Trigeminal nerve injuries in relation to the local anaesthesia in mandibular injections

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VERIFIABLE CPD PAPER

RESEARCH

IN BRIEF

- Local anaesthetics have been known to cause trigeminal nerve injuries.
- Informs the reader of the key symptoms and functional disturbances experienced by patients with iatrogenic inferior alveolar nerve and lingual nerve injuries.
- Results indicate that multiple and high concentration inferior alveolar nerve block injections should be avoided.
- Strategies to reduce nerve injuries may include buccal infiltration with articaine.

Objective This study reports the signs and symptoms that are the features of trigeminal nerve injuries caused by local anaesthesia (LA). **Methods** Thirty-three patients with nerve injury following LA were assessed. All data were analysed using the SPSS statistical programme and Microsoft Excel. **Results** Lingual nerve injury (LNI; n = 16) and inferior alveolar nerve injury (IANI; n = 17) patients were studied. LNI were more likely to be permanent. Neuropathy was demonstrable in all patients with varying degrees of paraesthesia, dysaesthesia (in the form of burning pain) allodynia and hyperalgesia. All injuries were unilateral. A significantly greater proportion of LNI patients (75%) had received multiple injections, in comparison to IANI patients (41%) ($p < 0.05$). Fifty percent of patients with LNI reported pain on injection. The presenting signs and symptoms of both LNI and IANI included pain. These symptoms of neuropathy were constant in 88% of the IANI group and in 44% of LNI patients. Functional difficulties were different between the LNI and IANI groups, a key difference being the presence of severely altered taste perception in nine patients with LA-induced LNI. **Conclusions** Chronic pain is often a symptom after local anaesthetic-induced nerve injury. Patients in the study population with lingual nerve injury were significantly more likely to have received multiple injections compared to those with IANI.

INTRODUCTION

Injuries to the inferior alveolar nerve (IAN) and lingual nerve (LN) can be caused by local analgesic block injections. The estimated incidence ranges between 1:26,762 to 1:800,000.[1,2] Such injuries can result in a variety of symptoms ranging from altered sensation to pain.[3] These symptoms may interfere with many social interactions.[4] Consequently patients suffering such damage report significant reduction in their quality of life and may have associated psychological problems.[5,6] A recent settlement of over a million dollars (Maine USA) for lingual nerve injury caused by an IAN block highlights the recognition of the associated disability and social repercussions.[7]

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Few studies describe the range of signs, symptoms and functional deficits that result from iatrogenic injury to the inferior alveolar and lingual nerves. The aims of the present study were:

- To assess the signs, symptoms and functional problems experienced by patients suffering from non-surgical iatrogenic damage to the inferior alveolar or lingual nerves
- To identify risk factors associated with these injuries.

METHODS

Subjects

Thirty-three patients referred to the Kings College London specialist nerve injury clinic were identified to have had nerve injury as a result of local anaesthetic administration. Patients who had their symptoms for longer than 6 months were classified as having permanent nerve injury.

Assessment

A full history relating to the episode that resulted in nerve damage was recorded for each patient. This included information regarding whether pain occurred upon injection, the type and volume of local anaesthetic administered, and whether multiple injections were used. Standardised neurosensory tests[8–10] were carried out to assess the subjective and objective neurosensory status of the injured nerve. All patients were evaluated for pain and functional difficulties.

The lingual nerve dermatome was assessed by evaluating the neuropathic area over the lingual gingivae, dorsal and ventral aspect for the tongue. The inferior alveolar nerve neuropathic area was assessed evaluating the neuropathic area over the extra-oral area (vermillion of lip, skin and chin) and intra-oral area (buccal gingivae and vitality of teeth using ethyl chloride). The area of neuropathy was described as a percentage of the total neural distribution (100%).

Clinical assessment of the neuropathic area carefully excluded injuries caused by endodontics, surgery or implants. IAN or LN neuropathy caused by the LA was identifiable if the whole of the dermatome was affected, since other causes result in partial neuropathy distal to the lesion to nerve. Patients were excluded if

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the cause of their injury was ambiguous. Radiographs aided in the correct diagnosis of the patient.

