# Pathology Associated with the Third Molar

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**KEYWORDS**

• Third molar • Wisdom tooth • Pathology • Cyst

**KEY POINTS**

- Erupted, disease-free third molar teeth may be retained indefinitely.
- Periodontal abnormality is common at third molar sites, and may be difficult to control or eradicate with conventional periodontal therapy techniques because of abnormal eruption patterns or proximity of teeth to the mandibular ramus.
- Third molar sites commonly harbor microbial flora known to be associated with periodontal disease, and evidence suggests that third molar sites may first be affected by periodontitis that moves to more anterior locations over time.
- The periodontal status of second molars tends to improve after extraction of third molars that exhibit periodontal abnormality.
- Pericoronal tissue that is histologically indistinguishable from a dentigerous cyst may affect greater than one-third of impacted third molars without abnormal pericoronal radiolucency, and this is more common in patients after age 20 years.
- At present, the relationship of retained third molars to systemic disease is tenuous.

## INTRODUCTION

There has been much discussion in the literature regarding the prevalence of third molar pathology and extraction.[1–6] The cost to the individual and to society (in the form of lost productivity), and the morbidity associated with surgery for third molar extraction, seems to form the basis for many investigators to discourage extraction of asymptomatic teeth. So-called prophylactic extraction of third molar teeth has, in fact, been deemed a "public health hazard."[7] Lack of symptoms has led investigators to recommend retention of third molars[8]; others recommend a watchful waiting approach, and intervention when disease is identified.[4,5] Few published articles, however, have taken into account the possibility of early or occult disease that could be eliminated by intervention before symptom development, and it has been rightly recognized that lack of symptoms does not necessarily equate to lack of disease.[2] Just as no dentist would fail to treat a carious lesion because it is asymptomatic, the surgeon should recognize that the presence (and sometimes likelihood) of asymptomatic disease may necessitate extraction of retained third molars at an age when morbidity is likely to be less and recovery faster.

As it has been recognized that third molars that are not fully erupted commonly change position over time (even past the "normal" eruption age), it is prudent to monitor retained teeth for development of pathosis for a lifetime.[9–12] For example, in one 5-year study where retained third molar teeth were monitored, it was necessary to extract about one-third of them during the time frame of the investigation,[13] and it is still unclear as to whether the majority of third molar teeth can be retained in a reasonable state of health as individuals age.

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Disease associated with third molar teeth may be clinically obvious or occult. Although tooth pain is commonly associated with third molars,[14] patients will frequently present with nebulous complaints of headache, "pressure," or pain that is not readily attributable to the teeth. In many of these scenarios, clinical examination will not be able to definitively attribute the symptoms to the third molars. The surgeon is then faced with the dilemma of recommending retention or extraction for a given individual. It is hoped that the following discussion will aid in both the diagnosis and management of these patients.

For the purposes of this article, pathologic manifestations will be divided into soft-tissue conditions (primarily pericoronitis and periodontal disease), conditions affecting hard tissues of teeth, and lytic lesions of bone. Each is discussed in turn.

## SOFT-TISSUE CONDITIONS

### *Pericoronitis and Infection*

Pericoronitis, an inflammatory condition associated with the soft tissue around a partially erupted third molar, commonly occurs when a lower third molar tooth cannot erupt fully and remains partially covered by a soft-tissue operculum because of its position in the jaw (**Fig. 1**). It has been suggested that the teeth most likely to develop pericoronitis are vertically positioned lower third molars at or near the level of the occlusal plane,[15–18] but pericoronitis is also seen in a high percentage of orthodontically treated cases with mesioangular position of the lower third molars.[19] In some cases, pericoronitis may be chronic and painless[20] with only intermittent symptoms, but is often acutely recurrent in a specific individual. The gingival tissues may be exquisitely tender and purulent, causing significant discomfort for the patient, and limiting jaw opening and chewing function. In certain circumstances, as with deployed service personnel, the condition can be particularly problematic.[21] There is also evidence that mandibular third molar pericoronitis may be associated with more underlying periodontal inflammatory disease in young adults when compared with a similar population without pericoronitis,[22] and, even 3 months after removal of offending teeth, microbial loads and inflammatory mediators may remain elevated.[16]

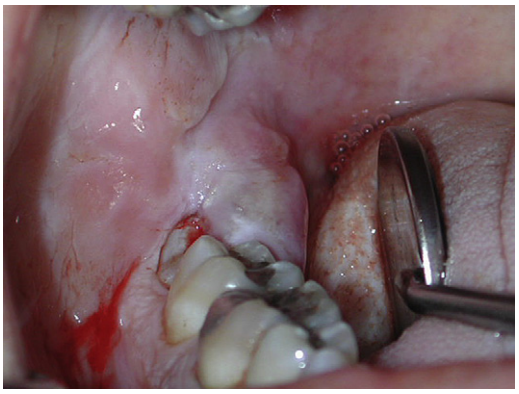

**Fig. 1.** Third molar demonstrating pericoronitis with operculum and associated swelling.

Ample peer-reviewed literature has reported the flora associated with both acute and chronic pericoronitis.[23–28] Many of the bacterial species are facultative or obligate anaerobes, and several species have been identified as periodontal pathogens.[25,29,30] Some data, however, suggest that the flora is more consistent with gingivitis than periodontitis.[16] Older published literature may not provide a complete picture of the bacterial flora associated with this condition because it is based on culture techniques that are not capable of growing all microbial species present. Newer molecular methodologies have discovered several uncultivable organisms not previously identified at third molar sites, and it has been suggested by some investigators that the soft tissues around third molars with acute or chronic pericoronitis may provide a niche for the establishment of periodontal abnormality at other oral sites.[29]

