

Severe Third Molar Complications Including Death—Lessons from 100 Cases Requiring Hospitalization

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Purpose: In this study we investigated patients that were hospitalized due to third molar (M3) complications. Specifically we analyzed frequency, age distribution, and outcome with respect to the M3 clinical status.

Patients and Methods: We set up a prospective cohort study and included 100 subjects admitted for management of acute M3-associated complications. The clinical status of the M3 was defined as 1) prophylactic M3 removal, 2) therapeutic (nonelective) M3 removal, or 3) M3 present at the time of admission. Outcome variables were clinical infection markers (C-reactive protein, leukocyte counts) and economic parameters (treatment costs, length of hospital stay, and days of disability). Nonparametric tests were used for comparison of subpopulations (surgical vs nonsurgical, prophylaxis-related vs nonprophylaxis-related).

Results: One third of the 100 patients were age 40 or older. Overall 80 severe infections, 11 mandibular fractures, 3 nerve injuries, 5 tooth/root luxations, and 1 postoperative hemorrhage were noticed. Twenty-seven complications resulted from prophylactic surgery, 44 from nonelective removal, and 29 from pericoronitis. Postoperatively, a 77-year-old male patient hospitalized with nonelective removal sustained fatal myocardial infarction. Treatment costs were 260,086 € (mean 2,608 €/case); total days of disability were 1,534. The postsurgical complications showed higher C-reactive protein values compared with pericoronitis-induced complications.

Conclusions: Within the catchment area of our institution, the majority of complications requiring hospitalization resulted from diseased third molars or their removal. Side effects of observational strategies such as the shifting of complications to higher ages deserve future attention.

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Apart from permanent nerve damage, hospitalization due to complications is one of the most critical events in dentoalveolar surgery. However, while third molar (M3)-associated nerve disturbance is extensively documented in the literature¹⁻⁷ and even aspects of moderate relevance like temporary quality of life impairment and swelling are well-investigated,⁸⁻¹⁰ the issue

of severe complications requiring hospitalization has received only little attention. By and large, the respective communications appeared in the form of case reports presenting spectacular and critical events like life-threatening hemorrhage,¹¹ Ludwig's angina with thorax involvement,¹² or even subdural empyema¹³ owing to M3s or their removal.

The few systematic approaches as performed by Yoshii and coworkers, Flynn and coworkers, and especially by Trond Inge Berge are either confined to deep space infections alone,¹⁴ are not restricted to M3 complications,^{15,16} or deal with a very small number of cases due to the limited catchment area of the respective institution.^{17,18} Although at least theoretically population based, as the data were derived from a geographically rather isolated population in Norway, the analyses of Berge solely targeted the issue whether admittance to hospital occurred after osteotomy or due to pericoronitis. The second relevant predictor variable of M3 complications which is the

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Table 1. COMPLICATIONS AND DIAGNOSES

	Type of Complication	International Classification of Diseases Code	Frequency	Age, Mean (Range)	Direct Treatment Costs, Mean (Range) €	Days of Disability, Mean (Range)
Complication of retention	Severe infections	J39.0; K12.21; K12.28; K12.22; K12.23; K09.0; K05.2	29	42 (16-86)	2,346 (1,731-4,944) €	14 (2-30)
Complications of surgery	Severe infections	J36; J39.0; L03.8; K10.21; K12.21; K12.23; K12.28	51	33 (14-80)	2,309 (1,394-7,408) €	19 (4-35)
	Fracture of the mandible	S02.6	11	46 (20-74)	4,440 (1,259-7,775)	19 (9-42)
	Luxation of teeth, fragments or instruments to soft tissues or maxillary sinus	T81.9; S03.2; K08.3	5	23 (15-39)	2,826 (1,876-3,823) €	6 (3-11)
	Lingual nerve transection	S04.3	3	31 (27-38)	2,849 (2,747-2,900) €	9 (4-14)
	Postoperative hemorrhage	T81.0	1	38	2,705 €	11
All			100	36.3 (14-86)	2,608 (1,259-7,775) €	16.3 (2-42) days Total: 1,534 days

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status of the M3 prior to removal (diseased vs nondiseased) was not analyzed in the Bergen scenario, rendering the conclusion, “disapproval of prophylactic third molar removal,” somewhat speculative. Nevertheless, regarding an 80% prevalence of retained M3 in the adult population in developed countries¹⁹ and the impact of hospitalization on conduct of life and on treatment costs, severe complications and their respective management and costs remain a key focus of interest when the appropriateness of treatment and especially of prophylactic M3 removal is considered.

