General practitioners' and dental students' decisions on third-molar diagnoses, treatment, and referrals

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A questionnaire on third-molar problems was mailed to a systematic random sample of 200 Norwegian general dental practitioners in November 1991. The return rate was 88%. Similar questions were given to 59 5th-year dental students, with a return rate of 83%. Ten third-molar cases were presented by means of copies of radiographs and written information. The following conclusions were drawn: Apart from a terminology problem consisting of lack of discrimination between the terms *retention* and *impaction*, overall good diagnostic abilities were shown by both practitioners and students. Receiver operating characteristic analysis of treatment decisions indicated that students were more radical than practitioners. The students had an increased referral rate for third-molar surgery, whereas the practitioners indicated a more selective practice of referring advanced cases. □ *Diagnosis, oral; epidemiology; molar, third; surgery, oral; tooth, impacted*

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Most patients with complaints or symptoms from retained or partially erupted third molars initially seek help from their general dental practitioner (1). In Norway, general practitioners perform a substantial amount of third-molar surgery in their own practice, in addition to supplying oral surgeons with a considerable number of referrals each year, most of them concerning third-molar problems (2, 3). During the past decade, several reports and reviews have suggested a change in a conservative direction with regard to indications for removal of retained or partially erupted third molars (4–7). Norwegian general practitioners seem to have adopted this more conservative approach towards third-molar treatment decisions to a greater extent than 5th-year dental students (8).

The general practitioners' role in this context, as a first-line diagnostician and possible provider of treatment, will closely depend on his or her ability to assess various third-molar situations and to make correct decisions on treatment and referrals from available anamnestic, clinical, and radiologic information. The influence of clinical experience may be reflected in possible differences in decision strategies between practitioners and 5th-year dental students, the latter serving as a reference group. The aim of the present study was to evaluate the abilities of Norwegian general dental practitioners and 5th-year dental students to assess some defined third-molar situations with regard to diagnosis, treatment, and referral decisions.

Materials and methods

From the Norwegian Dental Associations' register of members and nonmembers in 1991, the following groups were excluded: registered specialists in any branch, occupation within research and teaching, year of graduation 1991, born in 1921 or earlier, and indicated place of residence outside Norway. In addition, the participants of a previous survey (2, 8) were excluded. The remaining population consisted of 3725 general dental practitioners (GPs). From this population 200 were selected by systematic random sampling (1:18) to receive an envelope containing a questionnaire and copies of radiographs in November 1991. No strati-

fication was attempted. The purpose of the study was explained in a covering letter; the anonymity of the respondents was guaranteed, and no reward was offered. After one selected reminder had been mailed after 2 weeks, 176 answers were received, giving a return rate of 88%.

Fifty-nine 5th-year dental students in Oslo and Bergen were handed identical envelopes at the end of two arbitrarily chosen lectures. Forty-nine answers were received, for a return rate of 83%.

No statistically significant group differences on the basis of sex, age, geographic region, and type of practice (private/public) were found between respondents and the population of GPs. Likewise, the age and sex distribution of the student respondent group showed no significant deviation from the corresponding population of a total of 83 students.

The receivers of the envelopes were presented with 10 cases of third-molar problems in patients of different ages. The presentation included copies of two radiographs and accompanying written anamnestic and clinical information for each case. Figs. 1 through 10 show the presentation of the 10 cases.

The respondents were asked to diagnose each case. One open and three closed response alternatives were given: pericoron-

Fig. 2. Case 2. Man in good health, 24 years of age, no past or present symptoms. 48 not detectable by probing.

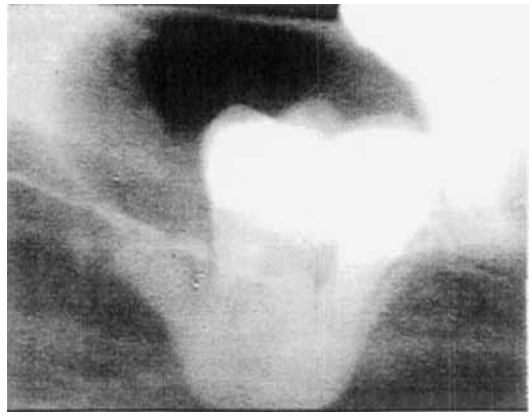

Fig. 3. Case 3. Woman 47 years old, taking atenolol medication for hypertension; otherwise in good health. No past or present symptoms and no clinical symptoms; 48 not detectable by probing.

