

Diseases associated with mandibular third molar teeth

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Key points

Provides awareness of the change in third molar disease as a consequence of NICE Guidance.

Highlights that an increase in caries is an indication for third molar removal.

Discusses increase in mandibular second molar tooth distal cervical caries in patients.

Aims To evaluate the clinical characteristics of mandibular third molar teeth (Md3M) requiring removal and to compare the characteristics of impacted Md3M with non-impacted Md3M. **Methods** One thousand and eleven patients who had 1,431 Md3M removed were evaluated. Features recorded included the age and gender of patients, the primary diagnosis indicating removal, the angulation and impaction status of the Md3M. **Results** The most common indications for Md3M removal were pericoronitis (49%), caries and related disease (C&RD) (27%), and distal cervical caries (DCC) of the mandibular second molar tooth (Md2M) (14%). The mean age of patients requiring removal of Md3M was 32.4 years. The mean age of patients, based on the angulation of impaction, were 28.6 years for vertical impaction, 30.1 years for mesio-angular impaction, 29.6 years for disto-angular impaction, 31.7 years for horizontal impacted and 41.6 years for non-impacted Md3M. The mean age of patients, based on the most common diseases were, 27.5 years for pericoronitis, 32.7 years for Md2M DCC, 36.1 years for C&RD, and 46.3 years for periodontal disease. Forty-one percent of all patients have Md3M removed due to disease related to dental caries with Md2M DCC accounting for 44% of all mesio-angular impacted Md3M removed. **Conclusion** Third molar disease varies according to the type of Md3M impaction. Impacted Md3M succumb to disease earlier than non-impacted Md3M. Pericoronitis remains the most common indication for impacted Md3M removal, however, C&RD and Md2M DCC have become more prevalent and are seen in older population groups. Md2M DCC is predominantly seen related to impacted mesio-angular third molars. Non-impacted Md3M, when indicated for removal, are generally removed in older patients due to C&RD and periodontal disease. The authors conclude that impacted third molars are more likely to be removed in younger patients due to pericoronitis while caries related disease (C&RD and Md2M DCC) is more common in older patient groups. With Md2M DCC accounting for 44% of all mesio-angular impacted Md3M being removed, consideration should be given to early intervention in the management of patients with mesio-angular impacted teeth.

Introduction

The eruption process for mandibular third molar teeth (Md3M) can result in two distinct end-points. Where present, many can erupt into a functional non-impacted position, however, many Md3M become impacted having failed to erupt into a functional position. Both impacted and non-impacted

mandibular third molar teeth can succumb to, or contribute to, a variety of dental related diseases that can indicate the removal of the Md3M tooth.¹⁻⁴ Common Md3M diseases include pericoronitis; dental caries; caries related disease such as peri-apical infection; odontogenic cyst formation and periodontal disease. Md3M can contribute to and be a causative factor in the development of disease in mandibular second molar teeth (Md2M) such as distal cervical caries (DCC) or periodontal disease.⁵⁻¹⁷ In addition, Md3M may also be removed to facilitate other forms of dental treatment such as orthodontics and orthognathic surgery.^{3,4}

In 2000 the National Institute of Health & Clinical Excellence (NICE) introduced its

guidance on the removal of wisdom teeth. Since then the profile of third molar disease has changed.¹⁸ During the period of 1995-2010, the mean age of patients having third molars removed increased from 28 to 32 years, with an associated increase in the incidence of dental caries as the primary indication for the removal of third molar teeth by over 200%.¹⁸⁻²⁰

This paper reports on a prospective cohort of 1011 patients attending for Md3M removal. The aims of the study were to determine the primary clinical indication for Md3M removal and to ascertain the variation and spectrum of disease based on the nature of impaction of the Md3M tooth. Both impacted Md3M and functional non-impacted Md3M were included in the study group cohort.

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Methodology

Data from 1,011 patients attending for Md3M removal was collated longitudinally over a 2-year period from 2013–2015 and then retrospectively analysed. Patients were evaluated and the variables recorded were; age, gender, the eruption status of the Md3M, the primary clinical indication for the removal of the Md3M tooth, and the angulation of impaction of the Md3M.

The primary aim of the study was to determine the clinical diagnosis for Md3M removal centred on five year age cohorts of patients to determine if there was any age-related variation. Furthermore, to assess these clinical diagnoses in relation to the eruption and angulation of impaction of the Md3M and to determine any association with the age of patients.

The eruption status was defined as either unerupted, partially erupted, erupted or over-erupted. Any tooth that was detectable either visually or clinically with a periodontal probe was deemed exposed to the oral environment and consequently defined as partially erupted. Teeth with a visible occlusal surface but with a high distal gingival collar were also deemed partially erupted. Md3M, which were defined as erupted, had a complete gingival collar

below the level of the maximum bulbosity of the crown and sitting in a vertical functional position on the level of the occlusal plane. The angulation of the Md3M was defined by convention as either vertical, mesio-angular, disto-angular, horizontal, or ectopic (ectopic was defined as all other possible angles of impaction distinct of the other four; for example, inverted.)