To this end we set out to investigate demographic and clinical parameters of patients that were hospitalized due to complications attributable to M3. Specifically, we initiated a prospective observational study to assess the disease burden according to the status of M3 especially with respect to prophylactic M3 removal versus the management of the diseased M3. Based on a 2-year inclusion period²⁰ we had recognized a higher disease burden due to severe complications associated either with symptomatic M3s or their removal when compared with prophylaxis-induced morbidity. In an effort to further substantiate these findings we re-evaluated the study population which now has expanded to a consecutive cohort of 100 patients.

Patients and Methods

STUDY DESIGN AND SAMPLE

In this study, we used a prospective case series design in which all consecutive patients were enrolled who were admitted from general dental practitioners, oral surgeons, and maxillofacial surgeons for management of acute complications associated with

M3. The patients were included in the study due to acute complications requiring urgent hospital treatment according to the German Appropriateness Evaluation Protocol (G-AEP) criteria for patient hospital-

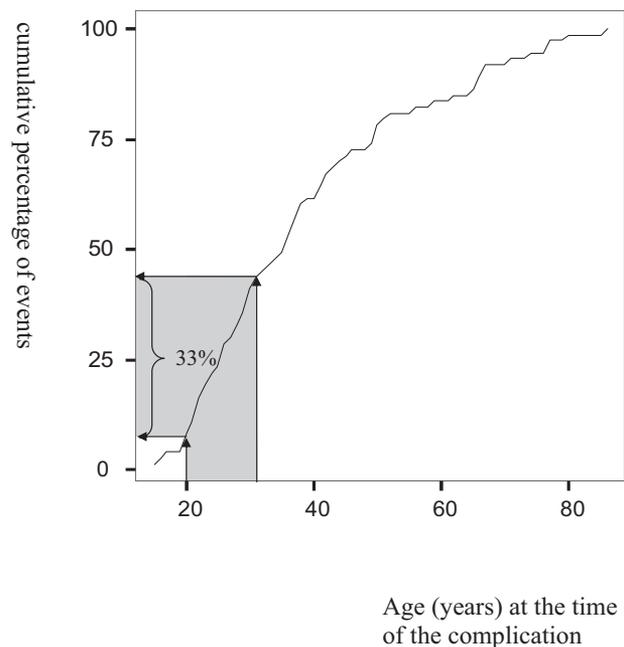


FIGURE 1. Cumulative percentage of patients according to age at the time of hospital admission for 73 complications due to symptomatic third molars or their removal. The curve shows more than 50% of third molar-associated complications were recognized at age 36 or older. The arrows indicate the percentage of complications that would have been recognized within a time frame of 10 years. This may illustrate the coverage of a prospective study design recruiting patients at age 20 years.

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Table 2. CLINICAL VARIABLES OF 100 CONSECUTIVE PATIENTS HOSPITALIZED FOR THIRD MOLAR-ASSOCIATED COMPLICATIONS