Analysis

All data were analysed using the SPSS statistical programme. Student's t-tests and Chi-square tests were used where appropriate for parametric and non-parametric testing of frequencies. The value of $p \leq 0.05$ was chosen as the level of significance.

RESULTS

Demography

Sixteen patients presented with lingual nerve injury (LNI) (mean age 48 years [range 27-64]) (Table 1) and 17 patients with inferior alveolar nerve injury (IANI) (mean age 47 years [range 32-67]) (Table 1). The male:female ratio was 7:8 for LNI and 8:9 for IANI. All injuries were unilateral.

IANI patients presented with a mean duration of injury of 9.7 months (range 1 week-39 months) compared with 12.3 months (mean 3 weeks-36 months) for LNI patients. Sixty percent of IANIs were permanent compared to 87.5% of LNIs (Chi-square test $p = 0.005$).

Presenting symptoms

Pain and altered sensation

The results indicated that significantly more females (n = 15) with nerve injuries experienced pain overall than males (n = 9; $p = 0.01$). Age did not have any effect on the experience of pain among IANI or LNI patients. Constant pain and altered sensation was the presenting complaint in 88% of patients with IANI and 44% of patients with LNI (Fig. 1). Two LNI patients stated pain upon protrusion of the tongue. Other exacerbating factors among the LNI patients included hot foods, highly flavoured foods, mint and citrus flavours, hot temperature and stress.

Despite the presence of pain, 11 IANI and six LNI patients also complained of numbness. Numbness was described by 15 IANI patients in comparison to ten patients with LNI. Slightly more patients with LNI (n = 10) than IANI (n = 9) experienced paraesthesia as tingling and/or 'pins-and-needles' (Fig. 1).

Table 1 Illustrating the patient demographics and nerve injury duration for inferior alveolar and lingual nerve injuries

Nerve	Gender	Age	Referral	Outcome	Duration		Dermatome affected	
					Weeks	Months	Extra-oral	Intra-oral
IANI1	F	39	GDP	Permanent		39	20	20
IANI2	M	45	GDP	Too early to say	1		20	10
IANI3	M	67	GDP	Permanent		12	30	4
IANI4	M	46	GDP	Not sure				
IANI5	M	56	GDP	Permanent		12	2	
IANI6	F	33	GDP	Too early to say		2	80	
IANI7	F	43	SCT	Too early to say		2	10	10
IANI8	M	47	GDP	Too early to say	9		50	100
IANI9	F	54	SCT	Permanent		7	80	80
IANI10	M	60	SCT	Permanent		20	100	
IANI11	F	32	GDP	Permanent		4	65	50
IANI12	F	54	GDP	Permanent		22	30	20
IANI13	F	57	GDP	Permanent		8	100	50
IANI14	F	33	SCT	Permanent		7	70	8
IANI15	M	52	GDP	Temporary		9	4	4
IANI16	M	56	GDP	Too early to say	3		10	10
IANI17	F	34	SCT	Permanent		6	90	80
LNI1	F	55	GDP	Permanent	22	5.5	30	80
LNI2	M	37	GDP	Too early to say	7		40	20
LNI3	F	61	GDP	Permanent	48	12	40	100
LNI4	F	49	GDP	Permanent	136	34	45	20
LNI5	M	39	SCT	Permanent	10		40	35
LNI6	M	40	GDP	Permanent	52	13	30	30
LNI7	F	27	GDP	Permanent	64	16	80	40
LNI8	F	63	GDP	Permanent	24	6	40	10
LNI9	M	48	GDP	Permanent	16	4	20	7.5
LNI10	F	44	SCT	Permanent	16	4	50	90
LNI11	F	60	GDP	Permanent	48	12	40	45
LNI12	M	51	GDP	Permanent	108	27	50	40
LNI13	M	48	SCT	Too early to say	7		3	65
LNI14	F	57	GDP	Permanent	72	18	80	60
LNI15	M	33	GDP	Permanent	12	3	50	40
LNI16	F	64	GDP	Permanent	144	36	40	35

Functional problems associated with the neuropathy

All but one LNI patients experienced difficulty with eating (Fig. 2a). Speech problems were reported among ten LNI patients. Six LNI patients reported a significant reduction in pleasure when kissing their partner and one patient reported problems with social confidence. Three LNI patients did not report any problems with their daily function.

