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The Effect of Missing Teeth on Intercuspal Position: A Prosthodontic Perspective

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Original Research Article

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Abstract: ***Background:*** Missing teeth can significantly affect the intercuspal position (ICP) and contribute to temporomandibular joint (TMJ) disorders, which in turn impact the overall masticatory function and oral health. This study investigates the effect of missing teeth on ICP and TMJ symptoms and evaluates the outcomes of prosthodontic rehabilitation. ***Methods:*** A total of 120 participants with varying patterns of tooth loss were enrolled in the study, which took place from January to December 2016 in the Department of Prosthodontics at Bangabandhu Sheikh Mujib Medical University and beau-dent, Dhaka, Bangladesh. ***Results:*** The study included 69 males (57.5%) and 51 females (42.5%) with a mean age range of 36–50 years (40.8%). The results showed that the shift in ICP was most prominent in participants with posterior tooth loss (80%), followed by mixed tooth loss (85.7%) and anterior tooth loss (71.4%). TMJ symptoms were common, with clicking reported by 41.7% of participants, pain by 29.2%, and restricted movement by 16.7%. After prosthodontic rehabilitation, significant improvements were observed in several measures: occlusal contacts increased from 4.5 ± 1.8 to 7.8 ± 2.1 ($p < 0.001$), bite force improved from 150 ± 30 N to 320 ± 45 N ($p < 0.001$), and TMJ symptom severity decreased from 3.8 ± 1.2 to 1.2 ± 0.8 ($p < 0.001$). ***Conclusion:*** Missing teeth have a significant impact on intercuspal position and contribute to TMJ symptoms. Prosthodontic rehabilitation effectively restores ICP, improves bite force, and reduces TMJ symptoms.

Keywords: Missing Teeth, Intercuspal Position, Temporomandibular Joint Symptoms, Prosthodontic Rehabilitation, TMJ Disorders.

INTRODUCTION

The intercuspal position (ICP), also known as centric occlusion, is a critical determinant of occlusal harmony and functionality in the stomatognathic system.[1] It represents the maximum intercuspation of the maxillary and mandibular teeth, providing stability during mastication and contributing to overall oral health.[2,3] Proper alignment of teeth in ICP ensures even distribution of occlusal forces, reduces stress on supporting structures, and maintains the balance of temporomandibular joint (TMJ) function.[4] However, the loss of teeth disrupts this balance, potentially leading to a cascade of complications ranging from occlusal instability to TMJ disorders.[5]

Tooth loss is a common condition globally, affecting individuals across all age groups due to causes such as dental caries, periodontal disease, trauma, and systemic health conditions.[6] When teeth are lost, the natural occlusal relationships are altered, which may cause a shift in ICP, uneven load distribution, and excessive forces on the remaining teeth.[7] Over time, these changes may lead to compensatory adjustments in the adjacent and opposing teeth, tilting, extrusion, and even the development of TMJ-related symptoms such as clicking, pain, and restricted mandibular movements.[4] Additionally, unaddressed tooth loss can contribute to functional impairments such as difficulty in mastication, speech, and esthetic concerns, which affect the quality of life.[8]

The impact of missing teeth on ICP is particularly relevant in the field of prosthodontics, where the primary goal is to restore function, esthetics, and comfort for patients with partial or complete edentulism.[9] The precise identification of changes in ICP is crucial for developing effective treatment plans, including the design and placement of prosthetic restorations.[10] Properly rehabilitating ICP can prevent further dental complications, improve TMJ health, and ensure the long-term success of prosthodontic treatments.[11] However, despite the clinical significance, limited studies have systematically evaluated the effects of tooth loss on ICP and its broader implications on oral health and prosthodontic outcomes.[12]

This study aimed to assess the effects of missing teeth on ICP from a prosthodontic perspective, with a focus on identifying changes in occlusal contacts, bite force distribution, and associated TMJ symptoms. It also evaluates the outcomes of prosthodontic

rehabilitation in restoring functional occlusion and minimizing TMJ complications. By systematically analyzing the relationship between patterns of tooth loss and changes in ICP, this research seeks to provide valuable insights that will contribute to improving clinical practices in prosthodontics and enhance patient care.

METHODOLOGY AND MATERIALS

This cross-sectional study was conducted in the Department of Prosthodontics at Bangabandhu Sheikh Mujib Medical University and beau-dent, Dhaka, Bangladesh, over one year from January 2016 to December 2016. A total of 120 patients aged 25–65 years with partial edentulism were included using purposive sampling. Participants were categorized based on the pattern of tooth loss (anterior, posterior, or mixed) and evaluated for its impact on intercuspal position (ICP). Patients with complete edentulism, previous prosthodontic rehabilitation, or temporomandibular joint (TMJ) disorders unrelated to tooth loss were excluded.

