

An analysis of primary and contributing reasons for extraction of permanent teeth given by the dentist

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The aim of the present study was to collect information about primary, secondary, and tertiary reasons that dentists gave for extracting permanent teeth and to determine whether and how dentist-associated characteristics might influence the relative emphasis on clinical diagnosis versus non-disease considerations given as reasons. A national random sample of Norwegian dentists ($n = 500$) recorded reasons for tooth extraction during a period of 2 weeks in 1988 (response rate, 70%). Nine hundred and eighty-five teeth were extracted from 692 patients. Disease-/condition-related diagnoses topped the list for primary and secondary reasons for extraction, whereas patients' wishes, economy, and esthetics came to the forefront among tertiary reasons. Logistic regression analysis showed that the choice between clinical diagnosis and non-disease considerations as primary and secondary reasons for extraction was significantly but moderately influenced by variables associated with the dentist. □ *Community dentistry; dental clinics; epidemiology; oral health; tooth extraction*

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Tooth mortality in a population can provide information about the prevalence of dental disease, availability of dental care, and attitudes towards tooth extraction. Surveys to determine the reasons for tooth extraction have been carried out for nationwide samples (for a review, see Klock & Haugejorden (1)) and for selected groups of people in several countries (2-5). In these studies dentists have been asked to record the teeth they extracted on the basis of more or less precisely defined diagnoses (6, 7). Mostly clinical diagnoses were included as reasons for extraction, and few non-disease considerations were given as reasons. The dentists were asked to record the main reason for extraction, but, although caries and periodontal disease are recognized as the predominant pathologic processes leading to tooth loss, previous studies suggest that the decisions to extract teeth are influenced by additional factors (7-9).

Bouma et al. (8) studied extractions leading to edentulousness in a combined socio-dental study in The Netherlands. They compared the clinical condition of the teeth with the patients' and dentists' perception

of their condition at the time a decision to extract all teeth was taken.

In Scotland, Kay & Blinkhorn (7) examined whether a patient's dental visiting habits influenced the dentist's clinical decision to extract a tooth. The use of pre-extraction radiographs and the effect of the dentist's age on tooth extraction policy were also investigated. Other studies (5-8, 10) have paid little or no attention to reasons contributing to tooth extractions.

The aim of the present study was to collect information about not only primary but also secondary and tertiary reasons given by dentists for extracting permanent teeth and to determine whether and how dentist-associated characteristics might influence the relative emphasis on clinical diagnosis versus non-disease considerations as reasons for extraction.

Materials and methods

In February 1988 a systematic random sample of 500 dentists (1 in 7) was drawn from the Norwegian Dental Association's

register of dentists (for details, see Klock & Haugejorden (1)). This sample of dentists received a covering letter explaining the purpose of the survey, other practical instructions, and three types of structured pre-coded questionnaires.

Of the 350 dentists (70%) who replied, 28 had not participated for various reasons (including holidays, pressure of work, illness, and death), and 96 had not extracted any teeth during the study period. The remaining 226 dentists had extracted 985 teeth from 692 patients—that is, 1.4 (range, 1–17) teeth per patient. For 83.5% of these patients, only one tooth had been extracted.

The participating dentists were reasonably representative of Norwegian dentists except with regard to service sector ($p < 0.025$).

The dentists were asked to complete a questionnaire concerning themselves, to collect demographic information about the patient, and to record the reasons for tooth extractions on a separate form, which contained 6 questions and specified 12 reasons for tooth extraction (Table 1). The reasons

given were both clinical diagnoses and non-disease considerations. From among these reasons the dentists were asked, if possible, to record the primary, secondary, and tertiary reason for extraction, in order of importance.

Data analysis

The Statistical Package for Social Sciences (SPSS-X Inc.) (11) was used for calculating frequencies and means. Frequency distributions were compared by using chi-square analyses, and the significance level was set at 5%.

