



REVIEW

Current management of damage to the inferior alveolar and lingual nerves as a result of removal of third molars

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7 KEYWORDS

8 Inferior alveolar nerve;
9 Lingual nerve;
10 Nerve injury;
11 Nerve repair;
12 Sensory testing

13 Introduction

14 Confusion and uncertainty still exists over the op-
15 timal management of patients who sustain nerve
16 damage during extraction of lower third molars.
17 This brief review is designed to clarify the man-
18 agement by presenting simple protocols to aid
19 decision-making. These protocols are based on ex-
20 perience gained from managing patients referred
21 to our unit, and so are particularly relevant to the
22 secondary care service in the UK. Complementary
23 guidance to the primary care sector in the UK has
24 been published recently.¹

25 We aim to identify those patients who may benefit
26 from some form of intervention, from within the
27 substantial number of patients with some form of
28 nerve injury. Patients who are ultimately left with a
29 minor degree of hypoaesthesia (reduced sensation)
30 or mild paraesthesia (abnormal sensation) cope well
31 with the sensory deficit, are unlikely to benefit from

intervention, and are probably best left untreated. 32
In contrast, patients who have either a substantial 33
sensory deficit or the painful sensory disorder of 34
dysaesthesia (unpleasant abnormal sensation) may 35
benefit from intervention, and so must be identified 36
and managed in a manner that will optimise the 37
outcome. 38

39 We will deal purely with clinical issues. Reviews
40 of the pathophysiological changes that follow in-
41 jury to the trigeminal nerve have been published
42 elsewhere,^{2,3} as has a review of the aetiology of
43 injury-induced trigeminal dysaesthesia.⁴

44 We will consider the management of injuries to
45 the inferior alveolar and lingual nerves individually.

46 Management of damage to the inferior 47 alveolar nerve

48 At the time of third molar removal

49 While attempts can be made to predict the likeli-
50 hood of damage to the inferior alveolar nerve dur-

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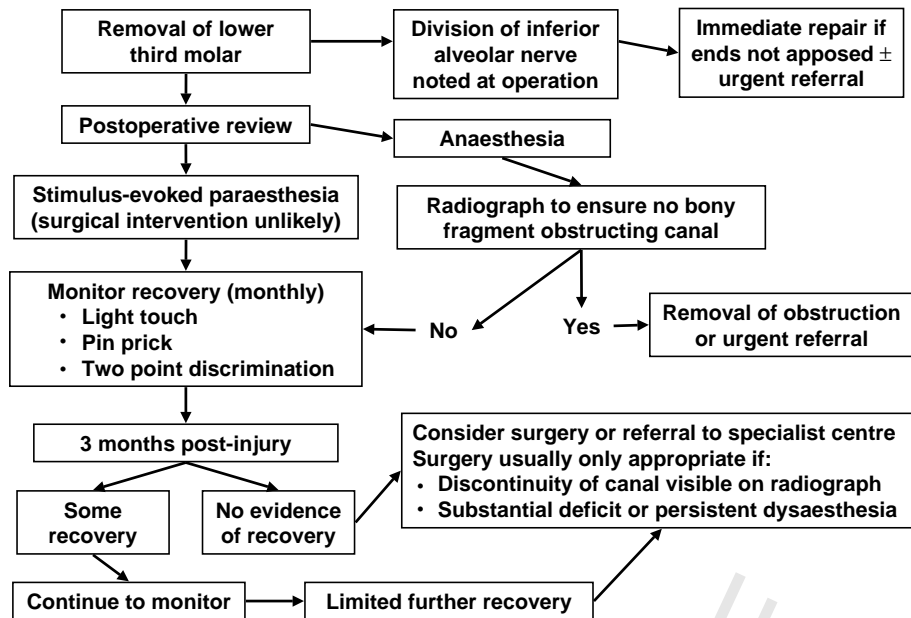


Figure 1 Algorithm showing the management of injuries to the inferior alveolar nerve after removal of a third molar.