Pericoronitis may be managed with a variety of interventions, including subgingival curettage to remove plaque and foreign bodies, irrigation with antimicrobials such as chlorhexidine, or antibiotic therapy. Operculectomy, although sometimes effective in reducing symptoms in the short term, does not appear to provide long-term benefit for most patients.[31] In cases where the erupted or partially erupted upper third molar impinges on a lower operculum, extraction of the upper third molar may aid pain control and speed the healing process. Extraction of the lower third molar tooth is generally indicated for patients once any infection and swelling have resolved, especially if recurrent.[32]

Although most cases of pericoronitis will resolve with local intervention, a small percentage will progress to major infection. The frequency of this outcome is reported to be low, however: on the order of 0.016 cases per year per 1000 patients at risk.[33] Such individuals are seriously ill, often demonstrating multispace infections compromising the airway, and requiring intubation, extensive drainage procedures in the operating room, and critical-care management for several days. It appears that most hospitalizations result from diseased third molars or nonelective removal of

diseased third molars.[34,35] Fortunately, death is rare.

Acute or chronic symptoms thought to be related to third molars have also been reported to delay the diagnosis and treatment of cancer in a small number of cases.[36] Clinicians should, of course, be aware that pain or other symptoms at third molar sites may reflect more serious conditions than localized pericoronitis.

### *Periodontal Disease*

There is mounting evidence that asymptomatic third molar teeth, especially lower third molar teeth, are frequently associated with pathologic periodontal probing depths.[37] In addition, the gingivae around these teeth have been repeatedly shown to harbor bacteria known to be associated with the development of periodontitis. Some investigators have demonstrated that these pathogenic bacteria are found first at third molar sites, which may thus serve as a reservoir for the development of more generalized periodontal disease.[29,38] In addition, there is evidence that removal of third molars reduces the presence of periodontopathic bacteria at second molar sites.[39] These findings suggest that early removal of lower third molars unlikely to erupt into a healthy periodontal state may prevent or delay the onset of adult periodontitis. In addition, they suggest that periodontal probing should be an integral part of clinical assessment to adequately advise the patient about retention or extraction of third molars.

As already indicated, periodontal pathogens are commonly found in pericoronal tissues of third molar teeth, and have been reported even in otherwise periodontally healthy individuals.[25] Periodontal pocketing and increased inflammatory mediators may be found even in patients with asymptomatic third molars.[40] Not surprisingly, periodontal abnormality at third molar sites increases over time in young adults,[3,41] and is seen more frequently in third molars than in first or second molars in this population.[42] It has also been suggested that chronic oral inflammation leads to progression of periodontal disease in the third molar region,[43] and that the presence of visible third molars may negatively affect periodontal health.[44] Visible third molars, however, have also been associated with periodontal inflammatory disease in non–third molar sites in young adults[45]; this is more likely for mandibular third molars than for maxillary,[46] and periodontal abnormality at third molar sites is predictive of the same at non–third molar regions over time in the young adult population.[47] In this same population, periodontal abnormality worsens over time in non–third molar sites, but this is more likely to happen in patients with at least one probing depth of at least 4 mm in the third molar region.[48] These probing depths also indicate a risk for progression of periodontal disease during pregnancy,[49] and have been associated with an increased risk of preterm birth.[50] In a large study of middle-aged and older Americans, fewer than 2% of subjects had third molars free of dental caries or periodontal abnormality,[51] and the presence of a visible third molar was significantly associated with more severe periodontal disease at sites more anterior, particularly on second and first molars.[52] Third molars may continue to negatively affect the health of the periodontium as individuals age.[53]

Improvement in the periodontal status of the second molar over time has been demonstrated after removal of both the lower and upper third molar, at least in younger adults,[54–58] and flap design for extraction does not appear to negatively affect periodontal healing.[59] Improvement in alveolar bone height has been demonstrated at the distal of the second molar after extraction of impacted mandibular third molars in comparison with their retention.[60] In general, second molar periodontal health improves or remains constant after extraction of the third molar. A possible exception to this outcome, however, is the patient with normal periodontal health preoperatively, as these individuals may see the periodontal status of the second molar worsen after third molar extraction[61]; increasing age may also be associated with worsening periodontal status.[62]

## HARD-TISSUE CONDITIONS

### *Dental Caries*

Certainly the most common hard-tissue disorder associated with third molar teeth is dental caries. Ahmad and colleagues[63] demonstrated that 27% of subjects with caries-free erupting third molars will develop dental caries within 5 years, and Venta and colleagues[64] report a 30% rate of caries or filled surfaces for erupting third molars within 6 years; the prevalence of third molar caries also appears to increase over time.[3] Because many of these teeth are malposed and/or never achieve complete eruption, they may be difficult candidates for dental restoration (**Fig. 2**). In such cases, extraction may be the most efficacious treatment.