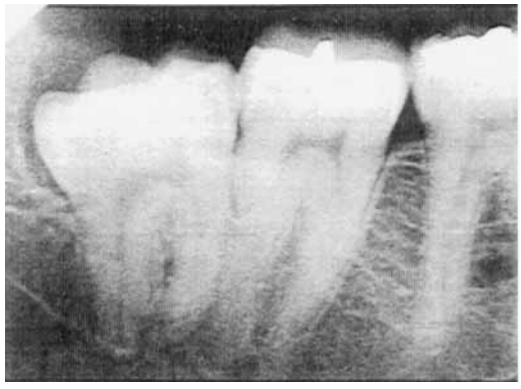

Fig. 1. Case 1. Woman in good health, 27 years of age, formerly slight symptoms, none at present. 48 detectable by probing, not visible. No clinical symptoms.

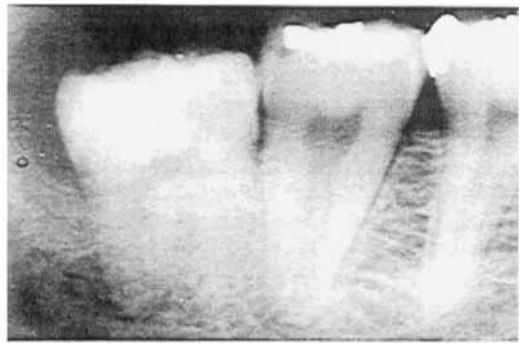

Fig. 4. Case 4. Man in good health, 35 years of age, no past or present symptoms. Mesial cusps of the lower right third molar partly visible; slight tenderness to palpation from covering soft tissue.

Fig. 5. Case 5. Man in good health, 37 years of age. Intermittent moderate nondescriptive symptoms from lower right jaw. 48 not detectable by probing; no clinical symptoms.

Fig. 8. Case 8. Man in good health, 39 years of age. No past or present symptoms. 48 not detectable by probing; no clinical symptoms.

Fig. 6. Case 6. Woman in good health, 56 years of age. No past or present symptoms. 38 not detectable by probing; no clinical symptoms.

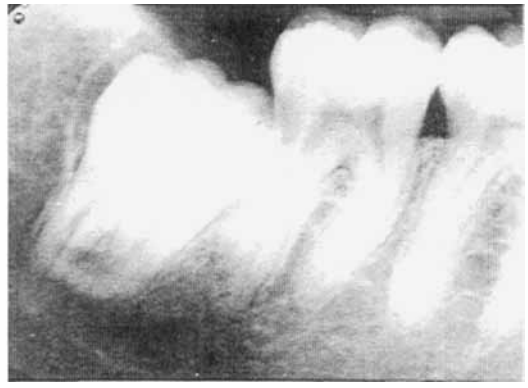

Fig. 9. Case 9. Woman in good health, 31 years of age. No past or present symptoms. 48 not detectable by probing; no clinical symptoms.

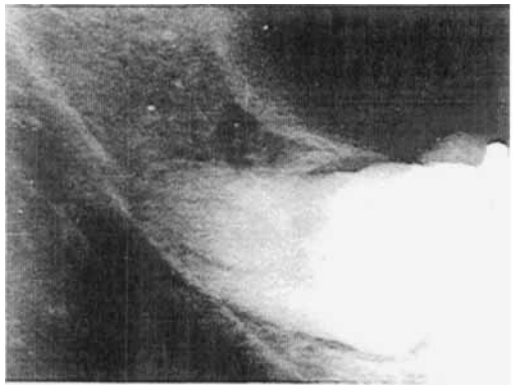

Fig. 7. Case 7. Woman in good health, 25 years of age. No past or present symptoms. 48 detectable by probing; no clinical symptoms.