ing removal of third molars on the basis of radiological appearance,⁵ there is little evidence that any change in surgical technique that results from this information affects the outcome. About 4% of patients sustain injury during removal of lower third molars.³ An algorithm to guide management decisions for such patients is shown in Fig. 1. In a small proportion of patients, damage to the inferior alveolar nerve is noted at the time of operation. As the neurovascular bundle is well supported within the mandibular canal, and even after section the ends do not retract, primary repair of the nerve is not normally required. Bleeding from the bundle should be controlled by gentle temporary packing with gauze (which is removed before the wound is closed), and diathermy should not be used. Medicaments or haemostatic agents such as Whitehead's varnish or 'Surgicel' should also be avoided as they can cause a chemical injury to the nerve.⁶ In the rare event that the two ends of the nerve become displaced and separated within the tooth socket, an attempt should be made to reapproximate them with epineurial sutures (using an 8/0 monofilament polyamide suture, Ethilon, Ethicon Ltd., UK), inserted with the aid of loupes or an operating microscope. This is only possible if the procedure is being undertaken under general anaesthesia, and access and visibility at this stage can be difficult.

79 At the postoperative review

80 The clinician usually becomes aware of the nerve
81 injury only at the time of a postoperative review,

approximately 1 week after the operation. At this stage, patients may have profound anaesthesia, or varying degrees of paraesthesia or dysaesthesia. If some sensation is evoked by mechanical stimulation of the lip and chin in the mental distribution, it suggests that at least part of the nerve remains intact and functioning and full recovery is likely. This should be distinguished from the spontaneous paraesthesia (reported by the patient as 'tingling' from the affected area) that can result from neural activity initiated at the site of nerve injury,^{7,8} and which does not predict spontaneous recovery. If there is complete anaesthesia, an appropriate radiograph (such as a segmental dental panoramic tomograph) should be obtained to show the mandibular canal at the site of the socket of the third molar. If this shows that a fragment of the cortical bone from the roof of the canal has been displaced and is obstructing the canal, then it seems appropriate to remove it, using the approach described below. In most cases an obstruction will not be identified, however, and recovery should be monitored for a time before any intervention. Of course, a full explanation for the occurrence of the nerve injury should be given to the patient, together with a description of the events that may follow.

Monitoring recovery

Various methods for monitoring recovery of sensation have been described⁹ but only a simple assessment is required for routine clinical use.² Light touch stimuli (ideally with a von Frey hair), pin-

113 prick stimuli, and the measurement of two-point
 114 discrimination thresholds, is adequate to detect ev-
 115 idence of early sensory recovery. The method of
 116 construction of the simple equipment required for
 117 these tests has been described.¹⁰ These tests can be
 118 repeated at approximately monthly intervals, and
 119 most patients will gradually recover normal sensa-
 120 tion. In the few patients in whom there is *no evi-*
 121 *dence* of recovery by 3 months, surgical interven-
 122 tion should be considered and discussed with the
 123 patient. The patient should be referred at this stage
 124 to a unit with a special interest in the management
 125 of injuries to the trigeminal nerve. Gregg has out-
 126 lined the case for this delay before intervention,
 127 and the restriction of an operation to those patients
 128 with either anaesthesia or a significant sensory dis-
 129 turbance such as dysaesthesia.¹¹ If there is some
 130 evidence of sensory recovery by 3 months, moni-
 131 toring should be continued until there is no pro-
 132 gressive improvement (up to 12 months).¹² At this
 133 stage, an operation should again be restricted to
 134 patients with either a substantial deficit or persis-
 135 tent dysaesthesia.

136 Surgical procedures

137 Patients referred with either very little recovery or
 138 significant dysaesthesia should have a radiograph
 139 of the mandibular canal, if this is not available.

