

Title	Reasons for Tooth Extractions in Japan: The Second Nationwide Survey
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Journal	International dental journal, (): -
URL	http://hdl.handle.net/10130/5712
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Description	

Scientific Research Report

Reasons for Tooth Extractions in Japan: The Second Nationwide Survey

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ARTICLE INFO

Article history:

Received 7 January 2021

Received in revised form

26 April 2021

Accepted 13 May 2021

Available online xxx

Key words:

Impacted tooth

Periodontal diseases

Tooth loss

Tooth extraction

Nationwide survey

Reason for extraction

ABSTRACT

Background: More than 10 years have passed since the first nationwide study on the reasons for tooth extraction in Japan. In the present study, we conducted the second nationwide survey to update the previous data.

Methods: This was a descriptive study. A sample population consisting of 5,250 dentists was selected by systematic random sampling using the 2018 membership directory of the Japan Dental Association. The reason for each permanent tooth extraction was documented by each dentist during a period of 1 week from June 4 to June 10, 2018. A questionnaire was provided for documentation. Reasons for tooth extraction were categorised into 6 groups as follows: caries, periodontal disease, fracture, orthodontics, impacted teeth, and others.

Results: A total of 2345 identified dentists responded to the questionnaire (recovery rate: 44.8%). Information on 7809 extracted teeth from 6398 patients was obtained. Periodontal disease was the main reason for tooth extraction for both sexes (men: 40.4%, women: 34.9%). Caries accounted for 30.2% of tooth extractions among men and 29.0% among women. Periodontal disease was predominant in the groups older than 55 years of age. Dental fracture accounted for 16.8% of tooth extractions among men and 19.2% among women.

Conclusions: Caries and periodontal disease are still the main reasons for tooth extraction in Japan. Moreover, dentists should note that fractures accounted for approximately one-fifth of permanent tooth extractions after the age of 45 years.

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Introduction

Retention of teeth has been reported to be associated with oral health-related quality of life.¹ Understanding the reasons for tooth extraction in a population is important when considering a strategy to prevent tooth loss. Several studies

have investigated the reasons for tooth extraction.²⁻⁹ Although some of these studies reported caries to be the main reason for tooth extraction,^{2,4,8} periodontal disease is the main reason for tooth extraction among individuals older than 40 years of age.^{3,6,7,9}

In 1994, Morita et al.¹⁰ reported caries to be the most frequent reason for tooth extraction in Japan (55.4%) followed by periodontal disease (38.0%). However, this study was conducted in only one prefecture of Japan. A nationwide survey was conducted in 2005 to investigate the reasons for tooth

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<https://doi.org/10.1016/j.identj.2021.05.008>

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extraction in Japan.¹¹ A total of 2001 dentists affiliated with the Japan Dental Association from all prefectures in Japan participated in this study that identified periodontal disease (41.8%) and caries (32.7%) as the main reasons for tooth extraction. However, more than 10 years have passed since that study. Updating the epidemiological data is essential so that any new patterns and changes are identified, thereby facilitating the development of a relevant and effective strategy for preventing tooth loss. This report presents the results from the second nationwide survey investigating reasons for the extraction of permanent teeth in Japan.

Methods

This was a descriptive study. The method used for this survey was similar to that used in the first survey conducted in 2005. We first obtained a list of the general dental practitioners who were members of the Japan Dental Association (52,449 dentists as of April 1, 2018). Therefore, the primary inclusion criterion for this study was an affiliation of a dentist with the Japan Dental Association. Based on the first survey, we set the required number of dentists for this study at 5000.¹² This sample size was used by the previous study to investigate the reasons for tooth extraction in Japan.¹⁰ A one-tenth sampling was performed based on the number of dentist members by each prefecture (Appendix A). We used systematic random sampling to identify dentists who will participate in this study; every 10th dentist on the list was selected. As a result, 5250 dentists were selected as the sample population of this study. We did not define any exclusion criteria for the dentists and cases of permanent tooth extraction. The dentists were asked to record the reasons for any permanent tooth extractions they performed between June 4 and June 10, 2018. We set the period of data recording at 7 days to determine the influence of specific days of the week. A data collection form was supplied to each dentist in the sample for this purpose. After the survey period, the dentists returned the completed data collection forms. Information regarding age, sex, and tooth type of the patients was collected.