Patient	Age	Gender	Reason for Complication	Pathology/ Pericoronitis	Type of Complication	Therapy	Exceptional Events, Comments
1	20	F	Tooth removal	Yes	Fracture	Osteosynthesis	
2	56	M	Tooth removal	Yes	Fracture	Osteosynthesis	
3	62	M	Pericoronitis	No	Submandibular abscess	Extraoral incision	
4	26	F	Tooth removal	Yes	Peritonsillar abscess	Intraoral incision	
5	27	F	Tooth removal	No	Parapharyngeal abscess	Extraoral incision	Tracheostomy, intensive care unit (4 days)
6	66	M	Pericoronitis	Yes	Pterygomandibular abscess	Extraoral incision	
7	22	F	Tooth removal	Yes	Phlegmonous cellulitis	Extraoral incision	Multiple incisions
8	21	M	Pericoronitis	Yes	Pterygomandibular infiltration	Intravenous antibiotics	
9	52	M	Tooth removal	No	Pterygomandibular abscess	Extraoral incision	Intensive care unit (6 days)
10	20	M	Tooth removal	Yes	Submandibular abscess	Extraoral incision	Intensive care unit (2 days)
11	36	M	Tooth removal	Yes	Parapharyngeal abscess	Extraoral incision	Secondary spread and cervical incision
12	41	M	Pericoronitis	No	Retromaxillary abscess	Extraoral incision	
13	26	F	Tooth removal	Yes	Submandibular abscess	Extraoral incision	
14	22	M	Tooth removal	Yes	Perimandibular abscess	Extraoral incision	
15	32	F	Pericoronitis	No	Pterygomandibular infiltration	Intravenous antibiotics	Pregnancy
16	40	M	Tooth removal	No	Pterygomandibular abscess	Extraoral incision	
17	30	M	Pericoronitis	No	Pterygomandibular abscess	Extraoral incision	
18	18	F	Tooth removal	No	Paramandibular abscess	Intraoral incision	
19	28	F	Tooth removal	No	Transsection of lingual nerve	Coaptation of lingual nerve	
20	42	F	Tooth removal	Yes	Retromaxillary abscess	Extraoral incision	
21	28	F	Tooth removal	No	Cheek abscess	Intraoral incision	
22	17	M	Tooth removal	No	Retromaxillary abscess	Intraoral incision	Empyema of the maxillary sinus requiring revision
23	22	M	Tooth removal	No	Cheek abscess	Intraoral incision	Empyema of the maxillary sinus requiring revision
24	35	M	Pericoronitis	Yes	Submandibular abscess	Extraoral incision	
25	33	F	Tooth removal	No	Perimandibular abscess	Extraoral incision	
26	22	F	Tooth removal	Yes	Parapharyngeal abscess	Extraoral incision	
27	38	F	Tooth removal	Yes	Transsection of lingual nerve	Coaptation of lingual nerve	
28	86	F	Pericoronitis	No	Submandibular abscess	Extraoral incision	
29	16	M	Tooth removal	No	Parapharyngeal luxation of left maxillary third molar	Revision	
30	24	M	Tooth removal	Yes	Paramandibular abscess	Intraoral incision	
31	32	F	Tooth removal	Yes	Cheek abscess	Intraoral incision	
32	37	F	Tooth removal	Yes	Pterygomandibular abscess	Extraoral incision	
33	25	M	Pericoronitis	Yes	Submandibular abscess	Extraoral incision	
34	28	F	Tooth removal	Yes	Paramandibular abscess	Intraoral incision	
35	22	M	Tooth removal	Yes	Retromaxillary infiltration	Intraoral incision	
36	65	M	Tooth removal	Yes	Fracture	Osteosynthesis	Follicular cyst of right lower third molar
37	50	M	Pericoronitis	No	Submandibular infiltration	Intravenous antibiotics	
38	14	M	Tooth removal	No	Paramandibular abscess	Intraoral incision	
39	23	M	Tooth removal	Yes	Phlemonous cellulitis	Extraoral incision	Secondary tracheostomy, intensive care unit (5 days)
40	20	F	Tooth removal	No	Parapharyngeal abscess	Extraoral incision	
41	26	F	Tooth removal	No	Perimandibular abscess	Extraoral incision	
42	35	M	Tooth removal	No	Pterygomandibular abscess	Extraoral incision	
43	36	F	Pericoronitis	No	Paramandibular infiltration	Intraoral incision	Leucopenia due to administration of antibiotics
44	66	F	Tooth removal	Yes	Pterygomandibular abscess	Extraoral incision	
45	21	F	Pericoronitis	No	Perimandibular abscess	Extraoral incision	Follicular ameloblastoma in a dentigerous cyst
46	24	F	Tooth removal	Yes	Retromaxillary abscess	Intraoral incision	Secondary extraoral incision
47	49	M	Tooth removal	Yes	Fracture	Osteosynthesis	
48	50	M	Tooth removal	Yes	Fracture	Revision, IMF	
49	43	M	Tooth removal	No	Fracture	Revision, IMF	
50	51	F	Tooth removal	Yes	Submandibular abscess	Extraoral incision	
51	31	F	Pericoronitis	No	Parapharyngeal infiltration	Extraoral incision	
52	15	F	Tooth removal	No	Retromaxillary abscess	Intraoral incision	
53	50	F	Pericoronitis	No	Submandibular abscess	Extraoral incision	
54	59	M	Tooth removal	Yes	Cheek abscess	Extraoral incision	
55	45	M	Tooth removal	Yes	Fracture	Osteosynthesis	
56	29	M	Pericoronitis	No	Parapharyngeal abscess	Extraoral incision	
57	77	M	Pericoronitis	Yes	Infected cyst	Cystectomy	
58	16	M	Pericoronitis	No	Parapharyngeal abscess	Extraoral incision	
59	33	F	Pericoronitis	Yes	Parapharyngeal infiltration	Extraoral incision	
60	38	M	Tooth removal	Yes	Postoperative hemorrhage	Revision and hemostasis	
61	32	M	Tooth removal	No	Fracture	Osteosynthesis	
62	27	F	Tooth removal	Yes	Pterygomandibular abscess	Extraoral incision	
63	26	M	Tooth removal	Yes	Perimandibular abscess	Extraoral incision	
64	15	F	Tooth removal	No	Infiltration of the cheek	Intravenous antibiotics	
65	25	M	Tooth removal	No	Pterygomandibular abscess	Extraoral incision	
66	37	M	Pericoronitis	Yes	Cheek abscess	Intraoral incision	
67	26	M	Pericoronitis	No	Submandibular abscess	Extraoral incision	
68	67	F	Pericoronitis	No	Paramandibular abscess	Intraoral incision	
69	43	M	Pericoronitis	No	Retromaxillary infiltration	Intravenous antibiotics	
70	39	M	Tooth removal	No	Root fragment luxation (floor of the mouth)	Revision	