140 If there is obvious deviation or disruption of the
 141 canal (Fig. 2), then 'decompression' of the affected
 142 area is indicated, a procedure first advocated by
 143 Merrill.¹³ This is done by an intraoral approach and
 144 the canal is reached by removing a segment of buc-
 145 cal plate: the anterior and posterior limits are def-
 146 ined by cuts through the cortex with a bur, a groove
 147 'scored' at the level of the canal, and the seg-
 148 ment removed with a chisel and discarded. This
 149 approach is similar to that described by Miloro.¹⁴
 150 More bone is carefully removed with a large round
 151 diamond bur, together with dental excavators, un-
 152 til the neurovascular bundle can be eased gently
 153 laterally from the canal for examination (Fig. 3).
 154 Under the operating microscope, any lateral neu-
 155 roma is excised and constricting scar tissue at the
 156 site of injury is released by longitudinal incisions
 157 through the epineurium (neurolysis). The mandibu-
 158 lar canal restricts mobilisation of the central and
 159 distal stumps, and so a long segment of damaged
 160 nerve cannot be excised. A limited degree of reap-
 161 proximation is, however, sometimes possible.

162 The outcome of this is variable^{15,16} and there is a
 163 surprising paucity of published data on the efficacy
 164 of any form of exploration or repair of the inferior
 165 alveolar nerve.¹⁷ Rather remarkably, Mozsary and
 166 Syers reported 'complete recovery' in 20 of 23 pa-
 167 tients who had had some form of decompression or
 reanastomosis, but they used no form of objective

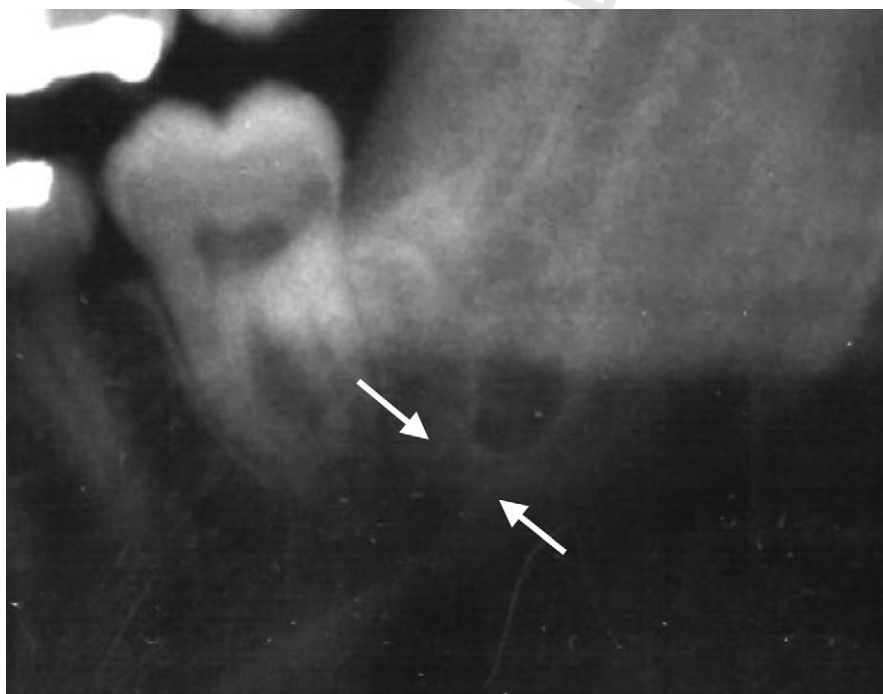


Figure 2 Radiograph taken 23 months after removal of a third molar. The mandibular canal is disrupted with little evidence of continuity either radiographically or at the time of subsequent exploration. The white arrows indicate an area of bone formation across the site of the original canal with a cortical outline to the proximal section.