In addition to dental caries in the third molar, third molar angulation may predispose to caries on the distal surface of the second molar tooth, with prevalence of second molar caries up to 12.6% in one studied population.[65] Early carious lesions on the second molar can be difficult to

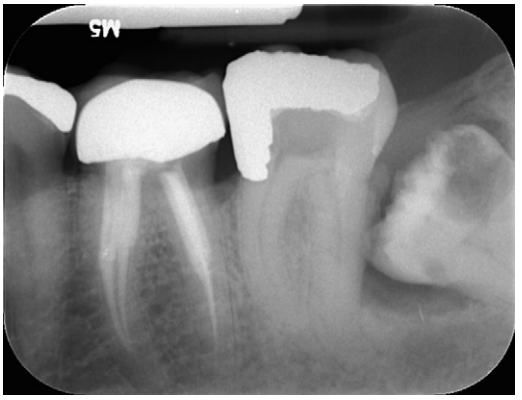

**Fig. 2.** Impacted, symptomatic third molar in a 70-year-old man demonstrating dental caries, lack of bone on the second molar, and pericoronal radiolucency.

distinguish from so-called cervical burnout, and treatment may thus not occur in the early stages of disease. Second molar lesions often begin in the area of the cementoenamel junction because of a mesioangularly or horizontally impacted third molar, and may involve significant portions of the distal second molar root. Resorption of the second molar root may occur even in the absence of dental caries (**Fig. 3**). In advanced lesions, restoration of the second molar is not possible, and both the second and third molar teeth must be extracted.

### *Odontogenic Cysts and Tumors*

Every oral and maxillofacial surgeon is familiar with displaced third molar teeth associated with large radiolucencies (**Figs. 4–8**). Sometimes associated with pain, swelling, or functional disturbances, these lesions most often have no signs or symptoms, and the condition is discovered incidentally during a radiographic survey. Lesions may occur in any age group, with extremes of age posing the greatest challenge in management. Because these patients are generally referred to the oral surgeon for diagnosis and management, the population seen by surgeons is skewed toward individuals with disease; what seems common in specialty practice could, in fact, be relatively rare in the general population. The frequency of these lytic lesions thus cannot be determined solely from practice populations because of selection bias in specialty practice. How, then, can the likelihood of cyst or tumor development associated with retained third molar teeth be determined?

The preponderance of literature regarding the development of odontogenic cysts and tumors associated with third molar teeth is radiographic, retrospective, and/or cross-sectional in nature.[66,67] Commonly an author will retrieve existing panoramic radiographs from a series of patients and assess them for the presence of radiolucencies around third molar teeth. Although this provides some information, there are several factors that preclude the ability to assess prevalence of cystic (or tumorous) change. First, many of the radiographs will demonstrate that the third molars are absent because they have previously been removed. Of course, it is not clear if such teeth had been removed to treat disease or if they were extracted prophylactically. Second, a radiographic study of this type cannot rule out early hard-tissue or soft-tissue disease. Panoramic radiography may not demonstrate early dental caries, and developing cysts or tumors may not yet have caused discernible bone destruction. Nevertheless, at least one retrospective study has reported an alarming frequency of radiographically detectable pathosis in 46.4% in 2432 impacted lower third molars,[68] and postorthodontic follow-up radiographs also report pathosis in both third molars and adjacent second molars.[11]

Histologic assessment of tissues remains the gold standard for disease diagnosis, and several

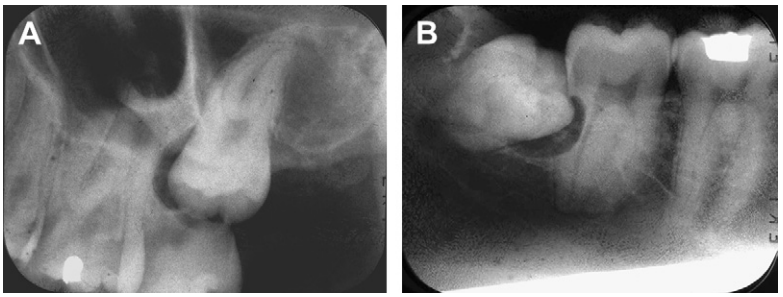


**Fig. 3.** (*A*) Severe second molar root resorption caused by maxillary third molar. (*B*) Severe second molar root resorption caused by mandibular third molar (same patient as in *A*). This individual had similar findings on all second molars.