Table 2. CLINICAL VARIABLES OF 100 CONSECUTIVE PATIENTS HOSPITALIZED FOR THIRD MOLAR-ASSOCIATED COMPLICATIONS (CONTINUED)

Patient	Age	Gender	Reason for Complication	Pathology/ Pericoronitis	Type of Complication	Therapy	Exceptional Events, Comments
71	17	M	Tooth removal	Yes	Perimandibular abscess	Extraoral incision	
72	77	M	Pericoronitis	Yes	Infected cyst	Cystectomy	Fracture of the mandible, fatal myocardial infarction
73	39	M	Pericoronitis	No	Retromaxillary abscess	Intraoral incision	Intensive care unit for 4 days
74	71	F	Tooth removal	Yes	Parapharyngeal abscess	Extraoral incision	
75	24	M	Tooth removal	No	Root fragment luxation (floor of the mouth)	Revision	
76	41	M	Pericoronitis	No	Parapharyngeal abscess	Extraoral incision	
77	36	M	Tooth removal	Yes	Fracture	Osteosynthesis	
78	37	M	Tooth removal	Yes	Fracture	Osteosynthesis	
79	19	F	Tooth removal	No	Fractured instrument and remaining root fragment	Revision	
80	30	M	Tooth removal	Yes	Paramandibular infiltration	Intraoral incision	
81	15	F	Tooth removal	No	Third molar-luxation to maxillary sinus	Sinuscopy and removal	
82	52	M	Tooth removal	Yes	Parapharyngeal abscess	Extraoral incision	
83	46	F	Tooth removal	Yes	Masseterico-mandibular abscess	Extraoral incision	
84	27	F	Tooth removal	No	Transsection of lingual nerve	Coaptation of lingual nerve	
85	74	M	Tooth removal	Yes	Fracture	Osteosynthesis	
86	23	F	Tooth removal	No	Parapharyngeal infiltration	Intravenous antibiotics	
87	47	F	Tooth removal	No	Perimandibular abscess	Extraoral incision	
88	34	F	Tooth removal	Yes	Submandibular abscess	Extraoral incision	
89	28	F	Pericoronitis	No	Masseterico-mandibular infiltration	Intraoral incision	
90	42	M	Tooth removal	No	Cheek abscess	Intraoral incision	
91	35	F	Tooth removal	No	Perimandibular abscess	Extraoral incision	
92	66	F	Pericoronitis	Yes	Submandibular abscess	Extraoral incision	
93	31	F	Tooth removal	Yes	Submandibular infiltration	Intravenous antibiotics	
94	44	F	Tooth removal	Yes	Submandibular abscess	Extraoral incision	
95	42	F	Tooth removal	Yes	Paramandibular abscess	Intraoral incision	
96	20	M	Tooth removal	Yes	Perimandibular abscess	Extraoral incision	
97	80	F	Tooth removal	Yes	Perimandibular abscess	Extraoral incision	
98	22	M	Tooth removal	Yes	Parapharyngeal abscess	Extraoral incision	
99	30	F	Tooth removal	Yes	Retromaxillary abscess	Intraoral incision	Readmission due to temporal spread
100	29	F	Pericoronitis	Yes	Parapharyngeal infiltration	Extraoral incision	

