Correlation between posterior tooth loss and temporomandibular joint disorders in elders: A cross-sectional study

Jemima Karynhapukh Tulak[1] ⓘ
Jane Amelia Vebriani Wibisono[2] ⓘ
Dominica Dian Saraswati Sumantri[3] ⓘ

[1]Department of Basic Dentistry, Faculty of Dentistry Universitätsklinikum Dresden, Germany
[2]Department of Prosthodontics, Faculty of Dentistry Maranatha Christian University, Indonesia
[3]Department of Radiologi, Faculty of Dentistry Maranatha Christian University, Indonesia

*Correspondence Email |
teamucul1027@gmail.com

ABSTRACT

Introduction: Tooth loss is one of the essential factors of oral health status, which affects individual quality of life and social factors. It is also a common oral health problem in adults and elders. A prolonged period of tooth loss, followed by an immediate replacement with dentures, can cause changes in occlusion due to the teeth' unsustainability; tooth position shift followed by extrusion leads to occlusion pattern disruption, resulting in gingival movement difficulties. This research analyses the correlation between posterior tooth loss and temporomandibular joint disorders in elders. **Methods:** Analytic observational with cross-sectional study. The sampling technique was simple random sampling, identifying a population of 39 people aged 60 to 75, consisting of 12 males and 27 females. The sample size was determined by the overall population size, calculated through the minimum single sample size formula incorporating the correlation coefficient (r). The primary data was obtained by completing the questionnaires and the respondents' clinical examination with the Helkimo index. **Results:** The findings showed that most respondents were female, 27 compared to 12. In terms of dysfunctional index data for tooth loss, the "Mild symptoms" were found to be predominant over "No symptoms", with the (HG) ≤ 4; while the (HG) ≥ 4, showed that the "No symptoms" were less common. Similarly, in the anamnesis index data, the "Mild symptoms" were the most common, with the (HG) ≤ 4; while the (HG) ≥ 4 showed that the "No symptoms" was predominated, with fewer cases of the "Mild symptoms" and the "Severe symptoms". The Spearman Correlation Rank test analysis showed that the r (coefficient of correlation) = 0,944, with p = 0.000. **Conclusion:** There is a relationship between posterior tooth loss and temporomandibular joint disorders in elders.

Keywords

Korelasi antara kehilangan gigi posterior dengan gangguan sendi temporomandibula pada lansia: studi cross-sectional

ABSTRAK

Pendahuluan: Kehilangan gigi merupakan salah satu faktor penting dari status kesehatan gigi dan mulut yang berdampak pada kualitas hidup serta faktor sosial seseorang. Kehilangan gigi merupakan masalah kesehatan mulut yang umum terjadi pada orang dewasa hingga lansia. Kehilangan gigi yang terlalu lama dan tidak segera digantikan dengan gigi tiruan, dapat menyebabkan terjadinya perubahan oklusi karena tidak adanya kesinambungan susunan gigi, pergeseran posisi gigi yang disertai ekstrusi menyebabkan pola oklusi berubah, dan mengakibatkan hambatan pada proses gerak rahang. Tujuan penelitian ini adalah untuk menganalisis hubungan kehilangan gigi posterior dengan gangguan sendi temporomandibular pada lansia. **Metode:** Jenis penelitian observasional analitik dengan pendekatan cross-sectional untuk mengetahui atau melihat ada tidaknya hubungan keterkaitan antara kehilangan gigi posterior terhadap gangguan sendi temporomandibula. Teknik sampel yaitu simple random sampling, untuk mengidentifikasi populasi dengan rentang usia 60-75 tahun dengan jumlah 39 populasi. Besar sampel ditentukan oleh besar populasi, yang dihitung berdasarkan rumus besar sampel tunggal dengan menggunakan koefisien korelasi (r). Data primer diperoleh melalui pengisian kuesioner dan pemeriksaan klinis indeks Helkimo pada responden. **Hasil:** Distribusi data responden menunjukkan jumlah perempuan lebih banyak 27 subjek, dibandingkan dengan laki-laki 12 subjek. Pada indeks disfungsional dengan hilang gigi, "Gejala ringan" lebih dominan daripada "Tidak ada gejala" pada (HG) ≤ 4, pada (HG) ≥ 4 "Tidak ada gejala" lebih jarang terjadi. Demikian juga, data indeks anamnesis, "Gejala ringan" pada (HG) ≤ 4, pada (HG) ≥ 4, "Tidak ada gejala" mendominasi, dengan lebih sedikit pada kasus "Gejala ringan" dan "Gejala berat". Berdasarkan hasil analisis uji Rank Spearman Correlation menunjukkan r (koefisien korelasi) = 0,944, dan p = 0,000. **Simpulan:** Terdapat hubungan antara kehilangan gigi terhadap gangguan sendi temporomandibula.