In the LNI group six patients reported reduced taste function, two reported absent taste function and one patient had 'tastant

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allodynia' with severe discomfort with any highly flavoured foods. This was reminiscent of gustatory sweating. Although taste alterations were present among nine LNI patients, the number of fungiform papillae reduced in only two of the patients with reduced taste sensation and was normal among the remaining patients.

Despite none of the IANI patients reporting taste problems, these patients had difficulty with eating (n = 9) (Fig. 2b). Drinking ability was severely affected in 4/17 and moderately in 4/17 IANI patients. Speech was severely affected in 5/17 patients and moderately in one patient. Severe to moderate problems with kissing were reported among five of the 17 IANI patients. Social confidence and tooth brushing were severely affected in 5/17 patients. Five IANI patients reported sleep disturbances predominantly due to mechanical allodynia (pain on touch) awakening them when the neuropathic area was touched by the pillow. Mechanical allodynia also interfered with make-up application (n = 2) and shaving (n = 2) among the IANI patients. Four patients with IANI did not have any functional impairment.

Risk factors

Type of local anaesthetic agent

Only 4/16 practitioners who initially treated the patients who presented with LNI provided information regarding the type of injection; two had received 2% lidocaine and two 4% prilocaine. Similarly, information regarding the local anaesthetic was only available for 6/17 IANI patients; three were injected with 2% lidocaine, two with 4% prilocaine, and one followed injection of 4% articaine.

Multiple blocks and pain upon injection

Multiple injections were given to 75% of LNI patients, compared to a significantly lower 41% of IANI patients (Chi-square = 3.86, $p < 0.05$). All multiple injections given to the LNI patients were multiple IAN blocks, as indicated by the patient notes and their practitioner. However, it was not clear whether the multiple injections given to 29% of these IANI patients were multiple IAN blocks. Pain upon injection was reported by 50% of LNI patients and 12% of IANI patients. This pain was described as being electric, shooting or stinging in nature. Information regarding the number of patients who had multiple injections was determined from patient notes and by contacting the practitioner. Details concerning the presence of pain upon injection were not available for three LNI patients and five IANI patients.

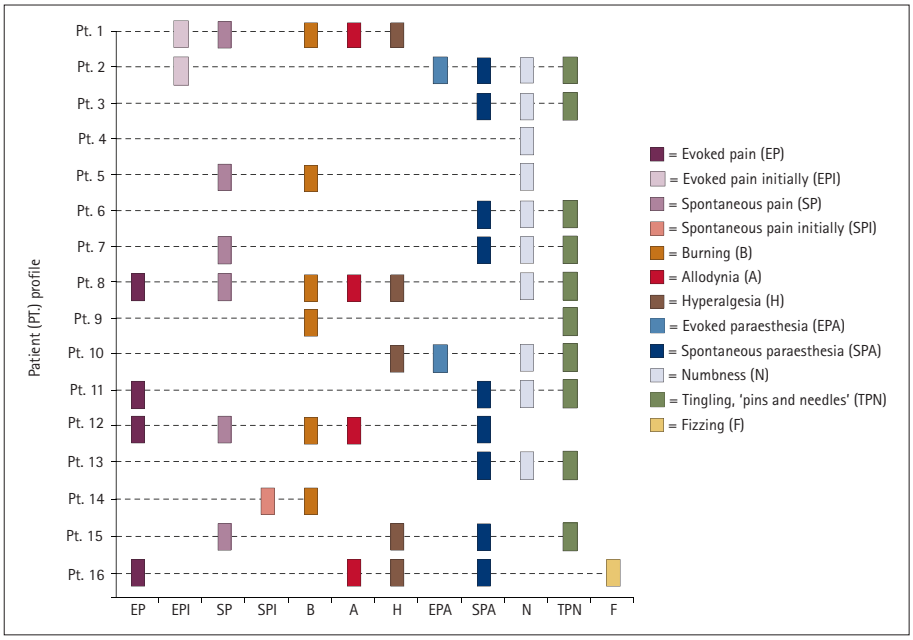

Fig. 1a Incidence of the main complaints stated by patients with LNI due to the LA