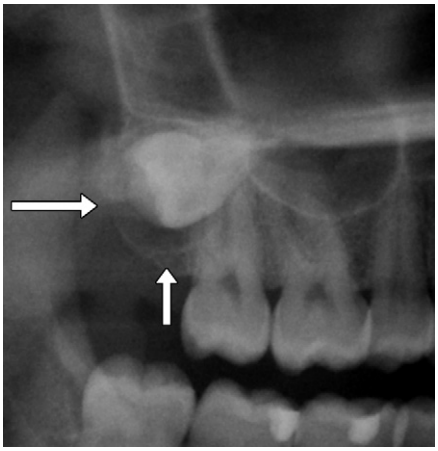

**Fig. 4.** Arrows illustrate typical small dentigerous cyst surrounding a maxillary third molar tooth in a female patient.

peer-reviewed publications have reported findings when soft tissues associated with third molars were analyzed histologically.[69,70] Some of these report retrospectively only on findings from submitted tissues (ie, only when the surgeon deemed the tissues obviously pathologic),[71,72] and frequency of reported pathologic change varies widely, less than 10% in some reports.[73] Others report some disease entity in nearly 60% of pericoronal tissues of unerupted third molars[74]: chronic soft-tissue inflammation and dentigerous cysts were commonly encountered; odontogenic tumors or malignancies were rare. Manganaro[75] demonstrated similar findings, with a dentigerous cyst reported in nearly 46% of pericoronal radiolucencies (0.1–3.0 mm) around impacted third molar teeth. Several recent studies have evaluated soft tissues retrieved from third molar sites without radiographic evidence of disease (follicular spaces 3 mm or less), and have reported pathologic change in high percentages, greater than 50% in some reports.[76,77] Inflammatory changes and cyst formation are common in pericoronal tissues of even fully impacted asymptomatic third molars.[78]

Glosser and Campbell[79] designed a prospective evaluation of soft tissues from third molars without radiographic evidence of disease (less than 2.5 mm pericoronal radiolucency). Tissues were evaluated independently by 3 different oral pathologists, and only when all 3 agreed that a specimen represented disease was the tissue deemed to be pathologic. In this study, 31 of 96 specimens were diagnosed as dentigerous cyst; no other pathologic lesions were identified.

A similar trend was reported by Adelsperger and colleagues,[80] in whose study 99 specimens were evaluated independently by 2 oral pathologists. In the event of a disagreement in diagnosis, a consensus diagnosis was achieved. Surprisingly, 34% of the specimens were found to represent dentigerous cysts, concurring nearly exactly with the findings reported by Glosser. In this study, however, a subset of follicular and cystic tissues was further assessed for the presence of proliferating cell nuclear antigen (PCNA), a marker of active cellular division. A high percentage of positivity was found in the cystic tissues (62.5%), whereas none of the examined follicular tissues showed mitotic activity. Although there were no gender differences in the percentage of cystic tissues, the actively growing cysts were associated with increasing age, suggesting that these may have become radiographically evident at some future time. Others have also associated a higher frequency of cystic change in patients older than 20 years,[70,74] and Daley and Wysocki[81] reported that approximately 30% of dentigerous cysts in a large pathology database occurred in patients older than 39 years.

A third histologic analysis attempted to correlate patient symptoms with the presence of cysts.[82] Patients presenting to a private oral surgeon completed a questionnaire regarding their perceptions

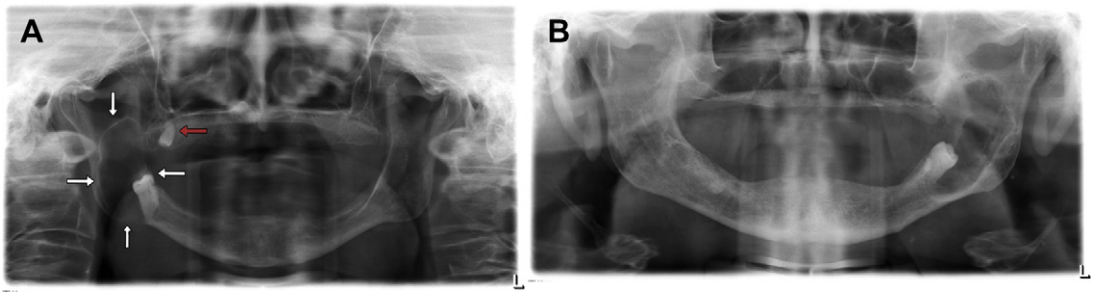


**Fig. 5.** (*A*) Dentigerous cyst associated with a displaced, impacted third molar tooth in a 94-year-old woman (*white arrows*). Red arrow indicates impacted maxillary third molar with discontinuity in overlying bone but no overt disease. (*B*) Similar dentigerous cyst in an 83-year-old male patient.