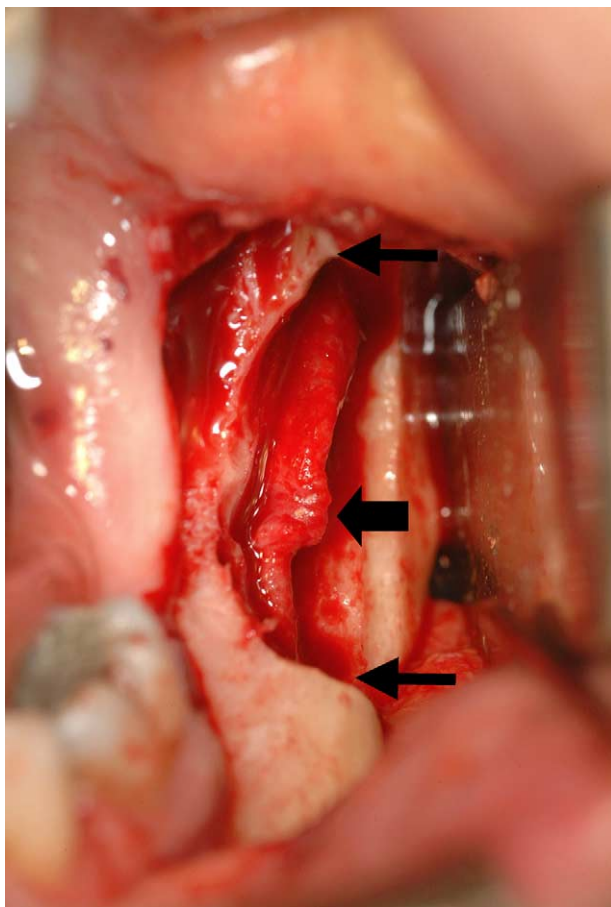


Figure 3 Exploration and decompression of the left inferior alveolar nerve. The small arrows indicate the site of the cortical cuts made before a segment of the buccal plate was removed. The large arrow indicates a neuroma that extended laterally and towards the alveolar crest from the neurovascular bundle, and the bundle narrows distal to this point.

168 testing.¹⁸ The largest report is an appraisal using
 169 retrospective postal questionnaires of 316 operations
 170 on the inferior alveolar nerve at seven units in
 171 the USA.¹⁹ This included a range of procedures and
 172 the authors reported an overall success rate of 74%.
 173 We have found that some patients gain a significant
 174 degree of recovery, but a reduction in dysaesthesia
 175 may only be transient in others.

176 Various approaches to the inferior alveolar nerve
 177 have been described, together with a 'cascade' of
 178 options for managing the site of injury.²⁰ Various
 179 forms of nerve grafting,^{21,22} entubulation,²³⁻²⁵ or
 180 nerve sharing^{26,27} operations have been reported
 181 but usually with few cases or as single case reports,
 182 so their value remains uncertain and indeed some
 183 procedures may do more harm than
 184 good.

Management of damage to the lingual nerve

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At the time of removal of the third molar

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The surgical technique used for removal of the tooth
 does affect the incidence of damage to the nerve
 and our primary concern should be the reduction of
 any form of iatrogenic injury. There is good and in-
 creasing evidence that lingual flap retraction should
 be avoided for most cases,²⁸⁻³¹ but this issue has
 been extensively debated elsewhere and will not
 be pursued here. The mean incidence of damage to
 the lingual nerve in a series of reported studies is
 approximately 7% of operations,³ and an algorithm
 to guide management decisions for these patients
 is shown in Fig. 4. In a few patients, damage to
 the lingual nerve is noted at the time of removal of
 the third molar. In such circumstances, if the oper-
 ation is being undertaken under general anaesthesia,
 immediate microsurgical repair should be under-
 taken. We recommend the use of an operating
 microscope and insertion of 6 to 8, 8/0 monofila-
 ment polyamide epineurial sutures. If for practical
 reasons this is not possible, the patient should be
 referred urgently to a unit with a special interest
 in trigeminal nerve repair.

