Recovery after third-molar surgery: The effects of age and sex

Ceib Phillips,a Savannah Gelesko,b William R. Proffit,c and Raymond P. White, Jrd
Chapel Hill, NC

Introduction: In this study, we assessed the effects of age and sex on quality-of-life recovery after third-molar surgery. Methods: Healthy subjects scheduled for removal of third molars were recruited at multiple sites for this study. Each patient was given a condition-specific instrument to be completed each postsurgery day for 14 days. Lifestyle and oral-function recovery were assessed by using a 5-point Likert-type scale. Recovery was defined as the number of days until the patient reported no or little trouble. Recovery from pain was defined as the number of days until no medications were taken. For each quality-of-life item, a Cox regression analysis was performed to assess the effects of age and sex on recovery after controlling for surgical-procedure variables. Results: Nine hundred fifty-eight subjects treated at 9 academic centers and 12 community practices were enrolled. Except for ability to open the mouth, recovery for all quality-of-life items for those 21 years or older significantly ($P < 0.02$) lagged behind recovery for younger subjects. Recovery for female subjects was significantly longer than for male subjects for all outcomes ($P < 0.01$). Conclusions: Patients older than 21 and those who are female should be informed before removal of all 4 third molars that their oral function, lifestyle, and pain recovery will be prolonged compared with those who are younger and male. (Am J Orthod Dentofacial Orthop 2010;138:700.e1-700.e8)

Orthodontists often treat patients in the age range of 12 to 18 years. As a course of treatment is discussed with the patient, parents, or spouse, a recommendation concerning third molars should be made based on current data and the patient’s circumstances.1 Two questions are relevant. Should the third molars be removed? If the decision is third-molar removal, is it advantageous to the patient if the teeth are removed before treatment, even though the third molars might not be erupted, while the orthodontic appliances are in place, or soon after the appliances are removed? If a wait-and-see approach to third-molar management is adopted, will the patient comply with periodic monitoring of third molars for occlusal caries, periodontal inflammatory disease, and other less frequently occurring pathologies such as cysts or tumors?

Almost all young adults (95%) have at least 1 third molar, and three quarters have 4 third molars.2 According to Engstrom et al., third-molar crown development is usually complete by age 14 and root development by age 18, but third molars might or might not be in function at the occlusal plane (OP) by age 18. Failure of third molars to erupt to the OP has been attributed to a lack of space resulting from growth patterns of the jaw.3 Other authors have documented the difficulty in predicting before jaw growth is complete which third molars will erupt into function or remain impacted.4-7

Many clinicians including orthodontists advise their patients to have third molars removed before or just after the teeth are visible in the mouth, particularly if the assumption is that the teeth will not erupt to the level of the OP. Clinicians and the public believe that recovery time after third-molar surgery is shorter at a younger age, although data are limited to support or refute the assumption. Bruce et al.8 reported fewer clinical complications associated with third-molar surgery in younger patients. More older subjects had delayed healing and excessive pain after surgery. However, the reported data were not controlled for the complexity of the surgery, which was greater in older subjects. Chuang et al.9,10 reported data from a cross-sectional analysis on subjects at least 25 years old having third-molar surgery. Increasing age in deciles was not significantly associated with increases in postsurgery inflammatory complications, wound infection, or alveolar osteitis, controlling for other explanatory variables such as the

From the School of Dentistry, University of North Carolina, Chapel Hill.

*Professor, Department of Orthodontics.

†Dental student.

‡Kenan Distinguished Professor, Department of Orthodontics.

§Dalton L. McMichael Distinguished Professor, Department of Oral and Maxillofacial Surgery.

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Reprint requests to: Ceib Phillips, School of Dentistry, University of North Carolina, Manning Dr and Columbia St, CB #7450, Chapel Hill, NC 27599-7450; e-mail, Ceib_phillips@dentistry.unc.edu.

