Predictor evaluation of postoperative morbidity after surgical removal of mandibular third molars

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The effect of several pre- and per-operative variables on indicators of postoperative morbidity was assessed in 204 patients after unilateral mandibular third-molar surgery. The variables included gender, age, use of tobacco and alcohol, state of eruption, depth and angulation of the tooth, duration of the operation, pericoronitis, and time of day of surgery. Visual analogue scales were used for patient assessment of pain and swelling and for clinical assessment of swelling. Maximum pain was indicated 6 h postoperatively and maximum swelling the first postoperative evening. The results showed a mean reduction of mouth opening capacity (trismus) of 31% the 1st postoperative day. Mean analgesic consumption was 3.7 tablets, mean number of days of inability to work 1.1, and the rate of postoperative alveolitis 1.9%. The variation of the morbidity indicators was considerable. Multiple classification analyses showed that the predictors explained from 17% (clinically assessed swelling) to 8% (pain 6 h postoperatively) of the variance of these indicators. It is concluded that these commonly used predictors only to a minor extent can explain the wide variation in postoperative morbidity after mandibular third-molar surgery. □ *Impacted teeth; molar, third; oral surgery; post-operative pain*

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Surgical removal of mandibular third molars is normally followed by an inflammatory reaction characterized by pain, swelling, and trismus. Clinical experience and several reports (1–3) indicate a wide variation of these postoperative inflammatory indicators. A relationship between pre- and per-operative variables and inflammatory indicators has been reported, including gender (4, 5), state of eruption (6), presence of pericoronitis (4, 7), duration (1, 2, 7), difficulty of operation (7), and time of the day when surgery is performed (8). However, the remaining variation after considering these factors is believed to be substantial, suggesting that still unknown factors influence the postoperative reaction.

Cigarette-smoking has been shown to affect wound healing (9) and the postoperative course after surgical procedures, including such surgical interventions as periodontal (10) and bone grafting/implant insertion (11). Smoking has also been identified as a risk factor in relation to bone healing (12), localized osteitis after third-molar removal (13, 14), and healing after dental extractions (15). Consumption of alcohol has been associated with reduced posttraumatic edema formation in a rat model (16) and reduced zinc serum levels (17), which is considered an important factor of normal wound healing. Reports on the interrelationship between cigarette smoking, alcohol consumption, and indicators of postoperative morbidity after oral surgery have not been found.

In clinical work it would be useful to predict when to expect an increased postoperative reaction and to initiate prophylactic measures, and in research, better control of factors affecting morbidity indicators would be of value. This study was performed to assess combined and relative predictive values of several pre- and per-operative variables on the postoperative

Table 1. Preoperative characteristics of 204 patients undergoing mandibular third-molar surgery

	n	%
Sex		
Females	102	50
Males	102	50
Age, years: mean (range)	25.1 (17–47)	
Use of tobacco		
None	124	61
1–9 cigarettes/day	38	18
10–19 c/day	30	15
20 or more c/day	12	6
Use of alcohol		
Never	49	24
Once a month	48	24
Once a week	64	31
Once every 2nd day	43	21
Side		
Left	104	51
Right	100	49
Depth		
Superficial*	100	49
Deep	104	51
Angle		
Distal (< −5°)	40	20
Vertical (−5° to 29°)	78	38
Mesial (30° to 74°)	68	33
Horizontal (>74°)	18	9
Pericoronitis		
Present	28	14
Absent	176	86

* More than one-third of the crown above the level of the cementoenamel junction of second molar.

morbidity after surgical removal of impacted mandibular third molars.

Materials and Methods

Patients

A total of 204 consecutive patients, in general good health without any present regular medications, except 28 females taking oral contraceptives and 8 patients taking nonsteroid antiallergic/antiasthmatic medication volunteered to enter this study. All patients were in need of surgical removal of a single retained or partially erupted mandibular third molar. Preoperative characteristics of the 204 patients are shown in Table 1. Pericoronitis was registered if visible pus, marked local redness, tenderness, or swelling was present. The distribution of the principal indications for removal is shown in Table 2.

