Factors influencing nerve damage during lower third molar surgery

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Objective To investigate relationships between pathology, eruption status, age, anaesthetic modality and nerve damage during lower third molar surgery.
Design Single centre prospective study.
Setting Oral surgery out-patient clinics.
Subjects 367 patients unselected for age, gender or social class, scheduled for lower third molar removal. At 1 week, any evidence of iatrogenic nerve damage was recorded. Patients with altered lingual and/or labial sensation were followed up for 6 months.
Results 718 lower third molars were removed from 250 males and 117 females. 96 removals (13.4%) were associated with altered lingual, labial or buccal sensation. There were no significant associations between nerve damage and eruption status, age and pre-operative pathology. There was a highly significant difference in the incidence of nerve damage between LA removal (3%) and GA removal (18%) (chi-squared = 17.18; f = 2; $P < 0.01$) but no significant associations between surgical difficulty and nerve damage within each of the two groups.
Conclusions Lingual and inferior alveolar nerve damage was five times more frequent when lower third molars were removed under general anaesthesia rather than local anaesthesia. This could not be explained in terms of surgical difficulty, pre-operative pathology, age or anatomical position.

The complications of lower third molar surgery are well documented. Almost all patients experience some pain, swelling and difficulty in mouth opening after operation. Temporary or permanent iatrogenic nerve damage is not uncommon. Most studies of lingual nerve damage have shown an incidence ranging from about 1 to 6 per cent during surgical removal of lower third molars,[1] although a recent study found an incidence of 11 per cent.[2] This nerve damage is permanent in some cases. Sensory deficit lasting longer than 6 months is likely to be permanent,[3] and attempts to restore nerve function for these patients are often unsuccessful.[4] Rood,[5] has estimated the incidence of permanent lingual sensory deficit to be in the region of one per cent while Blackburn and Bramley report an incidence of half a per cent.[2]

Despite these complications, the removal of third molars associated with disease is generally justified,[6] but not if the teeth are pathology free[7,8] since the risk of future disease is low and impossible to quantify accurately for individual patients.[9,10] In an authoritative independent review, Song *et al.* found that evidence does not support the prophylactic removal of lower third molars.[10]

Wide clinician variation exists in the prescription of lower third molar removal and this has been explained in terms of the difficulties in predicting future pathology.[12,13] The most frequently cited criteria for the removal of lower third molars are those developed at the 1979 conference of the American National Institutes of Health (NIH).[8]

Decision analyses of the risks and benefits of prophylactic removal have concluded that prophylactic surgical extraction is not in patients' best interests.[13] Nerve damage resulting in lingual and/or labial paraesthesia or anaesthesia is perceived as particularly debilitating by patients.[14] From such studies the surgical outcomes considered to reduce health to the greatest degree included nerve damage causing permanent anaesthesia of the lip, tongue, or both lip and tongue. Decision analyses have also shown that prophylactic lower third molar removal is unwarranted both on the basis of patient derived utilities and those derived from oral surgeons.[15]

A great deal of research has been undertaken in relation to the incidence of nerve injury during lower third molar surgery, but little is known about the factors affecting the rate of damage. Surgical technique is one area that has been examined in this context. A randomised comparison of the lingual split procedure and removal using surgical burs did not find significant differences[16] though there is now strong evidence that lingual nerve damage is substantially less likely if a lingual flap is not raised.[17] A number of studies point to the elevation of the lingual flap as the most important surgical factor causing lingual nerve damage.[2,18]

The study reported here was designed to investigate the importance of factors (pathology, eruption status, age and anaesthetic modality) that might influence the rate of nerve damage during third molar surgery.

Methods

Data were collected in relation to all patients selected for surgery from a series of 500 consecutive patients referred to consultant oral and maxillofacial surgeons for lower third molar assessment. These patients were recruited over an 11-month period. Patients were unselected on the basis of age, gender, or social class.[19] All patients seeking an opinion regarding their third molars were included though cases where this was not the primary focus of referral were excluded. For example a patient attended with a fractured lower jaw and, inter alia, was considered for removal of third molars.

Patients were examined by one of four consultants or their designated deputies and treatment was planned in the standard manner. Immediately following this consultation the patients were examined and interviewed by a research hygienist in the same clinical area (though not in the presence of other clinical staff). This worker was appointed specifically to undertake this project and had wide experience of clinical assessment. The hygienist collected data on a standard proforma and recorded demographic information, clinical history and medical history. Maximum mouth opening, extra oral swelling, degree of eruption of each lower third molar, evidence of current pericoronitis, presence and site of caries in the adjacent tooth and periodontal probing depth distal to the adjacent teeth were recorded. The treatment scheduled was also recorded, in terms of the number of teeth selected for removal and anaesthetic modality.

