What Has Been the United Kingdom’s Experience With Retention of Third Molars?

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Background: In 2000, the first National Institute of Clinical Excellence (NICE) guidelines related to third molar (M3) surgery, a commonly performed operation in the United Kingdom, were published. This followed research publications and professional guidelines in the 1990s that advised against prophylactic surgery and provided specific therapeutic indications for M3 surgery. The aim of the present report was to summarize the available evidence on the effects of guidelines on M3 surgery within the United Kingdom.

Materials and Methods: Data from primary care dental services and hospital admissions in England and Wales during a 20-year period (Hospital Episode Statistics 1989/1990 to 2009/2010), and from private medical insurance companies were analyzed. The volume and, where possible, the nature of the M3 surgery activity over time were assessed together, as were the collateral effects of the guidelines, including patient age at surgery and the indications for surgery.

Results: The volume of M3 removal decreased in all sectors during the 1990s before the introduction of the NICE guidelines. During the 20-year period, the proportion of impacted M3 surgery decreased from 80% to 50% of admitted hospital cases. Furthermore, an increase occurred in the mean age for surgical admissions from 25.5 to 31.8 years. The change in age correlated with a change in the indications for M3 surgery during that period, with a reduction in “impaction,” but an increase in “caries” and “pericoronitis” as etiologic factors, in accordance with the NICE guidelines.

Conclusion: The significant decrease in M3 surgery activity occurred before the NICE guidelines. Thus, M3 surgery has been performed at a later age, with indications for surgery increasingly in accordance with the NICE guidelines. The importance of clinical monitoring of the retained M3s is discussed.

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Third molar (M3) removal was once 1 of the most commonly performed surgical procedures in the English National Health Service (NHS). The NHS provides medical care, without additional cost at the point of contact, to the population (~50 million people), and it is 1 of the largest employers in Europe.

NHS primary dental care is not free for most adults, who must make copayments for primary dental care. Unlike some other health systems, general medical and dental practitioners in primary care provide a gatekeeper role to specialist care, only referring as required. This specialist care can occur in either pri-

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What is fundamentally distinctive to the British NHS system is that multidrug sedation and general anesthesia (GA) (intubated) might only be prescribed in the hospital setting. The definition of a primary care setting is that in which care is provided by a general practitioner and, rarely, specialists, with local anesthetic, with or without sedation. As a result, most specialist surgical care is provided in the hospital or “secondary care” setting using either sedation or GA. In contrast, in the United States, most insurance-based surgery is performed in the dental office (primary care setting). National policy changes have increasingly favored the provision of oral surgical care in primary care setting provided by specialists or those with special interest roles.

From 1988 to 1994, the volume of M3 surgery increased by one third, resulting in more than 150,000 patients annually undergoing M3 removal in secondary care. Unlike M3 operations in the United States, M3 surgery in the United Kingdom often uses GA and requires a stay in the hospital. Removing M3s in the hospital in high volumes is expensive to the health care system, and, as a surgical procedure, it has certain risks for individual patients. During 1994, M3 surgery was estimated to cost UK private medical care companies £22 million ($35 million) and the NHS £34 million ($54 million).1 In 1990, the estimates of costs from M3 surgery in the United States was $2 billion.

The removal of diseased or symptomatic lower M3s alleviates the pain and suffering associated with the pathology and improves oral health and function. However, just as with all clinical interventions, there is an element of risk inherent to M3 surgery. Aside from the obvious postoperative pain and discomfort and necessary rehabilitation, there are rare, but significant, risks of nerve injury from surgery. The incidence of temporarily impaired lingual and inferior alveolar nerve function is thought to range from 0.5% to 20% for M3 surgery, although permanent injury is much less frequent at 0.01% to 2%. Trigeminal nerve injury is complex, because it is the largest peripheral sensory nerve in the human body, represented by more than 40% of the sensory cortex. A recent report highlighted that 70% of patients with permanent lingual nerve and inferior alveolar injuries present with...
neuropathic pain, and many patients demonstrate post-traumatic stress disorder in relation to the significant pain and functional disability. However, because these cannot be completely repaired, the patient is left with a lifelong disability. If surgery is avoided, the risks include the probability of an infection, pathologic features, and carries on the distal surface of the second molars, resulting in a poorer prognosis for the adjacent teeth.\textsuperscript{5}

