Research Article
J Nepal Soc Perio Oral Implantol. 2024 Jan-Jun;8(15):12-8

Submitted: Apr 19, 2024
Accepted: Jun 14, 2024
Published: Jun 21, 2024

Prevalence and Patterns of Restorations on Permanent Molar Teeth: A Hospital-based Cross-sectional Study

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ABSTRACT

Introduction: Dental caries is the most prevalent oral disease globally. Molars are the most susceptible teeth for dental caries owing to their morphological features and position in the arch requiring restorations. In today's era, a variety of restorative materials with their own advantages and disadvantages are available.

Objective: This study aimed to determine prevalence and patterns of restorations on permanent molar teeth in adult dental patients.

Methods: This descriptive cross-sectional study was carried out with ethical approval, in patients visiting the Dental Department of Dhulikhel Hospital from 2023 December 01 to 2024 February 29. All molar teeth from 216 patients above 18 years were examined and recorded as restored, unrestored, or missing with convenience sampling technique. The types of restorations with its quality as intact or defective were noted. Statistical analysis in the form of descriptive statistics was carried out with SPSS software.

Results: A total of 2,592 molars, among 216 participants were examined, out of which 324 (12.50%) were restored, 1,906 (73.53%) were unrestored, and 362 (13.96%) were missing. Most frequently restored molars were first molars (176, 54.32%) and missing were third molars (362, 13.96%). Restored molars were more in mandibular arch, with higher frequency for first molars (108, 33.33%). The majority of teeth had intact composite restoration (198, 61.11%). Most of the unrestored teeth were non-carious (1,332, 69.88%).

Conclusions: Molar teeth, especially the permanent first molars are more susceptible to caries and frequently restored teeth. Timely intervention, if needed, with appropriate treatment modality prevents miserable complications.

Keywords: Amalgam; composite; pattern of restoration; permanent molars.

INTRODUCTION

According to the World Health Organisation around 2.3 billion people suffer from dental caries in permanent teeth making it one of the most prevalent non-communicable disease globally.[1] Dental caries in permanent and deciduous teeth are ranked in first and twelfth position respectively in Global Burden of Disease Study.[2] If the caries is detected early, the best treatment option is restoration. In restorative dentistry, wide ranges of restorative materials are available.[3]

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Citation
Chakradhar A, Nepal M, Pradhan SP, Khadka J. Prevalence and Patterns of Restorations on Permanent Molar Teeth: A Hospital-based Cross-sectional Study. J Nepal Soc Perio Oral Implantol. 2024 Jan-Jun;8(15):12-8.

In comparison with incisors, canines, and premolars; molars are the most susceptible teeth for dental caries specially permanent first molar.[4,5] This can be related to early eruption, age, anatomical features, large crown size, and its posterior location in the mouth.[5,6] Deep pits and fissures may retain food particles and harbour bacteria, making it more susceptible to carious attack.[7]

Ample studies have been conducted regarding dental caries in permanent first molars among children[8-10] and prevalence of caries among adults in Nepal.[11-14] However, there is paucity of study related to prevalence and pattern of restorations on permanent molar teeth in adult dental patients[7] and the authors of this study have not found any such study in Nepal till date. So, this study aimed to determine prevalence and patterns of restorations on permanent molar teeth in adult dental patients attending tertiary care centre of Bagmati Province, Nepal.

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METHODS

This descriptive cross-sectional study was conducted among the patients who visited to the Outpatient Department of Conservative Dentistry and Endodontics, Dhulikhel Hospital, Kathmandu University School of Medical Sciences (KUSMS) between 2023 December 01 to 2024 February 29. Ethical approval was obtained from the Institutional Review Committee, KUSMS (Ref. 241/23). Convenience sampling method was used. The sample size was calculated using the following formula:

$$\text{Sample size} = \frac{Z_{1-\alpha/2}^2 p(1-p)}{d^2}$$

Here,

$Z_{1-\alpha/2}$= 1.96 = standard normal variate, at 5% type 1 error (P <0.05)

p = Expected prevalence = 0.5 (no previous study, so 50% prevalence was considered)

d = Absolute error or precision = 0.07 (7% taken)

Thus, the minimum sample size was calculated to be 196. In the calculated sample size, 10% was added and the total sample size was 216.