Panoramic radiographs were examined by a research dentist who

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recorded the angulation of the third molars to the occlusal plane, evidence of cystic change and caries not amenable to restorative measures. Surgical difficulty was also assessed radiographically by means of the WHARFE assessment described by Macgregor.[3] This allows scoring of the expected difficulty of any lower third molar extraction on a scale of zero to 16, where 16 represents maximal surgical difficulty. Six factors are analysed to determine the final score: Winter's classification,[20] height of the mandible, angle of the second molar, root shape and development of the third molar, follicle size and exit path of the third molar.

In all cases, a standard surgical approach was adopted; almost fully erupted teeth were removed using a relieving incision only. For other teeth, a standard two sided buccal flap and a lingual flap were raised and buccal/distal bone was removed. For all teeth requiring bone removal, the lingual tissues were retracted during bone removal with a Howarth's periosteal elevator. All the surgical removals described in this paper were carried out before the publication of the randomised trial which demonstrated higher incidence of lingual nerve damage in cases where a lingual flap was raised.[17] This finding led to a substantial reduction in the use of lingual retraction in the study centre. Those patients who did proceed to lower third molar surgery ($N = 367$) were reviewed 1 week after operation when they were asked about altered sensation related to the lingual, inferior alveolar and buccal nerves. Sensory disturbance and anatomical distribution were assessed by testing with a probe or cotton wool. Additional objective assessments could have been carried out, but since the primary focus of this study was overall nerve damage rates and not the degree of sensory deficit present, this was not necessary. Those patients with evidence of sensory disturbance were reviewed at 1 month, 3 months and 6 months to determine whether sensory disturbance was acute or chronic. Sensory disturbance at 6 months was classified as permanent.

Results

Three hundred and sixty-seven patients (250 males, 117 females) with 718 lower third molars were included in the study. The mean age was 24.92 years (SD = 4.67, range = 15–47 years). Thirty-four per cent of the study group were social class 1 or 2, 43 per cent were social class 3, 9.5 per cent were social class 4 or 5, while the remainder (13.5%) were not classifiable or this information was not recorded. Bilateral lower third molar removal was carried out in 312 (85%) patients while the remainder had only one lower third molar removed. Two hundred and seventy-one patients were treated under GA (74%) while 96 patients were treated under LA (Table 1). There was no difference between the two groups in terms of age, gender and social class.

Six hundred and twenty-two removals (87% of all teeth) were not associated with nerve damage while 96 removals (13%) were associated with evidence of damage to the inferior alveolar or lingual nerves in 72 patients. While 618 removals resulted in a temporary sensory disturbance, only five removals (1%) resulted in a sensory disturbance that remained at 6 months post surgery and was therefore categorised as permanent. There was no significant association between prophylactic removal and nerve damage (chi-squared = 0.012; $P > 0.05$), a history of pericoronitis and nerve damage (chi-squared = 2.13; $P > 0.05$), caries and nerve damage (chi-squared = 0.87; $P > 0.05$), cystic change and nerve damage (chi-squared = 0.001; $P > 0.05$) or periodontal indications for removal and nerve damage (chi-squared = 0.43; $P > 0.05$). There was no significant relationship between nerve damage and eruption status (chi-squared = 1.59; $P > 0.05$). There was no significant association between age, when categorised by 5-year intervals (chi-squared = 4.2; $P > 0.05$), or social class (chi-squared = 0.02, $P > 0.05$) and nerve damage.

Table 1 Anaesthetic modality prescribed for removal of lower third molars

Anaesthetic modality	Number of patients (n)	Percentage of patients (%)
Local Anaesthesia only	76	(20.5)
Local Anaesthesia with intravenous sedation	20	(5.5)
General Anaesthesia (Daycase)	154	(42.0)
General Anaesthesia (In-patient)	117	(32.0)
Total	367	(100.0)

Seven patients with evidence of nerve damage at 1 week did not complete the follow-up process. These cases were recorded as having temporary sensory disturbance. Although it is possible that the rate of permanent damage is an underestimate, this would not affect the significance of the correlations reported here.

Table 2 shows the incidence of nerve damage for treatment under different anaesthetic modalities. There were highly significant differences between LA with or without sedation compared with GA whether on a day care or in-patient basis (chi-squared = 17.18; $P < 0.01$). The incidence of nerve damage for teeth removed under general anaesthesia was greater than five times the incidence of damage for those removed under local anaesthesia (Table 2). This finding held for inferior alveolar nerve damage where no cases were reported for procedures carried out under local anaesthesia, compared with 43 cases associated with general anaesthesia (8%). This was also the case for lingual nerve damage where six cases (3%) were associated with local anaesthesia compared with 63 cases associated with general anaesthesia (12%).