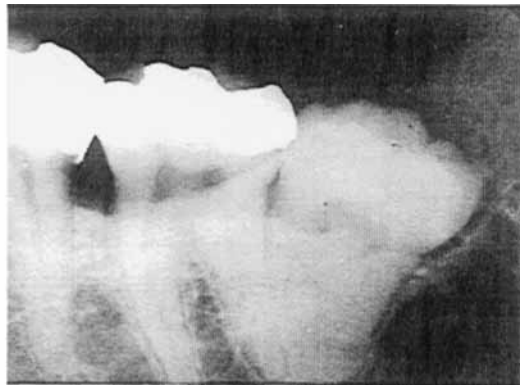

Fig. 10. Case 10. Woman in good health, 64 years of age. No past or present symptoms. 38: crown partly visible; no clinical symptoms.

itis, partial eruption, and retention, with possibilities for more than one answer for each case. For the analysis the following definitions were used: dentigerous cyst = follicular space width more than 2.5 mm and no oral communication; pericoronitis = partial eruption and clinical or radiologic signs of local inflammation; partial eruption = part of crown visible or detectable by blunt probing; and retention = no oral communication, completely covered by soft tissue and possibly bone.

The respondents were further asked to decide on removal at the present time, by her/himself or by referral, by using one of the following alternatives: remove now, uncertain, do not remove now. The following statement: 'The tooth is for some reason to be removed now; would you. . .', had two response alternatives: operate myself, refer for surgery. In addition, the practitioners were asked to state the principal reason for referral, if referral was chosen. The five closed response alternatives are shown in Table 7.

ROC analysis

The receiver operating characteristic (ROC) analysis requires a true answer or a 'gold standard' as a reference, and since such standards do not exist with regard to treatment

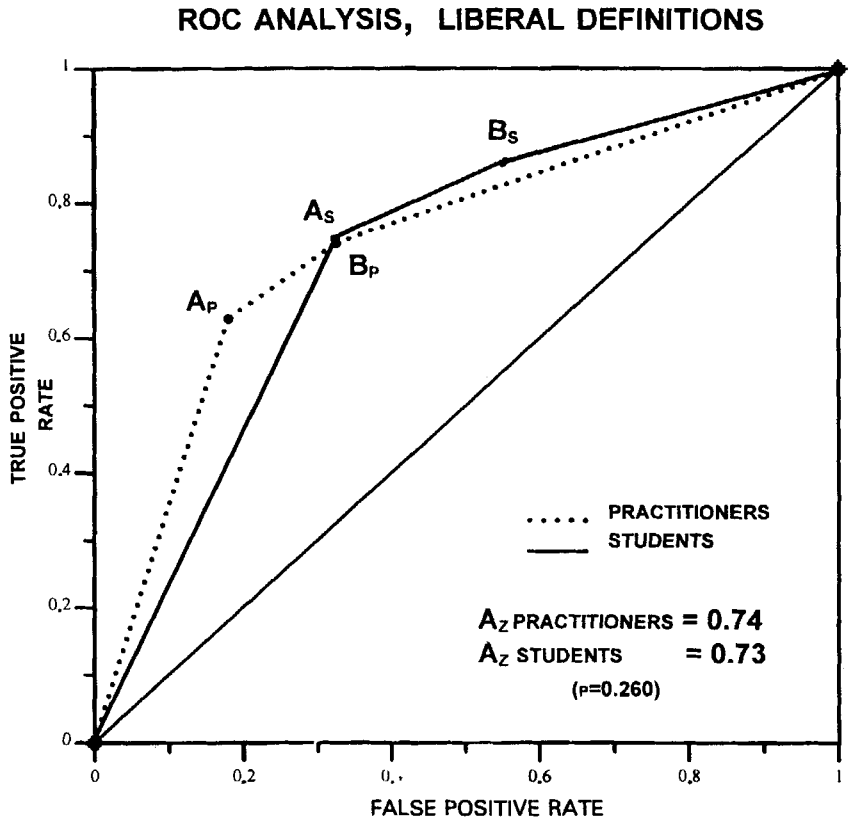

Fig. 11. Receiver operating characteristic (ROC) analysis of general practitioners' (n = 176) and dental students' (n = 49) decisions on removal of 10 third-molar cases, according to liberal definition of criteria. Points A represent the decision to 'remove now' and B the pooled responses to 'remove now' and 'uncertain' for practitioners (p) and students (s), respectively. The A_z value represents the area under the ROC curve.

decisions on third-molar removal, two sets of true answers or definitions were constructed.

1. Restrictive definition. Third molars with symptoms or lesions and third molars partially erupted between the ages of 20 and 25 years should be removed. According to this definition, a decision to remove should be made in cases 3, 4, and 7.