The primary diagnosis and clinical indication for Md3M removal was recorded but was not circumscribed: this was to permit any possible diagnoses to be recorded. Patients requiring Md3M removal due to pulpitis, dental abscess, peri-apical periodontitis, etc, where caries of the Md3M tooth was the promoter lesion for the development of these consequent diseases, were defined and recorded collectively as 'caries and related disease' (C&RD), as these diagnoses represent specific stages of the progression of dental caries. All subgroups of pericoronitis, such as acute, chronic, sub-acute and recurrent pericoronitis were grouped collectively into a single diagnosis of pericoronitis.

All patients attended either a primary care-based specialist oral surgery clinic, or a secondary care oral surgery department of a major teaching hospital. Treatment was

carried out with either local anaesthesia, local anaesthesia and sedation, or day-case general anaesthesia.

Statistical analysis

Sample size was determined by power calculation and the sample and outcome characteristics were summarised using descriptive statistics. The comparison of Md3M subgroups for the disease variation and the Md3M angulations of impaction were carried out using Z test for proportions. The mean age of patients for different disease presentation and with impaction status were compared using one way ANOVA. Statistical significance was assumed at 5% level and all the analyses were carried out using SPSS version 23.0.

Results

Of the 1,011 patients who were assessed, 604 (60%) were female and 407 (40%) male. In total, 591 patients had one Md3M removed and 420 patients had bilateral Md3M removed: a total of 1431 Md3M were removed. The number of Md3M present with no clinical indication for removal was 376, and 215 Md3M were clinically absent. The mean age of patients having Md3Ms removed was 32.4 years, (SD 11.5years, range 12–87 years).

Md3M characteristics and disease

The overall distribution of disease that indicated Md3M removal is shown in Table 1. Pericoronitis was the most common indication recorded accounting for 49% of all Md3M removed. C&RD for 27% of Md3M removed; Md2M DCC for 14%; periodontal disease for 5%, and dental/odontogenic cyst for 2%. Collectively, the remaining ten recorded diagnoses accounted for 4% of all diagnoses, and individually accounted for less than 1%. Caries combined, that is, C&RD and Md2M DCC, as an overall indication for removal of Md3M, accounted for the removal of 41% of all Md3M.

Of the 1431 Md3M removed, a total of 82% Md3M were impacted and 18% were vertical, non-impacted and in a functional position. Mesio-angular impacted Md3M accounted for 29% of the total removed, with horizontal Md3M impactions accounting for 14%; disto-angular Md3M impactions for 15%, and ectopic impactions for less than 1%. Vertically impacted Md3M accounted for 24% and 18% Md3M were vertical and non-impacted (Table 2).

If non-impacted Md3M are isolated from and compared with impacted Md3M then

Table 1 Primary diagnosis and distribution of all Md3M requiring removal

| Diagnosis for removal | Number of Md3M removed | Percentage distribution (%) |
|---|------------------------|-----------------------------|
| 1 – Pericoronitis | 698 | 49% |
| 2 – Caries & related disease (C&RD) | 382 | 27% |
| 3 – Md2M DCC | 198 | 14% |
| 4 – Periodontal disease | 63 | 5% |
| 5 – Dentigerous/odontogenic cyst | 33 | 2% |
| 6 – Prevention DCC second molar | 18 | 1% |
| 7 – Pre-orthognathic surgery | 12 | 0.80% |
| 8 – Food trap | 9 | 0.60% |
| 9 – External resorption of second molar | 4 | 0.30% |
| 10 – Prophylactic secondary to GA | 4 | 0.30% |
| 11 – Fractured tooth (not caries) | 3 | 0.20% |
| 12 – Pre-orthodontic | 2 | 0.20% |
| 13 – Pre-radiotherapy | 2 | 0.10% |
| 14 – Ramus bone graft pre-implant | 1 | 0.10% |
| 15 – Internal resorption | 1 | 0.10% |
| 16 – Non function | 1 | 0.10% |
| Total number of Md3M removed | 1,431 | 100% |

Table 2 Primary diagnosis and distribution of Md3M requiring removal based on angulation and impaction

| Primary diagnosis for removal of Md3M | Vertical impaction | Disto-ang impaction | Horizontal impaction | Mesio-ang impaction | Ectopic impaction | Vertical non-impacted |
|---------------------------------------|--------------------|---------------------|----------------------|---------------------|-------------------|-----------------------|
| (N = 1,431) | N = 348 (24%) | N = 210 (15%) | N = 198 (14%) | N = 413 (29%) | N = 11(<1%) | N = 251 (18%) |
| Pericoronitis | 271 (78%) | 176 (84%) | 106 (53%) | 131 (32%) | 6 (54%) | 8 (3%) |
| C&RD | 56 (16%) | 26 (12%) | 22 (11%) | 62 (15%) | Nil | 213 (85%) |
| Md2M DCC | Nil | Nil | 18 (9%) | 180 (44%) | Nil | Nil |
| Periodontal disease | 2 (<1%) | 3 (1.5%) | 25 (13%) | 13 (3%) | Nil | 22 (9%) |
| Dentigerous/odontogenic cyst | 4 (1%) | 4 (2%) | 16 (8%) | 5 (1%) | 4 (36%) | Nil |
| Prevention DCC second molar | Nil | Nil | 3 (1%) | 14 (3%) | Nil | Nil |
| Pre-orthodontic/ orthognathic surgery | Nil | Nil | 4 (2%) | 6 (1%) | Nil | Nil |
| All other indications total | 15 (<5%) | 1 (<1%) | 4 (2%) | 2 (<1%) | 1 (9%) | 8 (<4%) |

