Lower bound	Upper bound	
Number of missing teeth	2.62	0.699	9.812	0.153
Pain				
Yes	6.089	0.071	525.156	0.427
No	1			
Headache				
Yes	0.97	0.097	9.73	0.979
No	1			
Clicking sound				
Yes	13.86	1.051	182.857	0.046*
No	1			

*Statistical significance at p<0.05.

Table 10. Logistics regression analysis of symptoms together with the TMD.

Model variables	Adj. OR	95% C.I.		p-value
		Lower bound	Upper bound	
Pain				
Yes	6.021	0.143	253.296	0.347
No	1			
Headache				
Yes	0.708	0.074	6.803	0.765
No	1			
Clicking				
Yes	67.22	9.014	501.267	0.001*
No	1			

*Statistical significance at p<0.05.

The number of missing teeth showed OR=2.620 times higher risk of TMD (variable) as well as pain showed OR=6.089 times higher (p>0.05). Whereas, clicking was significantly associated and OR=13.8 times more likely to have TMD (variable) (p<0.05) (Table 9). The pain was OR=6.021 times more likely associated with TMD (p>0.05). Whereas, clicking showed a significant association with the TMD (variable) (p<0.05) (Table 10).

Discussion
The relationship between multiple posterior teeth missing and TMJ disorders always remains controversial. In addition, signs and symptoms like headache and muscular pain, TMJ sound, and restricted mouth opening may be some of the signs or symptoms associated with TMD disorders. Thus, the present study was planned to assess the correlation between posterior teeth loss and TMJ disorder symptoms in adult patients. The current study showed that patients with TMD (TMJ

disc displacement with reduction) are more likely to have pain, headache, and TMJ clicking with statistically significant differences. A study by Aggarwal et al. is in agreement with the present study findings which showed that headaches occur more frequently in patients with TMD symptoms (27.4% vs 15.2%).[27] In line with the current investigation, another study by Derwich et al. found that TMJ reciprocal clicking is a common clinical sign of disc displacement with reduction and one of the most prevalent forms of TMJ internal derangements.[28]

Furthermore, the present study showed that maximum mouth opening was greater with (no pain, no headache, and no TMJ clicking) with statistically significant differences. There are many previous reports relating to mouth opening and headaches. Schokker et al. found a close relationship between recurrent headaches and craniomandibular disorders, including the opening of the mouth.[29] Calixte et al. also reported less headaches with improved mouth-opening.[30] The degree of mouth opening and the quantity of auditory symptoms are associated with the severity of TMD, according to yet another study report by Kitsoulis et al.[31] The present study showed that the number of missing teeth and the age increased as the maximum unassisted mouth opening decreased. This result is consistent with a study by Sawair et al. who showed that wide unassisted maximum mouth opening was associated with less risk of tooth loss and preservation of the third molar.[32]

The present study found that the number of missing teeth was higher with disc displacement with a reduction with a statistically significant difference. According to a study by Tallents et al., the TMJ components become overloaded when posterior teeth are absent. The lack of posterior teeth has been hypothesized and experimentally demonstrated to cause mandibular overclosure, which would cause the condyles to shift from their typical centric position in the TMJ, resulting in joint dislocation.[24] Another study found that articular eminence in younger people and the onset of lesions on the load-bearing articular surfaces of the condyle were both influenced by loss of molar support.[33] Thus, it appears that most of the study reports are in accordance with the present study. The loss of posterior teeth is expected to bring similar changes in the TMJ joints. Missing posterior teeth appears to be responsible for the changes seen in the TMJ.[34]

The evaluation in this study was conducted using the DC/TMD axis I and II, which is very pain-oriented, and (dis)function is not given much attention. Furthermore, the classification process, which is more subjective in nature, still heavily relies on palpation and operationalized pressure on the tissues of the masticatory muscles and the TMJs. Overdiagnosis (myofascial pain) and overtreatment while adhering to this classification are the outcomes. However, there was also evidence of the potential for underdiagnosis when using the RDC/TMD criteria. Therefore, it is necessary to implement a balance between these two. In the field of dentistry, the link between tooth loss and temporomandibular disorders is contentious because there may be more than one cause for these issues. Future research will need to evaluate factors like age, gender, and estrogen level. Additionally, evaluating research on secondary occlusion contact feature changes after posterior tooth loss, the effects of these secondary occlusion modifications, and the possible advantages of rectifying such occlusal abnormalities would be interesting.

