

Age as a Risk Factor for Third Molar Surgery Complications

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Purpose: The purpose of this study was to estimate the frequency of complications after third molar (M3) surgery, with age as the primary risk factor.

Patients and Methods: This was a prospective cohort study of a sample of subjects having at least 1 M3 extracted as part of the American Association of Oral and Maxillofacial Surgeons' Age-Related Third Molar Study. The predictor variables were categorized as demographic, health status, anatomic, and pathological. The outcome variable was overall complications, including both intraoperative and post-operative complications. Appropriate univariate and bivariate statistics were computed. A multiple logistic regression model was used to evaluate the simultaneous effects of multiple covariates.

Results: The study sample was comprised of 4,004 subjects having a total of 8,748 M3s removed. The mean age was 39.8 ± 13.6 years, with 245 subjects (6.1%) age 25 and younger. Approximately half of the subjects were female. The overall complication rate was 19%. In bivariate analyses, age above 25 years, gender, American Society of Anesthesiologists classification, number of preoperatively identified risk factors for complication, impaction level of M3, evidence of periodontal disease, preoperative infection, and evidence of any pathology associated with M3 were associated with complications ($P \leq .15$). In the multiple regression model, age above 25 years was associated with an increased risk of complications (odds ratio = 1.5; $P = .05$).

Conclusions: The results of these analyses suggest that increased age (>25 years) appears to be associated with a higher complication rate for M3 extractions.

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Third molar (M3) removal is among the most common surgical procedures performed annually in the United States and represents a significant proportion of the outpatient surgical procedures performed by oral and maxillofacial surgeons (OMFS).^{1,2} As such, numerous studies have been devoted to evaluating all aspects of M3 surgery, including indications for removal,³⁻⁵ ra-

diographic analyses for surgical planning,^{6,9} estimates of difficulty and risk factors for difficulty,¹⁰⁻¹² as well as complications by rate and type.¹³⁻¹⁶ Studies devoted to complications have garnered significant attention, due to the fact that a large volume of cases results in significant numbers of complications, even though the overall incidence remains relatively low.

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In 1995, the American Association of Oral and Maxillofacial Surgeons (AAOMS) convened a special committee charged with assessing outcomes of surgical procedures performed by practicing OMFSS in the United States.¹⁷ Specifically, the committee was instructed to establish a national database for tracking national trends, reporting risk-adjusted outcomes of surgical procedures, and evaluating the effectiveness of current standards of care against other alternatives.

Among the studies conceptualized by the committee was a study devoted to outcomes of M3 surgery and one specifically focused on age as a risk factor for complications of M3 surgery. The AAOMS Age-Related Third Molar Study was designed to collect, in a prospective manner, data pertaining to a cohort of patients undergoing M3 extraction and to evaluate the overall complication rates, with a focus on patients 25 years and older. A previous study explored the outcome of M3 surgery in patients over age 25 and concluded that "third molar surgery in patients 25 years of age or older is associated with minimal morbidity, a low incidence of postoperative complications, and minimal impact on the patients' quality of life."¹⁷ This conclusion indicates that patients age 25 and older can undergo M3 surgery with minimal complications, but does not address whether the complication rates in this population differ significantly from those in younger patients.

The purpose of the present study is to estimate the overall frequency of complications after M3 removal, with a focus on age as the primary risk factor. We hypothesized that age is associated with an increased risk of complications after M3 extraction, all other factors being equal. With regard to this hypothesis, we aimed to 1) estimate the overall frequency of complications after M3 surgery and 2) identify risk factors for M3 complications, with a focus on age as a primary risk factor.

Patients and Methods

STUDY DESIGN/SAMPLE

This was a prospective cohort study, consisting of patients who had at least 1 M3 extracted over a 1-year period from January to December 2001 as part of the AAOMS Age-Related Third Molar Study. All patients who reported for at least 1 postoperative visit were included in the study sample.