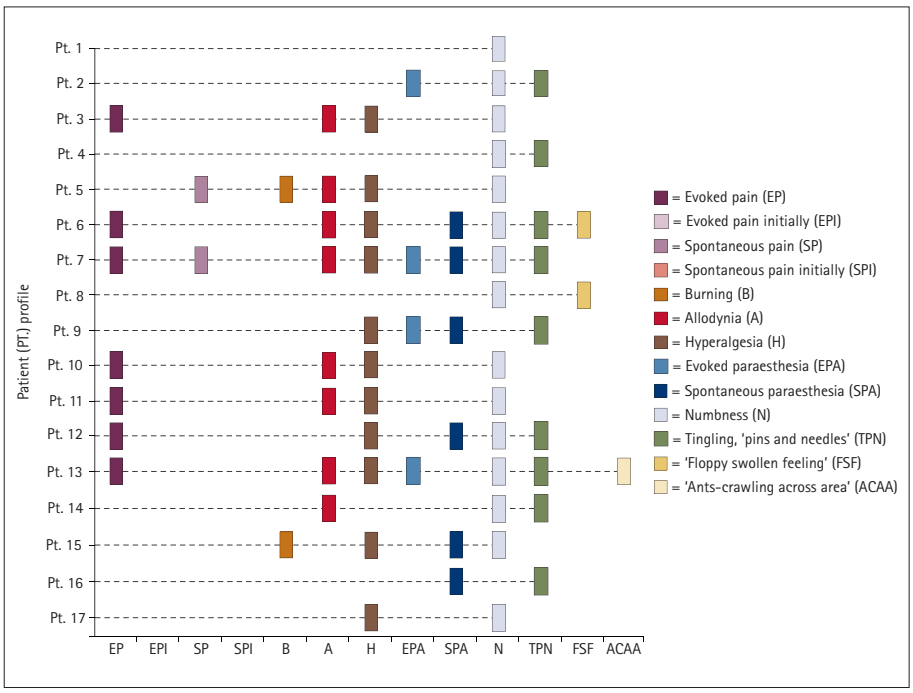

Fig. 1b Incidence of the main complaints stated by patients with IANI caused by LA

DISCUSSION

A number of studies have reported trigeminal nerve injury in relation to local anaesthetic block injections.[11–21] The nerve injury may be physical from the needle or chemical from the local anaesthetic solution. The mean age of patients presenting with trigeminal nerve injury in relation to LA in our study was 48 years, similar to that of previous studies.[2,13] Most of the patients presented with neuropathic pain in relation to their nerve injury.

Studies have reported that 1.3-8.6% of all patients experience an 'electric shock' type sensation during an IAN block.[22] In the present study, 50% of patients reported pain on injection during LA application and this is similar to the 57% of patients suffering from prolonged neuropathy in

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other studies.[2] It should be noted that this is not a specific sign as not all who experience prolonged neuropathy suffer pain during the injection.

It has been suggested that 81% of IAN block nerve injuries resolve at 2 weeks post-injection. In the present study most injuries were permanent but this probably reflects the delayed mean referral of 10 months. Injuries more than 6 months in duration were considered to be permanent.

It has been reported that repeating an inferior alveolar nerve block increases the risk of nerve damage.[2] The results of the present study suggest that this is particularly the case for the LNI as patients suffering this injury were significantly more likely to have received a repeat block compared to those who had IANI. Repeated blocks were most likely necessary because the IAN rather than the LN was not adequately anaesthetised in many of the LNI cases. This would suggest that if the LN is adequately anaesthetised following the first injection, the technique should be modified to avoid trauma to the LN on the second injection. It would also be appropriate to state purely on a statistical basis that there is a greater risk for damage to occur with the greater the number of injections.

There is controversy in the literature as to the effect of local anaesthetic concentration on the production of nerve injury. Certainly increasing the local anaesthetic concentration increases neurotoxicity *in vitro*.[23] The studies of Haas and Lennon,[1] Hillerup and Jensen[13] and Gaffen and Haas[24] suggest that more concentrated 4% solutions are more likely to produce damage, however others[12,25] dispute this, pointing out that the nerve most often damaged is the lingual nerve and the solution is more usually deposited closer to the inferior alveolar nerve during an IAN block. Although there are insufficient data in the present study related to the types of LA used in the study population to inform the debate about the effect of concentration, it is apparent from the results that nerve damage is not exclusively caused by higher concentrations of solutions.