**Fig. 6.** Cemento-ossifying fibroma associated with a displaced third molar tooth in a 21-year-old man.

**Fig. 8.** Odontogenic keratocyst in association with a displaced third molar in a 59-year-old male patient.

of symptoms associated with their third molar teeth. Again, pericoronal tissues were submitted for histologic diagnosis, and again nearly one-third of sites were found to have dentigerous cysts. On analysis, however, symptoms of infection, swelling, pain, or "pressure" showed no correlation with the location of the cysts. Nearly equal percentages of cysts and follicles had some symptom, and symptoms could thus not predict which teeth harbored odontogenic cysts.

Some controversy exists among pathologists regarding the diagnosis of dentigerous cysts. Whereas many consider squamous metaplasia of pericoronal tissues to indicate the diagnosis, others argue that histology alone cannot confirm the presence of cystic change.[81,83–86] The findings of increased cellular activity demonstrated by some of the previously referenced investigators support the conclusion that the histologic findings represent pathosis. Whether these actively growing tissues continue to grow, become quiescent, or involute over time has yet to be determined. It is likely, however, that because pericoronal tissues are not routinely submitted for histologic diagnosis, associated disease is underdiagnosed.

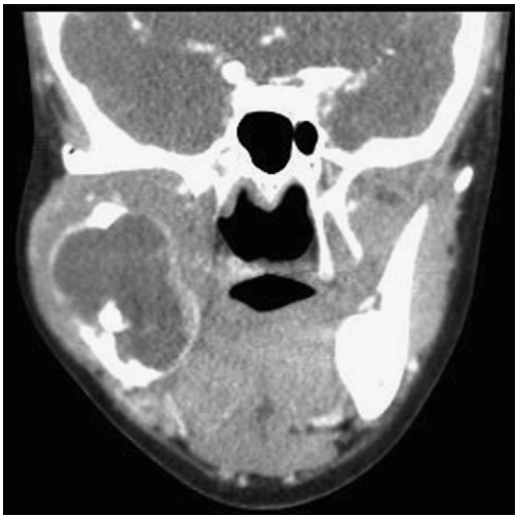

**Fig. 7.** A displaced third molar associated with ameloblastic carcinoma in an 11-year-old male patient.

## SUMMARY

Controversy continues to cloud the issue of third molar retention, although enough information is available for the surgeon to make informed decisions in recommending retention or extraction for his or her patients. The following points should be considered when advising patients:

- Erupted, disease-free third molar teeth may be retained indefinitely
- "Asymptomatic" does not mean "disease-free"
- Periodontal abnormality is common at third molar sites, and may be difficult to control or eradicate with conventional periodontal therapy techniques because of abnormal eruption patterns or proximity of teeth to the mandibular ramus
- Third molar sites commonly harbor a microbial flora known to be associated with periodontal disease, and evidence suggests that third molar sites may first be affected by periodontitis that moves to more anterior locations over time
- Acute or chronic pericoronitis sites may also harbor periodontal pathogens
- The periodontal status of second molars tends to improve after extraction of third molars that exhibit periodontal abnormality
- Pericoronal tissue that is histologically indistinguishable from dentigerous cyst may affect greater than one-third of impacted third molars without abnormal pericoronal radiolucency, and this is more common in patients after age 20 years
- Symptoms do not correlate with the location of most dentigerous cysts

- Third molar position may change long after the "normal" eruption time
- At present, the relationship of retained third molars to systemic disease is tenuous

The surgeon would do well to incorporate periodontal probing into the examination of the third molar for documentation of periodontal abnormality associated with erupted, partially erupted, and impacted third molar teeth. Patients who elect to retain third molars should undergo clinical and radiographic examination regularly (perhaps as frequently as every 2 years) for early diagnosis of disease, because the prevalence of third molar abnormality (especially asymptomatic) appears to be much higher than previously thought. Younger patients unable or unwilling to have regular surveillance may wish to consider removal of teeth at high risk of present or future disease at an age when surgical morbidity is likely to be less.