STUDY VARIABLES: PREDICTORS

The predictor variables for the study were sets of exposures considered plausibly related to complication rates. These measures were classified as demographic, health status, anatomic, and pathological. Demographic variables included age and gender. Age,

the primary study predictor, was analyzed as a binary measure (age <25 years vs age \geq 25 years) and in deciles (25 years, 26 to 35 years, 36 to 45 years, 46 to 55 years, 56 to 65 years, 66 to 75 years, and >75 years). Health status measures included American Society of Anesthesiologists (ASA) health status (I to V) and the presence or absence of the following chronic medical conditions: chronic heart disease, hypertension, diabetes, immune deficiency, malignancy, organ transplant candidate/recipient, or any other chronic condition necessitating medical treatment. Health risk measures included smoking (cigars, pipes, or cigarettes any time within 2 months of surgery), alcohol consumption (defined as consumption of 5 or more drinks in a day at any point within the 2 months before surgery), and medication use at the time of surgery (specifically, oral contraceptives, aspirin, ibuprofen or any other nonsteroidal anti-inflammatory drug, anticoagulants, or corticosteroids). The health risk status was classified according to the number of risk factors that a subject had (1 to 3). The anatomic measure was M3 position, defined according to the AAOMS Parameters of Care as absent, erupted, soft tissue impacted, partially bony impacted, or fully impacted.¹⁶ Pathological variables were those conditions that could be associated with an M3 and necessitate extraction: caries, periodontal disease, infection, adjacent pathology of tooth due to M3, adjacent tissue pathology, cysts/tumors, tooth fracture, resorption, mandibular fracture, unopposed/supraerupted/nonfunctional tooth, or any other pathology or abnormality.

STUDY VARIABLES: OUTCOMES

The outcome variable was overall complications, with a complication defined as any event requiring additional patient management outside of the planned treatment course. Overall complications included both intraoperative and postoperative complications. Intraoperative complications included nerve injuries (inferior alveolar or lingual), unexpected hemorrhage, unplanned administration of parenteral drugs/fluids, unplanned transfusion, aspiration or ingestion of tooth fragments, airway compromise, jaw fracture, injury to adjacent tooth, unplanned additional procedure, or death. Postoperative complications included alveolar osteitis (dry socket), inferior alveolar/lingual anesthesia/paresthesia, facial/trigeminal nerve dysfunction, unexpected/prolonged trismus, unexpected/prolonged hemorrhage, unplanned postoperative parenteral drugs/fluids, unplanned postoperative transfusion, retention/aspiration/migration or ingestion of fragments, postoperative airway compromise, jaw fracture (maxillary/mandibular), injury to adjacent tooth, oral/antral/nasal fistula, unplanned additional surgery, or any other complication.

Table 1. DESCRIPTIVE STATISTICS FOR STUDY POPULATION: PREDICTORS

	Value
Demographic Variables	
Age (yrs) (n = 3,955)	39.8 ± 13.6 (13 to 98)
≤25	245 (6.1)
26 to 35	1,666 (41.6)
36 to 45	964 (24.1)
46 to 55	607 (15.2)
56 to 65	285 (7.1)
66 to 75	99 (2.5)
>75	89 (2.2)
Female gender (n = 3,955)	1,910 (48.3)
Health status variables	
ASA classification (n = 4,004)	
Class I	2,928 (73.1)
Class II	981 (24.5)
Class III	89 (2.2)
Class IV	2 (0.05)
Class V	4 (0.10)
Medical conditions (n = 4,004)	
Hypertension (yes)	393 (9.8)
Diabetes (yes)	104 (2.6)
Immune deficiency (yes)	7 (0.17)
Malignancy (yes)	240 (5.9)
Organ transplant candidate/recipient (yes)	10 (0.25)
Other chronic condition necessitating medical treatment (yes)	388 (9.7)
Any chronic condition (yes)	1,327 (33.1)
Health risk factors (n = 4,004)	
Current smoking (yes)	657 (16.4)
Current alcohol consumption (yes)	354 (8.8)
Medication use	370 (9.2)
Risk factor (any)	1,381 (34.5)
Health risk sum measure (number of risk factors)	
0	2,835 (70.8)
1	978 (24.4)
2	170 (4.3)
3	21 (0.52)
Anatomic variables	
Level of impaction	
Maxillary right M3	
Unknown	402 (10.0)
Absent	1,059 (26.5)
Full bony impacted	434 (10.8)
Partial bony impacted	213 (5.3)
Soft tissue impacted	127 (3.2)
Erupted	1,769 (44.2)
Maxillary left M3	
Unknown	422 (10.5)
Absent	1,012 (25.3)
Full bony impacted	448 (11.2)
Partial bony impacted	214 (5.3)
Soft tissue impacted	146 (3.7)
Erupted	1,762 (44.0)
Mandibular left M3	
Unknown	392 (9.8)
Absent	850 (21.2)
Full bony impacted	723 (18.1)
Partial bony impacted	617 (15.4)
Soft tissue impacted	189 (4.7)
Erupted	1,233 (30.8)
Mandibular right M3	
Unknown	388 (9.7)
Absent	801 (20.0)
Full bony impacted	786 (19.6)
Partial bony impacted	604 (15.1)