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difficulty of the surgery. Phillips et al.\textsuperscript{11} reported that, after third-molar surgery, delayed healing, wound infection, and alveolar osteitis were not associated with age at the time of surgery if these outcomes were controlled for the complexity of surgery. However, prolonged recovery as evaluated by quality of life (QOL) outcomes was significantly more likely for subjects older than 18 and for females patients.\textsuperscript{11}

Since active orthodontic treatment is often finished before the third molars erupt and jaw growth is complete, recommending treatment for third molars can be problematic.\textsuperscript{12} This study was designed to further assess the effects of age and sex on recovery of QOL outcomes, lifestyle, oral function, and pain after third-molar surgery in patients treated in either a community practice or an academic clinical center.

**MATERIAL AND METHODS**

QOL after third-molar surgery and surgical data were obtained from subjects and clinicians at 21 clinical centers, 9 academic centers, and 12 community practices. Participating surgeons in community practices were fellows of the American Association of Oral and Maxillofacial Surgeons. In the academic centers, the surgeons were full-time faculty who were fellows of the American Association of Oral and Maxillofacial Surgeons or residents with at least 1 year of postdental school dentoalveolar surgical training. Patients scheduled for removal of all 4 third molars at these clinical sites were recruited between 1997 and 2009 for this clinical study approved by the institutional review board of the University of North Carolina.

Healthy subject-patients (ASA I and II), aged 14 to 40 years, were enrolled after consent for participation was obtained. Patients were excluded if they had a history of psychiatric treatment, were pregnant or lactating, or had radiographic evidence of severe periodontal disease. Presurgery baseline data were recorded, including reason for seeking third-molar removal and demographics (age, sex, ethnicity, education level). From the presurgery panoramic radiograph, mandibular third-molar position relative to the OP was categorized as 1 third molar below the OP or both below the OP. The standard surgery protocol consisted of common procedures in the United States: intravenous anesthesia, mandibular third molar, bone removal from the mandibular third molars by using rotary instrumentation. Bone removal was categorized as removal from 0 or 1 mandibular third molar or from both. Perioperative therapy with systemic or topical antibiotics or corticosteroids was administered at the surgeon’s discretion, but these data were not routinely recorded.

Extensiveness of the surgery was indicated by the length of the surgical procedure and the surgeon’s estimate of the degree of difficulty for each quadrant, on a scale of 1 (no difficulty) to 7 (maximal difficulty) with a possible subject total of 28. Length of surgery was categorized as \( \leq 20 \), \( >20 \) to 30, \( >30 \) to 40, and \( >40 \) minutes. Degree of total difficulty was categorized as \( \leq 9 \), \( >9 \) to 12, \( >12 \) to 16, and \( >16 \). The categorizations for OP position, bone removal, surgery time, and surgeon’s assessment were those used in the evaluation of prolonged clinical recovery.\textsuperscript{11}

After surgery, each patient was given a condition-specific QOL diary that had been developed, validated, and used in other clinical studies involving recovery after third-molar surgery.\textsuperscript{13-15} Each patient was asked to complete the 2-page diary each postsurgery day for 14 days. Recovery was organized into 3 QOL domains: lifestyle, oral function, and pain. The patient’s lifestyle and oral-function domains after surgery were assessed with a 5-point Likert-type scale with verbal anchors of “no trouble (1)” and “lots of trouble (5).” The impact of the surgery on the patient’s lifestyle included usual daily activities, social interactions, and recreation. Oral function items assessed difficulty with mouth opening, chewing, and eating a regular diet. Recovery for lifestyle and oral function was defined as the number of days until the patient reported “no trouble (1)” or “little trouble (2).” Based on the report of Snyder et al.,\textsuperscript{16} the patients were asked to record whether medications, including over-the-counter ones, were taken for pain each day, and recovery from pain was defined as the number of days until no medications were taken.