Conclusions
Pain, headaches, clicking, and a reduction in maximum mouth opening are more common in TMD patients. There is a relation between TMJ disorders and clicking; and TMJ disorders and the number of tooth loss.

Author contributions
Conceptualization, B.H.A. and M.W.A.; methodology, B.H.A. and M.W.A; software, B.H.A. and M.W.A; validation, B.H.A. and M.W.A; formal analysis, B.H.A. and M.W.A; investigation, B.H.A. and M.W.A; resources, B.H.A. and M.W.A; data curation, B.H.A. and M.W.A; writing—original draft preparation, B.H.A. and M.W.A; writing—review and editing, B.H.A. and M.W.A; visualization, B.H.A. and M.W.A; supervision, B.H.A. and M.W.A; project administration, B.H.A. and M.W.A; funding acquisition, B.H.A. and M.W.A. All authors have read and agreed to the published version of the manuscript.

Ethics and consent statement
The study was approved by the Institutional Review Board of Riyadh Elm University, Riyadh, Kingdom of Saudi Arabia (FPGRP/2021/574/527) on 25 December 2021. Written and informed consent was obtained from all subjects involved in the study.

Data availability statement
Underlaying data
Figshare.- Correlation between Posterior Teeth Loss and Temporomandibular Joint Disorder Symptoms in Adult Patients. https://doi.org/10.6084/m9.figshare.28078913.v1.[35]

This project contains the following underlying data:

1. data sheet.xlsx

Extended data

Figshare.- Correlation between Posterior Teeth Loss and Temporomandibular Joint Disorder Symptoms in Adult Patients. https://doi.org/10.6084/m9.figshare.28078913.v1.[35]

This project contains the following underlying data:

1. symptom quastionair.pdf

2. dctmd clinical form.pdf

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Open Peer Review

Current Peer Review Status: ✓ ✓

✓

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Title and Abstract
1. **Title Suggestion**: Consider slightly refining the title to specify the study design (e.g., *"A cross-sectional study on the correlation between posterior teeth loss and temporomandibular joint disorder symptoms in adult patients"*), which can enhance clarity and attract the appropriate readership.
2. **Abstract Clarity**:
   - Add brief details on the inclusion/exclusion criteria in the "Methods" section.
   - Include a numeric summary of key findings (e.g., prevalence, odds ratios) for better impact.

Introduction
1. **Literature Context**:
   - Strengthen the rationale by briefly elaborating on **conflicting evidence** in the literature and how this study fills a gap.
   - Include more recent references from the last 5 years to show up-to-date knowledge.
2. **Objectives**:
   - Clearly define a **primary hypothesis or objective** at the end of the introduction.

Methods
1. **Sampling Technique**:
   - Mention how the **convenience sampling** may influence generalizability and briefly justify its use.
2. **DC/TMD Protocol**:
   - Provide a **reference or footnote** for the Arabic translation validation of the DC/TMD Axis I questionnaire, if available.
3. **Calibration**:
   - Include the **intra-examiner reliability score** (e.g., kappa value) if calculated, to support reproducibility.

4. **Ethics**:
   - ○ The IRB and consent details are clear — good inclusion.

Results
1. **Tables**:
   - ○ Some table captions (e.g., Tables 1–6) could include a brief description of what comparison is being made for easier interpretation.
2. **Presentation**:
   - ○ Consider **graphical representations** (e.g., bar charts or box plots) for key variables like "maximum mouth opening" and "number of missing teeth" to enhance visual impact.
1. **Statistical Detail**:
   - ○ Report **confidence intervals** for all significant findings in-text, not just in regression tables.