the distribution of disease can be considered comparatively. Pericoronitis accounted for the removal of 58% of impacted Md3M compared with 3% of non-impacted Md3M ($P < 0.0001$), C&RD for 14% of impacted teeth compared with 84% of non-impacted teeth ($P < 0.0001$), Md2M DCC for 17% of impacted teeth and 0% of non-impacted teeth ($P < 0.0001$), periodontal disease for 4% of impacted teeth and 9% of non-impacted teeth ($P < 0.001$), and finally dental/odontogenic cyst for 3% of impacted teeth compared with 0% non-impacted ($P < 0.01$).

The most common eruption status for Md3M requiring removal was that of partial eruption, which totalled 1133 Md3M (79%). Erupted teeth accounted for 251 Md3M removed (18%); unerupted teeth accounted for 43 Md3M (3%), and four Md3M were over-erupted (<1%).

Md3M disease diagnoses and angulations

Disease diagnoses in relation to the angulation and impaction of the Md3M were also considered and are presented in Table 2 and Figure 1.

Of the most common diseases, pericoronitis accounted for the removal of 32% of all mesio-angular Md3M compared with 84% of all disto-angular Md3M ($P < 0.001$); 78% of all vertical impactions ($P < 0.001$); 53% of all horizontal Md3M ($P < 0.001$) and 3% of vertical non-impacted teeth ($P < 0.001$).

In contrast C&RD accounted for the removal of 15% of mesio-angular Md3M compared with 12% of disto-angular Md3M ($P = 0.4$), 16% of all vertical Md3M ($P = 0.7$), 11% of horizontal Md3M ($P = 0.2$), but 85% of vertical non-impacted teeth ($P < 0.001$). DCC of the Md2M accounted for the removal of 44% of all mesio-angular Md3M and 9% of horizontal

Md3M ($P < 0.001$) but was not recorded in any of the other groups ($P < 0.001$).

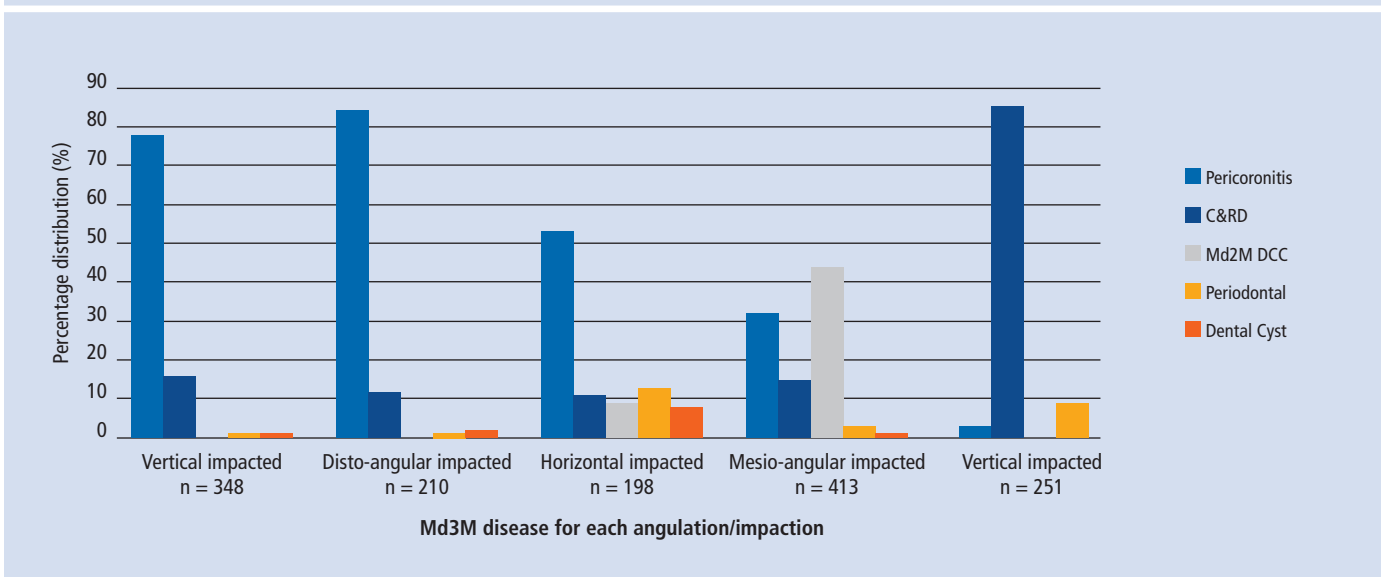
Periodontal disease accounted for the removal of 13% of all horizontal impacted Md3M compared with 3% of mesio-angular Md3M ($P < 0.001$); 1.5% of disto-angular Md3M ($P < 0.001$); 9% of vertical non-impacted Md3M ($P = 0.18$) and less than 1% of vertical impacted Md3M ($P < 0.001$).