Abbreviation: IMF, intermaxillary fixation.

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ization, forwarded by the German Hospital Federation together with the Head Association of Health Insurance Funds in Germany.²¹ Patients with long-term pathologic conditions such as chronic sinus disease (n = 1), osteomyelitis (n = 2), or dentigerous cysts (n = 6) and tumors (n = 1), even though caused by M3, were excluded from the analysis unless an acute M3-associated infection prompted immediate treatment. According to these criteria, the sample consisted of 100 patients admitted consecutively from January 1, 2003, to June 30, 2006. The diagnoses leading to hospitalization are specified in Table 1.

STUDY VARIABLES

The demographic variables recorded were age and gender. To address the status of the M3 at the time of hospitalization, the patients were grouped according to the following definitions: Subjects whose M3 were classified as “prophylactic removal” (group A) had no history of previous M3 pericoronitis or pain, no caries or other pathologic conditions as verified by thorough interviewing or preoperative radiographs. Subjects whose M3 were classified as “therapeutically re-

moved” (group B) had former episodes of pericoronitis, caries, pulpitis, or clinically manifest periodontal affection of the second or third molar. Group C (“M3 present at the time of admission”) consisted of subjects admitted for treatment of acute deep space infections owing to acute pericoronitis.

The clinical and economic outcome variables of the study were as follows: C-reactive protein (CRP) (mg/L) and white blood cell counts (/nL) for quantitative assessment of acute infectious complications, German diagnosis-related groups-based total costs of treatment, duration of hospital stay, and the days of disability from work.

STATISTICAL ANALYSIS

Descriptive data (frequencies, means, ranges) of the study variables are given for the groups A, B, and C. For the variables reflecting the intensity of inflammatory conditions (CRP and white blood cell counts) only the patients with infectious complications were included (n = 80).

For a comparison of groups the nonparametric U test according to Mann and Whitney was used. Surgi-

cally induced complications (group A + B) were compared with the nonsurgical (C) complications. Complications due to prophylactic removal (A) were compared with other complications (B + C). The reported *P* values are 2-sided.

Results

PATIENTS AND DIAGNOSES

The sample of 100 consecutive patients was enrolled within 3 years and 6 months. The patients requiring hospital treatment due to severe M3-associated complications represents 2.3% of the total number of patients hospitalized at our institution during this time interval. The catchment area of our hospital amounts to a population of roughly 2,600,000 which represents about 65% of the inhabitants of the county of "Rheinland Pfalz."

Although there was a preponderance of young adults in this cohort, one third of the patients were age 40 or older. For the 73 cases who did not undergo planned prophylactic removal but sustained pericoronitis or therapeutic M3 removal, Figure 1 describes the cumulative percentage of patients enrolled in this study as a function of age. The plot shows the distribution of complications due to diseased M3 with regard to the age of the patients.

The majority of patients sustained infectious complications which amount to 80% of the sample. The clinical data of all patients are summarized in Table 2. The deep space infections involved the parapharyngeal (ICD: J39.0) or peritonsillar (ICD: J36 or K12.22) space in 14 cases; the submandibular (ICD: K12.21) space in 13 cases; the pterygomandibular (ICD: K12.22) and the perimandibular (ICD: K12.28) space in 10 cases each; the retromaxillary (ICD: K10.21) space in 9 cases; the paramandibular (ICD: K12.28) space in 8 cases, the cheek (ICD: K12.23) in 6 cases; and the massetericomandibular (ICD: K12.28) space in another 5 cases. Two cases of phlegmonous cellulitis (ICD: L03.8) primarily involved multiple deep spaces at the time of hospital admission. The remaining three infectious complications were infections of a dentigerous cyst (ICD: K09.0) in 2 cases, and 1 case of advanced pericoronitis (ICD: K05.2).