The main reasons for tooth extraction were categorised into 6 groups as follows: (1) caries, (2) periodontal disease, (3) fracture, (4) orthodontics, (5) impacted teeth, and (6) others. "Impacted teeth" was not included as the reason for tooth extraction in the first survey. The main reason for each tooth

extraction was selected by the dentist extracting that particular tooth.

This study was approved by the Ethics Committees of Tokyo Dental College and Japanese Association for Dental Science (approval numbers 1027 and 018, respectively) and was conducted in full accordance with the World Medical Association Declaration of Helsinki. The findings of this study are reported in accordance with the STROBE statement.¹³

Cases with missing data were excluded from the analysis. Descriptive statistical analyses were performed, and data are presented as the mean \pm standard deviation (SD). The relative prevalence of each category was determined by representing the data as percentages. Further groups of data were created by stratifying the data by age and sex. The computerised statistical package SPSS, version 25.0 (SPSS Japan, Inc.) was used.

Results

A total of 2345 of the 5250 identified dentists (age: 56.9 ± 9.5 years; men: 2097 dentists, women: 237 dentists, unknown: 11 dentists) returned the data collection form (recovery rate: 44.8%), and data from 6398 patients (men: 3106 patients, women: 3292 patients) were analysed. During the defined observation period, 8003 teeth were extracted. We excluded 194 cases from the analysis because of missing data (sex: 8 cases, age: 38 cases, tooth information: 148 cases). As a result, 7809 teeth were analysed (men: 3800 teeth, women: 4009 teeth). The age of the patients ranged from 10 to 106 years. The mean numbers of extracted teeth were 1.22 ± 0.63 teeth per male patient and 1.22 ± 0.58 teeth per female patient.

The numbers of tooth extractions by age and sex are shown in Table 1. Among both sexes, the number of tooth extractions was highest for the age group 65 to 74 years (men: 1076 teeth, 28.3%, women: 945 teeth, 23.6%).

Figure 1 shows the distribution of the reasons for tooth extraction by day of the week. The highest number of teeth was extracted on Monday (1780 teeth, 22.1%), whereas the lowest number was extracted on Sunday (51 teeth, 0.7%). Periodontal disease was the main reason for tooth extraction on weekdays. However, at the weekend, caries was the main reason for tooth extraction (Saturday: 29.5%, Sunday: 41.2%).

Figure 2 shows the distribution of the reasons for tooth extraction by age. Orthodontics was the main reason for

Table 1 – Number of tooth extractions by age and sex.

Age(years)	Men		Women		Total	
	n	%	n	%	n	%
10-14	13	0.3%	31	0.8%	44	0.6%
15-24	174	4.6%	233	5.8%	407	5.2%
25-34	295	7.8%	319	7.9%	614	7.9%
35-44	339	8.9%	317	7.9%	656	8.4%
45-54	488	12.8%	463	11.6%	951	12.2%
55-64	667	17.5%	656	16.4%	1323	16.9%
65-74	1076	28.3%	945	23.6%	2021	25.9%
75-79	370	9.7%	423	10.6%	793	10.2%
80-84	224	5.9%	370	9.2%	594	7.6%
85+	154	4.0%	252	6.3%	406	5.2%
Total	3800	100%	4009	100%	7809	100%