The variation of disease seen in the differing types of impaction suggests that certain diseases, such as Md2M DCC, occur dependent upon the angulation of impaction and other disease, such as C&RD, independent of the angulation.

Mean age, impaction status & disease

The mean age of patients having Md3Ms removed was 32.4 years (range 12–87 years, SD: 11.5 years). In addition, the mean age of patients, based on the impaction status of the Md3M was

Fig 1 Percentage distribution of main Md3M diseases based on angulation impaction status



calculated (Fig. 2) and the mean age of patients based on the most common diagnoses (Fig. 3).

For patients having a mesio-angular Md3M removed, the mean age of patients was 30.1 years (range 12–67 years, SD: 7.7 years); for disto-angular Md3M impactions, the mean age was 29.6 years (range 19–86 years, SD: 8.3 years); for horizontal Md3M impactions – 31.8 years, (range 14–87 years, SD: 10.3 years); for vertical Md3M impactions – 28.6 years, (range 16–57 years, SD: 7.5 years); for vertical non-impacted Md3M 41.6 years, (range 17–83 years, SD: 15.6 years); and for ectopic impactions the mean age was 31.3 years, (range 18–45 years, SD 9.6 years). For reference, the Office for National Statistics in the UK report that the mean age of the UK population is 40.9 years.²¹

In terms of disease, for the most common diagnoses related to patients having a Md3M removed, the mean age of patients with a diagnosis of pericoronitis was 27.5 years (range 16–70 years, SD: 5.8 years); for C&RD, the mean age was 36.1 years (range 17–86 years, SD: 13.3 years); for periodontal disease, 46.3 years, (range 24–81 years, SD: 13.6 years); for Md2M DCC, 32.7 years, (range 21–55 years, SD: 7.3 years); and for dentigerous/odontogenic cyst, 43.1 years, (range 14–87 years, SD: 16.4 years). In relation to vertical impacted and non-impacted Md3M with a diagnosis of C&RD, the mean age of patients with a vertically impacted third molar was 31.9 years (range 19–65 years, SD: 9.6 years) and for a vertically non-impacted third molar it was 39.7 years (range 17–83 years, SD: 14.7 years).

Discussion

The spectrum of disease and impactions

This study, as with other reported studies, reports pericoronitis as the most common indication for Md3M removal, with dental caries, cyst formation and periodontal disease being other common diseases associated with Md3M.^{22,23} The scope of impacted Md3M angulations in this study is similar to other studies.^{22–24} Most Md3M studies do not, however, emphasise whether non-impacted Md3M are included in individual case-series or whether they have been incorporated as vertical impacted Md3M. The spectrum of disease related to non-impacted Md3M in this study is significantly different to the disease spectrum for impacted teeth and in a significantly older population ($P < 0.001$).

When considering the disease spectrum of Md3M, it is important to consider Md3M disease in relation to each type of Md3M impaction rather than produce a summative account for all Md3M. By categorising disease in relation to Md3M impaction, we can reflect on the clinical significance that the nature of impaction may have on the potential disease outcome for patients.

Pericoronitis

Pericoronitis is the most common indication for the removal of Md3M as a whole (49%), but where it accounts for only 3% of non-impacted vertical Md3M, it accounts for 32% of mesio-angular Md3M, 53% of horizontal impactions, 78% of vertical impaction and 84% of

disto-angular impactions ($P < 0.001$) (Fig. 1). The reasons for the variation in pericoronitis related to the differing types of impaction may be explained by the local anatomy and the presence of an operculum of mucosa overlying the occlusal surface of vertical and disto-angular impactions. This would create a local environment conducive to local soft tissue infections secondary to poor or inadequate oral hygiene. Due to the inclination of a mesio-angular Md3M this would tend to elevate the distal aspect of the crown away from the soft tissues eliminating the operculum and exposing the distal surface, which may then be more accessible to oral hygiene and reduce risk of pericoronitis.