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At the postoperative review

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As described for injuries to the inferior alveolar
 nerve, it is usually only at this time that the clinician
 becomes aware of the injury. Once again, the extent
 of sensory disturbance at this early stage is a guide
 to the likely extent of recovery. If some sensation
 is evoked by mechanical stimulation of the tongue,
 it suggests that at least part of the nerve remains
 intact and functioning, and full recovery is likely.
 Mason showed that recovery was most rapid when
 only the tip of the tongue was involved and slowest
 when the entire distribution was affected.³² Spontane-
 ous paraesthesia ('tingling' from the affected
 area) can again result from neural activity initiated
 at the site of nerve injury,³³ and should be distin-
 guished from sensations evoked by mechanical stimu-
 lation of the tongue. Whatever the outcome of this
 test, however, a short period of review is recom-
 mended and a full explanation for the occurrence
 of the injury and likely sequel should be given to
 the patient. This review period helps to distinguish
 between anaesthesia caused by a crushed nerve (in
 which case signs of recovery begin within 3 months
 and intervention is not usually required) and a sec-
 tioned nerve (when recovery is slow and an opera-
 tion is usually indicated). This is particularly impor-

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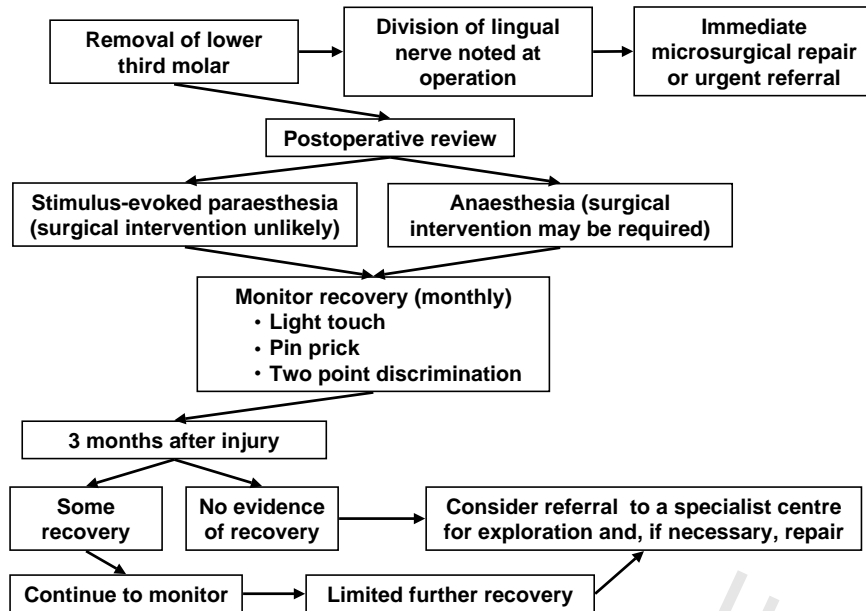


Figure 4 Algorithm showing the management of injuries to the lingual nerve after removal of a third molar.

236 tant in the UK where substantial crush injuries can
237 still occur as a result of attempts at lingual retrac-
238 tion.

239 Monitoring recovery

240 Sensory testing should be undertaken at approxi-
241 mately monthly intervals using light touch and pin
242 prick stimuli, and two-point discrimination thresh-
243 olds should be recorded, as described above. The
244 lack of any evidence of recovery by 3 months is
245 recommended as an indication for surgical
246 intervention³⁴ and laboratory studies suggest that
247 this delay has little detrimental effect on the
248 outcome.^{35,36} If there is some evidence of sensory
249 recovery by 3 months, monitoring should be con-
250 tinued for a further 3–6 months, until there is no
251 further improvement. At this stage, an operation
252 is considered if there is either poor recovery or
253 dysaesthesia. The potential value of surgery can be
254 assessed by comparing the patient's sensory deficit
255 with reported postoperative results (see below).