Table 1. DESCRIPTIVE STATISTICS FOR STUDY POPULATION: PREDICTORS (CONT'D)

	Value
Soft tissue impacted	177 (4.4)
Erupted	1,248 (31.2)
Pathological variables	
Caries	
Maxillary right M3	756 (18.9)
Maxillary left M3	798 (19.9)
Mandibular left M3	683 (17.1)
Mandibular right M3	715 (17.9)
Periodontal disease	
Maxillary right M3	451 (11.3)
Maxillary left M3	502 (12.5)
Mandibular left M3	692 (17.3)
Mandibular right M3	646 (16.1)
Infection	
Maxillary right M3	246 (6.1)
Maxillary left M3	282 (7.0)
Mandibular left M3	656 (16.4)
Mandibular right M3	651 (16.3)
Adjacent tooth pathology	
Maxillary right M3	142 (3.6)
Maxillary left M3	149 (3.7)
Mandibular left M3	294 (7.3)
Mandibular right M3	278 (6.9)
Adjacent tissue pathology	
Maxillary right M3	110 (2.8)
Maxillary left M3	127 (3.2)
Mandibular left M3	302 (7.5)
Mandibular right M3	276 (6.9)
Cyst/tumor	
Maxillary right M3	15 (0.37)
Maxillary left M3	13 (0.32)
Mandibular left M3	63 (1.6)
Mandibular right M3	71 (1.8)
Fractured tooth	
Maxillary right M3	16 (0.40)
Maxillary left M3	20 (0.50)
Mandibular left M3	23 (0.57)
Mandibular right M3	26 (0.65)
Mandibular fracture	
Maxillary right M3	0 (0.0)
Maxillary left M3	0 (0.0)
Mandibular left M3	0 (0.0)
Mandibular right M3	0 (0.0)
Unopposed/hypererupted/nonfunctional	
Maxillary right M3	450 (11.2)
Maxillary left M3	450 (11.2)
Mandibular left M3	239 (6.0)
Mandibular right M3	249 (6.2)
Other condition	
Maxillary right M3	116 (2.9)
Maxillary left M3	99 (2.5)
Mandibular left M3	115 (2.9)
Mandibular right M3	121 (3.0)
Any pathology	
Maxillary right M3	1,758 (43.9)
Maxillary left M3	1,820 (45.5)
Mandibular left M3	2,119 (52.9)
Mandibular right M3	2,144 (53.6)

Continuous measures are listed as mean ± standard deviation (range); categorical measures are listed as frequency (percentage).

Abbreviation: M3, third molar.

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Table 2. DESCRIPTIVE STATISTICS BY AGE (≤ 25 YEARS VS > 25 YEARS)