In 1979, the US National Institutes of Health held a symposium on M3 surgery (National Institutes of Health Consensus on M3 Surgery).\textsuperscript{6} One suggestion was that the practice of prophylactic M3 removal should cease. In the United Kingdom, this issue was first raised by Brickely and Shepherd and others,\textsuperscript{7-13} and media coverage appeared in almost all the national newspapers and included interviews on the most prominent UK radio and television current affairs programs. The media spotlight continued to be on third molar surgery (TMS) in the United Kingdom for the rest of the decade, resulting in the development of guidelines by the Royal College of Surgeons that were published in 1997.\textsuperscript{14} This was followed by the Scottish Intercollegiate Group recommendations.\textsuperscript{15} In 1997, a report estimated that 20\% of M3s removed in NHS patients were healthy teeth.\textsuperscript{14} In 1999, this was supported by the York clinical effectiveness unit stating, “There is no reliable research evidence to support a health benefit to patients from the prophylactic removal of pathology-free impacted M3s.”\textsuperscript{16} The UK National Institutes of Health estimated that if the guidelines were followed, the savings could be as much as £5 million.\textsuperscript{17}

In 2000, the National Institute of Clinical Excellence (NICE) published guidelines regarding M3 management.\textsuperscript{18} The guidelines recommended that “The practice of prophylactic removal of pathology-free impacted third molars should be discontinued.” There is no reliable evidence to support a health benefit to patients from the prophylactic removal of pathology-free teeth.\textsuperscript{19} Specific guidelines for M3 surgery were articulated (Table 1).

There has been heavy critique of the NICE M3 surgery guidelines from several parties in the United States citing, “The difficulty in applying these guidelines universally is that they are based around the premise of a nationally funded program in which removal of impacted third molars is typically hospital-based,” with the attendant increased costs associated with hospital and operating room use.\textsuperscript{20} However, more recently, a similar Cochrane Review on interventions for treating asymptomatic impacted M3s advised that watchful monitoring might be a more appropriate strategy: “Prudent decision-making, with adherence to specified indicators for removal, may reduce the number of surgical procedures by 60\% or more.”\textsuperscript{21} Finally, the American Public Health Association released a policy statement supporting NICE, stating that prophylactic surgery for M3s should be abandoned.\textsuperscript{19}

Surprisingly few studies on the effect of NICE guidelines on clinical practice have been published. Evidence has suggested a lack of compliance with the NICE guidelines, and others have reported that the NICE guidelines have had little effect on clinical practice (Table 2).\textsuperscript{22} In 2005, Tilley et al\textsuperscript{23} assessed Scottish dental service data and reported a significant decrease in surgical (“International Classification of Diseases” code F09.1) and nonsurgical (“International Classification of Diseases” code F09.3) removal of M3s from 1994 to 2004, which was associated with a significant decrease in the use of GA in primary care owing to implementation of the GA guidelines prohibiting the provision of GA in dental practice.

With regard to M3 surgery, although the NICE guidelines are generally accepted by surgeons, no study has yet tried to assess the effect of NICE guidelines globally across primary and secondary care in England.

The objectives of the present report were to describe the effects of the NICE guidelines on M3 surgery in terms of 1) trends in M3 surgery volume of admissions to the primary (general dental practice/dental offices) and secondary (hospital services) NHS and private sectors nationally (overall and by operating procedure codes F091 and F093); 2) trends in patient age at M3 surgery in NHS hospital care nation-