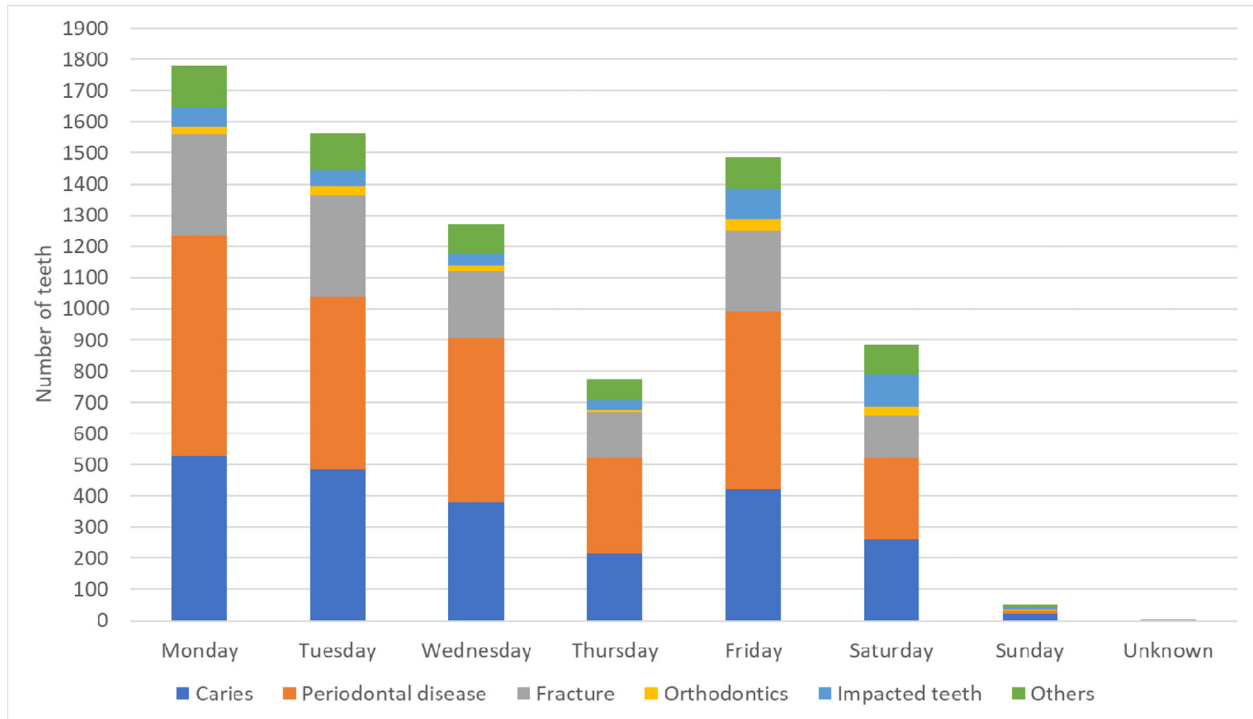


Fig. 1 – Distribution of the reasons for tooth extraction by day of the week.

tooth extraction among patients in the age group 10 to 14 years (81.8%). Tooth impactions represented the highest percentage of tooth extractions in the 15-24 age group (30.5%). For the age groups 25 to 34 years, 35 to 44 years, and 45 to 54 years, caries was the cause for the greatest number of

tooth extractions. Finally, periodontal disease was the most frequent reason for tooth extraction among individuals older than 55 years of age.

Table 2 shows the distribution of reasons for tooth extraction by age and sex. Among men, orthodontics was the main