	Age ≤ 25 (n1 = 245)	Age > 25 (n2 = 3759)	P Value
Demographic variables			
Age (yrs)	23.2 \pm 2.7 (13 to 25)	40.9 \pm 13.3 (26 to 98)	<.001
Female gender (n1 = 243; n2 = 3,712)	150 (61.7)	1,760 (47.4)	<.001
Health status variables			
ASA classification			<.001
Class I	204 (83.3)	2,724 (72.5)	
Class II	40 (16.3)	941 (25.0)	
Class III	1 (0.41)	88 (2.3)	
Class IV	0 (0.0)	2 (0.05)	
Class V	0 (0.0)	4 (0.11)	
Medical conditions (n = 4,004)			
Chronic heart disease	0 (0.0)	185 (4.9)	>.9
Hypertension (yes)	3 (1.22)	390 (10.4)	<.001
Diabetes (yes)	0 (0.0)	104 (2.8)	>.9
Immune deficiency (yes)	0 (0.0)	7 (0.19)	>.9
Malignancy (yes)	0 (0.0)	24 (0.64)	>.9
Organ transplant candidate/recipient (yes)	0 (0.0)	10 (0.27)	>.9
Other chronic condition necessitating medical treatment (yes)	32 (13.1)	356 (9.5)	.07
Any chronic condition (yes)	35 (14.3)	921 (24.5)	<.001
Health risk factors (n = 4,004)			
Current smoking (yes)	48 (19.6)	609 (16.2)	.17
Current alcohol consumption (yes)	25 (10.2)	329 (8.8)	.44
Medication use	9 (3.7)	361 (9.6)	.003
Risk factor (any)	69 (28.2)	1,100 (29.3)	.71
Health risk sum measure (number of risk factors)			
0	176 (71.8)	2,659 (70.7)	.26
1	56 (22.9)	922 (24.5)	
2	13 (5.3)	157 (4.2)	
3	0 (0.0)	21 (0.56)	
Anatomic variables			
Impaction level			
Maxillary right M3			
Unknown	8 (3.3)	394 (10.5)	
Absent	33 (13.5)	1,026 (27.3)	
Full bony impacted	57 (23.3)	377 (10.0)	
Partial bony impacted	36 (14.7)	177 (4.7)	
Soft tissue impacted	12 (4.9)	115 (3.1)	
Erupted	99 (40.4)	1,670 (44.4)	
Maxillary left M3			
Unknown	6 (2.5)	416 (11.1)	
Absent	31 (12.3)	381 (26.1)	
Full bony impacted	58 (23.7)	390 (10.4)	
Partial bony impacted	33 (13.5)	181 (4.8)	
Soft tissue impacted	16 (6.5)	130 (3.5)	
Erupted	101 (41.2)	1,661 (44.2)	
Mandibular left M3			
Unknown	7 (2.9)	385 (10.2)	
Absent	23 (9.4)	827 (22.0)	
Full bony impacted	84 (34.3)	639 (17.0)	
Partial bony impacted	68 (27.8)	549 (14.6)	
Soft tissue impacted	18 (7.4)	171 (4.6)	
Erupted	45 (18.4)	1,188 (31.6)	
Mandibular right M3			
Unknown	12 (4.9)	377 (10.0)	
Absent	25 (10.2)	776 (20.6)	
Full bony impacted	94 (38.4)	692 (18.4)	
Partial bony impacted	50 (20.4)	554 (14.7)	
Soft tissue impacted	14 (5.7)	163 (4.3)	
Erupted	50 (20.4)	1,198 (31.9)	

Table 2. DESCRIPTIVE STATISTICS BY AGE (≤25 YEARS VS >25 YEARS) (CONT'D)

	Age ≤25 (n1 = 245)	Age >25 (n2 = 3759)	P Value
Pathology variables			
Caries			<.001
Maxillary right M3	48 (19.6)	708 (18.8)	
Maxillary left M3	42 (17.1)	756 (20.1)	
Mandibular left M3	23 (9.4)	660 (17.6)	
Mandibular right M3	22 (9.0)	633 (18.4)	
Periodontal disease			.01
Maxillary right M3	20 (8.2)	431 (11.5)	
Maxillary left M3	22 (9.0)	480 (12.8)	
Mandibular left M3	32 (13.1)	660 (17.6)	
Mandibular right M3	28 (11.4)	618 (16.4)	
Infection			.46
Maxillary right M3	17 (6.9)	223 (6.1)	
Maxillary left M3	14 (5.7)	268 (7.1)	
Mandibular left M3	39 (15.9)	617 (16.4)	
Mandibular right M3	36 (14.7)	615 (16.4)	
Adjacent tooth pathology			.04
Maxillary right M3	8 (3.3)	134 (3.6)	
Maxillary left M3	4 (1.6)	145 (3.9)	
Mandibular left M3	6 (2.5)	288 (7.7)	
Mandibular right M3	7 (2.9)	271 (7.2)	
Adjacent tissue pathology			.04
Maxillary right M3	12 (4.9)	38 (2.6)	
Maxillary left M3	11 (4.5)	116 (3.1)	
Mandibular left M3	22 (9.0)	280 (7.5)	
Mandibular right M3	19 (7.8)	257 (6.8)	
Cyst/tumor			.01
Maxillary right M3	7 (2.9)	8 (0.21)	
Maxillary left M3	7 (2.9)	6 (0.16)	
Mandibular left M3	11 (4.5)	52 (1.4)	
Mandibular right M3	8 (3.3)	63 (1.7)	
Fractured tooth			.002
Maxillary right M3	0 (0.0)	16 (0.43)	
Maxillary left M3	0 (0.0)	20 (0.53)	
Mandibular left M3	1 (0.41)	22 (0.59)	
Mandibular right M3	1 (0.41)	25 (0.67)	
Mandibular fracture			N/A
Maxillary right M3	0 (0.0)	0 (0.0)	
Maxillary left M3	0 (0.0)	0 (0.0)	
Mandibular left M3	0 (0.0)	0 (0.0)	
Mandibular right M3	0 (0.0)	0 (0.0)	
Unopposed/hypererupted/nonfunctional			<.001
Maxillary right M3	21 (8.6)	429 (11.4)	
Maxillary left M3	23 (9.4)	427 (11.4)	
Mandibular left M3	12 (4.9)	227 (6.0)	
Mandibular right M3	11 (4.5)	238 (6.3)	
Other condition			.002
Maxillary right M3	45 (18.4)	71 (1.9)	
Maxillary left M3	44 (18.0)	55 (1.5)	
Mandibular left M3	41 (16.7)	74 (2.0)	
Mandibular right M3	41 (16.7)	80 (2.1)	
Any pathology			<.001
Maxillary right M3	149 (60.8)	1,609 (42.8)	
Maxillary left M3	148 (60.4)	1,672 (44.5)	
Mandibular left M3	163 (66.5)	1,956 (52.0)	
Mandibular right M3	154 (62.8)	1,990 (52.9)	