## REFERENCES


1. Obiechina AE, Arotiba JT, Fasola AO. Third molar impaction: evaluation of the symptoms and pattern of impaction of mandibular third molar teeth in Nigerians. Odontostomatol Trop 2001;24:22–5.
2. White RP Jr, Proffit WR. Evaluation and management of asymptomatic third molars: lack of symptoms does not equate to lack of pathology. Am J Orthod Dentofacial Orthop 2011;140:10–7.
3. Fisher EL, Garaas R, Blakey GH, et al. Changes over time in the prevalence of caries experience or periodontal pathology on third molars in young adults. J Oral Maxillofac Surg 2012;70:1016–22.
4. Hill CM. Removal of asymptomatic third molars: an opposing view. J Oral Maxillofac Surg 2006;64: 1816–20.
5. Kandasamy S. Evaluation and management of asymptomatic third molars: watchful monitoring is a low-risk alternative to extraction. Am J Orthod Dentofacial Orthop 2011;140:10–7.
6. Kandasamy S, Rinchuse DJ. The wisdom behind third molar extractions. Aust Dent J 2009;54:284–92.
7. Friedman JW. The prophylactic extraction of third molars: a public health hazard. Am J Public Health 2007;97:1554–9.
8. Sasano T, Kuribara N, Iikubo M, et al. Influence of angular position and degree of impaction of third molars on development of symptoms: long-term follow-up under good oral hygiene conditions. Tohoku J Exp Med 2003;200:75–83.
9. Phillips C, Norman J, Jaskolka M, et al. Changes over time in position and periodontal probing status of retained third molars. J Oral Maxillofac Surg 2007; 65:2011–7.
10. Venta I, Turtola L, Ylipaavalmiemi P. Radiographic follow-up of impacted third molars from age 20 to 32 years. Int J Oral Maxillofac Surg 2001;30:54–7.
11. Kahl B, Gerlach KL, Hilgers RD. A long-term, follow-up, radiographic evaluation of asymptomatic impacted third molars in orthodontically treated patients. Int J Oral Maxillofac Surg 1994;23:279–85.
12. Sewerin I, von Wowern N. A radiographic four-year follow-up study of asymptomatic mandibular third molars in young adults. Int Dent J 1990;40:24–30.
13. Hill CM, Walker RV. Conservative, non-surgical management of patients presenting with impacted lower third molars: a 5-year study. Br J Oral Maxillofac Surg 2006;44:347–50.
14. Samsudin AR, Mason DA. Symptoms from impacted wisdom teeth. Br J Oral Maxillofac Surg 1994;32: 380–3.
15. Hazza'a AM, Bataineh AB, Odat AA. Angulation of mandibular third molars as a predictive factor for pericoronitis. J Contemp Dent Pract 2009;10:51–8.
16. Blakey GH, White RP Jr, Offenbacher S, et al. Clinical/biological outcomes of treatment for pericoronitis. J Oral Maxillofac Surg 1996;54:1150–60.
17. Halverson BA, Anderson WH 3rd. The mandibular third molar position as a predictive criteria for risk for pericoronitis: a retrospective study. Mil Med 1992;157:142–5.
18. Leone SA, Edenfield MJ, Cohen ME. Correlation of acute pericoronitis and the position of the mandibular third molar. Oral Surg Oral Med Oral Pathol 1986;62:245–50.
19. Gungormus M. Pathologic status and changes in mandibular third molar position during orthodontic treatment. J Contemp Dent Pract 2002;3:11–22.
20. Laine M, Venta I, Hyrkas T, et al. Chronic inflammation around painless partially erupted third molars. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2003;95:277–82.
21. Combes J, McColl E, Cross B, et al. Third molar related morbidity in deployed service personnel. Br Dent J 2010;209:E6.
22. Gelesko S, Blakey GH, Partrick M, et al. Comparison of periodontal inflammatory disease in young adults with and without pericoronitis involving mandibular third molars. J Oral Maxillofac Surg 2009;67:134–9.
23. Sixou JL, Migaud C, Jolilvet-Gougeon A, et al. Evaluation of the mandibular third molar pericoronitis flora and its susceptibility to different antibiotics prescribed in France. J Clin Microbiol 2003;41: 5794–7.
24. Sixou JL, Magaud C, Jolivet-Gougeon A, et al. Microbiology of mandibular third molar pericoronitis: incidence of beta-lactamase-producing bacteria. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2003;95:655–9.
25. Rajasuo A, Sihvonen OJ, Peltola M, et al. Periodontal pathogens in erupting third molars of periodontally