Caries and related disease

C&RD accounts for 27% of all Md3M extractions with C&RD in each of the main categories of impacted Md3M comparatively uniform. C&RD accounted for 15% of mesio-angular impactions, 12% of disto-angular impactions, 11% horizontal impactions and 16% of vertical impactions were removed due to C&RD. This suggests that the diagnosis and incidence of C&RD is independent of the type of Md3M impaction. However, compared with impacted Md3M, C&RD accounts for 85% of all non-impacted vertical Md3M removal ($P < 0.001$) (Fig. 1). Md3M C&RD has been shown to increase with age and vertical, non-impacted Md3M tend not to be associated with the common diseases of impaction such as pericoronitis ($P < 0.001$). In older middle-aged patient groups with retained Md3M, non-impacted vertical third molars are more common than

Fig. 2 Mean age of patients requiring Md3M removal based on Md3M angulation and impaction

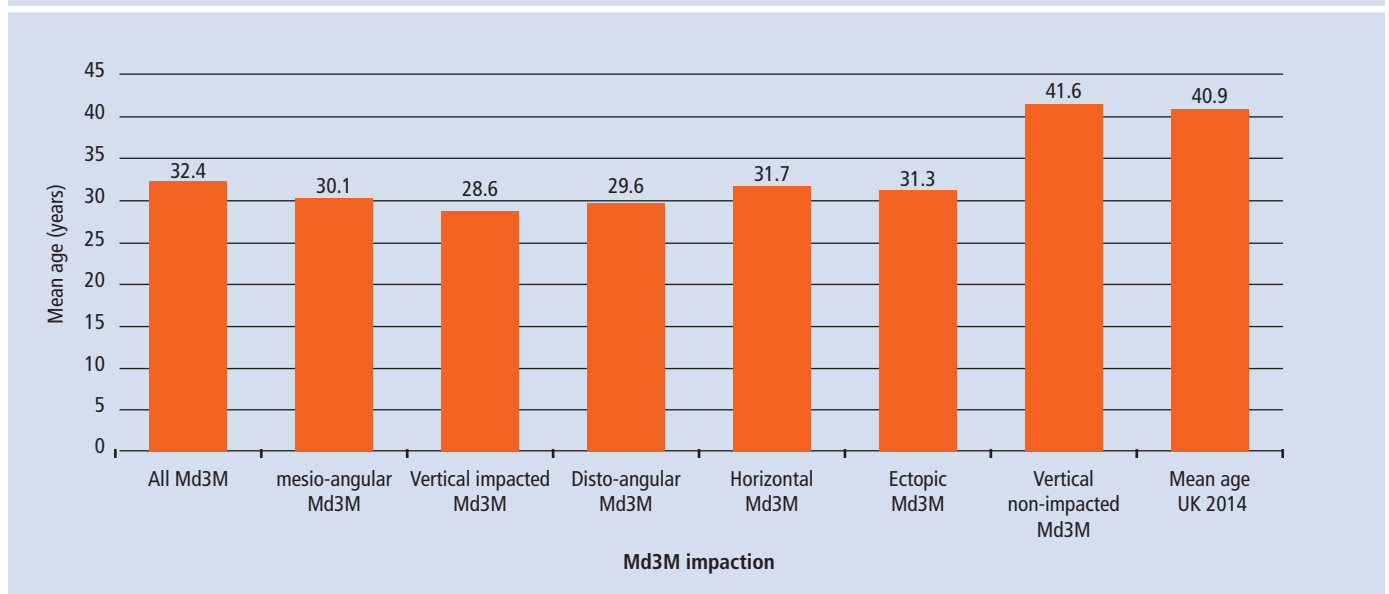
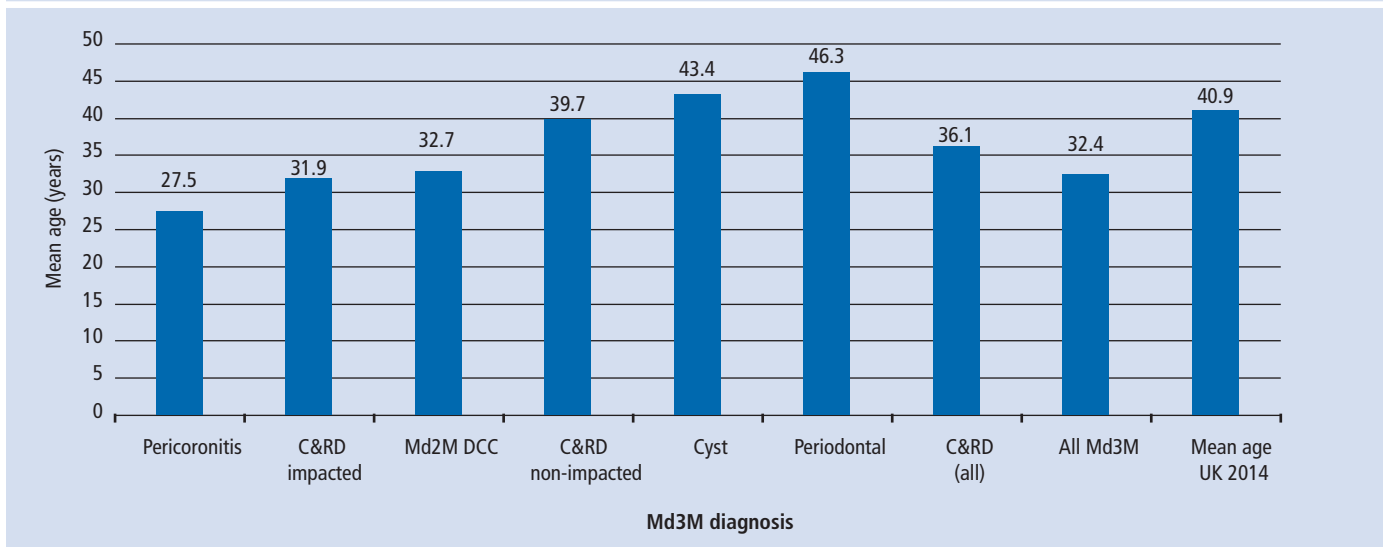