STUDY VARIABLES

Prophylactic removal of M3 (group A) had been performed in 27% of the study sample. The majority of the patients in this cohort (73%) had their M3 either removed therapeutically (44%; group B) or were admitted with complications originating from pericoronitis (29%; group C). Of the latter group, 18 out of 29 patients had not experienced previous in-

flammatory episodes or pain. Thus the actual severe infection leading to hospitalization was the initial manifestation of an M3-associated pathology.

The clinical and economic outcome variables according to M3 status are listed in Table 3. Patients with surgical complications (group A + B) showed remarkably higher CRP levels when compared with the nonsurgical complications of group C (146 mg/mL vs 93 mg/mL; *P* = .017, *U* test). However, this probably more severe inflammatory reaction was not equally reflected in the white blood cell counts (13.4 /nL vs 12.8 /nL; *P* = .802, *U* test). Neither quantitative markers of infection nor economic parameters showed significant differences or when complications attributable to prophylactic M3 removal (group A) were compared with complications resulting from therapeutically removed M3 or pericoronitis (group B + C).

In the subset of 80 patients who sustained acute inflammatory complications, mean CRP was 127 mg/L (range: 6-440) and white blood cell counts were 13.2/nL (range: 3.3-37.6). The mean hospital stay was 7.3 days (range: 2 to 28 days) and the mean time of disability from work was 16.3 days (range: 4 to 42 days) amounting to a total of 1,534 days of disability. Direct treatment costs based on diagnosis-related groups rates for hospital treatment were 260,086 € (mean 2,608 €/case; range 1,259 €-7,775 €). Within this subset of patients the days of hospital stay and the direct treatment cost were almost similar for complications of surgery versus complications of retention (mean 8.4 days vs 7.9 days, *P* = .273, *U* test; mean 2,309 € vs 2,346 €, *P* = .344, *U* test). However, disability from work was longer (18.9 days vs 13.7 days) for patients who sustained postoperative infectious complications when compared with those who had infectious complications of retention (*P* = .022, *U* test).

REPORT OF CASE

In a male patient aged 77, removal of a left lower M3 due to an infected pericoronial cyst failed due to insufficient pain control by local anesthesia and poor compliance. Removal of the tooth and the cyst was completed under general anesthesia and, due to a history of 3-vessel coronary artery disease, the patient was hospitalized for postoperative surveillance. On the morning after surgery the patient complained of chest pain and radiation of discomfort to his arms that did not cease after administration of nitroglycerin. Laboratory controls for troponin and creatine-kinase muscle brain were negative at that time. Due to former bypass surgery and a history of re-stenosis, the patient was taken for diagnostic coronary angiography. Coronary revascularization and stent implantation was performed due to subtotal stenosis of the

Table 3. CLINICAL AND ECONOMIC VARIABLES ACCORDING TO THIRD MOLAR STATUS

	C-Reactive Protein*	White Blood Cell Counts*	Days of Hospital Stay	Direct Treatment Cost/Case	Days of Disability
All patients, mean (range)	127 (6-440) mg/L	13.2 (3.3-37.6)/nL	7.3 (2-28)	2,608 (1,259-7,775) €	16.3 (2-42)
Group A: prophylactic third molar removal, mean (range)	144 (12-426) mg/mL	11.8 (7.5-18.6)/nL	6.7 (2-16)	2,650 (1,349-7,775) €	16.3 (3-42)
Group B: therapeutic third molar removal, mean (range)	147 (15-440) mg/mL	14.2 (8.1-37.6)/nL	7.9 (2-28)	2,747 (1,259-7,775) €	18 (6-35)
Group C: third molar present, mean (range)	93 (6-377)	12.8 (3.3-26.9)/nL	7.1 (2-14)	2,347 (1,732-4,945) €	13.7 (2-30)
Comparison: <i>U</i> test group (A+B) versus C (surgical vs nonsurgical)	<i>P</i> = .017	<i>P</i> = .802	<i>P</i> = .969	<i>P</i> = .503	<i>P</i> = .123
Comparison: <i>U</i> test group A versus (B+C) (prophylactic vs others)	<i>P</i> = .215	<i>P</i> = .200	<i>P</i> = .315	<i>P</i> = .935	<i>P</i> = .641

*Noninflammatory complications (fractures, nerve transections, tooth/root luxations, etc) excluded. Significant *P* values appear in bold.