An interesting finding from the present study is the relatively high number of IANIs, as studies in North America have shown that lingual nerve injury is normally more apparent after LA-induced damage.[2] It is not clear why this is the case. It might reflect differences in technique between UK and North American dentists such as the use of narrower gauge needles in the UK.

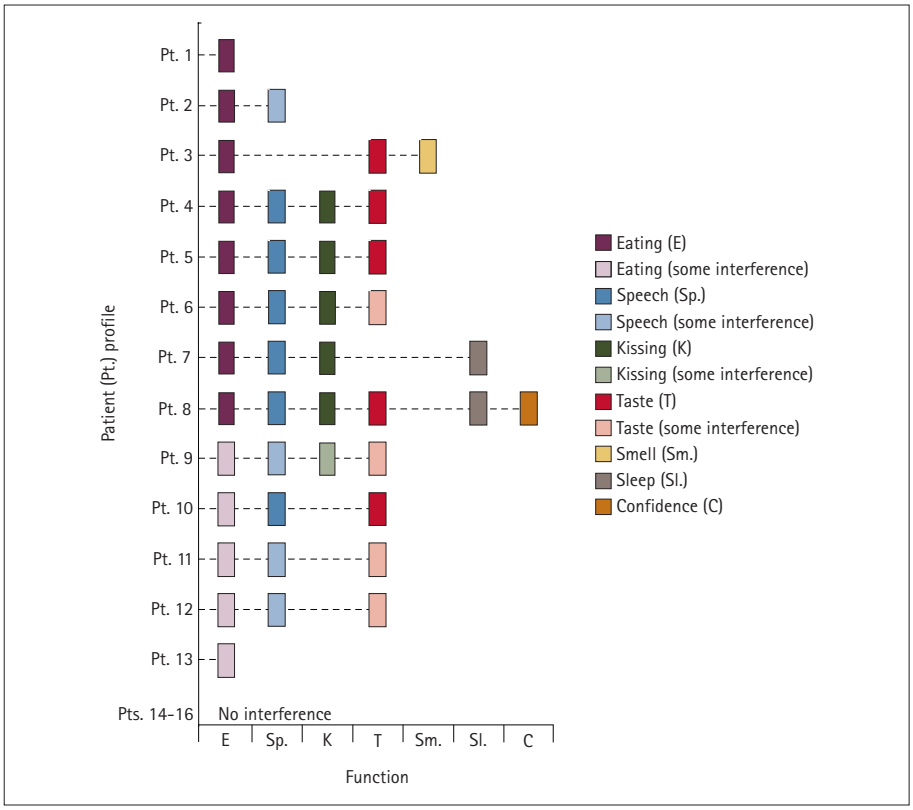

Fig. 2a Key reported functional difficulties amongst the LNI patients who had their injury due to the LA