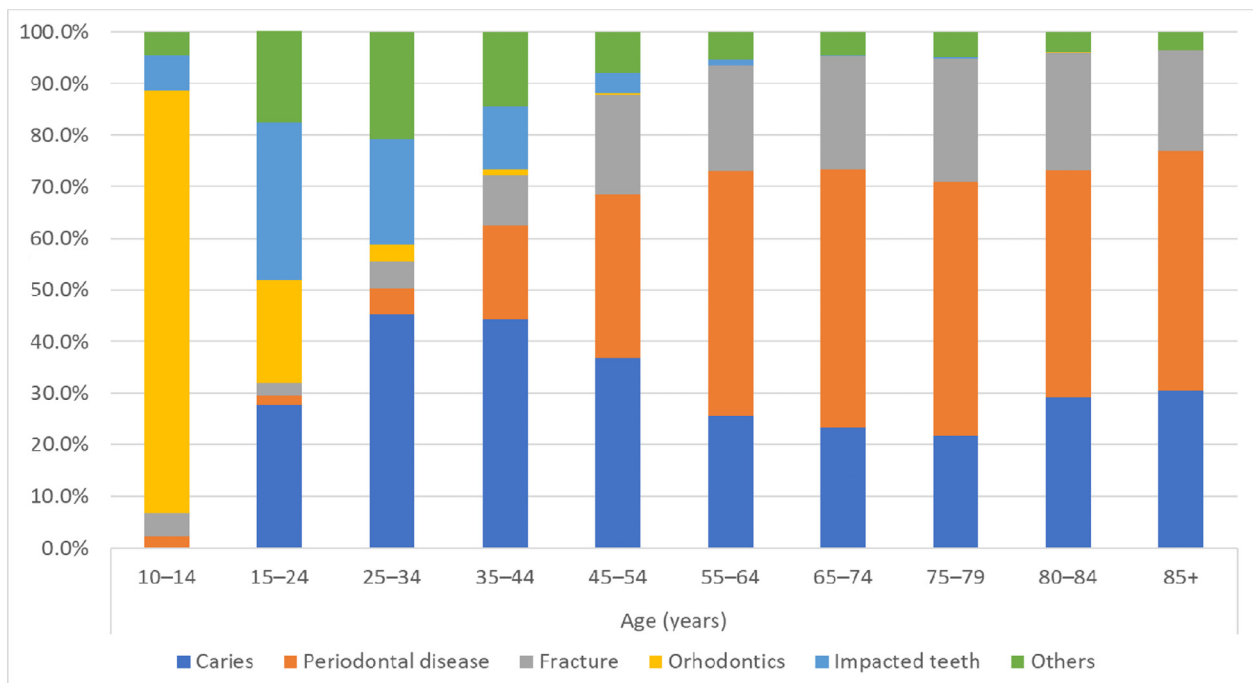


Fig. 2 – Distribution of the reasons for tooth extraction by age.

Table 2 – Reasons for tooth extraction by age and sex.

Men														
Age (years)	Caries		Periodontal disease		Fracture		Orthodontics		Impacted teeth		Others		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
10-14	0	0.0%	0	0.0%	0	0.0%	10	76.9%	1	7.7%	2	15.4%	13	100%
15-24	64	36.8%	2	1.1%	5	2.9%	28	16.1%	38	21.8%	37	21.3%	174	100%
25-34	150	50.8%	18	6.1%	18	6.1%	0	0.0%	54	18.3%	55	18.6%	295	100%
35-44	146	43.1%	76	22.4%	33	9.7%	2	0.6%	35	10.3%	47	13.9%	339	100%
45-54	180	36.9%	185	37.8%	79	16.1%	0	0.0%	17	3.5%	27	5.5%	488	100%
55-64	180	27.0%	330	49.5%	118	17.7%	0	0.0%	7	1.0%	32	4.8%	667	100%
65-74	230	21.4%	584	54.3%	214	19.9%	0	0.0%	2	0.2%	46	4.3%	1076	100%
75-79	75	20.3%	181	48.9%	88	23.8%	0	0.0%	2	0.5%	24	6.5%	370	100%
80-84	71	31.7%	89	39.7%	56	25.0%	0	0.0%	0	0.0%	8	3.6%	224	100%
85+	53	34.4%	71	46.1%	27	17.5%	0	0.0%	0	0.0%	3	1.9%	154	100%
Total	1149	30.2%	1536	40.4%	638	16.8%	40	1.1%	156	4.1%	281	7.4%	3800	100%
Women														
Age (years)	Caries		Periodontal disease		Fracture		Orthodontics		Impacted teeth		Others		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
10-14	0	0.0%	1	3.2%	2	6.5%	26	83.9%	2	6.5%	0	0.0%	31	100%
15-24	49	21.0%	5	2.1%	5	2.1%	53	22.7%	86	36.9%	35	15.0%	233	100%
25-34	128	40.1%	13	4.1%	14	4.4%	20	6.3%	72	22.6%	72	22.6%	319	100%
35-44	144	45.4%	44	13.9%	30	9.5%	6	1.9%	46	14.5%	47	14.8%	317	100%
45-54	170	36.7%	116	25.1%	105	22.5%	4	0.9%	20	4.3%	48	10.3%	463	100%
55-64	160	24.4%	297	45.3%	152	23.2%	0	0.0%	9	1.4%	38	5.8%	656	100%
65-74	242	25.6%	424	44.9%	229	24.2%	0	0.0%	3	0.3%	47	5.0%	945	100%
75-79	97	22.9%	210	49.6%	101	23.9%	0	0.0%	0	0.0%	15	3.5%	423	100%
80-84	102	27.6%	173	46.8%	78	21.1%	1	0.3%	0	0.0%	16	4.3%	370	100%
85+	71	28.2%	117	46.2%	52	20.6%	0	0.0%	1	0.4%	11	4.3%	252	100%
Total	1163	29.0%	1400	34.9%	768	19.2%	110	2.7%	239	6.0%	329	8.2%	4009	100%