healthy subjects. Int J Oral Maxillofac Surg 2007;36: 818–21.
26. Leung WK, Theilade E, Comfort MB, et al. Microbiology of the pericoronal pouch in mandibular third molar pericoronitis. Oral Microbiol Immunol 1993;8: 306–12.
27. Mombelli A, Buser D, Lang NP, et al. Suspected periodontopathogens in erupting third molar sites of periodontally healthy individuals. J Clin Periodontol 1990;17:48–54.
28. Hurlen B, Olsen I. A scanning electron microscopic study on the microflora of chronic periocoronitis of lower third molars. Oral Surg Oral Med Oral Pathol 1984;58:522–32.
29. Mansfield JM, Campbell JH, Bhandari AR, et al. Molecular analysis of 16S rRNA genes identifies potentially pathogenic bacteria and archaea in the plaque of partially erupted third molars. J Oral Maxillofac Surg 2012;70:1507–14.
30. Peltroche-Llacsahuanga H, Reichart E, Schmitt W, et al. Investigation of infectious organisms causing pericoronitis of the mandibular third molar. J Oral Maxillofac Surg 2000;58:611–6.
31. Ness GM, Peterson LJ. Impacted teeth. In: Miloro M, editor. Peterson's principles of oral and maxillofacial surgery, vol. 1, 2nd edition. Hamilton (New Zealand): BC Decker; 2004. p. 141.
32. National Institute for Clinical Excellence. Guidance on the extraction of wisdom teeth. 2000. Available at: www.nice.org.uk/nicemedia/pdf/wisdomteethguidance.pdf. Accessed November 6, 2012.
33. Berge TI. Incidence of infections requiring hospitalization associated with partially erupted third molars. Acta Odontol Scand 1996;54:309–13.
34. Kunkel M, Morbach T, Kleis W, et al. Third molar complications requiring hospitalization. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2006;102: 300–6.
35. Kunkel M, Kleis W, Morbach T, et al. Severe third molar complications including death—lessons from 100 cases requiring hospitalization. J Oral Maxillofac Surg 2007;65:1700–6.
36. Venta I, Oikarinen VJ, Soderholm AL, et al. Third molars confusing the diagnosis of carcinoma. Oral Surg Oral Med Oral Pathol 1993;75:551–5.
37. Blakey GH, Marciani RD, Haug RH, et al. Periodontal pathology associated with asymptomatic third molars. J Oral Maxillofac Surg 2002;60:1227–33.
38. White RP Jr, Madianos PN, Offenbacher S, et al. Microbial complexes detected in the second/third molar region in patients with asymptomatic third molars. J Oral Maxillofac Surg 2002;60:1234–40.
39. Rajasuo A, Meurman JH, Murtomaa H. Periodontopathic bacteria and salivary microbes before and after extraction of partly erupted third molars. Scand J Dent Res 1993;101:87–91.
40. White RP Jr, Offenbacher S, Phillips C, et al. Inflammatory mediators and periodontitis in patients with asymptomatic third molars. J Oral Maxillofac Surg 2002;60:1241–5.
41. Blakey GH, Jacks MT, Offenbacher S, et al. Progression of periodontal disease in the second/third molar region in subjects with asymptomatic third molars. J Oral Maxillofac Surg 2006;64:189–93.
42. Garass RN, Fisher EL, Wilson GH, et al. Prevalence of third molars with caries experience or periodontal pathology in young adults. J Oral Maxillofac Surg 2012;70:507–13.
43. White RP Jr, Offenbacher S, Blakey GH, et al. Chronic oral inflammation and the progression of periodontal pathology in the third molar region. J Oral Maxillofac Surg 2006;64:880–5.
44. Elter JR, Cuomo CJ, Offenbacher S, et al. Third molars associated with periodontal pathology in the Third National Health and Nutrition Examination Survey. J Oral Maxillofac Surg 2004;62: 440–5.
45. Blakey GH, Gelesko S, Marciani RD, et al. Third molars and periodontal pathology in American adolescents and young adults: a prevalence study. J Oral Maxillofac Surg 2010;68:325–9.
46. Blakey GH, Golden BA, White RP Jr, et al. Changes over time in the periodontal status of young adults with no third molar periodontal pathology at enrollment. J Oral Maxillofac Surg 2009;67:2425–30.
47. White RP Jr, Phillips C, Hull DJ, et al. Risk markers for periodontal pathology over time in the third molar and non-third molar regions in young adults. J Oral Maxillofac Surg 2008;66:749–54.
48. Blakey GH, Hull DJ, Haug RH, et al. Changes in third molar and nonthird molar periodontal pathology over time. J Oral Maxillofac Surg 2007;65:1577–83.
49. Moss KL, Ruvo AT, Offenbacher S, et al. Third molars and progression of periodontal pathology during pregnancy. J Oral Maxillofac Surg 2007;65: 1065–9.
50. Moss KL, Mauriello S, Ruvo AT, et al. Reliability of third molar probing measures and the systemic impact of third molar periodontal pathology. J Oral Maxillofac Surg 2006;64:652–8.
51. Garass R, Moss KL, Fisher EL, et al. Prevalence of visible third molars with caries experience or periodontal pathology in middle-aged and older Americans. J Oral Maxillofac Surg 2011;69: 463–70.
52. Moss KL, Oh ES, Fisher E, et al. Third molars and periodontal pathologic findings in middle-age and older Americans. J Oral Maxillofac Surg 2009;67: 2592–8.
53. Elter JR, Offenbacher S, White RP, et al. Third molars associated with periodontal pathology in older Americans. J Oral Maxillofac Surg 2005;63:179–84.

