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Incidence of tooth loss and pattern for partial edentulism among people above 20 years age from urban, rural areas in Barabanki district in India

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Abstract:
Tooth loss remains a major public health concern, but the distribution of partial edentulism patterns and their underlying causes vary across different populations and require regional evaluation. Therefore, it is of interest to assess the prevalence and distribution of partial edentulism in 500 patients aged over 20 years using Kennedy's classification, while recording age, gender, arch involvement and causes of tooth loss. Kennedy Class III was the most prevalent pattern of partial edentulism; tooth loss occurred most frequently in the 31–40-year age group and dental caries was the leading cause, followed by periodontal disease. Partial edentulism affected both dental arches and showed significant variation in distribution according to Kennedy's classification and patient characteristics. Thus, data support preventive oral healthcare strategies and facilitate appropriate prosthodontic treatment planning for partially edentulous patients.

Keywords: Partial edentulism, Kennedy's classification, prevalence, dental caries, epidemiological study

Background:
Oral health is a part of overall health and plays a crucial role in the quality of life of any person. Tooth loss is one of the most common and significant oral health issues globally. It not only hinders mastication, speech and esthetics, but also has a negative impact on psychological health and social interaction **[1]**. Notwithstanding the progress in preventive and restorative dentistry, partial edentulism remains a significant public health problem especially in developing countries such as India **[2]**. Partial edentulism is the absence of one or more natural teeth in the dental arch. The distribution and pattern of tooth loss is highly variable and depends on many factors including age, gender, socioeconomic status, oral hygiene habits and dental care availability **[3]**. The effects of untreated tooth loss include drifting of adjacent teeth, supra-eruption of opposing teeth, temporomandibular joint disorders and eventual deterioration of oral function **[4]**. The classification of partial edentulism is an important part of diagnosis, treatment planning and prognosis. The classification system of Kennedy, which was established in 1925, is still the most commonly used classification system because of its simplicity and clinical applicability. It classifies partially edentulous arches into four groups according to the position and size of the edentulous areas **[5]**. It is important for prosthodontists to know where these classes are found in a population so that they can plan the treatment accordingly and predict the biomechanical problems. The incidence and pattern of tooth loss are influenced by multiple etiological factors. The most common conditions worldwide are dental caries and periodontal disease, which make up most of the extractions **[6]**. Other factors are trauma, orthodontic extraction, congenital absence and systemic diseases **[7]**. In rural communities, socioeconomic and educational inequalities may contribute to greater tooth loss. A study from Barabanki district reported significantly greater periodontal disease-associated tooth loss among rural adults than urban adults, with age, education and socioeconomic status also significantly associated with tooth loss **[8]**. However, urban populations can have different patterns because they have improved access to health care, but may be exposed to higher levels of dietary and lifestyle risk factors **[9]**. Partial edentulism is a significant factor and is related to age. In younger people, caries and trauma are the most common causes of tooth loss, while in older age groups, periodontal disease is the main cause of tooth loss **[10]**. Gender differences have also been reported, with some studies indicating that males were more likely to have tooth loss than females because of less oral hygiene practices and others stating that females were more likely to have tooth loss than males because of their increased use of dental services and extractions **[11]**. Another factor to consider in prosthodontics is the distribution of tooth loss—whether it is arch-wise or not. Research has shown that mandibular arches are more frequently involved than maxillary arches, perhaps because of different bone density, plaque formation or periodontal susceptibility **[12]**. Furthermore, distal extension cases (Kennedy Class I and II) are commonly seen in the elderly, which adds to the difficulties in prosthetic rehabilitation **[13]**. Barabanki district in Uttar Pradesh is a mixed population district with both urban and rural population. Differences in socioeconomic status, education and health care services between these populations could affect oral health outcomes, such as tooth loss patterns. There is, however, little epidemiological information on the incidence of tooth loss and the pattern of partial edentulism in this area. The knowledge of the prevalence and distribution of partial edentulism in a population is crucial for the planning of effective preventive and rehabilitative dental services. It also helps to identify high-risk groups and to target public health interventions accordingly **[14]**. In addition, the assessment of the causes of tooth loss can help identify the success or failure of current dental health programs and indicate what needs to be improved **[15]**. Therefore, it is of interest to evaluate the prevalence of tooth loss and distribution of partial edentulism in urban and rural population of Barabanki district above 20 years of age and also

analyze the distribution of Kennedy's classification by age group and gender, determine the common causes of tooth loss and assess the involvement of the arches among patients who seek prosthodontic treatment.