Fig 3 Mean age of patients requiring Md3M removal based on Md3M diagnosis



impacted third molars.²⁵ A non-impacted Md3M would not be excluded from the potential of experiencing dental disease at some point but most would remain functional and disease free for a period of time before a proportion of them succumb to dental disease such as caries and periodontal disease as reported here. This is supported by the observation that the mean age of patients with impacted Md3M with C&RD compared with non-impacted Md3M with C&RD is 31.9 years compared with 39.7 years respectively ($P < 0.001$).

Md2M DCC

Md2M DCC, as an indication for Md3M removal, has been reported as contributing a relatively small proportion of Md3M removal in older studies.^{5,22–24} In this series it is not associated with vertical, disto-angular or ectopic impactions and its significance should not be considered collectively with all other types of Md3M impactions.

Md2M DCC in this study accounts for 14% of all Md3M removed and 17% of all impacted Md3M removed. It accounts for 9% of all horizontal impactions, however, Md2M DCC accounts for 44% of all mesio-angular Md3M removed.

The mean age of patients with Md2M DCC is 32.7 years compared with patients with pericoronitis (27.5 years) ($P = 0$), with pericoronitis being the most common reason for Md3M removal. In this case series over 50% of all Md3M are removed in patients between 20–29 years of age suggesting that the majority of patients who will require Md3M removal will have lost them by the time they are 30 years old. This corroborates that Md2M DCC is a

disease of older patients and, as pericoronitis is the most common indication for impacted Md3M removal, patients will generally succumb to other forms of disease such as this before Md2M DCC can occur.

In addition to the loss of the Md3M to facilitate treatment of Md2M DCC, it has been reported that Md2M DCC has significant financial costs attributed to it and results in the eventual loss of 40% of Md2M.²⁶ The primary risk factor related to Md2M DCC formation is the partially erupted mesio-angular or horizontally impacted Md3M and with such a high incidence of Md2M DCC in mesio-angular impactions, consideration should be given to this disease's potential.

NICE advocated the proscriptio of prophylactic third molar removal in the late 1990s and the change in patient management had resulted in the mean age of patients requiring third molar removal increasing to 32 years by 2009/10, with 30% of third molars removed due to dental caries as the primary indication for removal.¹⁸ This data could not differentiate between third molar caries and Md2M DCC, however, in this present study Md3M C&RD accounted for 14% of all impacted Md3M removed and Md2M DCC for 17% of impacted Md3M removed: in total 31% of all impacted Md3M were removed due to all categories of caries disease. With the addition of non-impacted Md3M C&RD, a total of 41% of Md3M were removed due to caries. Md2M DCC is the most common indication in this case series for the removal of a mesio-angular Md3M.

As 44% of all mesio-angular and 9% of horizontal Md3M removed due to Md2M DCC this

qualifies concern that observing and retaining mesio-angular Md3M, in particular, until disease occurs, may be an unsound management strategy. Contrary to NICE guidance, early removal of mesio-angular and horizontal Md3M may be indicated and should be considered so as to avoid the consequences of Md2M DCC.

Periodontal disease

Periodontal disease accounts for only 5% of all Md3M removed in this case series, however, it should be noted that only the primary indication for Md3M was recorded as opposed to all concomitant diseases that may have been associated with a particular Md3M. Nonetheless, periodontal disease was the primary indication for 12% of all horizontal, 9% of all vertical non-impacted Md3M, with smaller proportions for all other impacted teeth. Periodontal disease is generally a quiescent disease that patients are often unaware of and generally only gives rise to significant symptoms in the later stages of the disease. Periodontal disease has been reported to be a clinical finding related to impacted third molars,^{13–17} however, this data does not contradict these studies but may suggest that Md3M will become symptomatic and succumb to other Md3M diseases before periodontal disease becomes symptomatic and then the prime indicator for intervention.

Other disease

All the remaining indications for Md3M removal collectively accounted for 4% of all indications and less than 1% individually. Some of these indications for third molar removal are interventional to facilitate other

forms of treatment such as orthodontics, orthognathic and dental implant treatment, others are uncommon such as internal or external resorption and others may be very weak indicators for removal, such as food packing. Food packing, and similar diagnoses, should not be dismissed as an indication for Md3M removal as these types of problems can be a constant source of irritation to a patient and the preference of the patient for the removal of the offending tooth is as valid a treatment option than any. Although a small number: 18 (1%) of Md3M were removed for the prevention of Md2M DCC, consideration has to be given to the weight of evidence for the potential for this disease to occur and for patients to be able to consider the options of intervening early or monitoring accordingly.