Further analysis was carried out in two steps: a) The dependent variable, reasons for tooth extraction, was dichotomized into clinical diagnosis (reasons 1–7, 11) = 1, or non-disease considerations as reasons (reasons 8–10) = 0 (Table 1); and b) To cope with the hierarchical structure caused by teeth grouped within individuals and patients grouped within dentists, a score was calcu-

Table 1. Definitions of principal reasons for extractions of permanent teeth (1)

Principal reasons	Definitions
1. Caries and sequelae of caries	Main reason for extraction was caries or its sequelae, including root remnants, endodontics, and fractures of teeth weakened by caries or endodontics.
2. Periodontal disease	Teeth requiring extraction due to loss of function, mobility, periodontal abscess, and/or pain.
3. Prosthetic reasons	Teeth removed before fitting a denture even though they could have been saved.
4. Orthodontic reasons	Teeth removed to prevent or correct malocclusion.
5. Trauma	Teeth removed owing to non-caries-associated trauma, including teeth involved in a fracture of the jaw.
6. Pericoronitis	Persistent inflammation making extraction necessary.
7. General medical reasons	Prophylactic extraction due to a cyst, odontoma, and/or carcinoma, etc.
8. Economic reasons	The tooth/teeth could have been saved but the patient found it too expensive.
9. Esthetic reasons	The patient insisted on extraction because of displeasing tooth appearance.
10. Patient's request	The tooth/teeth could have been repaired, but the patient insisted on extraction.
11. Occlusal problem	Teeth to be removed for occlusal reasons, such as overeruption or tilting.
12. Other reasons	Any other reason for extraction (please specify).

lated for the teeth extracted from the same patient. This score was the mean of the dichotomous scores assigned to the reason for extraction given for each tooth. For each patient a mean score for each dentist was then calculated. Thus each dentist received a score between 0 and 1, and this was made into a dichotomous variable again. A dentist with score 0 would be one who extracted teeth from patients only for non-disease considerations as reasons. For the primary reasons the categories of the dependent variable were defined as 1 = dentists who had extracted teeth for clinical diagnosis as reasons; the other group consisted of dentists for whom non-disease conditions as reasons had played a variable part in the decision to extract. For the secondary reasons the dependent variable was categorized as 0 = dentists who extracted teeth for non-disease considerations as reasons, and the other group consisted of dentists for whom clinical diagnosis as reasons had to various extents influenced the decision to extract.

The descriptive comparisons and bivariate analyses (unadjusted rates) were made between clinical diagnosis and non-disease considerations as reasons, followed by logistic regression analysis (adjusted rates) for identification of the determinants.

Since the multifactorial concept of reasons given for dental extractions requires techniques for handling several variables and their interactions simultaneously, a multiple logistic regression analysis was the method of choice. For this analysis the independent variables were dichotomized, and the definition of categories is shown in Table 2. Comparisons were made between dentists giving clinical diagnosis as a reason for tooth extraction and those who tended to give non-disease considerations as their reasons. Analyses were restricted to primary and secondary reasons for tooth extraction because the number of teeth for which a tertiary reason had been recorded was too small for a meaningful multivariate analysis.

The BMDP Statistical Software (12) was used for calculating odds ratios (OR), p values, and 95% confidence intervals for OR. The 95% confidence intervals were calculated with Wollf's equation (13).

Results

The dentists had given primary reasons for extracting the 960 teeth; both primary and secondary reasons had been recorded for 425 teeth, and a primary, a secondary, and a tertiary one for 186. The ranking of the leading primary reasons was caries (35.0%), orthodontics (19.7%), periodontitis (19.5%), and pericoronitis (7.4%). This changed to caries (23.5%), periodontitis (16.9%), patients' decision (13.2%), and prosthetic reasons (10.1%) for secondary reasons, and to patients' decision (24.1%), esthetics (22.4%), economics (11.2%), and periodontitis (10.6%) for tertiary reasons (Fig. 1). These changes were highly significant ($p < 0.001$).

The extractions were attributed to a large number of combinations of reasons. The combinations including caries as primary and periodontitis as secondary reason and vice versa constituted the largest categories but accounted for only 25% of the 425 teeth for which at least two reasons had been recorded.

Bi- and multi-variate analyses

The bivariate analyses showed a statistically significant effect of gender, practice location, and mean number of teeth extracted per patient per dentist. Female dentists and dentists who extracted permanent teeth from one or two patients tended to choose non-disease considerations as the primary reason less often than male dentists and dentists who had seen more than two patients for extraction. Dentists who practiced in communities with more than 10,000 inhabitants tended to give non-disease considerations as reason more often than dentists practicing in communities with less than 10,000 inhabitants.