Kata kunci

INTRODUCTION

A prolonged period of tooth loss, followed by an immediate replacement with dentures, can cause changes in occlusion due to the teeth' unsustainability; tooth position shift followed by extrusion leads to occlusion pattern disruption, resulting in gingival movement difficulties.[1] Tooth loss is a common oral health problem in seniors.[2] The 2018 Indonesian Basic Health Research (RISKESDAS) discovered that oral problems were 25.9%. Of this number, the prevalence of tooth loss in the 55–64-years age group was 10.13%, while in the ≥65 years age group was 17.05%.[3]

Tooth loss is essential to adult oral health status and significantly affects individual quality of life and social factors.[4] The 2018 Indonesian Basic Health Research reported that the national prevalence of oral health problems was 57.6%. Of this number, the national prevalence of tooth loss at age 35-44 years was 1.3%, compared to the national tooth loss rate of 0.1%. The prevalence value increases with age, as research results showed a significant increase above 65 years and over, which was 9.0%.[5] However, there was a decrease in the national prevalence of tooth loss in the previous Indonesian Basic Health Research report to 25.9%. Ageing is a natural process of the human life cycle, followed by a decrease in the ability to resolve, regenerate, and repair cells and tissues.[3]

Decreasing the number of posterior teeth due to ageing can lead to temporomandibular joint disorders. The functional impact of tooth loss included masticatory function decrease, resulting in a lack of nutritional intake.[6] Alveolar bone resorption due to ageing also influences tooth loss and edentulous conditions in elders.[7,8] Individuals with missing posterior teeth have four times more problems in the mastication process.[9]

Temporomandibular joint disorders, also widely known as temporomandibular disorders (TMD), are clinical symptoms involving the masticatory muscles in the orofacial area, joints, or both. Symptoms of TMD include sounds or noises in the joints, limited or distorted movements, and bone and muscle pain, recognised as orofacial pain. Few previous studies have explicitly discussed the relationship between posterior tooth loss and TMD in elders.[10]

This research holds significant potential in understanding the role of posterior tooth loss in developing or exacerbating TMD. The novelty of this research lies in its comprehensive methodology, which includes collecting clinical data and direct interviews, measuring masticatory quality, assessing temporomandibular joint function, and evaluating the quality of life of elderly patients who have lost posterior teeth. This approach can provide a deeper understanding of the intricate relationship between posterior tooth loss and temporomandibular joint disorders in elders.

This research has the potential to shape future dental interventions. For instance, it could pave the way for more effective strategies to prevent or reduce TMD in elders. This might involve considering more holistic treatment plans and tailoring dental care to the unique needs of the ageing population. By incorporating these innovative approaches, the research can make a more valuable and relevant contribution to our understanding of the relationship between posterior tooth loss and TMD in elders and the development of appropriate treatments. This research analyses the correlation between posterior tooth loss and temporomandibular joint disorders in elders.

METHODS

This research was an analytic observational cross-sectional study. The sampling technique was a simple random sampling method.[11,12] The subjects were 39 individuals, 12 males and 27 females. This research was conducted following ethical procedures. The research population were elders from Tresna Werdha Budi Pertiwi Nursing Home and

Yayasan Pembinaan Peduli Ibu Kota Bandung, Juniati Bandaso Dental Clinic of Rantepao City.