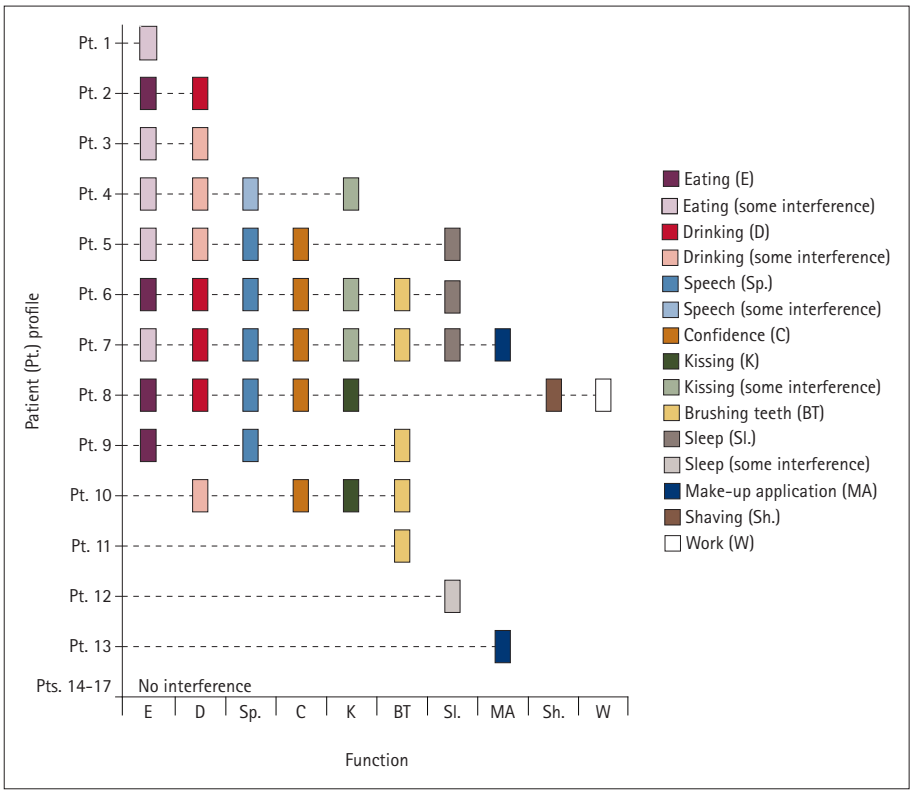

Fig. 2b Key functional problems reported by the IANI patients who had their injury due to the LA

The results of this study show that iatrogenic damage to the inferior alveolar and lingual nerves has serious consequences for the patient. Pain is a major symptom and many important functions such as eating,

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speaking, kissing, toothbrushing, shaving and application of make-up are affected. Allodynia is particularly troublesome, as patients experience evoked 'neuralgic' sensations similar to those experienced in trigeminal neuralgia that last a few seconds following the stimulus and that would not normally cause pain. The avoidance of such damage is obviously important and the present results suggest that repeated injection is a contributory factor, especially for LNI. Dealing with a failed block by other methods such as intraligamentary, intraosseous or infiltration techniques may be wise.[26] Indeed, the primary use of such methods might eliminate the need for block anaesthesia completely. Much research is ongoing at present looking at the use of infiltration techniques in the mandible using 4% articaine as an alternative to block anaesthesia.[27] Certainly volunteer studies[28,29] have shown that an infiltration with 4% articaine can be as effective as an inferior block with 2% lidocaine in providing anaesthesia of the adult mandibular first molar, however there is no evidence as yet that the same occurs in patients. If regional blocks can be avoided then it is reasonable to assume that nerve injury can be eliminated, so endeavours in this regard should be encouraged.

CONCLUSION

Iatrogenic damage to the inferior alveolar and lingual nerves by LA injections has serious consequences for the patient. Repeated ID blocks appear to be a risk for causing LN injuries in this patient cohort. Pain is a major symptom and can consequently affect many important daily functions.