Logistic regression analysis was used to assess the effect of more than one variable at a time. The independent variables age and practice location were initially entered into the analyses with four categories each, but the results are presented using dichotomized age and practice location as variables, because the results of the two analyses were

Table 2. Definition of characteristics of the dentists (independent variables) and unadjusted (OR_{un}) and adjusted (OR_{adj}) odds ratios with confidence intervals (CI) for primary reasons

Variables (dentists)	Categories	Extr. reason < 1 (other)		Extr. reason = 1 (disease)		OR_{un}	95% CI	OR_{adj}	95% CI
		n	n	n	n				
Sex	Female	61	8	53	0.3	0.3	(0.13, 0.67)	0.3	(0.13, 0.74)
	Male	163	60	103	1	1		1	
Age	≤40 years	100	36	64	1.6	1.6	(0.90, 2.84)	1.9	(1.00, 3.97)
	≥41 years	124	32	92	1	1		1	
Place of education	Norway (Bergen/Oslo)	177	54	123	1.0	1.0	(0.50, 2.02)	0.6	(0.27, 1.47)
	Abroad	47	14	33	1	1		1	
Service sector	Private	119	39	80	1.3	1.3	(0.73, 2.31)	1.4	(0.69, 2.83)
	Public	105	29	76	1	1		1	
Practice location	Level 2/3 = >10,000 inhabitants and functions of an administrative service center	56	28	28	3.2	3.2	(1.70, 6.03)	2.4	(1.16, 5.16)
	Level 1/0 = ≤10,000 inhabitants with or without functions of an administrative service center	168	40	128	1	1		1	
Mean no. of patients with extractions per dentist	1-2 patients	120	20	100	0.2	0.2	(0.11, 0.37)	0.2	(0.13, 0.45)
	>2 patients	104	48	56	1	1		1	
Mean no. of teeth extracted per patient per dentist	1-2 teeth	68	60	139	0.9	0.9	(0.37, 2.20)	1.3	(0.69, 2.44)
	>2 teeth	156	8	17	1	1		1	

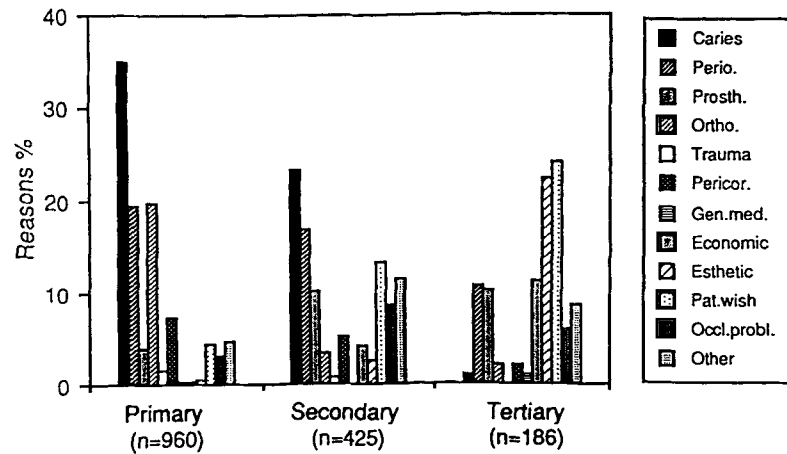


Fig. 1. Percentage distribution of teeth on the basis of primary, secondary, and tertiary reasons for extraction, Norway 1988.

essentially the same. The adjusted OR for primary reasons did not differ markedly from the unadjusted ones (Table 2), and the statistically significant bivariate effects persisted after allowing for the other independent variables that entered into the logistic regression analysis.

All dentist characteristics except the mean number of teeth extracted per patient per dentist had a statistically significant bivariate effect on the choice of secondary reasons for extraction of permanent teeth (Table 3). Non-disease considerations as the secondary reason for extraction was most likely to be given by female dentists and by dentists who had extracted teeth from one or two patients. An opposite trend was true for place of education, service sector, and practice location. In the logistic regression analysis the statistically significant bivariate effects of sex, place of education, and practice location disappeared, whereas the effect of age became borderline significant (Table 3).

