Level and predictors of agreement between patients and their dentists concerning need for replacement of teeth at the time of extraction

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The aims were to determine the level of agreement between patient and dentist about the need for a replacement of teeth at the time of extraction, and to identify and assess the effect of predictor variables on the level of agreement. Data were obtained from questionnaires. A systematic random sample of 1,500 Norwegian general dental practitioners were contacted, 67% of them responded and 75% of their patients. The final sample consisted of 427 patients (16–92 years old) and 224 dentists. Overall agreement was 62% of the cases and agreement about replacement 26%. Multiple logistic regression analysis with overall agreement as dependent variable identified tooth type (OR = 2.7 for anterior teeth versus molars, 95% CI: 1.3; 5.6 and OR = 1.9 for molars versus premolars, 95% CI: 1.2; 3.2), service sector, dentist's age and patient gender as significant predictors. Tooth type (OR = 36.0 for anterior teeth versus molars, 95% CI: 12.5; 104.0 and OR = 5.8 for premolars versus molars, 95% CI: 2.7; 12.3), service sector (OR = 7.0, 95% CI: 2.3; 21.1), the number of teeth extracted and the number of remaining natural teeth affected the likelihood of agreement about the need for replacement of extracted teeth. Predictors of no need for replacement were tooth type (OR = 6.7 for molars versus premolars, 95% CI: 3.3; 13.7) and the dentist's age (OR = 2.1, 95% CI: 1.2; 3.6). Clinical factors were the most important predictors of patients' and dentists' likelihood to agree about replacement, but service sector, dentist's age and patient's gender had also a significant impact on the level of agreement. □ *Adults; decision-making; prosthodontics; questionnaire survey; tooth loss*

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Dental treatment need has traditionally been determined in accordance with professional standards (1, 2). A number of studies have considered the patient's perceived need as opposed to the dental profession's recommendation of treatment (2–9). A common finding is that patients tend to underestimate their need for dental treatment and that this discrepancy is most distinct in the case of periodontal diseases (8), possibly because these diseases are rarely associated with pain or other symptoms in their early stages.

Among persons aged 65–79 years in Northern Norway, Rise (10) found that professional assessment of treatment need gave rise to a relatively high proportion of 'false-positive' judgments (sensitivity: 88%, specificity: 43%) compared with subjects' self-reports of treatment need. Previous analyses on the present material have shown that tooth type and the number of teeth extracted influence both the patient's perceived need for replacement and the dentist's recommendations significantly (11, 12). Previous investigations have merely reported that differences exist (e.g. 8, 13, 14), without focusing on overall agreement and agreement *not* to replace missing teeth. To our knowledge, the factors that may influence the level of agreement between patients' perceived treatment need and the professionally recommended treatment have not been studied in depth. The aim of the present paper was to determine the level of agreement between the patient and the dentist about the need for a replacement of teeth at the time of their extraction, and to identify and assess the effect of predictor variables on the level of agreement.

Materials and methods

Subjects

A systematic random sample drawn from the Norwegian Dental Association's register of dentists in January 1998 ($N = 3{,}929$) comprised 1,500 general dental practitioners <70 years of age. The final response rate was 51% ($n = 772$) after exclusions (15). Three-hundred-and-fifty-four dentists had not extracted any teeth during the 2-week observation period in February/March 1998. Patients with third molar extractions, extractions as part of orthodontic treatment or dentists who returned incomplete questionnaires were excluded (116 dentists). Dentists gave information from the records concerning their patients' oral condition and demographics (11, 12). Information about the patients was collected using a self-administered structured questionnaire which the dentist handed out at the time of extraction. The dentists were asked to distribute the patient questionnaire but not to become involved in its completion. No reminders could be sent to

Table 1. Frequency distribution of practicing Norwegian dentists in 1998, respondents and participants according to age, sex, service sector and practice location