**Statistical analysis**

Before analysis, age at surgery was stratified into 3 groups: \(<18\), \( 18 \) to 21, and \( >21 \) years old. For each QOL item, unadjusted Kaplan-Meier estimates of the quartile values for recovery for the 3 age groups and for the sexes were calculated (version 9.1, Proc Lifetest SAS, Cary, NC) and a Cox regression time to event analysis (version 9.1, Proc PHREG SAS) was performed to assess the effects of age and sex on recovery. The hazard functions were calculated after controlling for the clinical and surgical predictor variables (OP position of the mandibular third molars, bone removal from the mandibular third molars, length of surgery, and surgical difficulty) identified by Phillips et al.\textsuperscript{11} The reference cells were female, less than 18 years of age, less than 20 minutes of surgery, bone removal on 0 or 1 mandibular third molar, 0 or 1 mandibular third molar below the OP, and total difficulty as assessed by the surgeon of 9 points or less. For all models, the proportional hazards
assumption was assessed and considered appropriate. The level of significance was set at 0.05.

RESULTS

We enrolled 958 subjects who returned a completed 14-day postsurgery diary to the data center. A smaller proportion of subjects were treated in academic centers compared with community practices: 39% vs 61%, respectively. Forty-seven percent of the subjects were 21 years of age or older at the surgery (median, 24 years; interquartile range [IQR], 23-27 years); 31% were between 18 and 21 (median, 19; IQR, 18.5-20); and 21% were 18 or younger (median, 17; IQR, 16-17.5). More subjects were female (60%) and white (85%), although African Americans were well represented (8%). The subjects were well educated. Fifty-seven percent of all subjects and 74% of those 18 or more years old had at least some college education. A third of the subjects reported having third-molar symptoms before surgery that were sufficiently bothersome to prompt them to have the third molars removed “before it happens again.”

The median surgery time was the shortest for the youngest group and longest for the oldest group (Table I), although the average degrees of difficulty as estimated by the surgeon were highest for the youngest group and lowest for the oldest group. Both mandibular third molars were below the OP in 74% of the youngest subjects and required bone removal for access, compared with 49% of the oldest subjects. Both sexes were, on average, 21 years old at the surgery. Median surgery time and estimated degree of difficulty were slightly higher in the male subjects (Table I). The percentage of subjects with both mandibular third molars below the OP was slightly higher in the female subjects, but bone removal for access to the mandibular third molars was higher in the male subjects.

The median number of days to recovery for all lifestyle and oral-function items was similar for all age groups. However, except for mouth opening, the distribution in the oldest group (≥21) was shifted by at least 1 day longer for recovery time, as indicated by the estimated time to recovery for 75% of the subjects in that group (Table II). The recovery from pain was prolonged by an average of 2.5 days in the oldest group.

The recovery function for all lifestyle items and all oral-function items, except mouth opening and pain, were significantly affected by age even after controlling for surgical procedural variables, tooth position, and sex (Tables III and IV). For all QOL outcomes, the oldest group, those at least 21 years of age at surgery, had a risk ratio significantly less than 1 relative to the youngest group (≤18), indicating that the likelihood of recovery on a given postsurgical day was significantly reduced for the subjects 21 or older. For example, on any day after surgery, the oldest group would be only 69% as likely to report recovery for regular routine and eating and only 52% as likely to report no medication for pain as the youngest group. The recovery functions for the youngest and middle groups (18-21 years) were not significantly different. Representative recovery curves for eating a regular diet, resuming a regular routine, and taking pain medications are shown in Figures 1 through 3.

On average, male subjects reported no or little trouble with lifestyle and oral function 1 day earlier than female subjects (Table II). Recovery from pain was, on average, 2 days shorter for male than female subjects: 6 vs 8 days, respectively. The recovery function for all lifestyle items, all oral-function items, and pain were significantly affected by sex even after controlling for surgical-procedural variables, tooth position, and age (Tables III and IV). Male subjects had a risk ratio significantly greater than 1 relative to female subjects, indicating that the likelihood of recovery on a given postsurgical day was significantly better for the male subjects. On any day after surgery, the male subjects would be 42% more likely to report recovery for regular routine and eating and 44% more likely to report no medication for pain (Figs 1-3).