2. Liberal definition. Third molars with symptoms and lesions and all third molars in patients less than 36 years old, regardless of state of eruption, should be removed. Accordingly, the third molars in cases 1, 2, 3, 4, 5, 7, and 9 should be removed.

The various responses on the treatment options were combined to obtain ROC curve points (Figs. 11 and 12). Point A represents the decision to 'remove now', and B represents pooled responses to 'remove now' and 'uncertain'. The area beneath the ROC curve (A_z) is commonly used as an index of decision quality. The higher the curve is located toward the upper left corner, the better is the performance. The A_z value varies between 0.5 (pure guessing) and 1.0 (perfect).

Statistics

The chi-square test was used to test univariate differences of proportions. Unless stated, differences did not reach significance

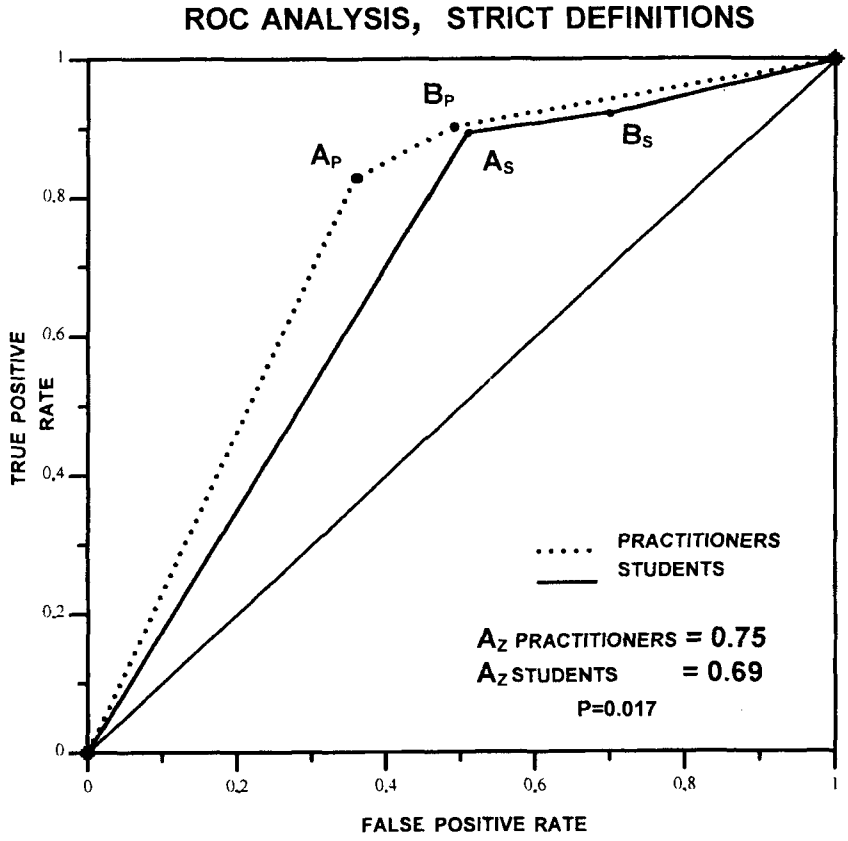

Fig. 12. Receiver operating characteristic (ROC) analysis of general practitioners' (n = 176) and dental students' (n = 49) decisions on removal of 10 third-molar cases, according to strict definition of criteria. Points A represent the decision to 'remove now' and B the pooled responses to 'remove now' and 'uncertain' for practitioners (p) and students (s), respectively. The A_z value represents the area under the ROC curve.

at the 5% level. When significant differences were detected by univariate analysis, multiple classification analysis (9) was used to assess the bivariate (eta) and multivariate (beta) effects of the predictor variables sex, age, region of residence, and type of practice, and the proportion of variance in the dependent variables was explained by all predictors together (multiple R^2). Analysis of the relations to predictor variables of the student respondent group was omitted, owing to the size and composition of the group. The BMDP and SPSS-X release 2+ statistical packages for computer analysis were used for the statistical calculations, respectively. For calculation of A_z of the ROC analysis, the ROC Analyzer (version 6.0, 1992) based on RSCORE II (10) was applied.

