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## Prevalence of Endodontically Treated Teeth in an Adult Malaysian Population Attending a Dental School Clinic

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### Abstract

**Introduction:** The study of endodontic epidemiology may help in prediction of future needs for dental treatment in a dentate population. The prevalence of endodontically treated teeth in the Malaysian population has never been investigated and their estimates have been based on studies from other countries. This study evaluated the prevalence of endodontically treated teeth in an adult Malaysian population attending a dental school clinic in northern Malaysia. **Methods:** The sample of this cross-sectional study examined the orthopantograms of 1663 patients in age group 18 to 75 years old, visiting the clinics of AIMST dental institute. A total of 33462 teeth were examined by four calibrated professionals. Any radiographic evidence of presence of radio-opaque material in pulp space was considered as endodontic treatment for the particular tooth. Third molars, supernumerary teeth and faulty radiographs were excluded from the study. Data was recorded with respect to gender, age and ethnicity of the patient and also the type of tooth. It was statistically analysed using Odds ratio, logistic regression and chi-square test. **Results:** There was a greater prevalence of endodontic treatment in females than males and 31 to 40 years age group. Malay population had higher number of cases of overall endodontically treated teeth, while Indian population showed highest percentage of cases within any ethnic group. Maxillary molars and mandibular molars were most frequently treated teeth, whereas canines showed the lowest prevalence. Findings were more significantly higher for maxillary teeth than mandibular teeth and for left side than right side. **Conclusion:** The prevalence of endodontically treated teeth in the Malaysian adult population was higher than that observed in epidemiological studies from other countries. This might be considered due to the higher incidence of caries and awareness emerging among the sub-population for preserving natural teeth. The results also concluded the necessity of more educational programs in Endodontics.

**Keywords:** Age, Endodontic, Ethnicity, Gender, Malaysia, Prevalence, Tooth, Treatment

**Abbreviations:** ET-Endodontic Treatment or Therapy, OPGs-Orthopantograms

### Introduction

Literature has shown that endodontic treatment is rendered most commonly following microbial aggression to the dental pulp [1]. Recently, there has been increase in overall endodontic treatments across the world due to more patient awareness and desire to save the natural teeth. The study of endodontic epidemiology may help prediction of future needs for dental treatment in a growing dentate population since the endodontic status of a tooth is important for its survival. It may also be a useful tool in the evaluation and planning of dental education in a particular country. There are many epidemiological studies which have reported prevalence of endodontically treated teeth in respective populations by evaluating either the total number of treated teeth or the number of individuals with endodontic treatment [2-17]. These studies showed that 2.3% to 21.4% of all teeth had endodontic treatment and the variation is seen along with the geographic variation of population (Table 1).

To our knowledge, the prevalence of endodontically treated teeth in the Malaysian population has never been investigated. The estimates on their prevalence have mainly been based on studies from other

countries. Hence, the purpose of this study was to use radiographic examination to investigate the prevalence of endodontic treatment in an adult Malaysian population with respect to age, sex, ethnicity and type of tooth.

### Materials and Methods

The sample of this cross-sectional study examined the records of total 1663 patients visiting the dental clinics of an AIMST University in Kedah state of Malaysia from July 2015 to November 2020. The patients belonged to all the states of Malaysia and satisfied the inclusion criteria which were as follows, irrespective of sex and ethnicity: Malaysian nationality, age group 18 to 75 years, visited the dental clinic in last 5 years, minimum 7 teeth present. Orthopantograms (Cranex 3d, Kavo), were retrieved from records of patients. Any radiographic evidence of presence of radio-opaque material such as root canal filling material, endodontic post or restorative material in pulp chamber was considered as Endodontic Treatment or Therapy (ET) of the tooth [9]. Teeth were excluded whenever it was not possible to differentiate from a restoration of

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intact tooth without any pulpal involvement. Third molars, supernumerary teeth and faulty radiographs were also excluded.

Four independent dental professionals were designated for observation and recording the data under supervision of an experienced endodontist. The interpretation criteria were discussed while examining the radiographs. First 150 radiographs were initially examined by the observers for calibration and standardization of evaluation criteria. When a consensus was not reached after the four observers examined the radiographs, the endodontic specialist made the final decision. The interpretation of radiographs in terms of tooth showing the evidence of endodontic treatment or therapy was recorded as data along with the age, sex, ethnicity of the patients and the type of tooth. From 1663 records, a total of 33462 teeth were examined with mean 20.12 teeth per patient. A total of 16061 teeth were examined from male patients while 17401 teeth were examined from female patients (Table 2). Among the age groups, 6960 teeth were examined for patients less than 30 years of age and 4620 teeth were examined for patients above 60 years of age. Age group 31 to 40 years had maximum number of teeth examined being 11645 (Table 3).