Surgical procedure

All patients received standardized preoperative information. A 1-min preoperative mouthrinse with 2% chlorhexidine gluconate (Hibitane®, ICI) was performed by all patients. No pre- or post-operative antibiotics were used. After induction of local anesthesia, using lignocaine hydrochloride with adrenaline (Xylocain®, Astra) (20 mg/ml + 12 μg/ml), a buccal mucoperiosteal flap was mobilized via a standard envelope incision. Burs were used for bone removal and tooth sectioning with liberal saline irrigation. Bone removal was performed in 194 (95%), and sectioning of the tooth in 131 (64%) patients. A gauze drain impregnated with chlortetracycline (Aureomycin®, Lederle) ointment was inserted into the wound, which was subsequently closed with polyglactin (Vicryl®, Ethicon) sutures. All patients were operated on by the same oral surgeon, with a mean operating time from the time of incision to the completion of the last suture of 9.8 min (SD, 4.0; range, 3–34 min). Fifty-eight (28%) patients were operated on between 1300 h and 1500 h, and 146 (72%) between 0830 h and 1100 h. All patients were given five tablets of a standard analgesic preparation containing 500 mg paracetamol and 30 mg codeine (Pinex Forte®, AL), with written instructions to take one tablet within the 1st h, then one tablet every 3rd h as needed for pain. Patients were also given identical written postoperative instructions concerning food intake, possible bleeding problems, and information on anticipated pain and swelling. The patients were specifically instructed to return if symptoms indicating late complications should occur.

Registrations

The 1st postoperative day, after removal of the gauze drain, swelling was clinically assessed by an independent oral surgeon and recorded on a visual analogue scale (VAS). A clinical evaluation of possible postop-

Table 2. Principal indication for removal of 204 mandibular third molars

	n	%
Partially erupted	88	43
Previous or present infection	51	25
Orthodontic considerations	26	13
Present pain	23	11
Caries	14	7
Resorption, cystic lesion	2	1

erative complications was made on the 7th postoperative day. Postoperative alveolitis was recorded if the patient indicated increasing pain after an intermediate period of no or low-intensity pain. Patients were further asked for any sensory disturbances in the lower lip or tongue. Clinical tests for sensory functions were performed in case of a positive response. Postoperative infection was recorded in the presence of increased local swelling, tenderness, or visible pus after 4 days or more. Reduction of maximal interincisal distance (trismus) was calculated as relative to the preoperative opening capcity, and recordings were made on the 1st and 7th postoperative day. Vertical overjet was not included in the calculations.

A one-sheet self-registration form was given to each patient with verbal and written instructions to fill in VAS scores for pain and swelling and to answer other questions at specified times. All VAS's were arranged as 50-mm vertical lines ranging from 0 (no pain/swelling) to 10 (pain/swelling cannot be worse) (top). The patients had access to previous scores when making the registrations.

Statistics

The product moment correlation coefficient was applied to correlate continuous variables. Multiple classification analysis (18) was used to evaluate the bi- (eta) and multi- (beta) variate effects of predictor variables in addition to the proportion of the variance of the dependent variable explained by the predictors simultaneously (multiple R^2). The rank orders of the betas indicate the relative importance of the predictors in explaining the variance in the dependent variable when all other predictors are held constant. The predictors investigated were age, gender, use of oral contraceptives, use of tobacco and alcohol, clinical eruption status of the third molar, its sagittal angulation, presence of pericoronitis, duration of operation, and time of day the surgery was performed.

Results

The overall ratings of pain and swelling recorded during the 1st postoperative week are presented in Fig. 1. A phase difference in maximum pain and swelling of approximately 28 h can be seen in Fig. 1. Clinically assessed swelling the first postoperative morning was 5.1 mm lower than the patient-assessed swelling. Reduction in interincisal distance (trismus) the 1st and 7th postoperative day is shown in Table 3. The mean reported consumption of the prescribed analgesics on the day of operation was 3.7 tablets (SD, 1.4; range, 0–8). The mean daily consumption of analgesics dropped considerably the following days (Fig. 2). The mean number of indicated days of inability to work, including the day of surgery, was 1.1 (SD, 1.2). The distribution is shown in Fig. 3.

Bivariate correlations between each of the predictors age and duration of operation and the morbidity indicators were weak, reaching a maximum of 0.30 ($p < 0.01$) with duration of operation against clinically assessed swelling. The consumption of analgesics explained 5% of the variation in number of days of inability to work. Further, total pain (sum of all pain scores) explained 17%, whereas total swelling (sum of all swelling scores) and trismus each explained 6% of the variation in number of days of inability to work. Consumption of analgesics explained the variation of pain and swelling to a very small extent (0–2%). The use of oral contraceptives showed no correlation with any of the indicators investigated.