Materials and Methods:

Study design:

The study was done only with the patients who came to the department of prosthodontics, Chandra dental College and hospital, Barabanki for dental treatment.

Sample selection:

The study population was patients reported to the Outpatient Department of Prosthodontics during the study period. Random sampling was used to ensure representation of all eligible cases among the participants.

Inclusion criteria:

The age group above 20 years, because this age period is associated with a stable permanent dentition period with relatively lower chances of eruption anomalies. To ensure uniformity in data collection and to eliminate the variations due to mixed dentition, only patients with permanent dentition were included. Patients who were partially edentulous (one or more missing teeth in either arch). The study subjects were randomly selected and stratified by age groups. The population was also split into two groups according to the demographic characteristics and equal representation was obtained from each group.

Exclusion criteria:

Patients with complete natural dentition, since they did not contribute to the study objectives. Patients who were completely edentulous (*i.e.,* they could not be classified using Kennedy's classification system). People who have no other missing teeth except the third molars, as they are often extracted prophylactically and have little effect on the planning of the prostheses. Tooth loss resulting from orthodontic extraction was not included because it is not considered a disease-related tooth loss. Patients with partially erupted teeth and root stumps, as these can make edentulous space classification more challenging. Cases with retained deciduous teeth, to avoid confounding factors related to developmental anomalies.

Sampling:

A simple random sampling technique was used to reduce selection bias. For 12 month, 500 patients with eligibility criteria were enrolled. This number was considered adequate to provide statistically meaningful results and was determined based on feasibility and patient flow. Of the total sample, 275 were male and 225 were female, giving a fairly even gender split for comparison. The participants were divided into five age groups and the effect of ageing on the prevalence and type of partial edentulism was assessed:

[1] Group A: 21–30 years
[2] Group B: 31–40 years
[3] Group C: 41–50 years
[4] Group D: 51–60 years
[5] Group E: Over 60 years

This stratification allowed for the systematic evaluation of tooth loss in younger, middle aged and older populations.

Study method and tools:

A structured questionnaire proforma was created as the main data recording instrument. It contained patient identifiers and demographic data (Name, Age and Gender), clinical data (chief complaint, cause of tooth loss, arch and quadrant involved) and classification of edentulism. All the subjects were subjected to intraoral clinical examination with Mouth mirror and Probe under proper illumination. Clinical examination was performed in the Dental chair in a sterile environment. No Radiographic investigations were made and only visible missing teeth were taken into account for classification, for consistency. The pattern of partial edentulism was classified using the most practical and universally accepted classification system by Kennedy (Class I–IV). This classification ensured uniformity and enabled comparison to be made between the various age and gender groups.

Ethical considerations:

Prior to initiation, the study protocol was submitted to and approved by the Institutional Ethical Committee of Chandra Dental College and Hospital, Barabanki. All participants were given information about the study and asked for their consent to be examined before the examination. Confidentiality of personal information was maintained and participants were informed that their clinical care would not be impacted by their decision to Participate or Decline.

Validity and reliability of the study tools:

Standard diagnostic instruments and illumination were used during the entire study period and examination conditions were uniform.

Data collection procedure:

Data were gathered over a 12-month period by routine outpatient visits. All subjects were examined clinically intraorally following a systematic examination with a mouth mirror and probe. The results obtained were meticulously documented in the structured questionnaire. Tooth loss was attributed to one of the following causes:

[1] Dental caries – teeth that have been lost because of extensive decay, non-restorability or failed previous restorations.
[2] Periodontal issues – tooth loss due to advanced periodontal disease which results in mobility or bone loss.
[3] Dental trauma – accidental tooth loss due to physical injury.
[4] Combination/others – cases with more than one or other causes of tooth loss.

The completed questionnaires were then transferred to a master chart and checked for accuracy prior to statistical analysis.

Data analysis:
The data collected were systematically entered and analyzed using Statistical Package for the Social Sciences (SPSS) software version 26. Descriptive and inferential statistical techniques were used. Demographic characteristics, cause of tooth loss and distribution of Kennedy's classes were summarized using descriptive statistics like frequency distribution and percentages. The associations between categorical variables (age, gender and patterns of partial edentulism) were tested using the chi-square test (χ^2). A value of $p<0.05$ was considered statistically significant and thus the level of confidence in the results obtained was determined.