Abbreviations: M3, third molar; NA, not applicable.

Continuous measures are listed as mean ± standard deviation (range); categorical measures are listed as frequency (percentage).

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DATA ANALYSIS

Over the course of the study, data were recorded and entered into an electronic database. Descriptive statistics were computed to provide an overall picture of the study population, to enable comparisons to previously published studies. Bivariate logistic regression analyses were conducted to identify those measures associated with intraoperative or postoperative complications. Any associations in bivariate analyses with $P \leq .15$ and biologically relevant variables (age and gender) were included in a multiple logistic regression analysis, which was used to provide adjusted odds ratios (ORs), controlling for the simultaneous effects of multiple covariates. The regression model was constructed using a generalized estimating procedure to account for multiple observations within each subject (ie, some subjects had more than 1 tooth extracted). All data were analyzed using the commercially available statistical software package SAS, version 9.1 (SAS Institute, Carey, NC).

Results

The study sample was comprised of 4,004 subjects who had 8,748 M3s extracted during the study period. The mean age of the sample was 39.8 ± 13.6 years (range, 13 to 98 years), with 245 subjects (6.1%) under age 25 and 3,759 subjects (93.9%) over age 25. The largest proportion of subjects was contained within the age range of 26 to 35 years. The distribution of health status was as follows: ASA I, 2,928 subjects (73.1%); ASA II, 981 subjects (24.5%); ASA III, 89 subjects (2.2%); ASA IV, 2 subjects (0.05%); ASA V, 4 subjects (0.10%). Of the 4,004 study subjects, 657 (16.4%) reported smoking and 354 (8.8%) reported consuming alcoholic beverages. A total of 798 subjects (19.9%) had at least 1 M3 with caries, 692 (17.3%) had at least 1 M3 with a periodontal condition, 656 (16.4%) had at least 1 M3 with an associated infection, 294 (7.3%) had at least 1 M3 with associated pathology, and 71 (1.8%) had at least 1 M3 with an associated cyst. Descriptive statistics are summarized in Table 1. A comparison of the distribution of predictor variables according to age status (≤ 25 years vs > 25 years) is summarized in Table 2.

Table 3 summarizes the complications for the study population. The overall complication rate was 18.3%; the intraoperative and postoperative complication rates were 3.9% and 16.3%, respectively. The most common complications were alveolar osteitis (7.4%), inferior alveolar nerve injury (1.6%), unexpected trismus (1.2%), and postoperative infection (1.1%). It should be noted, however, that the individual complication rates were relatively low across the categories, ranging from less than 0.1% to a maximum of 7.4% (alveolar osteitis).