Description	Population* (n = 4,332) %	Sig.	Respondents (n = 772) %	Sig.	Participants (n = 251) %
Age (years)					
≤29	8.1		7.4		7.1
30–39	20.3		20.9		19.6
40–49	26.2	NS	28.9	NS	29.5
50–59	26.3		28.2		30.4
60–69	19.1		14.6		13.4
Sex					
Female	35.6	NS	37.2	P = 0.01	25.9
Male	64.4		62.8		74.1
Service sector					
Private	62.3	NS	61.5	P = 0.01	71.9
Public	37.7		37.2		28.1
Practice location					
Oslo	16.9		15.7		9.4
East	35.8		34.8		29.9
South	5.3	NS	4.9	P = 0.00	4.9
West	26.0		27.2		27.2
Middle	7.2		8.2		13.4
North	8.7		9.2		15.2

* November 1998.
NS $P > 0.05$.

the patients because their identities were unknown. Seventy-five percent returned the questionnaire within 2 weeks. Further information about working dentists in Norway in 1998, the respondents, the participating dentists and their patients, is given in Tables 1 and 2. The final sample, after exclusions for missing data, comprised 427 patients (aged 16–92 years) who had had 601 permanent teeth extracted by 224 dentists over a period of 2 weeks.

Dependent variables

The question 'Do you feel it is necessary or unnecessary to have a replacement for the extracted tooth or teeth?' assessed the patient's perceived need for a replacement. The response alternatives were 'definitely necessary', 'necessary', 'don't know', 'unnecessary' and 'definitely not necessary'. The question 'Are there professional indications to recommend a replacement for the extracted tooth or teeth?' was answered per subject and regardless of whether the patient had one or more teeth extracted. The response alternatives were 'yes, definitely', 'yes, but open to question', and 'no, absolutely not'. Agreement between the dentist's recommendation and the patient's perceived need for replacement after tooth extractions is presented in Table 3.

For the multivariate analysis, three binary dependent variables were defined as follows:

- *Overall agreement:* dentist: yes, definitely and patient: definitely necessary or necessary (1), or dentist: no, absolutely not and patient: unnecessary or definitely not necessary (1), other combinations of answers (0).

Table 2. Distribution of patients reported by dentists, respondents and non-respondents to the questions concerning need/wish for a replacement after tooth extraction according to demographic characteristics, oral health status and dental attendance

	Respondents	Non-respondents	Sig.
Patients (n)	427	160	–
Patient's gender, female (%)	50	46	NS
Patient's mean age in years (s)	54 (16.2)	53 (17.4)	NS
Service sector, private/public (%)	76/24	67/33	P = 0.02
Dentist's gender, female (%)	21	29	NS
Dentist's mean age in years (SD)	48 (10.5)	47 (11.9)	NS
Median no. of remaining teeth, range: 0–31	21	22	NS
Tooth type extracted, ant./prem./mol. (%)	18/27/55	26/27/47	NS
Regular dental attendance (%)*	67	50	P = 0.00
Replacement recommended (%)†	59	62	NS

* At least twice during the last 3 years.
† Dentists' recommendation: definitely or yes, but open to question.
NS $P > 0.05$.
s = standard deviation.

Table 3. Cross-tabulation according to dentist's recommendation and patient's perceived need for replacement after tooth extractions (*n*)

Dentist	Patient			Total
	Necessary[1]	Don't know	Unnecessary[2]	
Yes, definite need for replacement	109	6	8	123
Yes, but open to question	67	30	30	127
No, absolutely no need for replacement	24	29	124	177
Total	200	65	162	427

[1] 'Definitely necessary' + 'necessary'.
[2] 'Unnecessary' + 'definitely unnecessary'.
Overall agreement: 61.6%.

- *Agreement to replace:* dentist: yes, definitely and patient: definitely necessary or necessary (1), other combinations (0).
- *Agreement not to replace:* dentist: no, absolutely not and patient: unnecessary or definitely not necessary (1), other combinations (0).

Predictor variables

Seventeen predictor variables were identified (Table 4). The dentists were characterized by age, sex, place of residence and service sector. The dichotomy used for place of residence was community scores, 1–6 = urban (0) versus community score, 7 = rural (1). The categories refer to the *Main Classification of Municipalities from the Official Statistics of Norway* (16), in which the criteria for classification are economic structure and population density.