Results:
The study population was predominantly composed of individuals in the 31–40 years age group, which represented the highest proportion (31.6%). The 21–30 and 41–50 years groups showed comparable distributions, indicating a concentration of cases in the young to middle-aged population. A gradual decline in frequency was observed with increasing age, with the lowest proportion in individuals above 60 years (9.8%). In terms of gender distribution, there was a slight male predominance (55.0%) compared to females (45.0%), suggesting a modest gender difference in the occurrence of cases **(Table 1).** The findings demonstrate that edentulous spaces were highly prevalent, particularly in the mandibular arch (85.2%) compared to the maxillary arch (80.4%), with a significant proportion (65.6%) showing involvement of both arches. According to Kennedy's classification, Class III was the most predominant pattern in both maxillary (55.0%) and mandibular (58.0%) arches, while Class IV was rare, indicating that bounded edentulous spaces are the most common presentation. Regarding etiology, dental caries emerged as the principal cause of tooth loss (78.2%), followed by periodontitis (14.0%), highlighting that largely preventable conditions account for the majority of cases **(Table 2).** The analysis shows that age has a statistically significant association with edentulous spaces in the maxillary arch and in both arches combined, with prevalence increasing in older age groups, particularly those above 60 years. However, no significant association was observed between age and mandibular edentulous spaces, indicating a more uniform distribution across age groups in the mandible. Regarding sex, no statistically significant association was found in any category, although males consistently showed a slightly higher prevalence than females. Overall, these findings suggest that age is an important determinant for maxillary and combined arch involvement, while sex does not significantly influence edentulous space distribution **(Table 3).** The results show that age has a strong and statistically significant influence on Kennedy's classification in both arches, with Class III predominating in younger individuals and a progressive shift toward Class I in older age groups, reflecting increasing posterior tooth loss with age. However, sex does not significantly influence classification patterns in either arch. The cause of tooth loss remains consistent across age and sex, with dental caries being the dominant factor, followed by periodontitis, while trauma and other causes contribute minimally. A highly significant association was observed between cause of tooth loss and the presence of edentulous spaces, where caries was strongly linked to the presence of edentulous spaces across all arches, whereas periodontitis and trauma were more commonly associated with cases without such spaces. Furthermore, the relationship between cause of tooth loss and Kennedy's classification was significant, particularly in the mandible, where periodontitis and trauma contributed more substantially to Class I and II patterns, while caries predominated across all classes **(Table 4).** Overall, these findings highlight that age and etiology are key determinants of partial edentulism patterns, whereas sex has minimal influence.

Table 1: Distribution of cases by age group and gender (n = 500)

Variable	Category	Frequency (n)	Percentage (%)
Age Group	21–30 years	109	21.8%
	31–40 years	158	31.6%
	41–50 years	107	21.4%
	51–60 years	77	15.4%
	>60 years	49	9.8%
Gender	Male	275	55.0%
	Female	225	45.0%

Table 2: Distribution of edentulous spaces, kennedy's classification and causes of tooth loss (n = 500)

Variable	Category	Frequency (n)	Percentage (%)
Maxillary Arch	Edentulous Space Present	402	80.4%
	Edentulous Space Absent	98	19.6%
Mandibular Arch	Edentulous Space Present	426	85.2%
	Edentulous Space Absent	74	14.8%
Both Arches	Present in Both	328	65.6%
	Not in Both	172	34.4%
Kennedy's Classification (Maxillary)	Class I	78	19.4%
	Class II	99	24.6%
	Class III	221	55.0%
	Class IV	4	1.0%
Kennedy's Classification (Mandibular)	Class I	80	18.8%
	Class II	97	22.8%
	Class III	247	58.0%
	Class IV	2	0.5%
Cause of Tooth Loss	Dental Caries	391	78.2%
	Periodontitis	70	14.0%
	Trauma	22	4.4%

Table 3: Association of edentulous spaces with age and sex (n = 500)