Results

Diagnoses

The results of the diagnostic evaluations are presented as a 2 × 2 decision matrix for each of the four diagnoses dentigerous cyst, pericoronitis, partial eruption, and retention. The overall distribution of the diagnoses is shown in Table 6.

Table 1 shows the 2 × 2 decision matrix for the diagnosis dentigerous cyst, in which the students indicated a significantly higher rate of true positives and lower rate of false negatives than the GPs.

However, on the diagnosis pericoronitis (Table 2), the GPs indicated a significantly lower rate of false positives, and a higher score of true negatives. The students indicated an increased rate of pericoronitis in cases 1, 2, and 9, all with a slightly widened follicular space.

No significant differences between GPs and students could be detected for the diagnosis partial eruption (Table 3). Both groups indicated a high score of false negatives and a corresponding underscore of true positives. The results for the diagnosis retention is shown in Table 4, again without significant group differences. An increased rate of false-positive responses was noted for both groups, of a magnitude corresponding to the false-negative rate on the diagnosis of partial eruption, and with a corresponding underscore of true negatives.

The occurrence of simultaneously indicated contradictory diagnoses is presented in Table 5. The students indicated a significantly ($p < 0.01$) higher score for the

Table 1. 2 × 2 decision matrix for the diagnosis dentigerous cyst by general practitioners (GP) ($n = 176$) and 5th-year dental students ($n = 49$). One case of 10 (10%) displayed the true diagnosis of dentigerous cyst

Indicated diagnosis	True diagnosis, %	
	Yes	No
Yes	GP 7	GP 1
	Students 9	Students 1
No	GP 3	GP 89
	Students 1	Students 89

$p < 0.05$.

Table 2. 2 × 2 decision matrix for the diagnosis pericoronitis from general practitioners (GP) ($n = 176$) and 5th-year dental students ($n = 49$). One case of 10 (10%) displayed the true diagnosis of pericoronitis

Indicated diagnosis	True diagnosis, %	
	Yes	No
Yes	GP 8	GP 15
	Students 9	Students 26
No	GP 2	GP 75
	Students 1	Students 64

$p < 0.01$.

Table 3. 2 × 2 decision matrix for the diagnosis partial eruption from general practitioners (GP) ($n = 176$) and 5th-year dental students ($n = 49$). Four cases of 10 (40%) displayed the true diagnosis of partial eruption

Indicated diagnosis	True diagnosis, %	
	Yes	No
Yes	GP 16	GP 2
	Students 19	Students 1
No	GP 24	GP 58
	Students 21	Students 59

Table 4. 2 × 2 decision matrix for the diagnosis retention from general practitioners (GP) ($n = 176$) and 5th-year dental students ($n = 49$). Six cases of 10 (60%) displayed the true diagnosis of retention

Indicated diagnosis	True diagnosis, %	
	Yes	No
Yes	GP 53 Students 54	GP 24 Students 20
No	GP 7 Students 6	GP 16 Students 20

combination of retention and pericoronitis. No significant group difference was noted for the combination of partial eruption and retention; this response was also at a lower level.

Treatment decisions

Univariate analysis of the predictor variables sex, age, location, and type of practice of the GPs in relation to treatment decisions shows that in case 2, female respondents expressed more uncertainty ($p < 0.05$) and that GPs more than 54 years of age were more restrictive with regard to removal. The expressed uncertainty also increased with increasing age of the GP respondents ($p < 0.05$). In case 9, private practitioners indicated an increased rate of positive removal decisions, whereas dentists employed in the public dental health service were more restrictive and more uncertain ($p < 0.01$). In all other cases no significant univariate differences could be detected. Multiple classification analysis of treatment decisions in case 2, 3, and 9 showed multiple R^2 of 0.097 ($p < 0.05$), 0.019, and 0.110 ($p < 0.05$), respectively. The calculated etas and betas were noncontributory.

ROC curves for both sets of definitions and groups of respondents are shown in Figs. 11 and 12. When the liberal definitions were used, no difference in area under the two curves was noted (Fig. 11). When the restrictive definitions were used, as shown in Fig. 12, a significantly ($p = 0.017$) increased area under the ROC curve for the GPs compared with the students was detected. With both sets of definitions, the students were operating more on the upper right part of the curves compared with the GPs.