The sample size was determined by the overall population size, calculated through the minimum single sample size formula incorporating the correlation coefficient (r) as follows[13]: $n \geq (Z\alpha + Z\beta / 0.5 \ln X 1 + r / 1 - r) 2 + 3$; $n \geq (1.96 + 0.78 / 0.5 \ln X 1 + 0.5 / 1 - 0.5) 2 + 3 = 27.88125097$, with a conclusion: $n \geq 27.88125097$, rounded up to 28 respondents (because the population size was calculated to be less than 40, the researchers used simple random sampling). Thus, the sample in this study was at least 28 people, both male and female.

The research was conducted from February to May 2023, and the research analysis was performed using Excel MegaStat 10.4 v.3.2.1, released for Mac. The research tools were essential dental equipment (mouth mirror, sonde, tweezers, excavator), stationery, vernier, and gloves. Data analysis was conducted using the Spearman-Rank Correlation test.[14]

The work procedures began by collecting some tools in this research: essential dental tools (mouth mirror, sonde, tweezers, and excavator), stationery, digital callipers, and gloves, followed by the preparation of research subjects, determined by the subject's chronological age and who met the inclusion criteria. The inclusion criteria include elders in the advanced aged group of 60-75 years with bilateral free end; posterior tooth loss of the maxilla and mandible for 6-12 months; elders with posterior tooth loss of at least two teeth in both upper and lower region, the teeth counted are premolars and molars (the M3 is not counted); elders with independent physical ability and being able to communicate verbally well; willing to be a research participant.

Participants who met the inclusion criteria were then given a consent form to become research subjects. Researchers explained the objectives, benefits, research flows, and implementation procedures. They were asked to sign informed consent. The researcher interviewed respondents in common, understandable language, using the questions from the anamnesis index questionnaire sheet. Afterwards, the researcher filled out the sheet according to their answers.

The anamnesis and Helkimo indexes are valid and reliable instruments with the Rank Konkordal Kendall (W) test used; the calculation results obtained have a relationship of 15.2 %, significant with a p-value ≤ 0.005. The clinimetric properties were assessed to be adequate and able to discriminate between affected-TMD and unaffected-TMD subjects.[17]

The researcher performed a clinical examination by instructing the subjects to sit with their head slightly tilted upwards. A maximum mouth opening examination was performed by measuring the subject's maximum mouth opening as measured from the centerline of the subject's upper and lower central incisors using digital callipers. The presence of clicking was determined by instructing the subject to open and close the mouth. At the same time, the clicking or popping sound in the superficial area of the temporomandibular joint was carefully listened to using a stethoscope.

Deviation measurement was based on the maximum shift distance observed from the midline of the mouth and the presence of shift when the subject opened the mouth. The pain or disturbance in the temporomandibular joint (TMJ) was assessed by examining the pain area, which was carried out by palpating. Also, the subject's feeling around the muscles related to mastication, such as the masseter, temporalis, pterygoid, digastric, and mylohyoideus muscle, as well as the acoustic duct, then, the score was filled on the Helkimo index sheet according to the points based on the Dysfunctional Helkimo index to discovered the signs of TMD. The score was based on the DI.[15,16]

Table 1. Anamnesis Index (AI) assessment category[17]

Classification	Symptoms (at least one symptom)
AI0	Asymptomatic
AI-I (mild symptoms)	Sound in the temporomandibular joint
	Gingival fatigues
	Gingival stiffness when waking up or when moving the lower mandible
AI-II (severe symptoms)	Difficulty opening the mouth wide
	Locked gingiva
	Joint luxation
	Pain or soreness when moving the mandible
	Pain or tenderness in the TMJ region or masticatory muscles

Table 2. Anamnesis Index (AI) Questionnaire[17]

No	Question	No	Yes
1	Do you have sounds (clicking or crepitation/cracking) in the TMJ area?		
2	Do you experience jaw stiffness upon waking up or slow mandibular movement?		
3	Do you feel fatigued in the mandibular area?		
4	Do you have difficulty opening your mouth?		
5	Do you experience jaw-locking when opening your mouth?		
6	Do you feel joint pain in the buccal region?		
7	Do you feel pain/soreness when making mandibular movements?		
8	Do you have a luxation (dislocation) of the lower mandible?		