Multiple classification analyses of the predictor variables' joint influence on the morbidity indicators showed an explanation rate

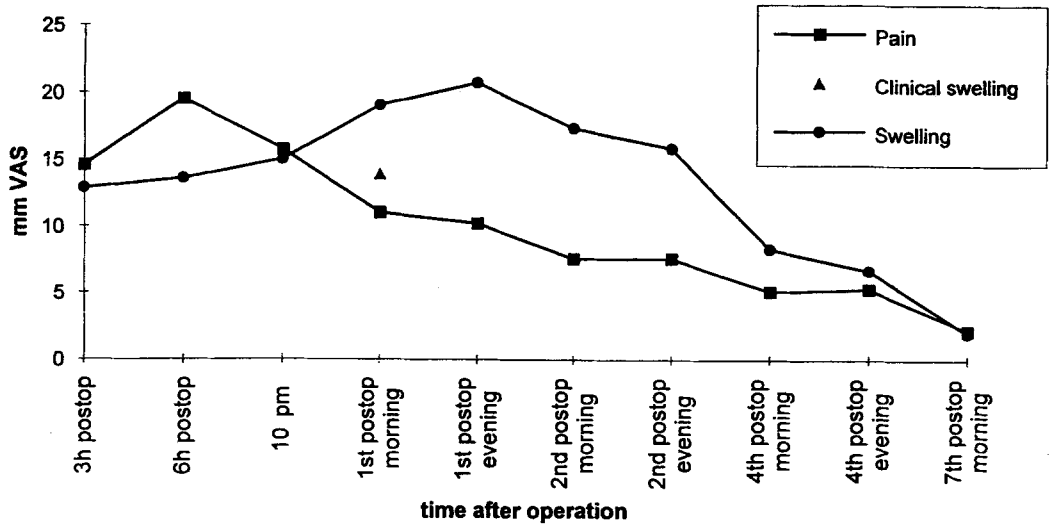

Fig. 1. Postoperative pain and swelling as a function of time in 204 patients after surgical removal of a mandibular third molar. Pain and swelling scores derived from a 50-mm visual analogue scale (VAS).

Table 3. Reduction in interincisal distance (trismus) in 204 patients after mandibular third-molar surgery

	Reduction (%)		
	Mean	SD*	Range
First postoperative day	31	18	−6 to 92
Seventh postoperative day	9	16	−15 to 69

* SD = standard deviation.

of between 17 (clinically assessed swelling, the 1st postoperative day) and 8 (pain, at 6 h postoperatively) of the variation of the morbidity indicators. An example of the analysis is given in Table 4. Deviation of observed values from the grand mean indicates the direction of influence of the predictor.

Multiple classification analysis, based on adjusted means, indicated an increased swelling the 1st postoperative day by both clinical (Table 4) and subjective assessments in females with a deep, horizontal third molar, with a duration of operation of 14 min or more. The predictors explained 11% and 17% of the variation, respectively. A tendency to increased pain at 6 h postoperatively was associated with vertically, deeply located teeth in female patients more than 31 years of age. Increased trismus the 1st postoperative day was found in females with a deep, horizontal third molar and a duration of operation of 14 min or more, and an increased number of days of inability to work was reported by female heavy smokers with a duration of operation of 14 min or more.

Postoperative complications

One patient presented with a purulent infection 10 weeks postoperatively. Four patients (1.9%) met the criteria of postoperative alveolitis. Two patients presented with minor sensory disturbances of the lingual and the inferior alveolar nerves, respectively. Both resolved completely within 4 months.