### Table 1. NICE M3 SURGERY GUIDELINES

<table>
<thead>
<tr>
<th>Action</th>
<th>Removal Approved by NICE</th>
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<tbody>
<tr>
<td>Approach</td>
<td>Surgical removal of impacted M3s should be limited to patients with evidence of pathologic features</td>
</tr>
<tr>
<td>Examples</td>
<td>Second or subsequent episodes of pericoronitis</td>
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<td></td>
<td>Unrestorable caries</td>
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<tr>
<td></td>
<td>Nontreatable pulpal and/or periapical pathologic findings</td>
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<tr>
<td></td>
<td>Cellulitis, abscess, and osteomyelitis</td>
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<tr>
<td></td>
<td>Internal/external resorption of tooth or adjacent teeth</td>
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<tr>
<td></td>
<td>Tooth fracture, disease of follicle, including cyst/tumor</td>
</tr>
<tr>
<td></td>
<td>Tooth/teeth impeding surgery or reconstructive jaw surgery</td>
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<tr>
<td></td>
<td>Tooth is involved in, or within, field of tumor resection</td>
</tr>
</tbody>
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Abbreviations: NICE, National Institute of Clinical Excellence; M3, third molar.

Data from National Institute for Clinical Excellence.\textsuperscript{18}

ally; and 3) indications for M3 surgery in NHS hospital care nationally using the “International Classification of Diseases,” 10 revision (World Health Organization) codes.

Materials and Methods

To achieve the stated purpose of examining the trends in M3 surgery activity from 1989/1990 to 2009/2010, we used several databases. The first was the Hospital Episode Statistics (HES) NHS admissions on the primary procedure for patients admitted to hospital based specialist care (1989/1990 to 2009/2010).

The second was the NHS primary dental care on M3 removal up to 2006 (dental practice board before 2006). Finally, the private medical insurance data (2 providers covering about 75% of the insurance market activity from 1989 to 2010) were examined. Descriptive analyses of the trend data were undertaken of population data sets within the defined study period. This included analysis of the M3 surgery activity over time (eg, volume, age, and indications for surgery). The latter used the surgical “International Statistical Classification of Diseases and Related Health Problems, 10th revision” codes F09.1 (“surgical removal of impacted wisdom tooth”) and F09.3 (“surgical removal of wisdom tooth”) and the collateral effects of the guidelines, including patient age at surgery (HES data) and the indications for surgery.

Results

PRIMARY CARE M3 SURGERY

National primary care data using primary care equivalent codes for M3 removal (Fig 2) demonstrated that from 1992/1993 to 2004/2005, M3 surgical activity peaked in 1996/1997 and decreased thereafter. Surgical data from primary dental care were not available from April 2006 onward.

SECONDARY CARE M3 SURGERY

Changes in the volume of admissions for M3 surgery to secondary and tertiary care service occurred from 1989/1990 to 2009/2010, as demonstrated by the coded surgical activity on removal of M3 surgery (codes F09.1 and F09.3; Fig 3). The M3 surgery volume was at 50,000 patient episodes in 1989 and had increased to 70,000 patient episodes in 1995, after which a significant decrease in activity occurred from 1996 onward. Thus, a significant decrease occurred in activity before the NICE guidelines, possibly in response to the Royal College of Surgeons guidelines in 1997.14 Some rebound in M3 surgery activity occurred in 1997 to 1998; however, a second phase of decline began lowering the activity to 40,000 patient episodes annually. From 2005/2006, a gradual increase in surgical activity appears, increasing to more than 60,000 patient M3 surgery episodes in 2009/2010 according to the hospital secondary care data (HES) relating to F09.1 (removal of impacted M3s) and F09.3 (removal of M3s). Removal of impacted M3s (F09.1) was at 30,000 patient episodes in 2000, decreasing to 22,000 in 2003/2004, with a slow increase from 2006 to 2009, back to 33,000 episodes of care. In contrast, removal of M3s (F09.3) was recorded at 14,000 patient episodes in 2000, increasing gradually to 27,000 final consultant episodes to 2009. Removal of nonimpacted M3s was, therefore, the dominant operation code.

PRIVATE CARE M3 SURGERY (INSURANCE-BASED)

Data on M3 surgery activity were obtained from private settings—data from the 2 leading health insurance providers, contributing to 75% of overall privately insured activity, which are generally provided in hospitals. For provider 1, the M3 surgery activity was at 4,000 to 5,000 patient episodes in 1995, decreasing to 2,000 in 2010. For provider 2, the M3 surgery activity was at 9,000 patient epi-
sodiums in 1995, decreasing to less than 4,000 in 2010. These data amounted to about one half of the volume of the NHS hospital admissions, decreasing to about 10% of NHS admissions during the period examined.