DISCUSSION

The 958 subjects we studied were a diverse mix having third molars removed in academic centers and community practices by trained surgeons. Outcomes might differ if other dentists performed the surgery. The age distribution in the sample was similar to most patients who have third molars removed in the United States: 47% of the sample was at least 21, but few subjects (7%) were over 30 years of age. Education levels in the sample were high; three quarters of those of college age and older had at least some college. However, the ethnic distribution of the sample was not representative of the United States: few Asian or Latino subjects were included, and only 8% were African American.

Recovery over the 2 weeks after surgery was significantly delayed for subjects who were at least 21 years old compared with those who were younger for pain, lifestyle, and oral function. On a given postsurgery day, the older patients were only 52% as likely to report no or little problem than the younger patients. These data add weight to the findings of Phillips et al,11 who suggested that the odds of a recovery longer than 11 days for pain and 8 days for oral-function outcomes increased incrementally with each year over 18, after
controlling for the extensiveness of the surgical procedures. In addition, male subjects, who comprised 41% of our sample, recovered more quickly than did the female subjects for these same outcomes independent of age. Phillips et al11 reported similar data: being female increased further the odds of prolonged recovery for oral function and pain, controlling for other variables including presurgery symptoms and the extensiveness of surgery. Outcomes in this study and that of Phillips et al were not controlled for anesthesia protocols or postsurgery pain management, variables that could affect recovery in the first few postsurgery days.

Is younger age associated with shorter recovery for other ambulatory procedures? Few data have been reported on the influence of age on recovery for short ambulatory procedures similar to third-molar surgery or for an age distribution similar to this sample. The few studies available have focused on older adults (approximately 30-60 years), and the findings are contradictory. Fabricant et al17 reported no effect of age on recovery for

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<th>Table I. Descriptive statistics for demographic and surgical characteristics of subjects</th>
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<tr>
<td><strong>Age (y)</strong></td>
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<tr>
<td>Bone removal*</td>
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<td>Both</td>
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<td>1 or none (missing 16 subjects)</td>
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<tr>
<td>Below OP*</td>
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<td>Both</td>
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<td>1 or none (missing 64 subjects)</td>
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<td><strong>Age at surgery (y)</strong></td>
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<td>Median (IQR)</td>
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<td>Total surgery time (min)</td>
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<td>Surgeon’s estimate of difficulty (4-28 possible)</td>
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*Only mandibular third molars were considered.

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<th>Table II. Unadjusted Kaplan Meier median and 25th and 75th percentile values by age and by sex for the number of days to recovery defined by “little” or “no” interference with lifestyle (regular routine, social life, recreation, sleeping), oral function (eating, chewing, opening mouth), and the number of days until no pain medications were taken</th>
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<tbody>
<tr>
<td><strong>Lifestyle</strong></td>
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<td>Regular routine</td>
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<td>Pain</td>
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<td>No pain medications</td>
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P25, represents the postsurgical day by which 25% of the subjects reported recovery.
Median, represents the postsurgical day by which 50% of the subjects reported recovery.
P75, represents the postsurgical day by which 75% of the subjects reported recovery.
arthroscopic knee surgery for patients who averaged 49 years of age. However, Egol et al.18 indicated that patients less than 40 years old were more likely to have recovered at 6 months after surgery for ankle fracture, based on scores from the short musculoskeletal function assessment, and had returned to at least 90% of presurgery function at 1 year compared with those older than 40.

Is recovery from pain longer for female patients after other ambulatory procedures? Snyder et al.16 reported that a significantly greater proportion of female patients took pain medications after third-molar surgery each day, beginning with day 5 and continuing through the 14-day study period. Women also appear to be at greater risk for clinical pain after short ambulatory procedures such as colonoscopy and arthroscopic knee surgery.17,19-21 In a review article, Fillingim et al.22 concluded that women have a lower threshold for experimental pain as well, suggesting that processing for painful stimuli differs by sex.