Discussion
1. **Interpretation**:
   - ○ Consider discussing possible **confounders or effect modifiers** (e.g., bruxism, prosthesis use) that may have influenced results but were not analyzed.
1. **Clinical Relevance**:
   - ○ Include a sentence or two on **how these findings could impact clinical practice**, particularly prosthodontic or orofacial pain management.
1. **Limitations**:
   - ○ Expand briefly on **selection bias** due to convenience sampling and possible **self-report bias** in questionnaire responses.

Conclusion
1. **Conciseness**:
   - ○ Slightly rephrase the conclusion to be more **actionable**—e.g., "Clinicians should consider posterior tooth loss as a potential contributing factor to TMD symptoms."

Other Minor Suggestions
1. **Language & Grammar**:
   - ○ Perform a **language check or proofreading** pass, especially for punctuation, article usage, and syntax to improve readability.
1. **Reference Formatting**:
   - ○ Ensure all references conform to the journal's citation style (e.g., spacing, punctuation).

Final Comment to Authors
The manuscript presents important findings on the relationship between posterior teeth loss and TMD symptoms, which has clinical value. With minor revisions as noted above to improve clarity, detail, and presentation,

Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
Yes

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Public Health

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Reviewer Report 20 May 2025

https://doi.org/10.5256/f1000research.176980.r378136

✔ **Eman AlJoghaiman** 🆔
Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia

The manuscript presents a valuable investigation into the correlation between posterior tooth loss and TMJ disorder symptoms. While the study is well-structured and addresses an important clinical question, the following constructive comments are offered to enhance clarity, interpretation, and rigor:

1. **Study Design and Limitations:**
   - The cross-sectional design limits causal inference. Please explicitly acknowledge this in the discussion and clarify that findings represent associations, not causation.
   - The convenience sampling may affect generalizability and statistical power. Consider discussing these as limitations and recommending larger, randomized studies for validation.
2. **Diagnostic Methodology:**
   - Clarify whether imaging (e.g., MRI) was used to confirm disc displacement diagnoses. Reliance on clinical examination alone may introduce diagnostic bias; this should be noted as a limitation.
   - Address the absence of psychosocial factors (DC/TMD Axis II) in the results. If these

data were collected, include a brief summary; if not, justify their exclusion.

3. **Questionnaire Validation:**
   ○ Confirm the validity and reliability of the Arabic-translated DC/TMD questionnaire. If validation studies exist, cite them; otherwise, acknowledge this as a potential limitation.

4. **Mechanistic Discussion:**
   ○ Elaborate on potential biomechanical mechanisms linking posterior tooth loss to TMJ disorders (e.g., altered condylar position, overloading). This would strengthen the discussion by contextualizing findings within existing pathophysiological frameworks.

5. **Statistical Considerations:**
   ○ The wide confidence intervals in logistic regression models (e.g., OR=6.089, CI: 0.071–525.156) suggest imprecision due to sample size. Discuss this as a limitation.

6. **Clinical and Demographic Factors:**
   ○ Discuss whether confounding variables (e.g., parafunctional habits, occlusal contacts post-tooth loss) were assessed. If not, propose their inclusion in future studies.

7. **Language and Conclusions:**
   ○ Avoid implying causation (e.g., "posterior tooth loss *leads to* TMJ changes"). Use correlational language consistently.
   ○ The abstract's conclusion could be tempered to align with the study's observational design.

8. **Ethical and Methodological Rigor:**
   ○ Reaffirm that informed consent procedures adhered to ethical standards, though this is likely implicit.

Summary:
The manuscript contributes meaningful insights into TMD and posterior tooth loss. Addressing the above points, particularly regarding limitations, diagnostic methods, and mechanistic context, will strengthen its impact and clarity.

Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and is the work technically sound?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
Yes

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Dentistry

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

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