Discussion

The results shown in Fig. 1 were in agreement with expectations. The clinical diagnoses outnumbered the non-disease considerations as reasons for the primary and secondary causes of extraction. The same

tendency was reported for primary reasons for extractions leading to edentulousness in a study in The Netherlands (8). However, it should be noted that the extractions were attributed to a large number of combinations of reasons.

Dentists gave fewer secondary and tertiary than primary reasons. This is because mostly only one reason was given when third molars were extracted and when teeth were extracted for orthodontic reasons.

The possible effect of the dentists' characteristics is of interest when discussing reasons given by the dentist, since dentists will be influenced by their concept of health and disease, their values and norms, and their knowledge of dental diseases and their possibilities for improving the existing condition (14). Thus, in a study of 156 general dental practitioners in the state of Washington, Grembowski et al. (15) found that patient factors may be of lesser importance than technical factors in a sample consisting of dentists with several years of practice experience. Over the years, dentists may have acquired the personal skill to address most patients' concerns. Furthermore, Kay & Blinkhorn (7) found that the year in which Scottish dentists graduated influenced their decision to extract teeth. This may explain why in our study dentists in the age group 41 years or older had a tendency to extract teeth

Table 3. Definition of characteristics of the dentists (independent variables) and unadjusted (OR_{un}) and adjusted (OR_{ad}) odds ratios with confidence intervals (CI) for secondary reasons

Variables (dentists)	Categories	n	Extr. reason > 0 (other)		n	Extr. reason = 0 (non-disease)		n	OR_{un}	95% CI	OR_{ad}	95% CI
			n	n		n	n					
Sex	Female	61	17	44	0.5	(0.26, 0.95)	0.6	(0.27, 1.18)				
	Male	163	74	89	1		1					
Age	≤40 years	100	49	51	1.9	(1.11, 3.26)	1.9	(1.00, 3.60)				
	≥41 years	124	42	82	1		1					
Place of education	Norway (Bergen/Oslo)	177	78	99	2.1	(1.04, 4.25)	1.8	(0.78, 4.26)				
	Abroad	47	13	34	1		1					
Service sector	Private	119	58	61	2.1	(1.22, 3.63)	2.1	(1.07, 3.96)				
	Public	105	33	72	1		1					
Practice location	Level 2/3 = >10,000 inhabitants and functions of an administrative service center	56	29	27	1.8	(1.49, 2.18)	1.5	(0.71, 3.03)				
	Level 1/0 = ≤10,000 inhabitants with or without functions of an administrative service center	168	62	106	1		1					
Mean no. of patients with extractions per dentist	1-2 patients	120	29	91	0.2	(0.11, 0.36)	0.2	(0.13, 0.45)				
	>2 patients	104	62	42	1		1					
Mean no. of teeth extracted per patient per dentist	1-2 teeth	199	82	117	1.2	(0.55, 3.09)	0.8	(0.69, 2.44)				
	>2 teeth	25	9	16	1		1					

with clinical diagnoses as primary reasons more often than younger dentists (Table 2). Female dentists tended to extract teeth for clinical diagnoses as primary reasons more often than male dentists did (Table 2). The reason for this may be that a relatively high proportion of female dentists in our study worked in the public service sector and that their extractions were mostly carried out for orthodontic reasons.

Dentists practicing in communities with more than 10,000 inhabitants gave non-disease considerations as primary reasons for extraction more often than colleagues practicing in less densely populated areas. Reasons for this finding may be differences between urban and rural areas in the dentist to population ratio, as indicated by Bouma et al. (16) and Ashford (17), or higher dental awareness and more concern about dental appearance in urban than in rural areas. That a higher rate of tooth loss has been found in rural than in urban areas tends to support this contention (16, 18, 19). Dentists who carried out extractions on one or two patients tended to consider clinical diagnosis a primary reason more often than dentists in the other group. We found no obvious explanation for this trend but believe that it is associated with differences between dentists or dental practices. Confounding seems to play only a small role, since there is practically no change from the bivariate to the multivariate results for primary reasons (Table 2).