reason for tooth extraction in the age group 10 to 14 years (76.9%). For the age groups 15 to 24 years, 25 to 34 years, and 35 to 44 years, the cause with the highest frequency was caries. After the age of 45 years, the most frequent reason was periodontal disease. By contrast, among women, impacted teeth were the reason with the highest percentage in the age group 15 to 24 years (36.9%). For the age group 45 to 54 years, the most frequent reason was caries (36.7%).

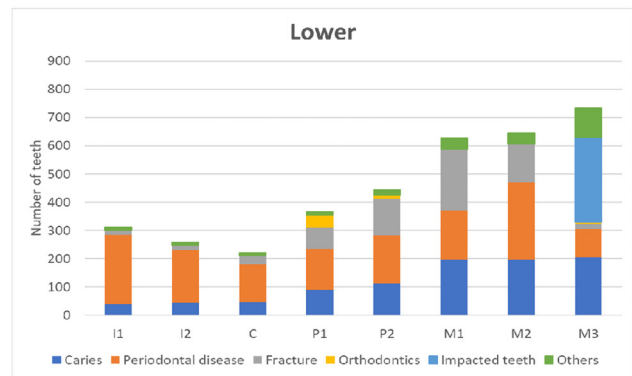
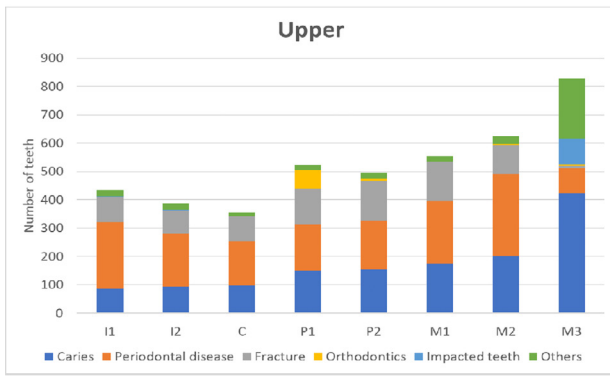
Figure 3 shows the distribution of the reasons for tooth extraction by tooth type. The third molar was the most frequently extracted tooth in both maxillary and mandibular dentitions (828 and 734 teeth, respectively). In the maxillary dentition, periodontal disease was the reason with the highest percentage, except for the third molar, for which the main reason was caries at 51.1%. In addition, in the mandibular dentition, the most common reason was periodontal disease,

except for the first and third molars, which were most frequently extracted due to fracture (34.7%) and impacted teeth (40.9%), respectively. A similar trend was observed for both men and women.

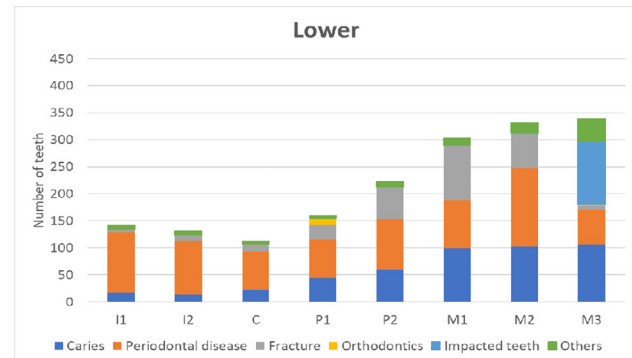
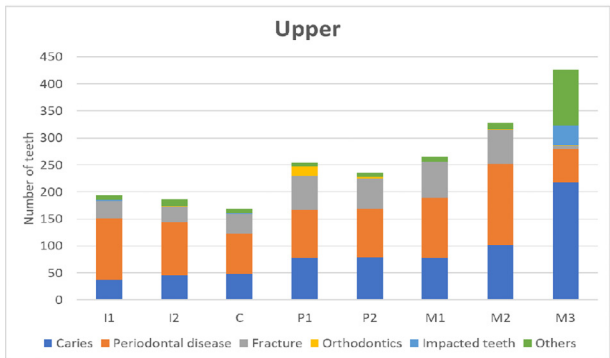
Discussion