1. Haas D A, Lennon D. A 21 year retrospective study of reports of paraesthesia following local anesthetic administration. *J Can Dent Assoc* 1995; **61:** 319–320, 323–326, 329–330.
2. Pogrel M A, Thamby S. Permanent nerve involvement resulting from inferior alveolar nerve blocks. *J Am Dent Assoc* 2000; **131:** 901–907.
3. Tay A B G, Zuniga J R. Clinical characteristics of trigeminal nerve injury referrals to a university centre. *Int J Oral Maxillofac Surg* 2007; **36:** 922–927.
4. Ziccardi V B. Trigeminal nerve injuries. *J N J Dent Assoc* 2000; **71(4):** 41–44.
5. Abarca M, van Steenberghe D, Malevez C, De Ridder J, Jacobs R. Neurosensory disturbances after immediate loading of implants in the anterior mandible: an initial questionnaire approach followed by a psychophysical assessment. *Clin Oral Investig* 2006; **10:** 269–277.
6. Kiyak H A, Beach B H, Worthington P, Taylor T, Bolender C, Evans J. Psychological impact of osseointegrated dental implants. *Int J Oral Maxillofac Implants* 1990; **5:** 61–69.
7. Venta I, Lindqvist C, Ylipaavalniemi P. Malpractice claims for permanent nerve injuries related to third molar removals. *Acta Odontol Scand* 1998; **56:** 193–196.
8. Robinson P, Smith K, Johnson F, Coppins D. Equipment and methods for simple sensory testing. *Br J Oral Maxillofac Surg* 1992; **30:** 387–389.
9. Zuniga J R, Essick G K. A contemporary approach to the clinical evaluation of trigeminal nerve injuries. *Oral Maxillofac Surg Clin N Am* 1992; **4:** 353–357.
10. Renton T, Thexton A, McGurk M. New method for the objective evaluation of injury to the lingual nerve after operation on third molars. *Br J Oral Maxillofac Surg* 2005; **43:** 238–245.
11. Krafft T C, Hickel R. Clinical investigation into the incidence of direct damage to the lingual nerve caused by local anaesthesia. *J Craniomaxillofac Surg* 1994; **22:** 294–296.
12. Malamed S F. Nerve injury caused by mandibular block analgesia. *Int J Oral Maxillofac Surg* 2006; **35:** 876–877.
13. Hillerup S. Jensen R. Nerve injury caused by mandibular block analgesia. *Int J Oral Maxillofac Surg* 2006; **35:** 437–443.
14. Cornelius C P, Roser M, Wietholter H, Wolburg H. Nerve injection injuries due to local anaesthetics. Experimental work. *J Craniomaxillofac Surg* 2000; **28(Suppl 3):** 134–135.
15. Caissie R, Goulet J, Fortin M, Morieli D. Iatrogenic paraesthesia in the third division of the trigeminal nerve: 12 years of clinical experience. *J Can Dent Assoc* 2005; **71:** 185–190.
16. Daublander M, Muller R, Lipp M D W. The incidence of complications associated with local anesthesia in dentistry. *Anesth Prog* 1997; **44:** 132–141.
17. Pogrel M A, Schmidt B L, Sambajon V, Jordan R C K. Lingual nerve damage due to inferior alveolar nerve blocks. A possible explanation. *J Am Dent Assoc* 2003; **134:** 195–199.
18. Paxton M C, Hadley J N, Edwards R C, Harrison S J. Chorda tympani nerve injuries following inferior alveolar injection: a review of two cases. *J Am Dent Assoc* 1994; **125:** 1003–1006.
19. Harn S D, Durham T M. Incidence of lingual nerve trauma and post injection complications in conventional mandibular block anaesthesia. *J Am Dent Assoc* 1990; **121:** 519–523.
20. Pogrel M A, Bryan J, Regezi J. Nerve damage associated with inferior alveolar nerve blocks. *J Am Dent Assoc* 1995; **126:** 1150–1155.
21. Hoffmeister B. Morphologic changes of peripheral nerves following intraneural injection of local anaesthetic. *Dtsch Zahnarztl Z* 1991; **46:** 828–830.
22. Smith M H, Lung K E. Nerve injuries after dental injection: a review of the literature. *J Can Dent Assoc* 2006; **72:** 559–564.
23. Johnson M E, Saenz J A, DaSilva A D, Uhl C B, Gores G J. Effect of local anesthetic on neuronal cytoplasmic calcium and plasma membrane lysis (necrosis) in a cell culture model. *Anesthesiology* 2002; **97:** 1466–1476.
24. Gaffen A S, Haas D A. Retrospective review of voluntary reports of nonsurgical paresthesia in dentistry. *J Can Dent Assoc* 2009; **75:** 579.
25. Malamed S F. Articaine *versus* lidocaine: the author responds. Letter. *J Calif Dent Assoc* 2007; **35:** 383–385.
26. Meechan J G. Supplementary routes to local anaesthesia. *Int Endod J* 2002; **35:** 885–896.
27. Meechan J G. Infiltration anesthesia in the mandible. *Dent Clin N Am* in press.
28. Corbett I P, Kanaa M D, Whitworth J M, Meechan J G. Articaine infiltration for anesthesia of mandibular first molars. *J Endod* 2008; **34:** 514–518.
29. Jung I-Y, Kim J-H, Kim E-S, Lee C-Y, Lee S J. An evaluation of buccal infiltrations and inferior alveolar nerve blocks in pulpal anesthesia for mandibular first molars. *J Endod* 2008; **34:** 11–13.

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