Age and diagnoses

The mean age of patients requiring third molar removal was 32.4 years, however, there was marked variation of patients' mean age based upon diagnoses. One-way ANOVA test was used to compare the mean ages of patients based on the most common diseases. Pericoronitis, with a mean age of patients being 27.5 years; C&RD mean age 36.1 years; and Md2M DCC, mean age 32.7 years, when compared individually with each other, showed a statistically significant relationship ($P = 0$).

The eruption of Md3M is generally accepted to occur between the ages of 18–24 years and the timing of disease presentation varies. Pericoronitis occurs frequently and relatively soon after failed eruption of the Md3M; it is the most common disease associated with impacted Md3M and in general occurs in younger age groups. Caries, in comparison, is a disease that will take time to develop before significant clinical signs and symptoms become present. As an indication for Md3M removal, C&RD occurs on average in older age groups than pericoronitis. Likewise, Md2M DCC tends to occur in older patient groups but only with those with a mesio-angular or horizontal impacted Md3M.

Primary v secondary disease

The primary consequence of third molar impaction is the failure of the occlusion to reach the endpoint of maturity with the resultant dental malocclusion at the posterior aspect of the dental arch. An impacted tooth is a developmental anomaly and is defined as a disease by the WHO within the ICD10 classifications of diseases (K011).²⁷ Impaction is

often overlooked as a disease in itself and the focus of defining third molar disease is often given to the consequent diseases of Md3M impaction, such as pericoronitis. However, the primary disease affecting the third molar is the impaction of the tooth and it is this which can then lead to consequential diseases such as pericoronitis, etc. These consequential diseases will generally occur secondary to the impaction, with patients experiencing a variety of differing disease. Where the third molar is erupted and functional, disease will not occur in the same manner as an impacted tooth. We should acknowledge that the impaction of the third molar is the primary disease that can then contribute to the development of secondary disease. Only in the non-impacted Md3M can we consider that caries, periodontal disease, etc, are the primary disease.

Variation in the characteristics of the Md3M contributes to when disease may occur and the type of disease that may occur. The capacity to understand the potential and the ability to anticipate third molar disease should guide clinical judgement in the management of patients. Understanding the spectrum and nature of disease in relation to impacted Md3M should allow better management of individual patients with impacted Md3M. Patients with third molars cannot be managed as a collective group as this can have negative outcomes, especially in relation to diseases such as Md2M DCC.

The prevalence of impacted third molars in the general population as a whole has been reported to be approximately 25%.²⁸ This figure is misleading as it would appear to include everyone, including people who have had third molars removed. This miscalculates the true prevalence as it mistakenly presumes that if a patient has no third molars that they never had any previously. It has been reported that the prevalence of impacted third molars in the 20–30 age group is over 70%.²⁹ It has also been reported that for those patients in middle-age only 13% retain an impacted Md3M.²⁶ Although these two later studies are not related, if these studies are representative of patients then 80% of patients with impacted third molars will have undergone third molar removal by the time they are middle-aged. With such a high potential proportion of the adult population requiring third molar removal, consideration should be given to addressing the potential for secondary disease rather than solely addressing secondary disease when it occurs.

Conclusions

Md3M can display a wide spectrum of disease that varies and is dependent on the type of Md3M impaction. Disease occurs in non-impacted Md3M as well as impacted Md3M with diseases affecting non-impacted teeth tending to be the typical dental diseases of caries and periodontal disease, and in an older population. Diseases related to impacted teeth reflect the more specific diagnoses of pericoronitis, Md3M caries and Md2M DCC, and in a younger population.

The variation of disease and the mean-age of patients seen in the differing types of impaction is significant in that some diseases, such as Md2M DCC, will occur dependent upon the angulation of impaction, and others, such as C&RD, independent of the angulation. Younger patients are more affected by disease such as pericoronitis and less so by other diseases such as C&RD, whereas older patients are more affected by C&RD and Md2M DCC.

Md2M DCC accounts for 44% of all mesio-angular impacted and 9% of horizontally impacted Md3M removed. The risk factors for the development of Md2M DCC have been previously reported.^{5–12} NICE guidance is flawed and early intervention in patients with impacted Md3M at risk of causing Md2M DCC should be considered and prophylactic intervention has a role to play in the management of patients.