Referral decisions

Decisions on referral for each case and both groups of respondents are shown in Table 6. The students indicated a higher overall rate of referrals than the GPs. In all cases except 1 and 4, the students were more in favor of referral. The dentigerous cyst in case 3 was indicated as being in greatest need of referral by both groups. No significant univariate differences were demonstrated with regard to the predictor variables.

The GPs were asked to indicate a principal reason for a possible referral decision. The response is summarized in Table 7, which shows that anticipated technical difficulties were the most frequently used argument for referral. Univariate analysis showed that respondents from eastern Norway indicated significantly ($p < 0.05$) 'better access to specialist service' in case 1, and respondents

Table 5. Occurrence of indicated simultaneous contradictory diagnoses on the same case by general practitioners (GP) and 5th-year dental students

Combination of diagnosis	% of all diagnoses		
	GPs ($n = 176$)	Students ($n = 49$)	p
Pericoronitis and retention	8	23	<0.01
Partial eruption and retention	4	3	NS*

* Not significant.

Table 6. Percentage indicated positive decision to refer 10 third-molar cases for treatment by oral surgeon, from general practitioners (GP) and 5th-year dental students

Case	Diagnoses	% GP ($n = 176$)	% Students ($n = 49$)	p
1	Partial eruption	47	33	NS*
2	Retention	65	88	<0.01
3	Dentigerous cyst	94	98	NS
4	Partial eruption/pericoronitis	19	12	NS
5	Retention	69	74	NS
6	Retention	72	90	<0.01
7	Partial eruption	77	88	NS
8	Retention	61	78	<0.05
9	Retention	65	86	<0.01
10	Partial eruption	61	69	NS
Mean		63	71	

* Not significant.

from northern Norway indicated 'technically difficult procedure' significantly ($p < 0.01$) less frequently in case 9. In case 2 and 9, GPs less than 45 years of age indicated more frequently 'technically difficult procedure', and GPs aged 45–55 years indicated more frequently the 'service to patient' alternative. Otherwise, no significant differences with regard to the predictor variables was noted.

Discussion

The results are derived from a questionnaire containing a total of 45 questions, of which 40 are used in this paper. Increased interest created by the accompanying copies of radiographs may explain the high response rates compared with previous studies on the same subject (2, 8, 11). The response rates of 88% and 83%, in conjunction with the comparable distribution of the demographic variables of the respondents and populations, indicate that the response from both groups is valid.

Table 7. Indicated reasons for referral of 10 third-molar cases for treatment by oral surgeon from general practitioners ($n = 170$)

Reason for referral	%
Technically difficult procedure	66
Inadequate surgical experience in general	14
Easy access to specialist service	12
Inadequate surgical equipment available	2
Service to patient	2
Other	4

Diagnoses

The 2 × 2 decision matrix is considered an adequate presentation of dichotomous decisions (10, 12). The applied definitions are derived from current textbooks (1, 13).

The responses to the dentigerous cyst problem were close to ideal for both groups, which would be 10% true positives and 90% true negatives. The students, however, performed significantly better than the GPs, as seen from their low false-positive response rate. The diagnostic performance was reversed and generally impaired when considering the pericoronitis problem, as can be seen from the increased false-positive responses, especially from the student group. The explanation is probably that the slightly widened follicular spaces in cases 1, 2, and 9 were interpreted as pericoronitis. This was confirmed by the students indicating an increased number of pericoronitis when simultaneously indicating retention, as

shown in Table 5. This is contradictory to common criteria for pericoronitis (13, 14), in which the follicular space should be in communication with the oral cavity to allow a diagnosis of pericoronitis. The width of the follicular space was in all of these cases less than 2.5 mm, which has been suggested as a downward limit to cystic abnormality (15).

The diagnoses of partial eruption and retention should be considered jointly, as the false-negative indications for partial eruption equaled approximately the false-positive indications for retention. This, together with the simultaneous use of both diagnoses on the same cases by both GPs and students (Table 5), suggests that the use of the terms differs from that of several textbooks (1, 13, 14, 16). It appears that the term *retention* to some extent was used as synonymous with *impaction*, the latter meaning a tooth with its normal path of eruption blocked, regardless of the state of eruption (17). As the state of eruption is an important criterion for recommending removal of a third molar (3, 4, 6), those who study third-molar treatment decisions should be aware of this terminology problem.