Table 3. DESCRIPTIVE STATISTICS FOR STUDY POPULATION: OUTCOMES

Outcome Variable	Overall (n = 4,004)
Complication (any)	757 (18.9)
Intraoperative complications	155 (3.9)
Death	0 (0.0)
Inferior alveolar nerve injury	15 (0.37)
Lingual nerve injury	2 (0.05)
Unexpected hemorrhage	32 (0.80)
Unplanned parenteral drugs/fluids	3 (0.07)
Unplanned transfusion	0 (0.0)
Aspiration of tooth fragments	30 (0.75)
Airway compromise	20 (0.50)
Jaw fracture	1 (0.02)
Injury to adjacent tooth	3 (0.07)
Oral/antral/nasal fistula	4 (0.10)
Unplanned additional surgery	6 (0.15)
Other complications	49 (1.22)
Postoperative complications	654 (16.3)
Death	0 (0.0)
Alveolar osteitis	296 (7.4)
Infection	45 (1.1)
Inferior alveolar nerve injury	65 (1.6)
Lingual nerve injury	13 (0.32)
Facial nerve injury	9 (0.22)
Unexpected trismus	48 (1.2)
Unexpected hemorrhage	6 (0.15)
Unplanned parenteral drugs/fluids	1 (0.02)
Unplanned transfusion	0 (0.0)
Aspiration of tooth fragments	5 (0.12)
Airway compromise	0 (0.0)
Jaw fracture	0 (0.0)
Injury to adjacent tooth	3 (0.07)
Oral/antral/nasal fistula	4 (0.10)
Unplanned additional surgery	7 (0.17)
Other complications	65 (1.62)

Continuous measures are listed as mean \pm standard deviation (range); categorical measures are listed as frequency (percentage).

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Table 4 summarizes the univariate associations between the predictor variables and the overall complication rate. In univariate analyses, female gender ($P = .11$), ASA status ($P < .001$), health risk sum measures ($P = .12$), level of M3 impaction ($P < .001$), presence of periodontal pathology ($P < .001$), presence of infection ($P < .001$), and evidence of pathology ($P < .001$) all met the criterion for inclusion in the multiple regression model.

Table 5 summarizes the multiple logistic regression model with age as a binary measure (≤ 25 [referent] or > 25). In this model, the OR for age was 1.46 (95% confidence interval [CI] = 1.00, 2.13; $P = .048$), suggesting that subjects over age 25 were 46% more likely to have a complication than those age 25 and younger, after controlling for other potential confounders/effect modifiers. Other covariates associated

Table 4. BIVARIATE ASSOCIATIONS BETWEEN PREDICTORS AND COMPLICATION RATES (P ≤ .15)

Exposure	OR (95% CI)	P Value
Age	1.27 (0.88, 1.81)	.20
Female gender	1.14 (0.97, 1.34)	.11
ASA (increasing status)	0.74 (0.61, 0.88)	<.001
Health risk sum measures	0.89 (0.77, 1.03)	.12
Level of Impaction		
Erupted	1.00 (reference)	Reference
Soft tissue impacted	1.18 (1.06, 1.32)	.003
Partial bony impacted	1.35 (1.23, 1.48)	<.001
Full bony impacted	1.38 (1.26, 1.52)	<.001
Presence of periodontal condition	1.15 (1.09, 1.22)	<.001
Presence of infection	1.21 (1.13, 1.29)	<.001
Any pathology	1.16 (1.12, 1.20)	<.001

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with increased risk of complications were increasing level of impaction, pre-existing periodontal condition, and evidence of any pathology. The covariate associated with a decreased risk of complications was increasing ASA status.

Table 6 summarizes the multiple logistic regression model, with age measured in deciles. In this model, subjects age 25 to 35 were statistically significantly more likely to have a complication compared with subjects under age 25 (OR = 1.63; 95% CI = 1.12, 2.37; P = .01). In this model, level of impaction, evidence of periodontal condition, and pathology were associated with an increased risk of complications.

Discussion

The purpose of this study was to estimate the overall frequency of complications after M3 removal

Table 5. MULTIPLE LOGISTIC REGRESSION MODEL (AGE = BINARY)

Exposure	OR (95% CI)	P Value
Age (>25 yrs vs ≤25 yrs)	1.46 (1.00, 2.13)	.048
Female gender	1.17 (0.99, 1.39)	.07
ASA (increasing status)	0.76 (0.63, 0.92)	.004
Health risk sum measures	0.96 (0.83, 1.12)	.6
Level of impaction		
Erupted	1.00 (reference)	Reference
Soft tissue impacted	1.15 (1.03, 1.28)	.012
Partial bony impacted	1.31 (1.20, 1.43)	<.001
Full bony impacted	1.38 (1.25, 1.51)	<.001
Presence of periodontal condition	1.09 (1.01, 1.19)	.035
Presence of infection	1.07 (0.97, 1.18)	.2
Any pathology	1.08 (1.00, 1.16)	.037

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Table 6. MULTIPLE LOGISTIC REGRESSION MODEL (AGE = DECILES)