1. National Institute for Clinical Excellence. Guidance on the removal of wisdom teeth. 2000. Available at <https://www.nice.org.uk/guidance/ta1> (accessed February 2018).
2. Scottish Intercollegiate Guidelines Network. Management of patients with unerupted and impacted third molar teeth. 2000. Available at <http://www.sign.ac.uk/guidelines/fulltext/43/index.html> (accessed February 2018).
3. Faculty of Dental Surgery of the Royal College of Surgeons of England. Current clinical practice and parameters of care: the management of patients with third molar teeth. 1997.
4. American Association of Oral & Maxillofacial Surgeons. Clinical Paper: The management of impacted third molar teeth. 2013.
5. McArdle L W, Renton T F. Distal cervical caries in the mandibular second molar: an indication for the prophylactic removal of the third molar? *BJOMS* 2005; **44**: 42–45.
6. Allen R T, Witherow H, Collyer J, Roper-Hall R, Nazir M A, Mathew G. The mesioangular third molar – to extract or not to extract? Analysis of 776 consecutive third molars. *Br Dent J* 2009; **206**: E23; discussion 586–587.
7. Ozeç İ, Hergüner Siso S, Taşdemir U, Ezirganlı S, Göktoğra G. Prevalence and factors affecting the formation of second molar distal caries in a Turkish population. *Int J Oral Maxillofac Surg* 2009; **38**: 1279–1282.
8. Chang S W, Shin S Y, Kum K Y, Hong J. Correlation study between distal caries in the mandibular second molar and the eruption status of the mandibular third molar in the Korean population. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2009; **108**: 838–843.

9. Falci S G, de Castro C R, Santos R C *et al.* Association between the presence of a partially erupted mandibular third molar and the existence of caries in the distal of the second molars. *Int J Oral Maxillofac Surg* 2012; **41**: 1270-1274.
10. Oderinu O H, Adeyemo W L, Adeyemi M O, Nwathor O, Adeyemi M F. Distal cervical caries in second molars associated with impacted mandibular third molars: a case-control study. *Oral Surg Oral Med Oral Pathol Oral Radiol*. 2012; DOI: 10.1016/j.oooo.2012.03.039.
11. McArdle L W, McDonald F, Jones J. Distal cervical caries in the mandibular second molar: an indication for the prophylactic removal of third molar teeth? Update. *Br J Oral Maxillofac Surg* 2014; **52**: 185-189.
12. Toedtling V, Coulthard P, Thackray G. Distal caries of the second molar in the presence of a mandibular third molar – a prevention protocol. *Br Dent J* 2016; **221**: 297-302.
13. Blakey G H, Marciani R D, Haug R H *et al.* Periodontal pathology associated with asymptomatic third molars. *J Oral Maxillofac Surg* 2002; **60**: 1227-1233.
14. Blakey G H, Jacks M T, 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**: 189-193.
15. White R P, Jr., Offenbacher S, Blakey G H *et al.* Chronic oral inflammation and the progression of periodontal pathology in the third molar region. *J Oral Maxillofac Surg* 2006; **64**: 880-885.
16. Elter J R, Offenbacher S, White R P, Jr. Association of third molars with periodontal pathology: The dental ARIC study. *J Oral Maxillofac Surg* 2004; **62**: 73-74.
17. Elter J R, Offenbacher S, White R P, Jr, Beck J D. Third molars associated with periodontal pathology in older Americans. *J Oral Maxillofac Surg* 2005; **63**: 179-184.
18. McArdle L W, Renton T. The effects of NICE guidelines on the management of third molar teeth. *Br Dent J* 2012; **213**: DOI: 10.1038/sj.bdj.2012.780.
19. NHS Digital. Hospital Episode Statistics. Available at www.hesonline.nhs.uk (accessed February 2018).
20. McArdle L W. NICE and the third molar debate. *FDJ* 2013; **4**: 166-171.
21. Office for National Statistics. National Population Projections: 2014 Statistical Bulletin. 2015. Available at <https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/bulletins/nationalpopulationprojections/2015-10-29> (accessed February 2018).
22. van der Linden W, Cleaton-Jones P, Lownie M. Diseases and lesions associated with third molars. Review of 1001 cases. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 1995; **79**: 142-145.
23. Knutsson K, Brehmer B, Lysell L, Rohlin M. Pathoses associated with mandibular third molars subjected to removal. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 1996; **82**: 10-17.
24. Bruce R A, Frederickson G C, Small G S. Age of patients and morbidity associated with mandibular third molar surgery. *J Am Dent Assoc* 1980; **101**: 240-245.
25. Brickley, M R; Tanner, M; Evans, D J; Edwards, M J; Armstrong, R A; Shepherd J P. Prevalence of third molars in dental practice attenders aged over 35 years. *Community Dent Health* 1996; **13**: 223-227.
26. McArdle L W, Patel N, Jones J, McDonald F. The mesially impacted mandibular third molar: The incidence and consequences of distal cervical caries in the mandibular second molar. *Surgeon* 2016; DOI: 10.1016/j.surge.2016.05.001.
27. World Health Organization. International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10). 2010.
28. Carter K, Worthington S. Predictors of third molar impaction: A systematic review and meta-analysis. *J Dent Res* 2016; **95**: 267-276.
29. Hugoson A, Kugelberg C F. The prevalence of third molars in a Swedish population: an epidemiological study. *Community Dent Health* 1988; **5**: 121-138.