Patients were explained about the investigations and informed consent duly signed by the participants who willingly agreed to participate was obtained. Study participants aged above 18 years who provided informed consent were included in this study while the participants who did not provide consent were excluded.

All the clinical examination orally was done by principal investigator using mouth mirror and explorer under dental chair's light. After examination of a participant, a predesigned proforma that included socio-demographic data of the participants was filled, and all the status of molars were recorded. The teeth were classified as restored, unrestored, or missing. The type of restorations on the restored molars was noted and the quality of the restorations was classified as intact or defective. The unrestored molars were further categorised as non-carious and carious. If carious, either pit and fissure caries or smooth surface caries were noted.

Data were entered in Microsoft Excel sheet and exported to IBM SPSS Statistics for Windows, version 25 (IBM Corp., Armonk, N.Y., USA) for analysis. The unit of analysis was the molar teeth. Statistical analysis in the form of descriptive statistics was carried out and represented as tables and figures.

RESULTS

Out of the total 216 patients examined, 126 (58.33%) were female and 90 (41.67%) were male. The mean age of study participants was 36.40±14.24 years and the age ranged from 18-77 years. The age group most represented was18-35 years accounting for 113 (52.31%) of the participants, followed by 79 (36.57%) 36-55 years, and 24 (11.11%) above 56 years.

A total of 2,592 molars were examined and classified as restored, unrestored or missing. Out of the molars examined, 324 (12.5%) were restored, 1,906 (73.53%) were unrestored, and 362 (13.96%) molars were missing. The most frequently restored teeth were the first molars (176, 54.32%) while third molars were mostly missing (260, 71.82%) (Table 1).

The most restored teeth were the mandibular first molars (108, 33.33%) followed by the mandibular second molars and maxillary first molars accounting for (81, 25%) and (68, 20.98%) respectively. Maxillary third molars were the least restored tooth (Table 2).

The mandibular arch had a higher prevalence of restored molars (211, 16.28%) while maxillary arch had higher prevalence of non-restored molars (1,001, 77.23%). Likewise, almost equal prevalence for missing molars were noted in both arches (Table 3).

The number of restored molars per participant ranged from none to 10. Among restored molars, single restored molar was the most frequent finding (47, 21.75%) followed by two restored molars (30, 13.88%) and the least frequent finding was greater than five restored molars (6, 2.80%). Among greater than five restored molars, three (1.38%) participants had six, one (0.46%) had eight, and two (0.92%) had 10 restored molars (Figure 1).

Out of 1,906 unrestored molars, 1,332 (69.88%) were non-carious whereas, 574 (30.11%) were carious with 510 (26.75%) pit and fissure caries, and 64 (3.35%) smooth surface caries (Table 4).

Most commonly used restorative material was composite (208, 64.19%) and the status of restoration was mostly intact (198, 61.11%) (Table 5).

Table 1: Status of molars of participants, n (%).

Teeth	Status of molars			
	Restored	Unrestored	Missing	Total
First molars	176 (54.32)	631 (33.10)	57 (15.74)	864 (33.33)
Second molars	121 (37.34)	698 (36.62)	45 (12.43)	864 (33.33)
Third molars	27 (8.33)	577 (30.27)	260 (71.82)	864 (33.33)
Total	324 (100)	1,906 (100)	362 (100)	2,592 (100)

Table 2: Status of individual molar tooth, n (%).