HOSPITAL CARE: INDICATIONS FOR, AND AGE AT, SURGERY

The following sections explore hospital activity data for England, in which most M3 surgery is currently undertaken, starting with patient age.

Trends in Age of M3 Surgery From 1989/1990 to 2009/2010 (Hospital Care)

The mean age of patients admitted for M3 surgery in secondary care in England and Wales has increased from 25.5 years in 1989/1990 to 31.8 years in 2009/2010, with increases gradually occurring across both codes (Fig 4).

Trends in Indications for Surgery

Using the operation codes for hospital admissions (F09.1 and F09.3), the indications for surgery (M3 surgery diagnosis) changed during the period assessed (Fig 5). First, disorders of tooth development (K010) significantly decreased in 1993/1994, and impaction (K011) has gradually decreased from 1994/1995 to 2009/2010. However, “impaction” still provided almost 50% of the indications for M3 surgery in 2010 (although this is not a specific NICE indication for M3 surgery). Diagnoses such as periapical abscess, anomaly of M3 position, and embedded/impacted, remained constant. “Pericoronitis” (K053) and “caries” (K029), which can relate to the M3 or the adjacent molar, have significantly increased from 1994/2005 to 2009/2010, now constituting 40% of the top 10 indications for M3 surgery. Both are NICE indications for M3 surgery.

Some evidence was seen that the indications for M3 surgery changed with patient age, because pericoronitis (inflammation of the gingiva around a partially erupted tooth) was more common in those aged 26 to 30 years, and caries was a more common indication for those aged 33 to 35 years, and dental abscess for those aged 37 years.

Discussion

The present report raises several important issues regarding the removal of M3s in England. First, M3 surgery remains a common procedure in the NHS; however, a reduction in activity occurred in association with professional and NICE guidelines in the 1990s and early 2000s across the NHS and private sectors. Second, the more recent increase in activity was associated with changes and specific initiatives in the health sector. Third, the average age of patients for whom M3 removal is undertaken has increased. Finally, M3 surgery has increasingly been used for nonimpacted M3s, with the indications for surgery shifting toward caries and pericoronitis. Each of these issues will be addressed in turn.

TRENDS IN VOLUME OF M3 SURGERY

The data we have presented highlight that M3 removal was, and remains, a common procedure within the NHS hospital dental services. However, in considering the health care system overall, a decrease has occurred in private and primary dental care M3 sur-
gery, although hospital M3 surgery, which initially decreased, appears to be increasing again. These data suggest that a shift might be occurring in required surgical activity from primary care and the private sector into NHS hospitals.

A clear reduction was seen in activity, across the NHS (primary and secondary) and in the private sectors, in the early/mid-1990s before the NICE guidelines. This was probably related to the National Institutes of Health recommendations and the many publications in this field attracting significant media interest on the issue of M3 surgery. In 2000, the National Institute of (Health and) Clinical Excellence (NICE or NIHCE) was established to reduce unwarranted variation in practice, encourage more rapid uptake of high value medicine, and ensure that taxpayers’ money was best used for maximum health benefit in the NHS. The first NICE guideline was for M3 surgery, capitalizing on the existing trend and acceptance that prophylactic M3 surgery was not evidence-based. The data we have presented support the findings in 2004 from Sheldon et al, who evaluated 12 sets of surgeries from NICE guidelines in 20 UK NHS trusts using various data sets. They suggested that the NICE guidelines seemed more likely to be adopted when there was strong professional support, a stable and convincing evidence base, and no increased or unfunded costs. In 2005, Tilley et al assessed Scottish dental service data and reported a significant decrease in surgical (code F09.1) and nonsurgical (code F09.3) removal of M3 surgery from 1994 to 2004, together with a significant decrease in GA in primary care owing to implementation of GA guidelines prohibiting the provision of GA in dental practice. When we sought to evaluate the effect of the NICE guidelines on the trends for M3 extraction in England, we had not anticipated so many difficulties accessing the different data points nor realized the potential significant flaws in the data available. This was partly owing to radical changes in the primary care system that resulted in a reduction of routine and moderately complex surgical care. From the accessible data, with recognition of the weaknesses, we have been able to report some significant changes in M3