Authors	Year	Total teeth examined	% of ET teeth	Population
Odesjo et al. [2]	1990	17430	8.6	Swedish
Buckley and Spangberg [3]	1995	5272	5.5	Americans
Saunders et al. [4]	1997	8420	5.6	British
De Moor et al. [5]	2000	4617	6.8	Belgium
Kirkevang et al. [6]	2001	15984	4.8	Danish
Lupi-Pegurier et al. [7]	2002	7561	18.9	French
Jimenez-Pinzon et al. [8]	2004	4453	2.1	Spanish
Tsuneishi et al. [9]	2005	16232	20.5	Japanese
Sunay et al. [10]	2007	8863	5.3	Turkish
Gulsahi et al. [11]	2008	24433	3.3	Turkish
Hollanda et al. [12]	2008	29467	21.4	Brazilian
Al-Omari et al. [13]	2011	7390	5.7	Jordanian
Kamberi et al. [14]	2011	4131	2.3	Kosovar
Peters et al. [15]	2011	4594	4.8	Dutch
Oginni et al. [16]	2015	21468	12.2	Nigerian
Tassoker et al. [17]	2016	6196	3.7	Turkish

**Table 1:** Results from various studies conducted for general population of different geographic areas.

	Total teeth examined in a sex group =Tx	ET teeth in a gender group=ETx	Percentage of ET teeth within one gender group=(ETx/Tx)X100	Percentage of ET teeth from a gender group=(ETx/ET)X100	Overall percentage of ET teeth per gender group=(ETx/T)X100	NET teeth in a gender group=NETx	Percentage of NET teeth within one gender group=(NETx/Tx)X100	Percentage of NET teeth from a gender group=(NETx/NET)X100	Overall percentage of NET per gender group=(NETx/T)X100
Males	16061 (Tm)	3103 (ETm)	19.32	39.5	9.27	12958 (NETm)	80.7	50.61	38.72
Females	17401 (Tf)	4753 (ETf)	27.31	60.5	14.2	12648 (NETf)	72.7	49.39	37.8
Total	33462 (T)	7856 (ET)				25606 (NET)			

Note: ET-Endodontically Treated, NET-Non-endodontically Treated

**Table 2:** Prevalence of endodontic treatment according to gender.

	Total cases examined in an age group=Ty	ET teeth in an age group=ETy	Percentage of ET teeth within one age group=(ETy/Ty)X100	Percentage of ET teeth from an age group=(ETy/ET)X100	Overall percentage of ET per age group=(ETy/T)X100	NET teeth in an age group=NETy	Percentage of NET teeth within one age group=(NETy/Ty)X100	Percentage of NET teeth from an age group=(NETy/NET)X100	Overall percentage of NET per age group=(NETy/T)X100
30 or less	6960	1642	23.59	20.9	4.91	5318	76.41	20.77	15.89
31-40	11645	2765	23.74	35.2	8.26	8880	76.26	34.67	26.54
41-50	5352	1053	19.67	13.4	3.15	4299	80.33	16.79	12.85
51-60	4885	1076	22.03	13.7	3.22	3809	77.97	14.88	11.38
>60	4620	1320	28.57	16.8	3.94	3300	71.43	12.89	9.86
Total 33462 (T)		7856 (ET)				25606 (NET)			

Note: ET-Endodontically Treated, NET-Non-endodontically Treated

**Table 3:** Prevalence of endodontic treatment according to age.

Malay, Chinese and Indian population had 11727, 10930 and 9543 teeth examined respectively according to ethnic groups (Table 4). Upper left canines were the most examined teeth for the tooth-wise category while lower left first molar were least in number to be examined when compared to other teeth (Table 5). Data was analysed statistically using Odds ratio, logistic regression and chi-square test. Significance level was set at p<0.05. Interobserver agreement was assessed using kappa (k) values.