The second nationwide survey of the reasons for tooth extraction in Japan showed that caries and periodontal disease are still the main reasons for tooth loss among the Japanese population. In the first survey (2005), caries accounted for 32.0% and periodontal disease accounted for 46.1% of tooth extractions among men, whereas caries accounted for 33.6% and periodontal disease accounted for 37.4% of tooth extractions among women.¹¹ In the present study, caries

Total



Men



Women

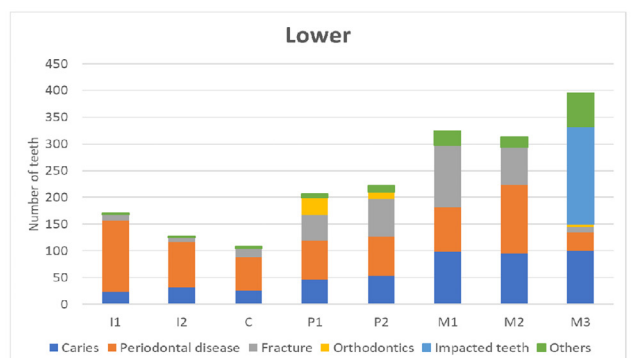
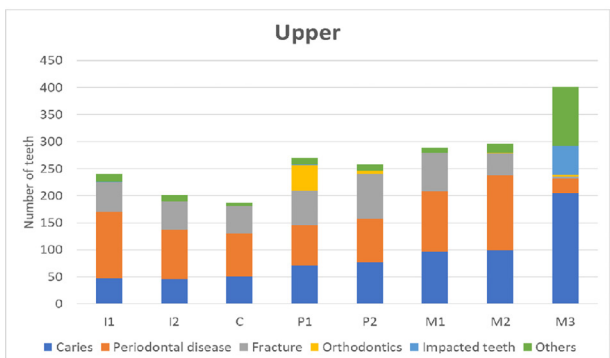


Fig. 3 – Distribution of the reasons for tooth extraction by tooth type. I1, central incisor; I2, lateral incisor; C, canine; P1, first premolar; P2, second premolar; M1, first molar; M2, second molar; M3, third molar.

accounted for 30.2% and periodontal disease accounted for 40.4% of tooth extractions among men, whereas caries accounted for 29.0% and periodontal disease accounted for 34.9% of tooth extractions among women. In Japan, a study in 1994 showed that caries was the most frequent reason for tooth extraction (55.4%) and the second most common reason was periodontal disease.¹⁰ In addition, the national statistical survey in Japan showed that the prevalence of decayed, missing, and filled teeth has decreased since 1993.¹⁴ Therefore, it is reasonable to assume that tooth extraction due to caries has decreased over the past years in Japan.

Although caries has been reported to be the main reason for tooth extraction in other countries,^{2,4,8} it has also been reported that periodontal disease is the main reason for tooth extraction in individuals older than 40 years of age.^{5-7,9} In the current study, although caries was the main reason for tooth extraction up to 54 years of age, periodontal disease was the main reason for tooth extraction in individuals aged 55 years or older (Figure 2). Therefore, the results of this study are in agreement with those of studies from other countries.