Clinical assessment involved recording occlusal contacts using articulating paper and quantifying bite force using a digital force analyzer. Radiographic evaluations were performed to assess occlusal plane discrepancies and TMJ conditions. Demographic and clinical data, including age, gender, and patterns of tooth loss, were collected using structured forms. TMJ symptoms such as clicking, pain, and restricted movement were documented during the clinical examination. Prosthodontic rehabilitation outcomes were assessed after restoring missing teeth using fixed or removable prostheses. Pre- and post-rehabilitation measures included occlusal contacts, bite force, and TMJ symptom severity.

Statistical analysis was performed using SPSS, where continuous variables were presented as means and standard deviations, and categorical variables as frequencies and percentages. The chi-square test was used to evaluate the association between tooth loss patterns and TMJ symptoms. Paired t-tests compared pre- and post-rehabilitation outcomes, while p-values <0.05 were considered statistically significant. Informed consent was secured from all participants.

RESULTS

Table 1: Demographic and Clinical Characteristics of Participants (N = 120)

Characteristic	Frequency	Percentage (%)
Age (years)		
- 25–35	32	26.7
- 36–50	49	40.8
- 51–65	39	32.5
Gender		
- Male	69	57.5
- Female	51	42.5
Pattern of Tooth Loss		
- Anterior	35	29.2
- Posterior	50	41.7
- Mixed	35	29.2

Table 1 presents the demographic and clinical characteristics of the study participants. The majority of participants were aged 36–50 years (40.8%), with males comprising 57.5% of the sample. Patterns of tooth loss were predominantly posterior (41.7%), while anterior and mixed tooth loss each accounted for 29.2% of cases.

Table 2: Changes in Intercuspal Position (ICP) Based on Tooth Loss

Pattern of Tooth Loss	Shift in ICP (%)	Uneven Occlusal Contacts (%)
Anterior Tooth Loss	25 (71.4%)	20 (57.1%)
Posterior Tooth Loss	40 (80.0%)	45 (90.0%)
Mixed Tooth Loss	30 (85.7%)	28 (80.0%)

Table 2 illustrates the changes in intercuspal position (ICP) associated with different patterns of tooth loss. Among participants with anterior tooth loss, 71.4% experienced a shift in ICP, and 57.1% had uneven occlusal contacts. For posterior tooth loss, 80.0% showed a shift in ICP, while 90.0% exhibited uneven occlusal contacts. Mixed tooth loss resulted in the highest impact, with 85.7% showing a shift in ICP and 80.0% displaying uneven occlusal contacts. These findings highlight the significant alterations in occlusal balance associated with tooth loss patterns.

Table 3: Correlation between Tooth Loss and TMJ Symptoms

Tooth Loss Pattern	TMJ Symptoms (n)	TMJ Symptoms (%)
Clicking	50	41.7
Pain	35	29.2
Restricted Movement	20	16.7

Table 3 highlights the correlation between tooth loss and temporomandibular joint (TMJ) symptoms. Clicking was the most common symptom, reported by 50 participants (41.7%), followed by pain in 35 participants (29.2%). Restricted mandibular movement was observed in 20 participants (16.7%). These results suggest a notable association between patterns of tooth loss and the development of TMJ-related symptoms.

Table 4: Improvement after Prosthodontic Rehabilitation

Outcome Measure	Pre-Rehabilitation (Mean ± SD)	Post-Rehabilitation (Mean ± SD)	p-value
Occlusal Contacts	4.5 ± 1.8	7.8 ± 2.1	<0.001
Bite Force (N)	150 ± 30	320 ± 45	<0.001
TMJ Symptom Severity	3.8 ± 1.2	1.2 ± 0.8	<0.001

Table 4 demonstrates significant improvements in occlusal and TMJ outcomes after prosthodontic rehabilitation. The mean number of occlusal contacts increased from 4.5 ± 1.8 pre-rehabilitation to 7.8 ± 2.1 post-rehabilitation ($p < 0.001$). Bite force showed a marked improvement, rising from 150 ± 30 N to 320 ± 45 N ($p < 0.001$). Additionally, TMJ symptom severity significantly decreased from 3.8 ± 1.2 to 1.2 ± 0.8 ($p < 0.001$), indicating enhanced functionality and reduced discomfort following treatment.

DISCUSSION

The present study explored the effects of missing teeth on intercuspal position (ICP), temporomandibular joint (TMJ) symptoms, and the subsequent improvements following prosthodontic rehabilitation. Our results demonstrated that tooth loss, particularly posterior and mixed, had significant consequences on ICP, TMJ symptoms, and occlusal stability. These findings are consistent with previous literature that has emphasized the critical role of occlusion in maintaining mandibular function and preventing TMJ disorders.