## Results

Out of 33462 included teeth, 7856 (23.48 %) teeth showed evidence of endodontic therapy. Table 2 to table 5 shows the prevalence of the distribution of endodontically treated teeth according to gender, age groups, ethnicity and tooth type respectively. There was a significant difference among the various groups. Females (60.5%, p<0.001) showed the greater prevalence than males (Table 2). The largest number of endodontic cases were found among individuals aged 31 to 40 years (35.2%, P<0.001) (Table 3). Malay population had higher prevalence of overall ET teeth, while Indian population showed highest percentage of ET teeth within any ethnic group (Table 4). Maxillary molars and mandibular molars were the teeth in which

endodontic treatment was most frequent, whereas canines showed the lowest prevalence (Table 5). These findings were in similar fashion among most of inter groups and intra groups comparison, i.e. compared to males, the females had higher prevalence of ET teeth from all ET teeth examined (27.31%) in both groups as well as all teeth examined in female group (60.5%). Interobserver agreement was excellent, since kappa values were greater than 0.9.

## Discussion

This study evaluated the prevalence of endodontically treated teeth in Malaysian sub-population with respect to sex, age, ethnicity and tooth type since no such study has been done earlier for this sub-continent. This methodology of this study was designed similar to many previous studies by examining radiographic images of a random sample from a database to calculate the number of endodontically treated teeth [6,7,9,18]. The inclusion criteria for cases stated the adult patients of age groups from 18 years to 75 years so that maximum number of permanent teeth could be included. The upper age limit also enabled to satisfy other inclusion criteria, minimum number of teeth present to be 7; which is one fourth of maximum 28 teeth



	Total cases examined in an ethnic group	ET teeth in an ethnic group= $E_t$	Percentage of ET teeth within one ethnic group= $(E_t/T_t) \times 100$	Percentage of ET teeth from an ethnic group = $(E_t/ET) \times 100$	Overall percentage of ET per ethnic group = $(E_t/T_t) \times 100$	NET teeth in an ethnic group = $NE_t$	Percentage of NET teeth within one ethnic group = $(NE_t/T_t) \times 100$	Percentage of NET teeth from an ethnic group = $(NE_t/NET) \times 100$	Overall percentage of NET per ethnic group = $(NE_t/T_t) \times 100$
Malay	11727	2845	24.26	36.21	8.5	8882	75.74	34.69	26.54
Chinese	10903	2383	21.86	30.33	7.12	8520	78.14	33.27	25.46
Indian	9543	2405	25.2	30.61	7.19	7138	74.8	27.88	21.33
Others	1289	223	17.3	2.84	0.67	1066	82.7	4.16	3.18
Total 33462 (T)		7856 (ET)				25606 (NET)			

Note: ET-Endodontically Treated, NET-Non-endodontically Treated

**Table 4:** Prevalence of endodontic treatment according to ethnicity.

	Total cases examined for a tooth type	ET teeth for a tooth type= $ET_t$	Percentage of ET teeth within one tooth type group= $(ET_t/T_t) \times 100$	Percentage of ET teeth from a tooth type group = $(ET_t/ET) \times 100$	Overall percentage of ET per tooth type group = $(ET_t/T_t) \times 100$	NET teeth for a tooth type = $NET_t$	Percentage of NET teeth within one tooth type group = $(NET_t/T_t) \times 100$	Percentage of NET teeth from a tooth type group = $(NET_t/NET) \times 100$	Overall percentage of NET per tooth type group = $(NET_t/T_t) \times 100$
11	1225	261	21.31	3.32	0.78	964	78.69	3.76	2.88
12	1217	248	20.38	3.16	0.74	969	79.62	3.78	2.9
13	1392	130	9.34	1.65	0.39	1262	90.66	4.93	3.77
14	1287	380	29.53	4.84	1.14	907	70.47	3.54	2.71
15	1216	439	36.1	5.59	1.31	777	63.9	3.03	2.32
16	1181	450	38.1	5.73	1.34	731	61.9	2.85	2.18
17	1049	385	36.7	4.9	1.15	664	63.3	2.59	1.98
21	1251	251	20.06	3.2	0.75	1000	79.94	3.91	2.99
22	1233	245	19.87	3.12	0.73	988	80.13	3.86	2.95
23	1486	121	8.14	1.54	0.36	1365	91.86	5.33	4.08
24	1283	320	24.94	4.07	0.96	963	75.06	3.76	2.88
25	1206	391	32.42	4.98	1.17	815	67.58	3.18	2.44
26	1107	405	36.59	5.16	1.21	702	63.41	2.74	2.1
27	1072	414	38.62	5.27	1.24	658	61.38	2.57	1.97
31	1113	134	12.04	1.71	0.4	979	87.96	3.82	2.93
32	1048	112	10.69	1.43	0.33	936	89.31	3.66	2.8
33	1417	123	8.68	1.57	0.37	1294	91.32	5.05	3.87
34	1336	306	22.9	3.9	0.91	1030	77.1	4.02	3.08
35	1223	310	25.35	3.95	0.93	913	74.65	3.57	2.73
36	922	343	37.2	4.37	1.03	579	62.8	2.26	1.73
37	1122	391	34.85	4.98	1.17	731	65.15	2.85	2.18
41	1243	127	10.22	1.62	0.38	1116	89.78	4.36	3.34
42	1239	121	9.77	1.54	0.36	1118	90.23	4.37	3.34
43	1256	102	8.12	1.3	0.3	1154	91.88	4.51	3.45
44	1167	255	21.85	3.25	0.76	912	78.15	3.56	2.73
45	1130	292	25.84	3.72	0.87	838	74.16	3.27	2.5
46	1056	399	37.78	5.08	1.19	657	62.22	2.57	1.96
47	985	401	40.71	5.1	1.2	584	59.29	2.28	1.75
Total 33462 (T)		7856 (ET)				25606 (NET)			