Molar teeth	Restored	Unrestored	Missing	Total
Maxillary first	68 (20.98)	342 (17.94)	22 (6.07)	432 (16.66)
Maxillary second	40 (12.34)	368 (19.30)	24 (6.62)	432 (16.66)
Maxillary third	5 (1.54)	291 (15.26)	136 (37.56)	432 (16.66)
Mandibular first	108 (33.33)	289 (15.16)	35 (9.66)	432 (16.66)
Mandibular second	81 (25)	330 (17.31)	21 (5.80)	432 (16.66)
Mandibular third	22 (6.79)	286 (15)	124 (34.25)	432 (16.66)
Total	324 (100)	1,906 (100)	362 (100)	2,592 (100)

Table 3: Status of molars by arch, n (%).

Status	Maxillary molars	Mandibular molars	Total
Restored	113 (8.71)	211 (16.28)	324 (12.50)
Unrestored	1,001 (77.23)	905 (69.83)	1,906 (73.53)
Missing	182 (14.04)	180 (13.88)	362 (13.96)
Total	1296 (100)	1296 (100)	2,592 (100)

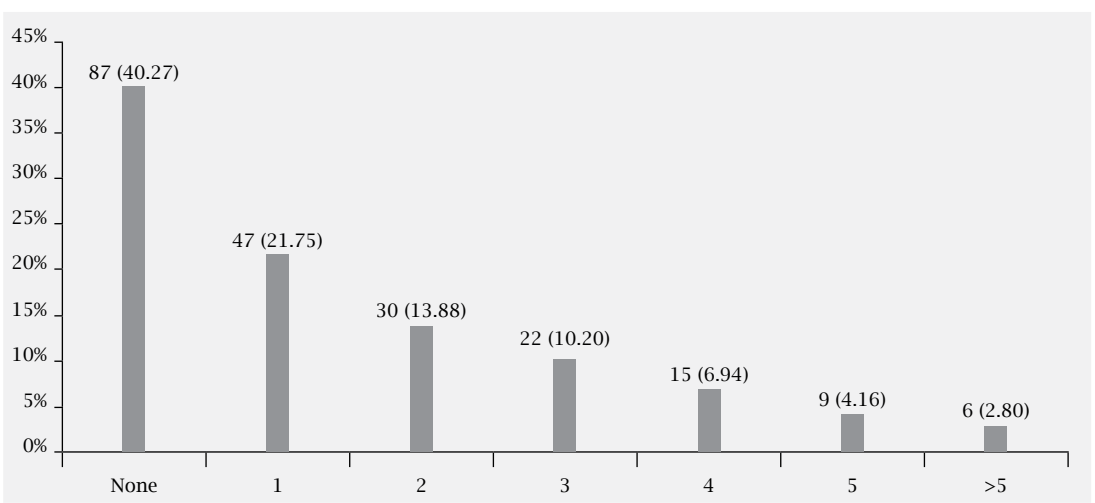

Figure 1: Distribution of restored molars, n (%).

Table 4: Status of unrestored molars.

Teeth	Non-carious	Carious	
		Pit and fissure	Smooth surface
Maxillary first	248	77	17
Maxillary second	257	103	8
Maxillary third	215	68	8
Mandibular first	197	80	12
Mandibular second	202	116	12
Mandibular third	213	66	7
Total N = 1,906 (100%)	1,332 (69.88%)	510 (26.75%)	64 (3.35%)

Table 5: Type of restoration and its status.

Molar teeth	Amalgam		Composite		Glass Ionomer Cement		Others
	Intact	Defective	Intact	Defective	Intact	Defective	
Maxillary first	3	1	44	0	4	0	16
Maxillary second	4	3	26	0	2	0	5
Maxillary third	1	0	4	0	0	0	0
Mandibular first	9	1	60	6	6	0	26
Mandibular second	14	1	51	3	2	1	9
Mandibular third	1	0	13	1	4	0	3
Total N = 324 (100%)	32 (9.87%)	6 (1.85%)	198 (61.11%)	10 (3.08%)	18 (5.55%)	1 (0.30%)	59 (18.20%)

DISCUSSION

There are altogether 12 molars in the oral cavity of an adult namely the first, second, and third molars on each side of both arches. Maxillary and mandibular molars in combination perform mastication and help in the comminution of food. While the deciduous teeth are all still in position and functioning, the first permanent molar erupts next to deciduous second molar with no predecessors. The mandibular first molar tends to emerge in the oral cavity at the age of 6-7 years followed by maxillary first molar. The second molars erupt at the age of 11-13 years followed by third molars which erupts at 17 years or later.