Variable	Category	Maxillary Present (%)	Mandibular Present (%)	Both Arches Present (%)
Age Group	21–30 years	77 (70.6%)	89 (81.7%)	57 (52.3%)
	31–40 years	130 (82.3%)	138 (87.3%)	110 (69.6%)
	41–50 years	92 (86.0%)	85 (79.4%)	70 (65.4%)
	51–60 years	59 (76.6%)	71 (92.2%)	53 (68.8%)
	>60 years	44 (89.8%)	43 (87.8%)	38 (77.6%)
Sex	Male	223 (81.1%)	241 (87.6%)	189 (68.7%)
	Female	179 (79.6%)	185 (82.2%)	139 (61.8%)
Statistical Significance	Age (χ^2, p-value)	12.50, **0.014**	7.73, 0.102	13.14, **0.011**
	Sex (p-value)	0.667	0.090	0.104

Table 4: Association of kennedy's classification and causes of tooth loss with age, sex and edentulous spaces (n = 500)

Variable	Category	Maxillary (%)	Mandibular (%)	Statistical Significance
Kennedy's Classification vs Age	Class III (21–30 yrs)	74.0%	83.1%	χ^2=45.91, **p<0.001** (Maxilla)
	Class III (31–40 yrs)	58.5%	63.0%	χ^2=62.19, **p<0.001** (Mandible)
	Class III (41–50 yrs)	58.7%	52.9%	
	Shift to Class I (>50 yrs)	↑ (35.6–34.1%)	↑ (35.2–39.5%)	
Kennedy's Classification vs Sex	Male vs Female	Similar distribution	Similar distribution	p=0.189 (Maxilla), p=0.858 (Mandible)
Cause of Tooth Loss vs Age	Caries	73.5–80.4%	73.5–80.4%	χ^2=3.54, p=0.990
	Periodontitis	11.9–16.5%	11.9–16.5%	
	Trauma/Others	<6%	<6%	
Cause of Tooth Loss vs Sex	Male	Caries 77.5%	—	p=0.053
	Female	Caries 79.1%	—	
Cause vs Edentulous Space (Maxilla)	Caries (Present)	94.3%	—	**p<0.001**
	Periodontitis (Absent)	49.0%	—	
Cause vs Edentulous Space (Mandible)	Caries	100% (Absent cases)	—	**p<0.001**
	Periodontitis/Trauma/Others	Only in present cases	—	
Cause vs Both Arches	Caries (Present)	93.0%	—	**p<0.001**
	Others (Absent)	Higher proportion	—	
Cause vs Kennedy's Class (Maxilla)	Caries	100% (Class I, II), 90% (III), 75% (IV)	—	χ^2=21.04, **p=0.002**
	Periodontitis	Mainly Class III & IV	—	
Cause vs Kennedy's Class (Mandible)	Caries	94.3% (III), 69.1% (II), 18.8% (I)	—	χ^2=210.02, **p<0.001**
	Periodontitis	High in Class I (40.0%)	—	
	Trauma/Others	Mainly Class I & II	—	

Discussion:

The present study aimed to assess the prevalence of tooth loss and the distribution of partial edentulism in urban and rural population of Barabanki district above 20 years of age. The results showed that partial edentulism is still a major oral health problem and that it is multifactorial with age, etiology and arch involvement being the factors. The age-wise distribution in the present study showed that the majority of cases were in the age group of 31-40 years (31.6%), 21-30 years (29.1%) and 41-50 years (19.2%), which clearly shows that tooth loss is not a problem of the elderly only, but also younger and middle aged population. Similar age-related variation in dentulous, partially edentulous and completely edentulous status has been reported in the rural and urban population of the Malwa region of India, with edentulism becoming more prominent with advancing age **[16].** This is similar to the study conducted by Prasad *et al.* **[1]** which found that the prevalence of partial edentulism was higher in the third and fourth decade of life. The decrease in prevalence of people aged above 60 years (9.8%) is likely due to complete edentulism or less health care seeking in older people as mentioned by Miyano *et al.* **[3].** Arini *et al.* similarly identified older age and low educational status as important risk indicators for tooth loss in adults from urban and rural areas of Uttar Pradesh, further supporting the influence of sociodemographic factors on tooth loss patterns **[17].** More recently, Matani *et al.* reported that edentulism in older Indonesian adults was significantly associated with age, education and economic status, highlighting the broader contribution of social determinants to tooth loss **[18].** In the present study, the gender distribution was slightly male (55.0%) with no statistically significant association with edentulous patterns. Few studies reported similar findings, indicating that gender differences may be more likely to be due to behavioral and sociocultural factors than to biological predisposition **[5]**. Other studies, however, have found a higher prevalence among females, suggesting some variability by population **[6]** due to hormonal influences and patterns of health care utilization. The high prevalence of edentulous spaces, especially in the mandibular arch (85.2%) as compared to the maxillary arch (80.4%) was a key finding of the present study. This is consistent with the findings of Kotze *et al.* **[7]** and Hussain *et al.* **[8]** who found that anatomical and functional differences can lead to more tooth loss in the mandible, as there is thinner cortical bone and increased periodontal destruction. The presence of both arches in 65.6% of the cases further reinforces the ubiquity of partial edentulism and the necessity of a full prosthodontic rehabilitation. A recent population-based study from Devbhumi Dwarka, Gujarat, similarly showed significant associations of partial and complete edentulism with advancing age, educational level and socioeconomic status, although the distribution of partial edentulism between rural