Patients' attitudes to the importance of dental appearance and function were obtained from principal components factor analysis (with varimax rotation) of four items reflecting dental attitude (12). The Kaiser criterion was used to identify two new factors: (a) attitude to dental appearance and (b) attitude to dental function.

Four variables described the patients' demographic characteristics. The 10 patients with missing information about year of birth were given the study group's median year of birth (1944). Tooth type extracted was the only variable describing the patient's oral status at tooth level. One randomly listed tooth per patient was included in the analyses to eliminate the effect of intra-patient association, which involved 86 patients (20%). Two dummy variables were constructed to assess if and to what extent extraction of anterior teeth and premolars, compared to molars, affected agreement.

Whether the tooth extraction was dentist or patient initiated was measured by a question with three response categories, 'dentist's suggestion', 'don't remember' or 'own initiative', where patients answering 'don't remember' were excluded (9%).

The dentist reported information about dental attendance and the number of teeth extracted per patient. Two dummy variables were constructed to assess to what extent extraction for patients with 0–15 or 16–22 remaining teeth, compared to patients with more than 22 teeth, affected agreement (Table 4). Dental attendance had the response alternatives: regularly, at least once a year or twice during the past 3 years (1) and less often and no visits during the latest 3 years (0).

Statistical methods

Data analyses were performed using the Statistical Package for Social Sciences (17). Chi-squared analyses were used to compare frequency distributions. Binary logistic regression models were used for analysis of associations. The influences of covariates were tested with simple factorial ANOVA and bivariate relationships with Pearson's correlation (18) (Table 4). Multiple logistic regression analysis was used to assess the effect of predictors on the patient's and dentist's likelihood of agreeing about treatment/no treatment. Predictor variables correlated with the dependent variable at the level of $P < 0.10$ were included in the analyses (enter procedure). The patient's and dentist's gender and age were used as control variables in all models. Of the attitudinal factors from the factor analysis, only attitude to dental appearance was significantly associated (bivariate) with agreement between patients' and dentists' opinion of the need for replacement after tooth extraction.

The number of patients in the analysis exceeds the number of dentists, as each dentist treated on average 3.1 patients (SD = 1.67, range 1–10 patients). Using PROC GENMOD of SAS (release 6.12 for WINDOWS, subversion TS060 (19)), intra-dentist correlation in treatment philosophy was taken into account in logistic regression analyses for clustered binary data using generalized estimating equation methodology (GEE) (20). Patients treated by the same dentist constituted a cluster. An adjustment for clustered data (GEE) was not possible to perform in the analysis of agreement *not* to replace because of model fitting error (19).

The overall correct classification of cases, significance of the model and the probability of the observed results (−2 times the log of the likelihood, −2LL) were calculated. Nagelkerke's R^2 attempts to quantify the proportion of explained variance in the logistic regression model. Regression coefficients (β) and odds ratios (OR) adjusted for clustering with 95% confidence intervals (CI) were calculated. When the 95% CI does not include unity, the odds ratio is taken to be significant. The chosen level of statistical significance was 5%.

Table 4. Frequency distribution of agreement (%) between dentist's and patient's opinions of the need for replacement after tooth extraction according to predictor