**FIGURE 3.** National trends in M3 surgery (F091 and F093) from 1989/1990 to 2009/2010. Data from HES Online. Copyright © 2010. Reused with permission from the Health and Social Care Information Centre. All rights reserved.

surgical activity in the United Kingdom during the past 2 decades (1989/1990 to 2009/2010). The NICE guidelines were introduced halfway through this period. The consequences of the NICE guidelines, and perhaps more importantly, their predecessors, on M3 surgery, are multiple, including significant decreases in surgical activity within both NHS primary and secondary care and private care sectors. In summary, in all sectors, the trend of reduction increased in the NHS in the mid-1990s; the timeline suggests this was associated with the professional and NICE guidelines. The reduction continued after the publication of the NICE guidelines in 2000, with an overall reduction of 66% in the primary care sector, 10% in secondary care, and 56% in the private sector.

These changes in M3 surgery could not be attributed to the professional guidelines alone and the setting of the sector of care. In particular, they might have been influenced by several other factors. For example, several health policy changes during the study period caused additional difficulties with data collection included changes to the new primary dental care contract in the early 1990s, and attempts to shift care out of the hospitals might have been responsible for the peak in the removal of M3s in the mid-1990s. During this period, there were various initiatives to develop primary care-based oral surgery services, and the GA guidelines in 1996 preventing GA surgery in primary care, thus increasing referrals to secondary care and patient choice in 2003, allowing patients to dictate a preference for care in hospital. More recently, the increase in surgical admissions for M3 surgery in 2006/2007 and, particularly, in 2007/2008, probably resulted from a range of factors such as waiting list initiatives, resulting in additional activity undertaken by the NHS to ensure that patients do not wait more than 18 weeks from referral to surgery.

After changes in the NHS primary dental care contract in April 2006, there appeared to have been an overall increase in, and activity by, hospital specialist services, which are generally referred from primary care.
PATIENT AGE AT M3 SURGERY

From the HES data, the mean age for M3 surgery in secondary care in England and Wales has increased by more than 6 years during the 2 decades of hospital data examined, in line with published studies, suggesting later management. This is considerably greater than the US mean age for M3 surgery (age 17 to 18 years), probably reflecting the practice of most adolescents to have their M3s removed before college while still covered by their parents’ medical insurance. This change in average age suggests a delay in surgery and might reflect the time necessary for a tooth to erupt and the patient to present with pericoronitis or caries in the M3 or cause food packing and caries in the adjacent second molar (M2). The diagnostic data support this emerging trend. There is also evidence that male patients might have their M3s removed an average of 2 years later than female patients, which might be associated with less regular dental attendance and/or associated with later eruption of their M3s.

The increase in age for surgery might be significant in that now most patients have retained their M3s for more than 35 years. The difficulty of M3 surgery increases in older patients, probably from the decreased flexibility of bone and the presence of other comorbidities. One of the significant complications of M3 surgery is trigeminal nerve injury, which has been reported in several studies, to increase in incidence with increased patient age at M3 surgery: older than 24 years, older than 35 years, and older than 40. These iatrogenic nerve injuries cause significant psychological and functional morbidity, associated with a 70% rate of chronic postoperative pain; hence, if surgery is undertaken later in life, it needs to be balanced against the increased risks of surgery.