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bypasses. Twelve days after M3 surgery, the patient collapsed during a vertigo attack and sustained a fracture of the mandible at the osteotomy site. Due to the preceding coronary intervention we restrained from an osteosynthesis under general anesthesia and used cortical screws for intermaxillary fixation. Hereafter, healing at the fracture site was uneventful but the patient sustained an acute myocardial infarction due to secondary thrombosis of the stents and died 23 days after M3 removal.

Discussion

It was the lack of adequate data on M3-associated severe complications that prompted our prospective observational study in 2003. Meanwhile, we enrolled 100 cases in this sample which provides the basis to further analyze the clinical and economic variables with respect to the status of M3.

As in our previous report²⁰ and in accordance with the data of Berge^{17,18} we found a 2:1 preponderance of patients hospitalized due to complications arising from M3 removal versus those hospitalized due to pericoronitis. However, based on the data obtained with this enlarged cohort, it again became obvious that the majority of severe M3-associated complications had to be attributed to diseased M3s or their removal and not to prophylactic removal. The larger patient sample also confirmed, that in a relevant pro-

portion of patients hospitalized for deep space infections due to pericoronitis, this infection resulted immediately from the first inflammatory episode. Considering 18 “first events” out of 29 patients admitted with M3 present in this cohort, an observational concept which does not advocate removal of the M3 until it first becomes clinically diseased is apparently not always successful in averting severe complications.

Besides this “immediate onset” pattern of severe complication without alarming symptoms, the age structure seen in our study group deserves attention. Despite a slight preponderance of young adults, M3-associated complications or consecutive therapeutic removal were observed in all age groups ranging from 14 to 86 years. A substantial proportion of severe complications seen in this cohort occurred after a symptomless interval of 4 and more decades. The data presented in Figure 1 suggest that it is highly unlikely to find a threshold value for classifying a third molar as safe according to the age of the patient. Moreover, these data again emphasize that severe complications due to diseased M3 or due to pericoronitis would be substantially underestimated in a 2-arm prospective study design (removal vs observation) unless the complications of a 30- to 40-year follow-up period are included. The hatched area and the arrows in Figure 1 show the proportion of complications that would

have been recognized in our cohort, within a 10-year follow-up period starting at age 20.

In this context, the case of death following M3 removal in a 77-year-old patient, although exceptional, exemplifies the fundamental problem, that treatment delay to avoid perioperative complications at young ages may result in significant shift of morbidity to older ages which per se constitutes a considerable health threat. This again sheds light on the methodological problem of objectively assessing the disease burden associated with M3 complications. There is no comprehensive study design to reliably assess such long-term effects of an observational strategy except for impracticable (life) long follow-up. The high percentage (20%) of patients in our cohort who sustained complication at age 50+ suggests, however, that the proportion of such late effects cannot be neglected.

Moreover, one has to take into account that the age structure encountered in our study reflects a population with a traditionally high proportion of prophylactic M3 removals. In Germany it has been the recommended standard of care to remove M3 in a prophylactic approach during adolescence, in early adulthood, or at least prior to prosthetic treatment²² for many decades. If we assume an observational strategy as the prevailing standard of care, we have to expect an increase in M3-related late complications.

At this stage of the analysis, it is a limitation for the interpretation of this study that epidemiological data on M3 incidence, on surgical treatment, and especially on the relation between prophylactic and therapeutic M3 removal are not available for Germany. However, if we assume the prevalence of diseased M3s in Germany to be comparable to the data of the UK (44.8%) as established in the National Third Molar Project,²³ the data obtained in our study suggest a substantially higher disease burden due to severe complications associated with diseased M3s or their therapeutic removal.

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