256 Surgical procedures

257 The optimal surgical management of patients who
258 sustain lingual nerve injuries is clearer, as the out-
259 come of surgical intervention is better understood.
260 The use of microsurgical techniques to repair dam-
261 aged lingual nerves was first described about 25
262 years ago, but early reports included little infor-
263 mation about outcome^{13,37,38} or about the meth-
264 ods used to assess a successful result.³⁹ The first

265 published reports on outcome evaluated by sensory
266 testing appeared mainly in the 1990s^{15,40–44} and,
267 while some results were encouraging, the number
268 of patients assessed was small or they were treated
269 by many different surgical procedures. The largest
270 report was from an appraisal by retrospective postal
271 questionnaire of 205 repairs of lingual nerves at
272 seven units in the USA.¹⁹ The operations included
273 direct suture or grafting, and although the authors
274 reported an 80% success rate, their main conclusion
275 was “it is apparent that there is need for a detailed
276 prospective study of specific injury conditions and
277 their response to standardised microneurosurgical
278 interventions”.

279 In this journal we have reported the out-
280 come of a prospective, quantitative study of lin-
281 gual nerve repair in 53 patients, and this is the
282 largest single-centre study ever published to our
283 knowledge.⁴⁵ The protocol we used was based
284 on the results of an extensive series of labora-
285 tory investigations^{46,47} and led us to excise the
286 damaged segment of nerve, including any neu-
287 roma, mobilise the central and distal stumps, and
288 repair with epineurial sutures, without a nerve
289 graft (Fig. 5). Postoperatively, most patients re-
290 gained some sensation, fewer tended to bite the
291 tongue by accident, and there were highly sig-
292 nificant improvements in the results of sensory
293 tests. Most importantly, the operation was con-
294 sidered by the patients to be worthwhile. How-
295 ever, the level of success was variable; some
296 patients did not improve, speech and taste sen-
297 sation sometimes remained affected, and recov-

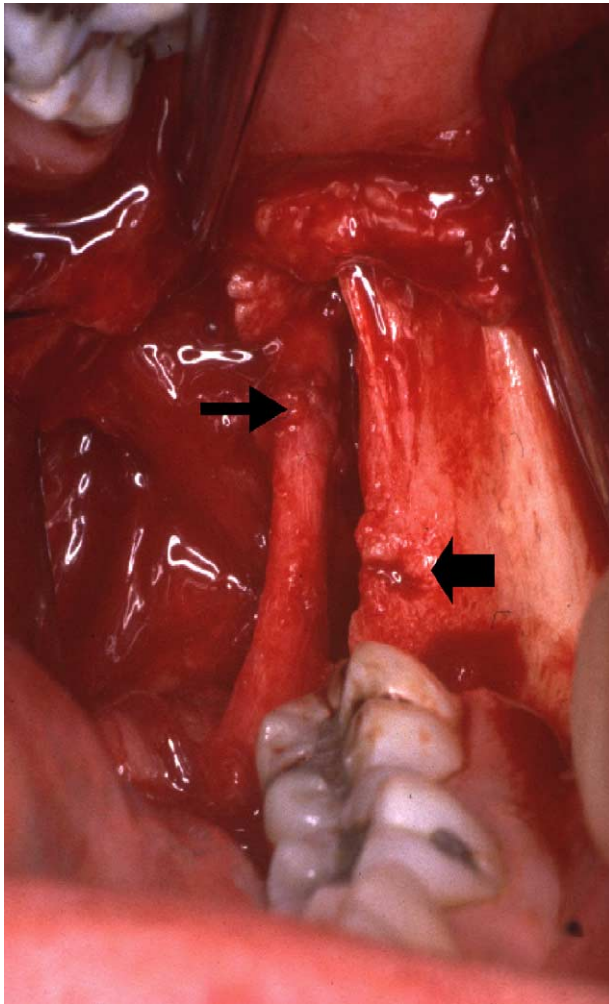


Figure 5 A repaired left lingual nerve. The small arrow shows the site of suture to the proximal stump after the damaged segment has been excised. The large arrow indicates the probable site of the initial injury where a bur has penetrated the lingual plate during removal of the third molar.