Note: ET-Endodontically Treated, NET-Non-endodontically Treated

**Table 5:** Prevalence of endodontic treatment according to tooth type.

evaluated in a patient. This was to avoid any false higher number of the endodontically treated teeth per non treated teeth and to get the sample size with minimum error [18]. Evaluation of an orthopantograms (OPGs) was used to collect data since these have been used very often used for such purpose in epidemiological studies [7,18]. An OPG is an effective and more advantageous method to record the large volume of patient data in university dental clinics where full-mouth periapical radiographs are not used routinely [11,19]. It conveniently allows a quick examination of all teeth using only one radiograph, thereby a lower patient radiation dose. The ethical concept of this study did not involve any further exposure of the patient to radiation; hence no new radiographs were taken.

We examined a large number of patients' records to collect a significant data that could get results closer to that truly exists. This was the main challenge faced during the study taking few years. A total of 33462 teeth from 1663 patient records were examined after excluding the cases which did not satisfy inclusion criteria. The mean number of remaining teeth per patient in this study was 20.1, which is lower than other reported in other studies [8,20,21]. This might be the reason for a higher overall percentage since lesser teeth were present per patient. Patients having seven or more teeth were counted so that teeth in function could be included and to rule out cases where teeth might have been removed

following a severe periodontal disease. Had those teeth been counted, it would have resulted in far higher number of ET teeth. This studied showed that 22.81 % of examined teeth were endodontically treated, which is higher than any other population including European and American. Table 4 shows the results of the similar studies done in general populations of adult age groups from other geographic locations. Another study which revealed higher prevalence of endodontic treatment (20.5%) was done by Tsuneishi et al [9] for Japanese adult population. However, they used full-mouth intraoral radiographs instead of OPG which might be a factor of higher results [3,8].

The results from this study can be correlated to other studies in few areas. The percentage of root filled teeth was highest when compared to other populations but can be compared to those obtained from French and Brazilian studies [9,12] (Table 1). The high results of this study could also be related to the fact that a larger proportion of the patients attending dental school might be from lower socio-economic status having poorer oral health and available during operating dental school hours [22]. Lack of referral to specialist might have led to extraction as the treatment of choice rather than root canal therapy for difficult cases; but this fact should not have any overall effect on percentage of ET since the extracted teeth will reduce the total number of teeth examined.



The results of this study showed that females had higher prevalence of ET cases as compared to males ( $P<0.01$ ); however, the number of teeth evaluated were also more in females. The significant difference definitely suggests that females have more tendencies to undergo treatment and save the teeth, but it also might indicate that more females attended the dental clinic and additionally females have less missing teeth. These results were in agreement with previous studies [10,23], however some studies had showed that gender had no effect on frequency of ET [6,19,21]. These results are consistent with many other studies done across the globe in which males had significantly fewer remaining natural teeth than females and hence average number of root-filled teeth was also lower among males [6,7].