There was no significant relationship between the use of GA and pericoronitis (chi-squared = 1.7; $P > 0.05$), cystic change (chi-squared = 0.44; $P > 0.05$), caries of the second or third molar (chi-squared = 0.0002; $P > 0.05$) or signs of acute infection (chi-squared = 0.94; $P > 0.05$) though teeth removed under GA were more likely to be unerupted than those removed under LA (chi-squared = 42; $P < 0.05$). The mean WHARFE score for all lower third molars was 8(SD = 2.26). There was no significant difference in the surgical difficulty between cases treated under LA (mean = 8) and GA (mean = 8) using an unpaired t test ($t = -0.30$, $P > 0.05$). To investigate further the association between surgical difficulty and the occurrence of nerve damage WHARFE scores

Table 2 Incidence of Iatrogenic nerve damage for different anaesthetic modalities

Modality	Total number of teeth removed (N)	Number of teeth associated with nerve damage*	Percentage of all removals (GA and LA) producing nerve damage
Local anaesthesia alone	142	5 (5.2%)	3.6%
Local anaesthesia and sedation	371	(1.0%)	2.7%
General anaesthesia (day care)	303	49 (51.0%)	16.2%
General anaesthesia (in patient)	232	41 (42.8%)	17.7%
Total	718	96 (100.0%)	

*The values reported here represent the percentages of all removals that were associated with nerve damage.

were converted into three categories at 5-point intervals. A chi-squared analysis revealed that there was no significant relationship between surgical difficulty and nerve damage for cases carried out either under LA (chi-squared = 0.8; $P > 0.5$) or GA (chi-squared = 5.82; $P > 0.05$).

Discussion

These results suggest that the incidence of nerve damage is unrelated to age. This finding is not consistent with that of Bruce *et al.*[21] However this could be explained by changes in surgical technique and improved surgical management since 1980. It has been suggested that prophylactic surgery should be performed on young individuals to avoid increased risk of complications in older patients.[22] The lack of any significant correlation suggests that prophylactic surgery is unjustified on these grounds.

No evidence was found of a relationship between pathology prior to surgery and the incidence of nerve damage. Likewise, eruption status was found to have no statistically significant relationship with the incidence of nerve damage. This was also the case when labial and lingual nerve damage was considered separately. This is perhaps surprising, though previous studies[2–5] have found that nerve damage reflected surgical technique more than anatomical position of the tooth.

The incidence of nerve damage under LA closely resembles the incidence reported by Blackburn & Bramley.[2] In contrast there is a discrepancy between the reports concerning the incidence of nerve damage following surgery performed under GA, the study reported here having a higher incidence rate. However Blackburn & Bramley[2] did not state whether LA included removals also carried out under sedation or what proportion of removals carried out under GA involved day-case or in-patient care. Therefore, direct comparisons between the two studies are difficult.

In this study, those teeth removed under GA were no more surgically difficult than those scheduled for removal under LA. Importantly, the findings suggest a more than fivefold increase in the incidence of nerve damage when removal is carried out under GA as against LA with or without sedation, regardless of the level of surgical difficulty. The proportion of patients treated under GA reflected practice in this centre at the time the study was carried out. It is higher than reported elsewhere and since then practice at the study centre has been modified to reduce substantially the number of third molar removals carried out under GA.

The underlying reasons for this finding are uncertain. Perhaps when carried out under GA, the procedure may be complicated by the supine position of the patient or the extent of muco-periosteal stripping and bone removal. It is also possible that the degree of surgical force is greater under GA and that a conscious patient, whether sedated or not, presents the surgeon with a series of cues which tends to limit soft tissue retraction and surgical force and therefore the risk of nerve damage. It is however unlikely that the actual anaesthetic itself had an effect on the incidence of nerve damage. More research is required into the degree to which these and other factors may influence the incidence of nerve damage, particularly since permanent nerve damage has been shown to be the complication considered most debilitating by patients[15] and continues to be the focus of litigation.

From an international standpoint, third molar removal under GA and the willingness of purchasers to pay for it are considered a peculiarly British phenomena. Although the principal finding of this research should, ideally, be tested in a randomised controlled trial, these results provide evidence that despite the often stated patient and operator preference for this option, in terms of some of the most serious surgical complications, general anaesthesia should be avoided whenever possible.

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