The multivariate analysis for the secondary reasons (Table 3) showed that only the effect of the dentists' age, service sector, and the mean number of patients with extracted teeth per dentist were significant ($p < 0.05$). This indicates that there was interaction between independent variables. Non-disease considerations as secondary reasons had been given by dentists 41 years of age or older, and this effect became borderline significant, as shown by the 95% confidence interval for the adjusted OR. The primary reasons given by this age group of dentists tended to be clinical diagnosis, while the secondary reasons favored non-disease considerations as the reason. The same trend may explain why dentists working in the public service sector and dentists who carried

out extractions on one or two patients tended to give secondary non-disease considerations as reasons more often than private-practicing dentists and dentists who extracted teeth for more than two patients.

Surveys to determine the primary reasons for tooth extraction have been carried out nationwide (for a review, see Klock & Haugejorden (1)) and for selected groups of people in several countries (2–5). Studies in the past have only rarely mentioned (9) or considered contributing reasons (7, 8). Forcing dentists to give only the main reason for extraction of a tooth may have biased the results. Allowing for contributing reasons, as was done in this study, has probably improved the validity of our results.

It is concluded that the disease-/condition-related diagnoses topped the list for primary and secondary reasons for extraction, whereas patients' wishes, economy, and esthetics came to the forefront among tertiary reasons. The choice between clinical diagnosis and non-disease considerations as reasons for extraction was significantly but moderately influenced by the dentist characteristics sex, age, practice location, and the mean number of patients with extractions per dentist; similarly, the choice of secondary reasons was significantly affected by age, service sector, and the mean number of patients with extractions per dentist.

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References

1. Klock KS, Haugejorden O. Primary reasons for extraction of permanent teeth in Norway: changes from 1968 to 1988. *Community Dent Oral Epidemiol* 1991;19:336–41.
2. Coxhead JL. Reasons for extractions in general practice. *N Z Dent J* 1960;56:182–3.
3. Davis CH. Relative causes of tooth mortality, a pilot study. *J Public Health Dent* 1961;21:85–91.
4. Johansen SB, Johansen JR. A survey of causes of permanent tooth extractions in South Australia. *Aust Dent J* 1977;22:238–42.

5. Chauncey HH, Glass RL, Alman JE. Dental caries. Principal cause of tooth extraction in a sample of US male adults. *Caries Res* 1989;23:200-5.
6. Cahen PM, Frank RM, Turlot JC. A survey of the reasons for dental extractions in France. *J Dent Res* 1985;64:1087-93.
7. Kay EJ, Blinkhorn AS. The reasons underlying the extraction of teeth in Scotland. *Br Dent J* 1986;160:287-90.
8. Bouma J, Schaub RMH, Poel ACM van de, Westert GP. Dentists' and patients' opinions of the dental condition at moment of full clearance. *Community Dent Oral Epidemiol* 1987;15:79-84.
9. Todd JE, Whitworth A. Adult dental health in Scotland. London: Her Majesty's Stationery Office, 1972:131.
10. Ainamo J, Sarkki L, Kuhlampi ML, Palolampi L, Piirto O. The frequency of periodontal extractions in Finland. *Community Dent Health* 1984;1:165-72.
11. SPSSx user's guide. A manual. 3rd ed. Chicago: McGraw-Hill Book Company, 1988.
12. BMDP statistical software. A manual. Vol 2 (LR). Los Angeles: University of California Press, 1988: 941-69.
13. Altman DG. Practical statistics for medical research. London: Chapman & Hall, 1991:268-70.
14. Gjermo P. Factors influencing the assessment of treatment needs. *J Clin Periodontol* 1991;18:358-61.
15. Grembowski D, Milgrom P, Fiset L. Factors influencing dental decision making. *J Public Health Dent* 1988;48:159-67.
16. Bouma J, Poel F van de, Schaub RMH, Uitenbroek D. Differences in total tooth extraction between an urban and a rural area in the Netherlands. *Community Dent Oral Epidemiol* 1986;14:181-3.
17. Ashford JR. Regional variations in dental care in England and Wales. *Br Dent J* 1978;145:275-83.
18. Central Bureau of Statistics of Norway. Health survey 1985. Oslo-Kongsvinger: Central Bureau of Statistics of Norway, 1987:92-5.
19. Heløe LA, Holst D, Rise J. Development of dental status and treatment behavior among Norwegian adults 1973-85. *Community Dent Oral Epidemiol* 1988;16:52-7.

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