Treatment decisions

Analysis by means of the 2×2 decision matrix is strictly dependent on the cut-off value applied by the observers. This problem is resolved by use of ROC analysis, which is normally used to evaluate a diagnostic test by means of a curve that is equivalent to a series of 2×2 matrixes with changing cut-off values. The ROC analysis has become widely used in decision-making theory in several fields, such as caries treatment (18, 19), cephalometric evaluation (20), evaluation of performance of observers and imaging systems in radiology (21), and in epidemiology (22). The ROC curve is a plot of the true positive rate versus the false positive rate, or hits versus false alarms. Strict cut-off points will result in values on the lower left part of the curve, whereas relaxed or liberal cut-off points will appear on the upper right part.

The ROC analysis was used to evaluate the strategy of the two groups of respondents on decisions on third-molar removal. As a uniform standard for indications for third-molar removal does not exist, we chose to construct two sets of definitions, based on formerly used radical indications (1, 5, 16) and on a more current conservative approach (4, 6). The ROC analyses were then performed independently for each set of definitions, to evaluate both respondent groups' decision strategies accordingly.

When the liberal definitions were used, the ROC curves for GPs and students showed no differences in overall decision performance. The GPs operated more on the lower left part of the curve, indicating the use of stricter cut-off points than the students.

When the strict definitions were applied, the GPs performed significantly better overall than the students; they made better decisions on the basis of the defined criteria. Again, the students operated more on the upper right part of the curve, indicating that their strategy was to remove more teeth than the GPs, thereby slightly increasing the rate of correct decisions, but at the expense of a marked increase in removal of teeth that should have been left in place.

The students' indication of a more aggressive or radical strategy than the GPs may be related to a teaching situation in which oral surgeons emphasize possible severe consequences of no-treatment decisions. A study by Weiss et al. (11), showed that oral surgeons recommend third-molar removal at a significantly higher rate than orthodontists, periodontists, and GPs.

The differences in treatment decisions strategies between GPs and students are in agreement with a similar study in which the respondents were supplied with only written information of the cases (8). Both studies agree that students are more aggressive or radical when deciding on removal of third molars and that the clinical experience of the GPs seems compatible with the current more conservative approach towards third-molar surgery decisions.

A study by Knutsson et al. (23), using a similar design including evaluation of radiographs, compared oral surgeons with GPs with regard to the decision to extract asymptomatic mandibular third molars. Oral sur-

geons were more radical than the GPs with regard to partially erupted third molars in patients less than 41 years old, while GPs were more radical with regard to teeth completely covered with soft tissue or bone, in patients more than 25 years old. As these results in general seem to disagree, the assumption that dental students reflect the attitudes of their faculty may be false. The lack of clinical experience then remains as the most likely explanation for the radical strategy towards third-molar removal expressed by the students.

Referral decisions

The GPs were more reluctant to refer cases to oral surgeons than students. The difference in clinical experience, both on evaluation of the cases and in performing the surgical procedures, partly explains this difference. In addition, the students may reflect attitudes of a faculty of specialists in oral surgery, which for several reasons may advocate a high rate of referrals. Case 3, with a dentigerous cystic lesion, was by both groups regarded as being in greatest need of referral. This reflects good judgement by both groups, as such cases are at highest risk of postoperative complications (24).

Two of three GPs stated 'technically difficult procedure' as their main reason for referral, indicating a realistic understanding of their own technical skills. For cases 2 and 9, differences in clinical experience within the group of GPs may be reflected in that younger GPs indicated technical difficulties more frequently. 'Easy access to specialist service' and 'service to patient' got overall low ratings. The GPs did not refer simple cases when specialist services were readily available, and vice versa; in northern Norway, where specialist services are relatively less available, reflected by increased patient travel time (3), there was no indication that GPs perform more advanced surgery.

Conclusions

General dental practitioners and 5th-year dental students showed overall good diagnostic performance with regard to third-molar situations. A terminology problem appeared to exist with regard to not discriminating between the terms *retention* and *impaction*.

ROC analysis of treatment decisions of third-molar situations indicated that students were more radical and aggressive, whereas practitioners had adopted a more conservative approach. More selective referrals of advanced third-molar cases to specialists seemed to result from the clinical experience gained by the practitioners.

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