298 ery was never complete. In addition, surgery did
299 not reduce the number of patients with dysaes-
300 thesia.

301 Our results from direct reapposition of the lin-
302 gual nerve by epineurial sutures seem to be better
303 than those reported after other methods of repair
304 such as nerve grafting,^{15,43,48} artificial conduits,²⁴
305 or some reports of external neurolysis.⁴⁰ However,
306 in a small proportion of patients, exploration of the
307 damaged nerve shows it to be intact but involved in
308 scar tissue, or only partially divided. Such injuries
309 could be the result of vigorous lingual retraction or
310 damage from the cutting needle at the time the
311 wound is closed. In this small group of patients it
312 seems appropriate to free the scar tissue or repair
313 only the area of partial section. Analysis of a se-

314 ries of such patients may explain the good recovery
315 sometimes reported after neurolysis.⁴⁹

Timing of repair

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317 Several papers have suggested that late repair is
318 followed by a poorer outcome than early repair^{39,48}
319 and Riediger et al.¹⁵ were sceptical about repair
320 undertaken more than 12 months after the injury.
321 Meyer⁵⁰ reported 90% success if the repair was un-
322 dertaken within three months, reducing to 10% suc-
323 cess by 12 months, although the nature of his analy-
324 sis is unclear. The timing of the repair in our study⁴⁵
325 ranged from 4 to 47 (mean 15) months after the
326 initial injury and we found no significant correla-
327 tion between delay and any measures of outcome.
328 We concluded that the method we described was
329 worthwhile for both early and late repair of lingual
330 nerves. Nevertheless, we advocate early referral af-
331 ter the 3-month monitoring period, as shown in our
332 protocol. Inevitable delays in both clinic and oper-
333 ation appointments mean that surgery is not com-
334 monly undertaken less than 5–6 months after the
335 injury.

The management of persistent dysaesthesia

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338 It is surprising that some patients who sustain a
339 nerve injury may be left with profound anaesthesia
340 but no dysaesthesia, while others complain bitterly
341 of chronic pain and tingling, often exacerbated by
342 moving or touching the affected area. The expla-
343 nation for these two widely differing outcomes is
344 not known, but the nature of the initial injury is
345 likely to be important. In this context it is of note
346 that patients in whom the inferior alveolar nerve is
347 damaged as a result of mandibular fractures or or-
348 thognathic surgery rarely complain of dysaesthesia,
349 whereas some patients in whom the inferior alveo-
350 lar nerve is damaged during removal of third molars
351 develop this disorder.

352 Despite our observation that lingual nerve re-
353 pair did not reduce the *number* of patients with
354 dysaesthesia, it seemed that the severity of these
355 symptoms was often reduced.⁴⁵ This is consistent
356 with other reports of a reduction in pain scores
357 after repairs of both inferior alveolar and lingual
358 nerves.¹⁹ For this reason, our first line of manage-
359 ment for patients with inferior alveolar or lingual
360 nerve dysaesthesia is surgical, using the methods
361 described above. However, even after operation,
362 some patients are left with severe symptoms that
363 cause great distress and disruption of daily life. For

364 this group a pharmacological approach is appropri-
 365 ate. Unfortunately, the drugs currently available
 366 are not universally effective, and at best produce
 367 only partial relief of symptoms. Gregg⁵¹ showed
 368 that tricyclic antidepressants were helpful in some
 369 patients. Carbamazepine, while also giving some
 370 relief of symptoms, is associated with side-effects
 371 in many patients. The more recently developed
 372 anticonvulsant drugs may also be of benefit⁵² but
 373 their efficacy after injuries to the trigeminal nerve
 374 has yet to be shown. Clinical and laboratory studies
 375 to determine the value of these drugs in trigeminal
 376 dysaesthesia are ongoing in our unit.

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