54. Montero J, Mazzaglia G. Effect of removing an impacted mandibular third molar on the periodontal status of the mandibular second molar. J Oral Maxillofac Surg 2011;69:2691–7.
55. Coleman M, McCormick A, Laskin DM. The incidence of periodontal defects distal to the maxillary second molar after impacted third molar extraction. J Oral Maxillofac Surg 2011;69:319–21.
56. Dicus C, Blakey GH, Faulk-Eggleston J, et al. Second molar periodontal inflammatory disease after third molar removal in young adults. J Oral Maxillofac Surg 2010;68:3000–6.
57. Blakey GH, Parker DW, Hull DJ, et al. Impact of removal of asymptomatic third molars on periodontal pathology. J Oral Maxillofac Surg 2009; 67:245–50.
58. Faria AI, Gallas-Torreira M, Lopez-Raton M. Mandibular second molar periodontal healing after impacted third molar extraction in young adults. J Oral Maxillofac Surg 2012;70:2732–41.
59. Chaves AJ, Nascimento LR, Costa ME, et al. Effects of surgical removal of mandibular third molar on the periodontium of the second molar. Int J Dent Hyg 2008;6:123–8.
60. Krausz AA, Machtei EE, Peled M. Effects of lower third molar extraction on attachment level and alveolar bone height of the adjacent second molar. Int J Oral Maxillofac Surg 2005;34:756–60.
61. Dodson TB, Richardson DT. Risk of periodontal defects after third molar surgery: an exercise in evidence-based clinical decision-making. Oral Maxillofac Surg Clin North Am 2007;19:93–8.
62. Kugelberg CF. Impacted lower third molars and periodontal health. An epidemiological, methodological, retrospective and prospective clinical, study. Swed Dent J Suppl 1990;68:1–52.
63. Ahmad N, Gelesko S, Shugars D, et al. Caries experience and periodontal pathology in erupting third molars. J Oral Maxillofac Surg 2008;66:948–53.
64. Venta I, Meurman JH, Murtomaa H, et al. Effect of erupting third molars on dental caries and gingival health in Finnish students. Caries Res 1993;27: 438–43.
65. Polat HB, Ozan F, Kara I, et al. Prevalence of commonly found pathoses associated with mandibular impacted third molars based on panoramic radiographs in Turkish population. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2008;105: e41–7.
66. Stanley HR, Alattar M, Collett WK, et al. Pathological sequelae of "neglected" impacted third molars. J Oral Pathol 1988;17:113–7.
67. Alattar M, Baughman RA, Collett WA. A survey of panoramic radiographs for evaluation of normal and pathologic findings. Oral Surg Oral Med Oral Pathol 1980;50:472–8.
68. Al-Khateeb TH, Bataineh AB. Pathology associated with impacted mandibular third molars in a group of Jordanians. J Oral Maxillofac Surg 2006;64: 1598–602.
69. Yildirim G, Ataoglu H, Mihmanli A, et al. Pathologic changes in soft tissues associated with asymptomatic impacted third molars. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2008;106:14–8.
70. Baykul T, Baglam AA, Aydin U, et al. Incidence of cystic changes in radiographically normal impacted lower third molar follicles. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2005;99:542–5.
71. Stathopoulos P, Mezitis M, Kappatos C, et al. Cysts and tumors associated with impacted third molars: is prophylactic removal justified? J Oral Maxillofac Surg 2011;69:405–8.
72. Guven O, Keskin A, Akal UK. The incidence of cysts and tumors around impacted third molars. Int J Oral Maxillofac Surg 2000;29:131–5.
73. Brkic A, Mutlu S, Kocak-Berberoglu H, et al. Pathological changes and immunoexpression of p63 gene in dental follicles of asymptomatic impacted lower third molars. J Craniofac Surg 2010;21: 854–7.
74. Raprasitkul S. Pathologic change in the pericoronal tissues of unerupted third molars. Quintessence Int 2001;32:633–8.
75. Manganaro AM. The likelihood of finding occult histopathology in routine third molar extractions. Gen Dent 1998;46:200–2.
76. Mesgarzadeh AH, Esmailzadeh H, Abdolrahimi M, et al. Pathosis associated with radiographically normal follicular tissues in third molar impactions. Indian J Dent Res 2008;19:208–12.
77. Kotrashetti VS, Kale AD, Bhalaerao SS, et al. Histopathologic changes in soft tissue associated with radiographically normal impacted third molars. Indian J Dent Res 2010;21:385–90.
78. Simsek-Kaya G, Ozbek E, Kalkan Y, et al. Soft tissue pathosis associated with asymptomatic impacted lower third molars. Med Oral Patol Oral Cir Bucal 2011;16:e929–36.
79. Glosser JW, Campbell JH. Pathologic change in soft tissues associated with radiographically "normal" third molar impactions. Br J Oral Maxillofac Surg 1999;37:259–60.
80. Adelsperger J, Campbell JH, Coates DB, et al. Early soft tissue pathosis associated with impacted third molars without pericoronal radiolucency. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2000;89: 402–6.
81. Daley TD, Wysocki GP. The small dentigerous cyst: a diagnostic dilemma. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1995;79:77–81.
82. Campbell JH, Coates DB, Summerlin D-J, et al. Are third molar symptoms associated with the presence

of dentigerous cysts? J Oral Maxillofac Surg 2005; 63(Suppl 1):38.
83. Kim J, Ellis GL. Dental follicular tissue: misinterpretation as odontogenic tumors. J Oral Maxillofac Surg 1993;51:762–7.
84. Eisenberg E. Discussion: dental follicular tissue: misinterpretation as odontogenic tumors. J Oral Maxillofac Surg 1993;51:767–8.
85. Damante JH, Fleury RN. A contribution to the diagnosis of the small dentigerous cyst or the paradental cyst. Pesqui Odontol Bras 2001;15: 238–46.
86. Stanley HR, Krogh H, Pannkuk E. Age changes in the epithelial components of follicles (dental sacs) associated with impacted third molars. Oral Surg Oral Med Oral Pathol 1965;19:128–39.