The Anamnesis Index questionnaire will be assessed by the following criteria: 1. If the subject had no symptoms or answered "No" from number 1 to number 8 on the questionnaire, the subject was classified as AI-0 or asymptomatic; 2. If the subject had one or more symptoms from numbers 1 to 3 on the questionnaire, the subject was classified as AI-I or mild symptoms; 3. If the subject had more than one symptom in questionnaire numbers 1 to 8, the subject was classified as AI-II or severe symptoms.[16]

Table 3. Dysfunctional Index (DI) assessment[16]

Domain	Criteria	Score
Mandibular Opening	ROM > 40 mm	0
	ROM 30 - 39 mm	1
	ROM < 30 mm	5
TMJ Dysfunction	No sounds/deviation on opening < 2mm	0
	Sounds and/or deviation 2 - 5 mm	1
	Locking and/or luxation > 5mm	5
Muscle Pain	No muscle pain	0
	Pain on palpation at 1 – 3 sites	1
	Pain on palpation at 4+ sites	5
TMJ Pain	No pain on palpation	0
	Lateral (superficial) TMJ pain	1
	Posterior (deep) TMJ pain	5
Mandibular Movement Pain	No pain	0
	Pain with 1 movement	1
	Pain with 2+ movements	5

ROM, or Range of Motion measurement, is measured from the moment the patient opens the mouth maximally by measuring the distance between the centre of the upper and lower incisors. Deviation measurement is measured when the patient opens the mouth to see any shift presence by measuring the maximum shift distance from the maxillary and mandibular midline. TMJ pain is measured by palpating or pressing (palpation) the masticatory muscle area, such as the masseter, temporalis, pterygoid, digastricus, mylohyoideus muscle, and *ductus acusticus*. TMJ pain measurement (superficial) is checked

by palpating the masticatory muscle area with both hands on the upper and lower areas around the masticatory muscles. Examination (deep) is checked by palpating with 1 finger, around 1 cm anterior to the temporomandibular joint. Mandibular motion pain is measured from the movement of the mandible to the left and right and the opening and closing of the subject's mouth.[16-17]

The measurement method used was the Helkimo questionnaire and clinical examination with an ordinal measurement scale-the categorisation of the Helkimo Index measurement results presented in Table 4. Based on the Dysfunctional Index assessment, it can be concluded that if the inspection result showed the sum of points of A + B + C + D + E = 0, then categorised as DI-0 (absence of dysfunction); if the inspection result showed the number of points of A + B + C + D + E = 1 - 4, then categorised as DI-I (mild dysfunction); if the inspection result showed the number of points of A + B + C + D + E = 5 - 9, then categorised as DI-II (moderate dysfunction); if the inspection result showed the number of points of A + B + C + D + E = 10 - 25, then categorised as DI-III (severe dysfunction).[16-17]

RESULTS

During the research, no research subjects were excluded because all research respondents were cooperative and acted according to instructions. No complaints were filed during the study. Examination of TMD in each older adult was performed after dividing the respondents into two groups of female and male based on age. The population of this research was 15 older adults at the Tresna Werdha Budi Pertiwi Nursing Home, 14 older adults at the Mother Care Development Foundation, and 10 older adults at the Juniati Bandaso Dental Clinic. The population was 27 female and 12 male respondents. The sampling technique was determined from the size of the research population. The sample in this research was obtained from a simple random sampling method. After examination, the symptom results obtained then be divided into four categories, "No Symptoms", "Mild Symptoms", "Moderate Symptoms", and "Severe Symptoms", with the results presented in Tables 6 and 7.