Predictors	*n*	Overall agreement between patients and dentists (%)	*P**	*P*†	*P*‡
Dentist					
Gender			0.652	0.994	0.626
Female (0)	90	56.7			
Male (1)	337	54.0			
Age in years			0.027	0.466	0.085
< Median, 48 years old (0)	193	48.7			
≥ Median (1)	234	59.4			
Service sector			0.002	0.027	0.196
Public (0)	104	41.3			
Private (1)	323	58.8			
Place of residence			0.871	0.595	0.739
Urban (0)	209	55.5			
Rural (1)	212	54.7			
Patient					
Gender			0.131	0.304	0.502
Female (0)	213	58.2			
Male (1)	214	50.9			
Age in years			0.012	0.000	0.011
< Median, 54 years old (0)	207	48.3			
≥ Median (1)	220	60.5			
Marital status			0.369	0.127	0.627
Single (0)	138	58.0			
Married (1)	285	53.3			
Education			0.353	0.041	0.347
Lower, <12 years (0)	351	54.7			
Higher (1)	66	48.5			
Attitude to dental appearance			0.664	0.120	0.056
Important (0)	198	52.0			
Unimportant (1)	203	54.2			
Tooth type, dummy 1			0.000	0.000	0.000
Molars (0)	223	52.9			
Anterior teeth (1)	74	79.7			
Tooth type, dummy 2			0.000	0.000	0.000
Molars (0)	223	52.9			
Premolars (1)	109	38.5			
Dental attendance			0.258	0.859	0.158
Irregularly (0)	142	50.7			
Regularly (1)	285	56.5			
No. of remaining teeth, dummy 1			0.003	0.000	0.000
More than 22 remaining teeth (0)	309	49.5			
0–15 remaining teeth (1)	92	67.4			
No. of remaining teeth, dummy 2			0.946	0.050	0.066
More than 22 remaining teeth (0)	312	53.5			
16–22 remaining teeth (1)	89	53.9			
No. of teeth extracted per patient			0.000	0.000	0.000
One (0)	341	50.1			
More than one (1)	86	72.1			
Who suggested the tooth extraction?			0.883	0.326	0.274
Dentist's suggestion (0)	252	54.4			
Own initiative (1)	136	55.1			
Influence on the decision to extract			0.654	0.049	0.019
Little or no influence (0)	111	52.3			
Very strong/strong influence (1)	307	54.7			

* Table 5 (dep.var. (0)/(1) = 45/55%); † Table 6 (dep.var. (0)/(1) = 75/25%); ‡ Agreement *not* to replace (dep.var. (0)/(1) = 71/29%).

Results

Level of agreement

Overall agreement between patient and dentist was observed in 263 of 427 cases (61.6%, 95% CI: 57.0%, 66.2%), while they agreed about the need for a replacement in 109 cases (25.5%, Table 3). Neither the attending dentist nor the patient had reached a decision in 30 cases. In 124 instances they agreed about *no* need for a replacement after tooth extraction.

Table 5. Odds ratio (OR) and 95% confidence interval (CI) of dentist's and patient's likelihood to agree about need for treatment/ no treatment after tooth extraction. Dependent variable: disagreement (0), overall agreement (1)

Predictor variables	Patients 16–92 years, $n = 400$	
	β	OR (95% CI)
Tooth type, dummy 1		
Molars (0)		1
Anterior teeth (1)	0.983	2.7 (1.27, 5.63)*
Service sector		
Public (0)		1
Private (1)	0.860	2.4 (1.43, 3.92)*
Tooth type, dummy 2		
Premolars (1)		1
Molars (0)	−0.653	1.9 (1.15, 3.22)*
Dentist's age in years		
<Median, 48 years old (0)		1
≥Median (1)	0.569	1.8 (1.13, 2.76)*
Patient's gender		
Male (1)		1
Female (0)	−0.491	1.6 (1.06, 2.50)*
Dentist's gender		
Male (1)		1
Female (0)	−0.552	1.7 (0.99, 3.05)
No. of teeth extracted per patient		
One (0)		1
More than one (1)	0.526	1.7 (0.97, 2.96)
No. of remaining teeth, dummy 1		
More than 22 remaining teeth (0)		1
0–15 remaining teeth (1)	0.431	1.5 (0.90, 2.64)
Patient's age		
≥Median, 54 years old (0)		1
<Median (1)	0.244	1.3 (0.81, 2.00)

−2LL: 490.1; 9 df; 65% correctly predicted; $P < 0.001$; Nagelkerke's $R^2 = 0.19$.
* $P < 0.05$.