Although caries and periodontal disease accounted for a major proportion of the reason for tooth extraction, fracture accounted for approximately 20% after the age of 45 years. Chrysanthakopoulos⁵ reported that root fracture accounted for 2.4% to 5.3% of tooth extractions among patients aged older than 45 years. Al-Shammari¹⁵ also reported that root fracture accounted for 0.5% to 1.4% of tooth extractions among patients aged older than 41 years. Therefore, the prevalence of fractures as the reason for tooth extraction is relatively higher according to this study than observed in other studies. In Japan, Yoshino et al.¹⁶ reported that 31.7% of teeth were extracted due to vertical root fracture among 626 patients of 24 dental clinics. Therefore, the fracture prevalence might be higher in Japan than in other countries. It has been pointed out that Japan has a national health insurance system that enables the Japanese population to visit dental clinics more easily.¹⁷ Therefore, it is reasonable to assume that Japanese patients might receive more endodontic treatment than those in other countries. Tsuneishi et al.¹⁸ reported that the prevalence of endodontically treated teeth was higher in Japan than in Europe or the United States. It has been reported that root fracture tends to occur in endodontically treated teeth.^{19,20} Therefore, the prevalence of tooth loss due to fracture might be higher in Japan than in other countries. Moreover, maintaining vital teeth might be effective in preventing tooth extraction due to fracture.

Moreover, in the first survey of reasons for tooth extraction in Japan, fractures accounted for 11.5% to 17.4% of tooth extractions after the age of 45 years.¹¹ In the present study, fractures accounted for approximately one-fifth of permanent tooth extractions after the age of 45 years. The reason for this might be an increase in the number of regular dental attenders. The national statistical survey shows that the prevalence of regular dental attenders was 32.2% in 2004, but it increased to 52.9% in 2016.²¹ Axelsson et al.²² reported that the main reason for tooth loss during 30 years of maintenance was root fracture. This might be associated with the increase in the prevalence of fractures as the reason for tooth extraction in Japan.

Regarding differences by tooth type, periodontal disease was the main reason for tooth extraction, except for the third molar and the mandibular first molar. Chan et al.¹⁹ reported that first molars were the most frequently fractured teeth among 274 patients. They also pointed out that the root shape might be correlated with the occurrence of fractures.

There are several limitations to this study. Although systematic random sampling was used to select dentists participating in this study, they were all members of the Japan Dental Association (participation rate: 48.8%). In addition, the recovery rate was relatively low (44.8%). Therefore, selection bias may have affected the results of the study. External validity might be relatively limited because this study was conducted in Japan, which has universal health coverage.¹⁷ Therefore, the effect of socioeconomic status on tooth extraction in Japan might be different from that in countries that do not have universal health coverage. The period of data recording was relatively short. The dentists participating in this study consisted of general practitioners who collected the data during clinic hours; therefore, we could not extend the period of data recording. Although no studies to date have examined the differences among the reasons for tooth extraction by season, it has been reported that August was the preferred month for third-molar extraction.²³ Therefore, there is a possibility that the season might affect the reason for tooth extraction. However, we could not assume how the season can affect the reason for tooth extraction at this time. Although the data are not shown, there was a significant negative correlation between the number of dentists in the prefectures and the recovery rate ($r = -0.3$). Therefore, the results of this study might have been influenced largely by the prefectures with a small number of dentists. Moreover, the mean age of dentists in this study (56.9 years) was lower than the mean age of the members of the Japan Dental Association (60.4 years). Morita et al.¹⁰ reported that younger dentists extracted more teeth than older dentists. Therefore, the total number of extracted teeth might be overestimated in this study.

In conclusion, our study clearly reveals that caries and periodontal disease still account for a major part of tooth extractions in Japan, as was the finding from the survey conducted in 2005. In addition, dentists should note that in Japan, fractures account for approximately one-fifth of permanent tooth extractions after the age of 45 years.

Conflict of Interest

None disclosed.

Acknowledgements

We would like to thank Editage (www.editage.jp) for English language editing.

Funding

This study was supported by the 8020 Promotion Foundation (<https://www.8020zaidan.or.jp/english/>). The funding source

had involvement in the study design or conduct; the collection, analysis, and interpretation of data; the preparation, review, or approval of the manuscript; or the decision to submit the manuscript for publication.

Supplementary materials

Supplementary material associated with this article can be found in the online version at <https://doi.org/10.1016/j.identj.2021.05.008>.

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