Table 5. Distribution of respondents based on sex and age

Age (years)	Male (individual)	Female (individual)	Q	%
60-64	4	10	14.00	35.90
65-69	3	4	7.00	17.95
70-75	5	13	18.00	46.15
Q	12	27	39.00	100.00

Table 6. Distribution of dysfunctional data based on the Helkimo index

HG (Tooth Loss)	DI (Dysfunctional index) symptoms				
	None	Light	Currently	Heavy	Q
≤ 4	25.64	38.46	7.69	15.38	87.18
>= 4	5.13	2.56	2.56	2.56	12.82
Q	30.77	41.03	10.26	17.95	100.00

The results presented in Table 6 showed the frequency distribution of patients experiencing TMD. In the DI for the HG ≤ 4, the "No Symptoms" category was found with a score of 25.64 in 10 subjects, the "Mild Symptoms" category of 38.46 in 15 subjects, the "Moderate Symptoms" category of 7.69 in 3 subjects, and the "Severe Symptoms" category of 14.38 was found in 6 subjects. In the HG ≥ 4, the "No Symptoms" category was found

with a score of 5.13 in 2 subjects, while only 1 respondent experienced "Mild-Severe Symptoms" with a score of 2.56.

Table 7. Distribution of anamnesis data based on the Helkimo index

| HG (Tooth Loss) | AI (Anamnesis Index) Symptoms | | | | |
	None	Light	Currently	Heavy	Q
≤ 4	28.21	35.90	0.00	23.08	87.18
≥ 4	5.13	2.56	0.00	5.13	12.82
Q	33.33	38.46	0.00	28.21	100.00

The results presented in Table 7 showed the frequency distribution of patients experiencing TMD. Based on the Anamnesis Index (AI) measurement for HG ≤ 4, the "No Symptoms" category with a score of 28.21 was found in 11 subjects, the "Mild Symptoms" category of 35.90 in 14 subjects, and the "Heavy Symptoms" with a score of 23.08 in 9 subjects. The HG ≥ 4 in the "No Symptoms" category with a score of 5.13 was found in 2 subjects, the "Mild Symptoms" category of 5.13 in only one subject, and the "Severe Symptoms" category of 5.13 was found in 2 subjects. The relationship between posterior tooth loss and the presence of TMD (the Dysfunctional Index (DI) and Anamnesis Index (AI)) can be analysed as non-parametric. After getting the distribution value for each symptom, the data correlation was analysed using the Spearman Rank correlation test, and the results are presented in Table 8.

Table 8. Spearman Correlation test between tooth loss and TMD variables

Variable	r	t	p-value	Characteristic	Linkages	Information
HG & DI	-0.010	-0.06	0.4749	Non-Sign	0.01	Weak Relationship
HG & AI	0.039	0.23	0.4078	Non-Sign	0.15	Weak Relationship
HG, DI & AI	0.944	17.44	0.0000	Sign	89.16	Strong Relationship

Based on the Spearman Rank Correlation analysis (Table 8), the variable group of HG with Dysfunctional Index (DI) and Anamnesis Index (AI) has a significant relationship of 89.16%, with a value of r (coefficient of correlation) of 0.944, and p = 0.000. However, the analysis of the relationship between tooth loss with each variable of the Dysfunctional Index (DI) and Anamnesis Index (AI) shows a very weak relationship of < 1%.[14]

DISCUSSION

The distribution data presented in Table 5 showed fewer male respondents than females because each research place has fewer male respondents. Previous research conducted by Dwipayanti et al.[1] in 2016 stated that based on sex, posterior tooth loss has no relationship with the presence of TMD.