The molars are the largest and strongest teeth, because of their bulk and anchorage. These strongest teeth turn to be weakest when it comes to caries susceptibility. High prevalence of caries in molars could be related to the incomplete post eruptive maturation and the presence of narrow and deep fissures harbouring bacteria. Molars being placed more posteriorly in the dental arch, may be more difficult to access with oral hygiene aids like tooth brushing.[5] The occlusal surfaces of permanent first molars, followed by the second molars, remain the sites in the dentition which are most frequently attacked by dental caries.[15,16] Permanent second molars also share similar morphological features to that of first molar with three to five cusps and grooves, fossa, pits and fissures. As these teeth are more prone for carious attack, they often require specific preventive measures or restorative treatments, or may be lost prematurely due to caries.

In the initial stage, dental caries may be asymptomatic. Later, the symptoms of reversible pulpitis that may be uncomfortable to the patient presenting as sharp short pain with thermal stimuli mainly cold that reverses rapidly after its removal may occur. If left untreated, pulpal involvement leading to spontaneous and lingering pain, swelling, abscess or even sepsis may develop. If detected early, simple treatment methods like restoration of the involved tooth can be employed with the best results. However, if the caries progress, more comprehensive treatment like root canal therapy may be required

or sometimes it may even be impossible to salvage tooth leaving extraction the only option. Therefore, early detection and treatment of dental caries may reduce the severity and prevent its complications.

The finding from this study reported that the first molars (176, 54.32%) were the frequently restored tooth. This may be justified by the fact that higher amounts of biofilm accumulated on the occlusal surface of partially erupted molars as it may often take a very long time to erupt fully that is six months to one year.[17] Also, this tooth erupts at an early age when the child lacks proper tooth brushing skills and may also neglect tooth brushing habit. These conditions are favourable for caries susceptibility needing for restoration at an early age. Comparing mandibular and maxillary first molars, the former had high frequency for restoration representing 108 (33.33%) out of 324 restored molars, followed by mandibular second molars (81, 25%) and maxillary first molar (68, 20.98%). The study done by Enabulele and Ehizele also reported first molars to be the most frequently restored teeth, however in their study, maxillary first molars followed by mandibular second molars had higher frequency compared to mandibular first molars.[7] Likewise, the study done by Macek et al. also represented mandibular second molar as number one in caries susceptibility followed by maxillary first and second molars and mandibular first molar in number two.[4] Most attention is paid to mandibular first molars and those teeth are more likely to be sealed with pit and fissure sealants, thus, reducing its susceptibility for caries. However, mandibular second molars are less likely to receive sealants than mandibular first molars. Nepal, being the developing country, knowledge and accessibility for preventive measures is lacking. Patients bother visiting dentists only after they face noticeable problems.

Considering the status of missing teeth, this study found that third molars (260, 71.82%) had higher frequency. Third molars may be congenitally missing from one side of the maxilla or mandible, if so, the probability of missing from other side is also high. Mandibular third molars are most likely to be impacted in the jaw, either wholly or partially. Being the last tooth to erupt, it may not get enough space for its accommodation. The finding is in agreement with the study done by Enabulele and Ehizele.[7]

Comparing the interarch observations, the frequency of restored molars was almost twice as great in mandibular molar (211, 16.28%) compared to maxillary molars (113, 8.71%) in this study. Higher prevalence for restored mandibular molars was reported in previous study as well.[7] Apart from this, there are no such comparable studies, however, Shrestha et al. reported that the most prevalent type of dental caries was the occlusal pit and fissure caries in the mandibular arch (298, 67.73%)[18] and Khan et al. also found that the dental caries was more prevalent in mandible (8162, 53%) than in maxilla (7158, 47%)[19] which may directly be related to why the frequency for restoration is higher in mandibular arch. In this study, among 216 participants, 47 (21.75%) had at least one molar restored while the highest number of restored molars were 10 which was present in just two participants.