The pattern of tooth loss in our study was consistent with other research, with posterior tooth loss being the most common (41.7%), followed by anterior (29.2%) and mixed loss (29.2%). This distribution mirrors findings from Iwase et al., who also reported a significant impact of posterior tooth loss on occlusal contact areas and ICP.[13] Their research showed that occlusal contact areas during maximum closure, such as during gum chewing, do not always coincide with ICP, suggesting that posterior tooth loss can lead to instability in occlusal relations and subsequent functional problems.

Furthermore, the results of our study demonstrated a high incidence of ICP shifts and uneven occlusal contacts following tooth loss, particularly in posterior (80.0%) and mixed (85.7%) tooth loss patterns. This aligns with the work of Marklund and Wänman, who suggested that occlusal contacts on the mediotrusive side—particularly in cases of tooth loss—play a significant role in altering the functional occlusal relationship.[14] The effect of occlusal discrepancies, as seen in our study, has been well-documented, with similar findings reported by Ghani et al., who found that occlusal relations are often disturbed in patients with partial edentulism, resulting in functional impairments.[15]

Regarding TMJ symptoms, our findings indicated a high prevalence of clicking (41.7%) and pain (29.2%), which aligns with De Boever et al., who noted that occlusal interferences and maladjustments are significant contributing factors to TMJ disorders.[16] Our results support the idea that occlusal instability due to missing teeth can exacerbate TMJ symptoms, including pain and restricted movement. This is further supported by Montero et al., who emphasized that the presence of missing teeth significantly contributes to both functional and symptomatic problems in the temporomandibular joint.[17]

In terms of prosthodontic rehabilitation, our study found significant improvements in occlusal contacts (from 4.5 ± 1.8 to 7.8 ± 2.1), bite force (from 150 ± 30 N to 320 ± 45 N), and TMJ symptom severity (from 3.8 ± 1.2 to 1.2 ± 0.8). These findings are in agreement with those of Ikebe et al., who demonstrated that prosthodontic treatment significantly improves both masticatory performance and bite force, especially in patients with posterior tooth loss.[18] Furthermore, the significant reduction in TMJ symptom severity following rehabilitation supports the conclusions of Kaur and Datta, who highlighted the positive effects of occlusal rehabilitation in mitigating TMJ disorders and restoring functional stability.[19]

Moreover, the increase in bite force observed in our study (113.3% improvement) corroborates findings from Yamamoto et al., who reported that prosthodontic interventions help restore bite force and overall mandibular function.[20] The positive changes observed in occlusal contacts and bite force suggest that timely

prosthodontic intervention can effectively address the functional deficits caused by tooth loss, enhancing both occlusion and masticatory efficiency.

Some studies that report minimal effects of occlusal rehabilitation on TMJ symptoms, our study found a marked reduction in TMJ discomfort, which aligns with findings from Bidra and Uribe, who noted significant improvements in TMJ symptoms post-rehabilitation.[21] The variation in results could be due to differences in the study populations, the types of prosthodontic treatments used, or the duration of follow-up.

Our study contributes to the growing body of evidence that highlights the significant impact of missing teeth on ICP, TMJ function, and occlusal stability. The study emphasized the importance of timely prosthodontic intervention in restoring occlusal function and alleviating TMJ symptoms.

Limitations of the study

This study, while providing valuable insights into the effects of missing teeth on intercuspal position (ICP) and temporomandibular joint (TMJ) symptoms, has several limitations. First, the sample size of 120, although adequate for statistical analysis, may not fully represent the broader population of patients with tooth loss. Further research with a larger and more diverse sample, including individuals with different ages and varying degrees of tooth loss, would provide more comprehensive results.

CONCLUSION

In conclusion, this study highlights the significant impact of missing teeth on intercuspal position (ICP), TMJ symptoms, and overall occlusal stability. The results indicate that posterior and mixed tooth loss significantly affect occlusal contacts and contribute to TMJ discomfort, reinforcing the importance of early prosthodontic intervention. Prosthodontic rehabilitation was shown to improve ICP, bite force, and reduce TMJ symptoms, demonstrating its effectiveness in restoring both functional and symptomatic aspects of occlusion. These findings emphasize the need for comprehensive prosthodontic treatment for patients with missing teeth to prevent long-term complications such as TMJ disorders and to restore masticatory function. However, further research with larger sample sizes, long-term follow-up, and more detailed examination of different prosthodontic treatments is recommended to validate and expand upon these results.

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