Table 6. Odds ratio (OR) and 95% confidence interval (CI) of dentist's and patient's likelihood to agree about need for treatment after tooth extraction. Dependent variable: disagreement (0), agreement about treatment (1)

Predictor variables	Patients 16–92 years ($n = 383$)	
	β	OR (95% CI)
Tooth type, dummy 1		
Molars (0)		1
Anterior teeth (1)	3.584	36.0 (12.48, 104.00)*
Service sector		
Public (0)		1
Private (1)	1.946	7.0 (2.32, 21.11)*
Tooth type, dummy 2		
Molars (0)		1
Premolars (1)	1.754	5.8 (2.70, 12.34)*
No. of teeth extracted per patient		
One (0)		1
More than one (1)	1.650	5.2 (2.29, 11.86)*
No. of remaining teeth, dummy 1		
More than 22 remaining teeth (0)		1
0–15 remaining teeth (1)	1.004	2.7 (1.11, 6.71)*
No. of remaining teeth, dummy 2		1
More than 22 remaining teeth (0)		
16–22 remaining teeth (1)	0.570	1.8 (0.72, 4.32)
Dentist's gender		
Male (1)		1
Female (0)	−0.578	1.8 (0.79, 4.04)
Patient's age		
<Median, 54 years old (0)		1
≥Median (1)	0.527	1.7 (0.79, 3.63)
Patient's gender		
Male (1)		1
Female (0)	−0.554	1.7 (0.88, 3.43)
Patient's education		
Higher (1)		1
Lower, <12 years (0)	−0.289	1.3 (0.58, 3.09)
Influence on the decision to extract		
Very strong/strong influence (1)		1
Little influence or no influence (0)	−0.192	1.2 (0.62, 2.37)
Dentist's age		
<Median, 48 years old (0)		1
≥Median (1)	0.011	1.0 (0.72, 4.32)

−2LL: 244.3, 12 df; 86% correctly predicted; $p < 0.001$; Nagelkerke's $R^2 = 0.56$.
* $P < 0.05$.

Predictors

Overall agreement (Table 5). The multiple logistic regression analysis showed that patients who had anterior teeth extracted were 2.7 times more likely to agree with their dentist than patients who had molars extracted. Patients and dentists in private practice were 2.4 times more likely to agree than in the public sector. Extracting molars rather than premolars gave OR = 1.9, while the dentists older than 47 years were 1.8 times more likely to agree with their patients than the younger dentists. Female patients were 1.6 times more likely to agree with their dentist than male patients (Table 5).

Agreement to replace (Table 6). Patients who had anterior teeth extracted rather than molars were 36.0 times more likely to agree about replacement. Patients and dentists in private practice were 7.0 times more likely to agree about replacement than in the public sector. Extracting premolars rather than molars gave OR = 5.8. Extracting more than one tooth at the time gave OR = 5.2 and extracting teeth for patients with 0–15 remaining teeth gave OR = 2.7 compared to patients with more than 22 remaining teeth. All the confidence intervals for significant variables were wide.

Agreement not to replace (OR unadjusted for intra-dentist correlation). The bivariate associations are given in Table 4. The significant predictors of patients' and dentists' likelihood to agree about *no* need for treatment were extracting molars rather than premolars: OR = 6.7 (95% CI: 3.3, 13.7) and dentists older than 47 years: OR = 2.1 (95% CI: 1.2, 3.6). The dentist's gender and the patient's gender, age or attitude to dental appearance had no significant effect in the regression model. Neither had extracting anterior teeth versus molars, the number of remaining natural teeth, extracting more than one tooth at the time, nor whether the tooth extraction was dentist or patient initiated. The log likelihood (−2LL) was 340.3 (11 df) and Nagelkerke's $R^2 = 0.35$.

Discussion

Level of agreement

In 26% of cases, the patients and dentists agreed about a definite need for replacement. No directly comparable results were found, but Tervonen & Knuuttila (8) reported 13% agreement when comparing need recorded by 19 dental examiners with the respondents' felt need for replacement in open tooth spaces in a survey of Finns aged 25–65 years. In a study of a sample of predominantly edentulous people (74%) aged 65–98 years in Nottingham, England, Smith & Sheiham (7) found that 42% of those who were clinically assessed as needing treatment felt that they required it, but only 19% had tried to obtain treatment. Although not directly comparable, these results confirm a low level of agreement between patients and dentists as far as prosthetic treatment need is concerned.

By including the proportions of agreement about *no* need for replacement and indecision about the need for replacement, the overall rate of agreement was 62%. Again no direct comparison was possible, but Tervonen (21) found that the patient's and dentist's assessment of the quality of removable dentures was in agreement in 76% of cases. Buoma et al. (4) reported that Dutch patients and dentists agreed in their perception of the dental condition in 60% of the cases in a sample of patients who received full mouth extractions. These findings lend indirect support to the estimated level of agreement between patient and dentist in our study.