In this study, out of 1,906 non-restored molars, most of the molars were non-carious (1,332, 69.88%) and 510 (26.75%) had pit and fissure caries while 64 (3.35%) had smooth surface caries. In the study conducted in one of the tertiary hospital of Nepal,[18] occlusal pit and fissure caries (595, 66.04%) was found to be most prevalent among the patients followed by smooth surface caries (220, 24.42%), the obtained frequency is higher than that of this study as only type of dental caries was recorded in their study but this study reported the overall status where restored, non-carious, carious and missing molar teeth were taken into considerations.

In restorative dentistry, a plethora of restorative materials can broadly be categorised into metallic and nonmetallic, and sub categorised as direct and indirect. Amalgam and direct filling gold are the examples of direct metallic restorations whereas, glass ionomer cements and composite resins are the examples of direct nonmetallic (tooth-colored) restorations. Similarly, cast metal restorations (inlays, onlays) are indirect metallic restorations while indirect composites and dental ceramics are indirect tooth-colored restorations.[3]

In terms of restorative materials, the most frequently used restorative material in this study was composite (208, 64.19%) and the restoration was defective in only 10 (3.08%) patients. Enabulele and Ehizele reported amalgam as the most prevalent restorative material

in their findings, which is in contrast with this result. Amalgam has been used for more than 150 years as a predictable and inexpensive restorative material. In recent years, with increase demand for aesthetics, the public concerns about mercury toxicity and national-level ban in the use of amalgam, its use has gradually been replaced by tooth-colored materials, offering advantages such as aesthetics and less invasive preparation techniques. However, a higher annual failure rate has been reported for posterior resin composite restorations than for amalgam.[20] Cochrane review concluded, there is low-quality evidence to suggest that resin composites lead to higher failure rates and risk of secondary caries than amalgam restorations.[21] In amalgam-restored tooth, six (1.85%) out of 38 (11.72%) restorations were defective whereas only 10 (3.08%) out of 208 (64.19%) composite restorations were defective, however, the life span of restorations were not considered in this study, to support the use of composite over amalgam. Glass ionomer cements were mostly used as an interim restoration for deep caries management which was less frequently encountered (19, 5.85%). The other restorative materials included, temporary fillings used commonly as a part of multi visit root canal treatments, cast metal restorations (inlays/ onlays) and extracoronal restorations including either zirconia/porcelain fused to metal crown or bridges accounting for 59 (18.20%) restorations.

The limitation of this study is that it was a hospital-based study conducted at a single tertiary centre of Bagmati province, Nepal. Multicentric studies with large sample size are still required for generalising the findings to overall Nepali population and get more conclusive results.

CONCLUSIONS

The permanent first molars, more specifically mandibular first molars were the frequently restored teeth and permanent third molars were found to be mostly missing teeth. Mandibular arch had a greater number of restored teeth compared to maxillary arch. Among non-restored teeth, more were non-carious while some were carious predominantly pit and fissure caries. In the context of restorative materials, restoration was mostly found to be done with direct tooth-colored composite resin which indicates the gradual phase-down of amalgam restoration. Besides, some of the restorations were found to be defective. More focus is given towards the caries status and the restoration component is mostly neglected, so, the authors recommend incorporating the type of restoration along with its status while checking Decayed Missing Filled Teeth (DMFT) index.

ACKNOWLEDGEMENTS

The authors would like to thank all the participants of this study and the staff of Department of Conservative Dentistry and Endodontics, Dhulikhel Hospital, Kathmandu University School of Medical Sciences for their support.

Conflict of interest: None.

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