Exposure	OR (95% CI)	P value
Age (yrs)		
≤25	1.00 (reference)	Reference
26 to 35	1.63 (1.12, 2.37)	<.01
36 to 45	1.33 (0.90, 1.98)	.15
46 to 55	1.29 (0.85, 1.96)	.24
56 to 65	1.37 (0.84, 2.23)	.2
66 to 75	0.55 (0.25, 1.18)	.13
>75	1.00 (0.48, 2.09)	.99
Female gender	1.14 (0.97, 1.35)	.12
ASA (increasing status)	0.84 (0.70, 1.02)	.086
Health risk sum measures	0.94 (0.81, 1.09)	.43
Level of impaction		
Erupted	1.00 (reference)	Reference
Soft tissue impacted	1.15 (1.03, 1.28)	.011
Partial bony impacted	1.30 (1.20, 1.42)	<.001
Full bony impacted	1.38 (1.26, 1.51)	<.001
Presence of periodontal condition	1.09 (1.01, 1.18)	.034
Presence of infection	1.07 (0.97, 1.17)	.2
Any pathology	1.08 (1.01, 1.16)	.035

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and to identify risk factors associated with complications, using age as the primary measure. We hypothesized that subjects over age 25 would be statistically significantly more likely to experience complications after M3 surgery compared with those under age 25.

Our results show an overall complication rate of 18.9%, with an intraoperative complication rate of 3.9% and a postoperative complication rate of 16.3%. Several risk factors were associated with complications. Those associated with an increased risk for overall complications were age, more difficult anatomic position of the M3, pre-existing periodontal condition, and any evidence of pathology associated with the M3. Risk factors associated with a decreased risk of overall complications were decreasing age (≤25 years), less difficult position of the M3, absence of periodontal condition, and absence of pathology associated with M3. These data suggest that subjects over age 25—specifically those age 25 to 35—are more likely to have complications associated with M3 surgery, even after controlling for other potential confounders.

Several strengths and weaknesses associated with the design and implementation of this study should be addressed so as to apply appropriate weight to the results. A significant strength is that the AAOMS Age-Related Third Molar study is one of the largest prospective cohort studies in the United States. The prospective design minimizes selection and recall bias, and the large sample size provides adequate power to detect differences in complication rates based on mul-

multiple covariates. These 2 factors give strength to the study and its conclusions, providing OMFSSs with reliable data related to complication rates (overall, intraoperative, and postoperative) and risk factors for complications.

Although these factors do improve the quality of the study and the validity of the results, the study design has some weaknesses that could adversely affect the generalizability of the results. The most significant weakness in this regard is selection bias. Because all of the M3s removed in the study were removed by OMFSSs, there is a possibility that the subjects included are not representative of the entire population of subjects requiring M3 surgery, because easier cases might not get referred to OMFSSs and may be treated by general dentists. Therefore, it might be reasoned that the complication rates in the study population may be higher than the true values. A second weakness pertains to the original study design. The AAOMS Age-Related Third Molar Study was originally designed to evaluate only subjects over age 25. As such, the presence of subjects under age 25 in the sample could potentially affect the precision (standard errors) of the CIs for the parameter estimates.

The results of this study suggest that the overall complication rate for M3 surgery is approximately 20%, with most complications occurring postoperatively. Although these data suggest that 1:5 patients will experience a complication, care should be taken not to overestimate the risk to patients from M3 removal. Among the intraoperative complications, few patients experienced what would be considered serious, debilitating complications requiring further treatment (eg, nerve injuries, jaw fractures). The largest proportion of postoperative complications (45.3%) was due to alveolar osteitis, a well-known complication with identifiable risk factors and well-established clinical management protocols.^{16,17} As with intraoperative complications, postoperative complications with associated long-term consequences (eg, nerve injury, jaw fracture) were relatively rare, representing less than 15% of all postoperative complications. It should be noted that out of approximately 4,000 subjects, there were no deaths associated with M3 extraction, no unplanned transfusions, and just 1 jaw fracture. The rates of other serious injuries, such as nerve injuries, were within the ranges established in the literature, occurring in less than 2% of all extractions.

The results of this study suggest that age is associated with an increased risk of complications. Patients over age 25 were statistically significantly more likely

to experience a complication compared with their counterparts under age 25. Future work in this area will focus on the rates of inflammatory (alveolar osteitis), infectious, or neurovascular complications and on risk factors associated with these types of complications.

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