DIAGNOSES

Finally, the indications for surgery shifted during the study period, with a move away from impaction as the dominant operation code and dominant diagnostic code. This is in line with the trend toward later removal of teeth that are more likely to have erupted and to have other pathologic features such as caries and pericoronitis. An analysis of hospital secondary care data illustrated that although the indications for M3 surgery have changed, “impaction” (K011), al-
though decreasing, still provides almost 50% of the indications for M3 surgery in 2010 and is not a specific NICE indication. “Periapical abscess,” a potential risk of retaining M3s remained constant. However ‘pericoronitis’ (K053 coded as chronic periodontal disease but nearest applicable code for pericoronitis) and caries (K029 unspecified) significantly increased as indications for surgery from 1995 to 2010, constituting 40% of the top 10 indications for M3 surgery; both are NICE indications for M3s. The indications for M3 surgery changed with age, moving from pericoronitis in younger adults to caries and dental abscess in older ones, reflecting the development of dental disease with retained and erupted M3s.

The development of caries in the adjacent molar (lower M2), is a significant issue, because it is often diagnosed late, resulting in prompt demise of the tooth and subsequent loss. It has been reported that 4% to 5% of patients underwent M3 surgery because of M2 caries in 2006. More recently, the incidence was 19%. However, we can report that in our study cohort of 2009, 30% of patients had caries as an indication for M3 surgery, although the coding does not differentiate between caries of the M3 or M2, making analysis difficult. A specific code is required for M2 caries in accordance with the NICE guidelines. The reported incidence of M2 caries has varied and might be related to patient age, with an incidence of 1% in those younger than 25 years, 2% to 3% in those aged 25 to 35 years, and 5% in those older than 35 years. A more recent study reported that patients undergoing M3 surgery for M2 caries were an average of 5 years older. The risk factors for developing M2 caries appear to be an erupted lower M3 and mesioangular impaction present for 4 to 5 years, this latter time delay again supports our findings regarding delayed M3 surgery.

This might provide a basis by which focused surveillance of mandibular M3s could be indicated for patients with these risk factors. One study attempted to survey 228 patients followed up for 5 years with retained mandibular M3s, and only 23 subsequently underwent extraction of their M3s. Other risks of M3 retention include the development of dental abscess and necessary drainage. There is no evidence of an increase in similarly associated pathologic features as an indication for M3 surgery, although both have been suggested as reasons for prophylactic surgery.

STUDY LIMITATIONS

We observed several significant weaknesses in the data sets. The HES only reflect those procedures performed with the patient under GA or with intravenous sedation (codes F09.1 and F09.3). M3 surgery undertaken in secondary care with a local anesthetic is coded as a consultation and has not consistently been included in the M3 surgery assessment, with anecdotal variations by hospital and over time. All data were case-based; thus, many procedures could have involved single or multiple extractions, unilateral or bilateral surgery, and maxillary or mandibular surgery. Other significant weaknesses included the diagnostic criteria such that there are omissions in the coding that do not correspond with the NICE recommendations, making evaluating compliance with NICE impossible in some aspects. In addition, as more oral surgery moves to primary care settings in the United Kingdom, it will be important to ensure that the coding of procedures is equivalent so we can monitor care effectively, particularly the shifts across sectors. Another issue that must be recognized in such a study is the potential weakness of the clinical coding. The person who performs the coding will have a significant effect on the accuracy. People undertaking the coding range from clinicians who could be senior or junior staff, who are often not directly involved in the surgery, to management staff and specific coding departments. There are also significant deficiencies in the codes themselves. Finally, the data were provided in summary format; therefore, it was not possible to assess the range of ages and the mode at which surgery was undertaken.

In conclusion, from the available activity data, the admissions for M3 surgery activity under the NHS have decreased from the mid-1990s and into the 2000s, in association with professional and policy guidelines. The private sector displayed a parallel reduction overall in M3 surgery activity of around 65%. Recent increases in hospital activity appeared to be associated with other NHS changes such as reduced waiting lists and changes in primary dental care. The average age has increased for M3 surgery, and surgery was less likely to be associated with impaction, and increasingly associated with other pathologic features such as dental caries or pericoronitis, in line with the NICE guidelines. The importance of equivalent coding and data collection across the whole dental system is highlighted. Clinically, we would suggest a case for focused surveillance of those patients at increased risk of M2 caries (adjacent to M3s) as recommended by NICE guidelines to family dentists in the course of standard dental care.

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