and urban populations differed from the present findings **[19]**. Kennedy's classification, Class III was the most common pattern in both arches (maxillary 55.0% and mandibular 58.0%). This is consistent with a number of studies, including those of Meine *et al.* **[9]** and Zhong *et al.* **[10]**, who also found Class III to be the most prevalent pattern. The majority of Class III indicates that bounded edentulous spaces are more common, probably because of early tooth loss than distal extension cases. In contrast, Class IV was the rarest class, which is similar to the results of international studies. The present study also showed a statistically significant correlation between age and Kennedy's classification in both arches. The majority of the younger age groups had Class III patterns and the older age groups had a shift toward Class I patterns which reflected distal extension edentulism. This is a gradual shift in posterior tooth loss as age increases and has also been reported by Iacob *et al.* **[12]** and Jiang *et al.* **[13]**. The results of this study emphasize the dynamic nature of edentulism and the need for age-specific planning of prostheses. In terms of etiology, dental caries was cited as the main cause of tooth loss (78.2%) followed by periodontitis (14.0%). This is consistent with the findings of the World Health Organization reports **[14]** and Agrawal *et al.* **[15]**, which highlight the fact that untreated dental caries is the most common cause of tooth loss worldwide. The findings of the present study highlight the importance of better caries prevention strategies, such as oral hygiene education, fluoride and early intervention. While less common, periodontitis is a large contributor, especially in older age groups. Interestingly, there was no statistically significant relationship between cause of tooth loss and age or sex, suggesting a uniform etiological pattern in all age and sex groups. The same was found by Gomes Filho *et al.* **[20]**, indicating that the environmental and behavioral risk factors, including diet and oral hygiene habits, may be more important than the demographic factors. There was a highly significant association between the cause of tooth loss and edentulous spaces. The presence of edentulous spaces in all arches was strongly associated with the presence of caries, while periodontitis and trauma were more common in cases without edentulous spaces. This can be attributed to the fact that tooth loss due to caries is acute and localized, whereas periodontal disease is progressive and generalized. Moreover, the association of the cause of tooth loss with Kennedy's classification was significant, especially in the Mandibular arch. Caries was the most common pattern and periodontitis and trauma were more common in Class I and II patterns. The study findings are corroborated by the study conducted by Antonoglou *et al.* **[21]**, which found that the periodontal disease is a significant factor in distal extension cases because of the progressive bone loss and tooth mobility. Jogezai and Kalsi **[22]** also found that the periodontal disease is a significant factor in distal extension cases because of progressive bone loss and tooth mobility. The present study emphasizes the role of early diagnosis and preventive treatment in the prevention of partial edentulism. The high prevalence of caries-related tooth loss suggests shortcomings in primary dental care and awareness. Interventions aimed at preventive dentistry, routine dental visits and community oral health educations are crucial in addressing these challenges. In addition, the results have implications for prosthodontic treatment planning. The high number of Class III cases indicates that there is a greater need for fixed partial dentures, whereas the increase of Class I cases in older patients requires the use of removable partial dentures or implant supported prostheses. Aging, arch involvement and etiology all have a role in the treatment approach that can make a big difference in the patient's outcome.

Conclusion:

Partial edentulism was highly prevalent among adults in Barabanki district, with Kennedy Class III being the most common pattern and dental caries the leading cause of tooth loss. Age showed a significant association with the distribution of partial edentulism, whereas no significant differences were observed between male and female patients. These findings emphasize the need for preventive dental care, early intervention and appropriate prosthodontic planning to reduce tooth loss and improve oral health outcomes.

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