Discussion

The VAS has long been established as a valuable tool in assessment of pain (19). It has also been found to be an accurate and

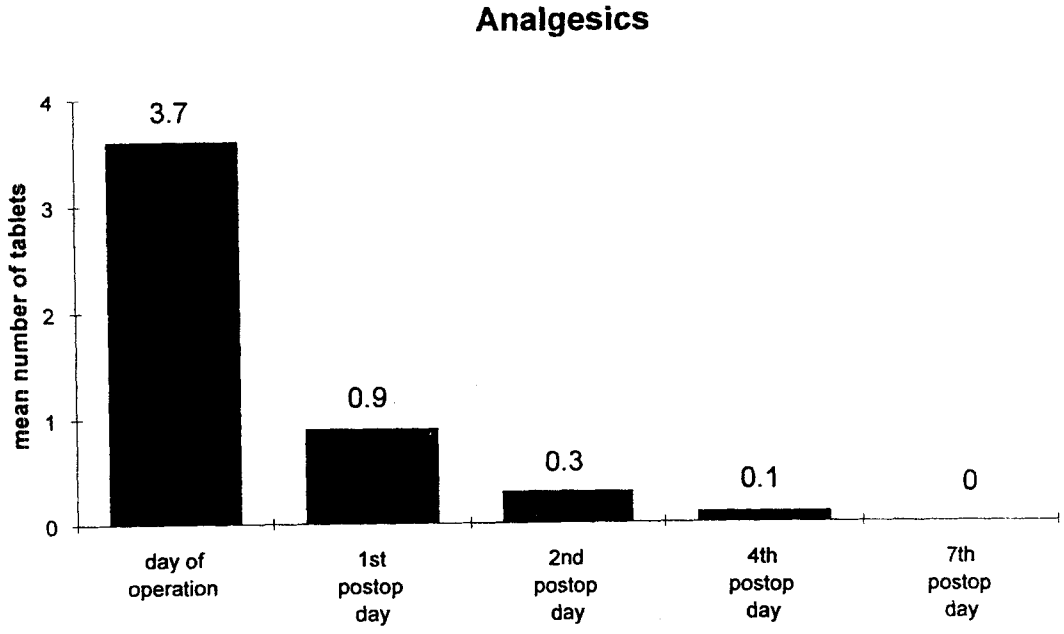

Fig. 2. Mean consumption of analgesics (Pinex Forte®, AL) the 1st postoperative week in 204 patients after surgical removal of a mandibular third molar.

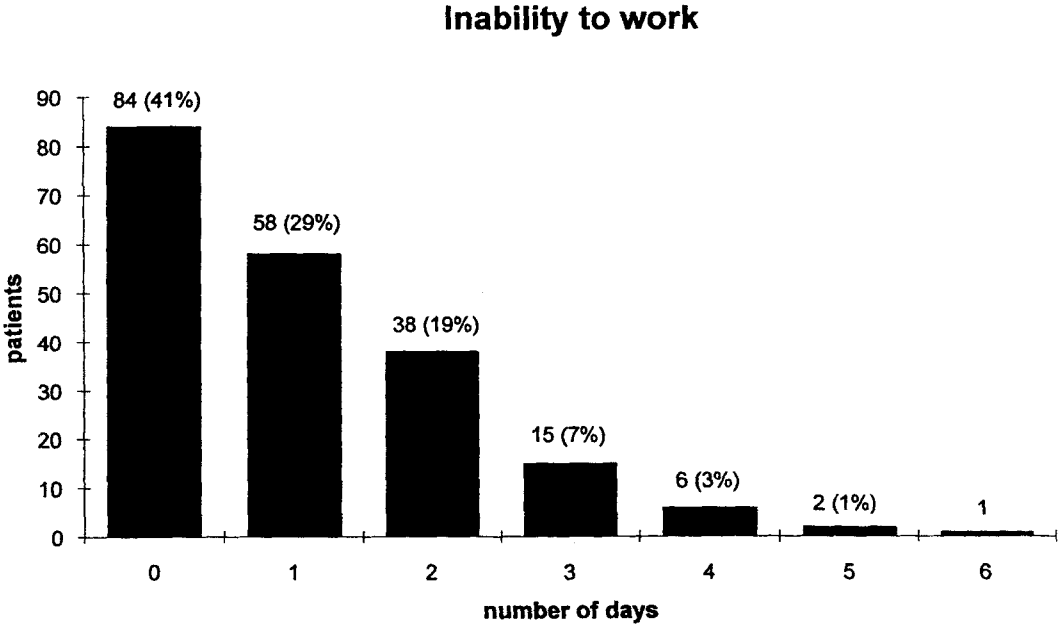

Fig. 3. Distribution of indicated days of inability to work in 204 patients after surgical removal of a mandibular third molar.