Is an increase in clinical complications, wound infection, or localized osteitis (dry socket) associated with age? Age appears to be related not only to recovery after third-molar removal but also to clinical complications. Bruce et al.18 reported more clinical complications and excessive pain in older subjects but did not control for the complexity of surgery. For 4000 subjects having 8750 third molars removed, the frequency of complications at surgery increased when the third molars were located more deeply in bone, usually requiring more extensive surgery for removal, although no specific measures of surgical difficulty such as the length of surgery or the surgeon’s estimate of difficulty were recorded.9,10 A more recent report of data from 149 subjects having third molars removed also suggested an association between the extensiveness of surgery (bone removal, tooth sectioning, and surgery time) and an increased frequency of alveolar osteitis and higher postsurgery pain levels.23 Kugelberg et al.24 studied 2 cohorts of patients before and 1 year after removal of all impacted mandibular third molars; 57 subjects were less than 20 years old, and 61 were at least 30 years old. The proportion of subjects with an alveolar bone defect after surgery on the distal aspect of the second molars was significantly higher in the older cohort.

What might happen if the third molars are monitored rather than removed? A recent report by Kandasamy et al.25 reviewed the options for third-molar management. They emphasized that the absence of third-molar symptoms does not equate to the absence of pathology, a concept not readily understood by patients and the public at large. Shugars et al.26 reported that, in a longitudinal study of young adults who averaged 25 years of age,
a third of 300 subjects overall and 39% of subjects over 25 years of age had occlusal caries on at least 1 third molar. Caries on third molars was associated with caries on teeth more anterior in the mouth; only 1% of subjects had third-molar occlusal caries without caries on a first or second molar. In the same study, two thirds of subjects with asymptomatic third molars at enrollment had clinical evidence of periodontal inflammatory disease in the third-molar region (at least 1 periodontal probing depth at least 4 mm) at the distal aspect of the second molars or around the third molars. White et al summarized data on periodontal inflammatory disease from 2 population studies and 2 clinical studies involving a total of 8500 subjects. In this meta-analysis, the presence of a visible third molar was significantly associated with increased probing depth on second molars and more extensive periodontal inflammatory disease overall compared with subjects with no third molars visible, suggesting that an exposed third molar is a risk indicator for periodontal inflammatory disease more anterior in the mouth.

What might happen to the distal aspect of the second molar when the third molar is removed? The reported effects of third-molar removal on the periodontal health of the adjacent second molar have been contradictory, with emphasis on the effects of the removal of impacted mandibular third molars. Some studies have shown improvement of periodontal health, whereas others have demonstrated loss of attachment and reduction of alveolar bone height. Age appears to be a factor in the periodontal status of the second molar after surgery. Kugelberg et al studied 2 cohorts of subjects before and 1 year after removal of all impacted mandibular third molars; 57 subjects were less than 20 years old and 112 subjects were 20 years or older. The data showed that the periodontal health of the second molar was significantly improved in the younger group but not in the older group.

**Fig 1.** Estimates of the percentages of subjects reporting at least some (≥3/5) trouble with regular diet on each postsurgical day after adjustment for the other predictor variables in the Cox regression analysis. A, Effect of age after adjusting for all predictor variables. B, Effect of gender after adjusting for all predictor variables.

**Fig 2.** Estimates of the percentages of subjects reporting at least some (≥3/5) difficulty with regular routine after adjustment for other predictor variables in the Cox regression analysis. A, Effect of age after adjusting for all predictor variables. B, Effect of gender after adjusting for all predictor variables.
old, and 61 were at least 30 years old. Older age was significantly associated with greater alveolar bone defects after surgery on the distal aspect of the second molars. Length of follow-up after removal might also be an important factor. Krausz et al enrolled 25 subjects between 20 and 60 years of age who underwent extraction of an impacted mandibular third molar and retention of the contralateral impacted third molar in a split-mouth design. Three years after removal, on average, the distal aspects of the second molars showed a significant gain of alveolar bone height on the extracted side and a slight loss on the nonextracted side.

CONCLUSIONS

These data suggest that the widely held belief by clinicians and the public might be accurate: recovery after third-molar surgery is faster at a younger age. Patients younger than 21 years, including adolescents completing an orthodontic treatment plan, recover more quickly for QOL outcomes, pain, lifestyle, and oral function compared with those 21 years and older.

We thank the surgeons and their patients who volunteered to provide data for these analyses and Debora Price for assistance in managing the data for this project.

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