Among the age groups, 31 to 40 showed significantly highest prevalent ET cases while 51 to 60 years showed least ( $P<0.05$ ). A study done in year 2015 for Nigerian subpopulation also revealed that younger age group patients had higher prevalence [16]. The highest ET cases in the age group 31 to 40 can be related to the fact that it had highest number of teeth examined and other factors like higher cariogenic potential due to modern dietary habits and better awareness for saving teeth rather than choosing the extraction as treatment option. Also, younger patients have easier root canal morphology, thereby making endodontic therapy treatment of choice. This was in contradiction of findings from other studies which emphasised that younger people tend to visit the dentist more often when compared to elderly and thus they have a lower incidence of caries and periodontal diseases (14). However, in future studies this age group might present with higher prevalence due to increased awareness and dynamic nature of this disease prevalence [24].

Age group 51 to 60 years had lower prevalence, mainly due to lesser number of teeth present in this age group and treatment plan modification due to age needs. This was in contrary of the findings from other studies which showed the frequencies of endodontic treatment increased with age [6,12,19]. However it had the highest percentage of ET within any group, i.e. percentage of ET found in particular group to overall teeth examined in that group was 28.1, highest when compared to others (intra group comparison), this might be due to fact that increase may be a cumulative effect resulting from longer exposure to function, caries, and subsequent operative procedures [2]. On percentage basis, 41 to 50 year group had lowest which may be due to higher number of teeth retained in this group while lesser incidence of caries leading to root canal.

This subpopulation consists of 3 major ethnic groups, namely Malays, Chinese and Indians in decreasing order of proportion [25]. However, these proportions may differ geographically within Malaysia. The findings of ET teeth were most evident in Malay population owing to the highest number of teeth evaluated in this group. Among these groups, following sequence was observed from highest to lowest on percentage basis: Indians, Malays, Chinese, others. Although Indian ethnic group constitutes to least to Malaysian population from three major ethnic groups, still the prevalence of ET teeth was highest for this group ( $P<0.05$ ). This result can be multifactorial including the socio-economic aspects and further cross-sectional studies must be done to support these findings. Least prevalence was seen in other group which constitutes very minor portion of the population [9].

Among the teeth examined, it was observed that molars had highest prevalence, followed by premolars, incisors and least in canines ( $P<0.05$ ). Findings were more significantly higher for maxillary teeth than mandibular teeth and higher for left side than right side. There was no significant difference between first and second molars. These findings can be related to both patient and tooth factors. A better care is expected for lower and anterior teeth by the patients, thereby reducing any chance of decay and subsequent treatment. At the same time, patients may have fewer posterior teeth remaining due to choice of treatment being extraction rather than endodontic treatment.

This can be due to lack of access to specialist referral for difficult posterior endodontic cases, thereby choosing extraction. Kirkevang et al [6] in 2001 found that significantly more molars had been endodontically treated (8.1%) than premolars (5.4%) or anterior teeth (2.5%). Another recent studies of French and Sudanese population demonstrated that molars had higher prevalence than anteriors or premolars as endodontically treated teeth [7,26]. Other previous studies also have reported that maxillary teeth were significantly more root filled teeth (62.3%) than in the mandible (37.7%) [11,23,27].

## Conclusion

The prevalence of endodontically treated teeth evaluated in the present study was 23.48% for a Malaysian adult population within age group of 18 to 75 years having minimum 7 teeth per individual. The prevalence is higher than that observed in epidemiological studies conducted in other countries. Endodontic treatment was most frequent in females, 31 to 40 year-olds and Indian ethnic group. First molars were most commonly treated teeth (20.25%) while canines were the least (6.06%). A higher percentage of the ET teeth suggest the strongly adverse impact of dental caries. This number might is considered high even when the concept of preserving natural teeth is still emerging to the sub- population involved in this study compared to other countries or communities. Although the data was collected from records of individuals visiting the dental clinic situated in Kedah state of northern Malaysia, a portion of them belonged to other states too. At any time in future, the prevalence of endodontic treatment will be definitely higher due to increased awareness, unless it will counter-balanced by lesser incidence of dental caries and its sequelae. These results also indicate the necessity of more educational programs and advanced training of a greater number of general dentists in Endodontics. Definitely, the access to dental care and awareness which is different in other parts of Malaysia, would affect the prevalence; hence this population may not be representative for whole of country and additional studies may be required to investigate further for other sub-populations.

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