Table 4. Multiple classification analysis of the influence of the principal predictors on clinically assessed swelling the first postoperative morning after surgical removal of mandibular third molars (mm/50-mm visual analogue scale (Grand mean = 13.9 (n = 204))

		Unadjusted		Adjusted
Predictor	n	Deviation from grand mean	Eta	Beta
Duration (min)				
3–6	40	−2.0		
7–9	66	−2.2		
10–13	72	0.3		
14–34	26	7.7	0.34	0.33
Sex				
Female	102	1.0		
Male	102	−1.0	0.11	0.15
Depth				
Superficial	100	−2.0		
Deep	104	1.9	0.22	0.14
Angle				
Distal	40	−2.1		
Vertical	78	−0.4		
Mesial	68	0.7		
Horizontal	18	4.1	0.18	0.11

Multiple $R^2 = 0.171$; $p = 0.0001$.

sensitive aid in patient assessment of postoperative swelling (20–22) and of observer-assessed postoperative swelling after surgical removal of mandibular third molars (23). The reliability and validity of self-reported frequency of consumption of alcohol in a nonalcoholic population have been found to be satisfactory (24). Frequency of alcohol consumption was therefore chosen as an indicator of drinking behavior of the patients.

The peak in indicated pain 6 h postoperatively compares well with earlier reports (4, 5) and is of clinical significance, as treatment can be initiated before the patient suffers. The pattern of postoperative swelling is characterized by a relatively moderate onset the day of operation, reaching its maximum the 1st postoperative evening and remaining at a high level until the 4th day. This pattern is in general agreement with earlier reports (1, 7, 25). The lack of correlation between consumption of analgesics and postoperative swelling indicates insignificant clinical antiinflammatory effect of the paracetamol component when the consumption of analgesics is self-administered.

The number of sick-leave days has, along with other variables, been used as a measurement of postoperative morbidity after surgical removal of lower third molars (21, 26, 27). The term "inability to work" was preferred here, to include patients not regularly employed (22). The indicated number of days of inability to work is comparable with that reported by Henrikson et al. (21) but lower than those reported by Van Gool et al. (1) and Happonen et al. (27). This difference may partly be related to current shifts in indications for third-molar removal towards simpler cases. The present results confirm that pain is predominantly responsible for the inability to work, as suggested by Happonen et al. (27) and indicate that better postoperative pain control may reduce the use of sick leave.

The total rate of complications in this study was 3%. In spite of the use of liberal criteria, only 1.9% of the patients developed

postoperative alveolitis. This rate is lower than in earlier reports (1, 13, 14, 28, 29). Analysis of possible risk factors will require a larger patient sample.

Both positive (2, 3, 7) and lack of (4, 5) correlations of duration of operation with postoperative pain have been reported. The duration of operation was in this study found to explain 9% of the variation of clinically assessed swelling the 1st postoperative day, and less than 1% of the variation of total pain and pain at 6 h postoperatively. The analyses further indicate that depth, angle, and duration of operation can to a limited extent predict the postoperative morbidity. Apart from a possible negative prognostic effect of heavy smoking (20 cigarettes or more per day) on days of inability to work, the nonproportional dose-response relationship in general with regard to alcohol and tobacco consumption on the morbidity indicators suggests that the fluctuations found in this study are accidental and do not support any hypotheses of causal relations. The multiple classification analyses show that the influence of the predictors, both individually and simultaneously, are small. Several of the predictors were markedly interrelated, indicating that the results of earlier reports using bivariate analyses could have been influenced by the composition of the patient material.

The present results suggest that still unknown, probably intrinsic factors strongly influence the postoperative reaction after third-molar surgery. The interpretation of both single-sided and bilateral cross-over studies might be affected, as the distribution of these factors is unknown or may vary with time. The present conclusions thus warrant increased attention to the patient-selection procedures in future studies. In clinical work it is not possible from present knowledge to accurately predict which patients will experience an increased postoperative reaction and to determine who would benefit from selective prophylactic measures, such as steroid medication. The presented patterns of postoperative pain and swelling will, however, be useful for the purpose of preoperative patient information.

It is concluded that the variation in pain, swelling, trismus, and days of inability to work after mandibular third-molar surgery is considerable. Commonly used predictors, including the use of tobacco and alcohol, simultaneously explain only 8% to 17% of this variation.

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