Predictors of agreement

In previous studies based on this material, demographic variables did not have a significant effect on the dentist's recommendations (11), nor on the patient's wishes for a replacement (12). In the present analysis, dentist age and patient gender affected the level of overall agreement significantly, while dentists' gender was borderline significant. Older dentists (≥48 years old) agreed with their patients more often than younger dentists did, possibly because of their longer professional experience. When dentists' age was not a significant factor in the analysis of agreement about replacement (Table 6), but predicted agreement about *no* treatment necessary (OR = 2.1, 95% CI 1.22, 3.59), it tends to support the notion that older dentists may be less inclined to recommend advanced prosthodontic treatment (22). Alternatively, they may be more realistic about what is acceptable dental treatment for patients. The dentist's age and years in the profession have also earlier been found to affect the practice profile, i.e. older dentists consistently provide less prosthetic treatment than younger dentists (22, 23).

Female patients were more inclined than their male counterparts to agree with their dentist concerning treatment needed after extraction. This contradicts the findings of Hakeberg et al. (24), who measured different aspects of the dentist–patient relationship among 204 patients receiving dental care at public dental service clinics (PDS), an emergency PDS clinic and an oral medicine clinic, and found no significant difference attributable to gender.

The patients and dentists in private practice were overall more likely to agree than patients and dentists in the public sector. Although the predictor variables were tested for interaction, the possibility of confounding cannot be ruled out. The analysis controlled for practice profiles, i.e. for different female/male dentist ratio in the private and public sector (1/2.4 versus 1/1), for dentists' age and for a possible difference in patient mix in the two sectors. Hence, the sector differences may be attributable to differences in patients' and dentists' preferences and to difference in socioeconomic status among patients. That service sector was an even stronger predictor (OR = 7.0) when analyzing agreement to replace contra overall agreement (OR = 2.4) may also point to differences in patients' and dentists' preferences.

The importance of restoring the visible spaces compared to non-visible spaces resulting from tooth extraction is self-evident for most Scandinavians (12, 25). As expected, tooth type was the strongest predictor in all models. Information on the effect of each predictor alone is not available from the output of the GEE analyses in terms of R^2, because the 'enter' procedure is the default format. Although not directly comparable (i.e. unadjusted results), tooth type dummy 1 and dummy 2 alone in the model gave Nagelkerke's $R^2 = 0.10$ of a total $R^2 = 0.19$ in overall agreement analysis. R^2 for tooth type equaled 0.46 of 0.56 and 0.31 of 0.35 in the models of agreement about replacement and agreement about *no* need for replacement, respectively.

As indicated by the explained variance in the three models, treatment decision is the result of a complex process that to some extent may depend on non-disease factors and factors other than those included in the present study. The wide confidence intervals of OR in the analysis of agreement to replace and agreement *not* to replace and a relatively low R^2 value (Table 5) indicate low power and lack of precision. Further research is needed to improve our ability to predict agreement about the need for replacement of extracted teeth. It is possible that the influence of non-disease factors might be more adequately captured employing qualitative methods.

The overrepresentation of male private practitioners in the northern part of Norway (Table 1) was expected because of our exclusion criteria. Although adjusted (direct method, not shown) for sector and dental attendance (Table 2), there was still no significant difference between the proportions of patients who were recommended a replacement by their dentist among respondents and non-respondents. Consequently, it is likely that the participating dentists (and their patients) are representative of the Norwegian dentists and patients who extracted teeth or had teeth extracted, and where a replacement was a possible consequence of the extraction.

It is reasonable to conclude that about 60% of

Norwegian patients agree with their dentist about the need for replacement after tooth extraction. Clinical factors are the most important predictors of dentists' and patients' likelihood to agree about replacement after tooth extraction, i.e. tooth type, number of teeth extracted per patient and number of remaining teeth. The service sector, dentist's age and patient's gender were also significant predictors of the level of agreement.

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