The analysis results in Tables 6 and 7 showed more "Mild Symptoms" results, which were the clicking symptoms, which aligns with the findings of Safira[26] in 2022, which suggested that unilateral mastication was able to stem from various factors, including painful cavities, sensitive teeth during mastication, and tooth loss on one side of the mandibular arch. Over time, this one-sided masticatory habit may lead to TMD, such as clicking. Clicking can occur due to several factors, including a changed masticatory pattern. Based on the results of direct interviews with respondents, it was discovered that the reason for such a particular habit was because there were no teeth on the opposite side or there were unfilled cavities. The value obtained for tooth loss (>=4) in the "No Symptoms" category was relatively high (5.13), and most likely influenced by the number of subjects in the "No Symptoms" category (1 subject). Meanwhile, 10 subjects experienced tooth loss (<=4) in the "No Symptoms" category, with a score of 25.64.

A total of 11 subjects scored 28.21 (Table 7). Research by Kristine[27] in 2021 stated that data collection through direct interviews or questionnaire filling can easily be influenced by the researcher's characteristics and, in reverse, the subject's desire to please the researcher. Differences in the number of teeth loss by each subject and the subject's total based on sex (Table 5) and anamnesis data assessment results can influence the results obtained; thus, this research could be biased because the tooth loss data were not homogeneous.[10,19,20]

Based on the Spearman Rank Correlation analysis in Table 8, the tooth loss variable group with dysfunctional and anamnesis indices had a significant relationship of 89.16% with p = 0.000. In 2023, Isya[28] conducted research using Spearman Rank Correlation to test the relationship between TMD variables and obtained the p-value = 0.000 (p < 0.05), with Spearman coefficient value (+) 0.401 indicating a positive correlation. However, the analysis of the relationship between tooth loss and each variable (dysfunctional and anamnesis indices) showed a very weak relationship of < 1%. This result was supported by research conducted by Ginting[23] in 2019, reporting that clinical examination with a Dysfunctional Index has a prevalence of symptoms of TMD of 57.8%. This result was higher based on the Fonseca questionnaire or Anamnesis Index, with a percentage of 50.7%; the Anamnesis Index is good enough to be used as a screening tool for TMD.[23]

In previous studies, it was discovered that many teeth of elders have been damaged or missing, causing masticatory difficulties and occlusion imbalances. Therefore, posterior tooth loss and TMD have a significant correlation. From this study, it can be concluded that loss of posterior teeth is not just a dental issue but a health concern associated with increasing TMD occurrence. The frequency of signs and symptoms of TMD increases along with reduced occlusive contact and excess pressure of the posterior teeth. This result was in line with research conducted by Ribka in 2015, who discovered the relationship between tooth loss and TMD based on the number of quadrants of posterior tooth loss, occlusal support, and increase in the incidence of TMD along with the amount of tooth loss.

Another study found that the most common tooth loss in bilateral posterior tooth loss was found in 78 older adults (79%) who experienced partial tooth loss, and in another 20 older adults (20%) experiencing complete tooth loss. This result was supported by previous research by Hatieganu[29], who reported that the level of edentulism in females was higher than in males, where one of the factors was a more complex hormonal structure compared to males. However, the research place had fewer male subjects than females, causing an imbalance in the subject sex distribution. Further influencing supporting factors can be found in the report of the Central Agency of Statistics of the Republic of Indonesia (BPS).[21–23,25]

Some factors that affect the occurrence of tooth loss include disease factors such as caries, periodontal disease, severe trauma, and attrition. Another factor is stress because someone who experiences stress tends to have bad habits such as frequent consumption of sweet foods and alcoholic beverages, smoking, and bruxism, which leads to oral health neglect. In female elders, the effect of decreased estrogen can lead to loss of bone mass and osteoporosis. Another study also found that females were more likely to have tooth loss than males.[24–25]

One potential limitation of this research is that when filling out the questionnaire, some respondents held back in conveying their most honest answers and chose the safest answer they considered would satisfy the researchers' will, thus potentially affecting the assessment results.

CONCLUSION

There is a relationship between posterior tooth loss and temporomandibular joint disorders in elders. The research's implications are to promote preventive measures for oral health in older adults to maintain healthy temporomandibular joints.

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