Risk assessment of patients with M3Ms, Implants, Endo and LA with a view to preventing nerve injury

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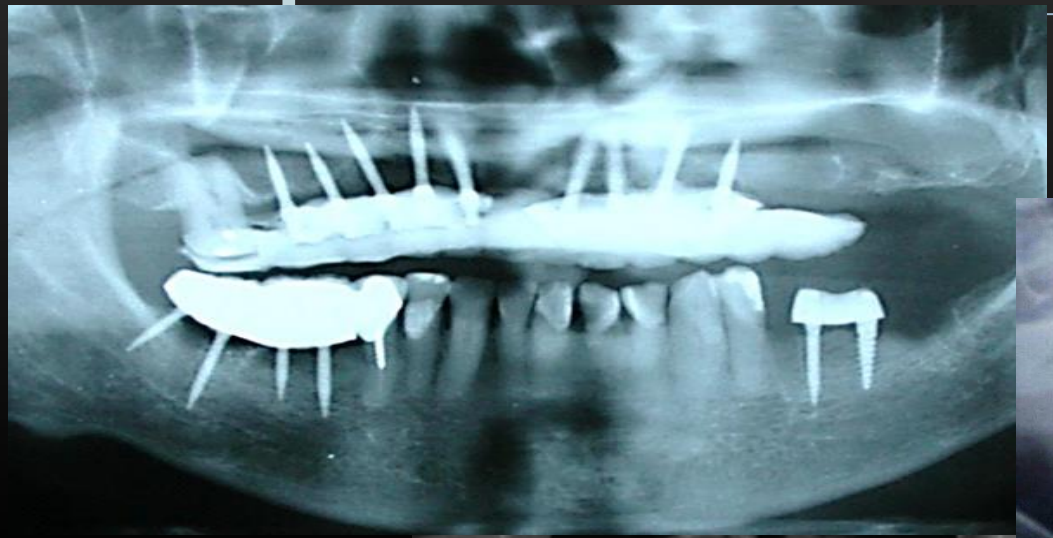
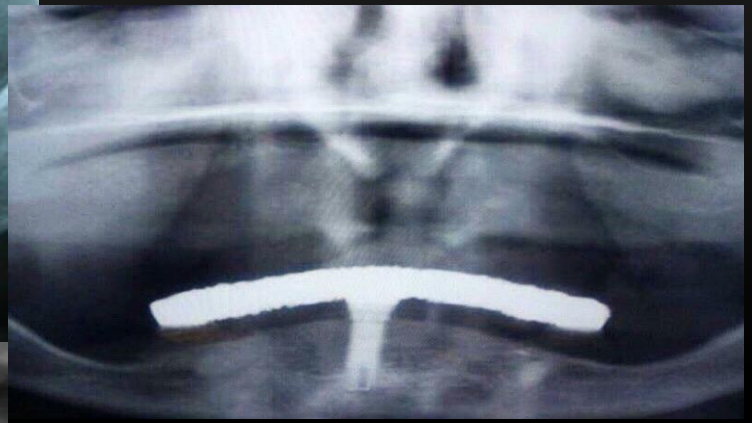
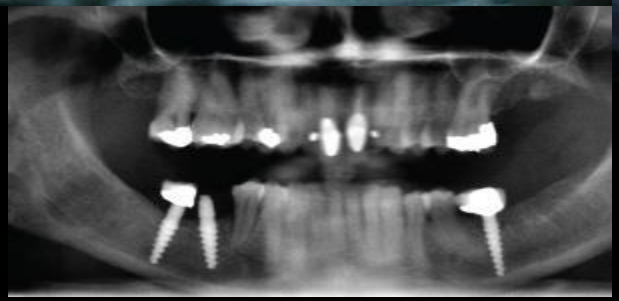
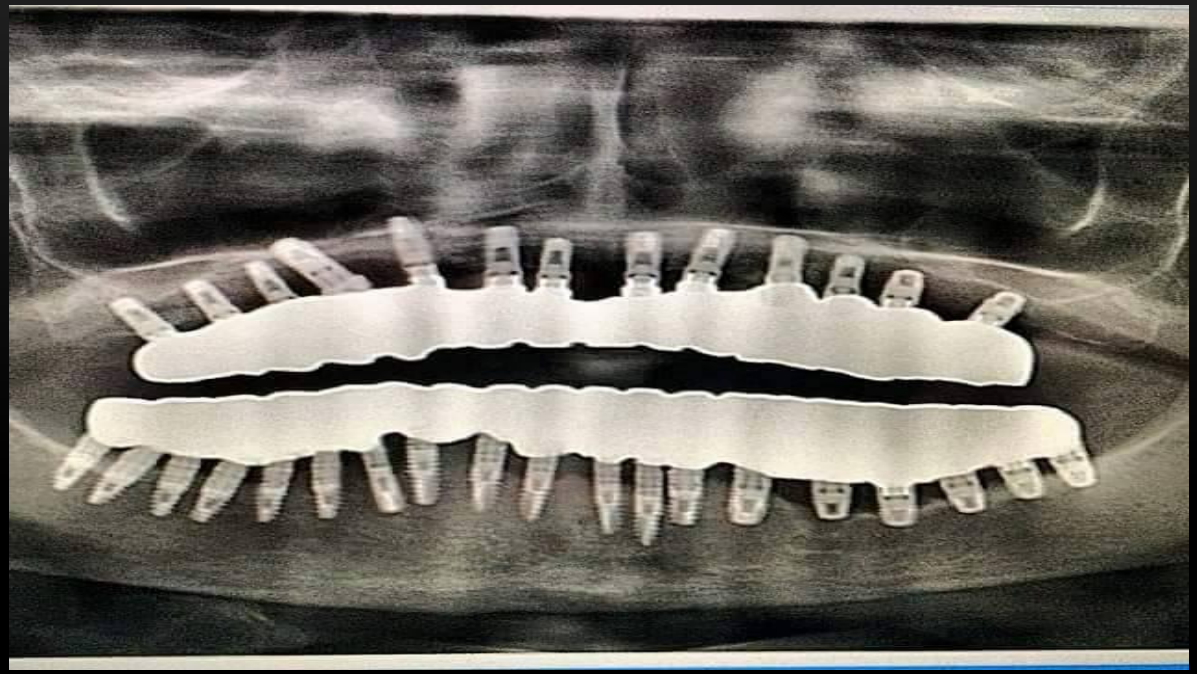
The Optimists



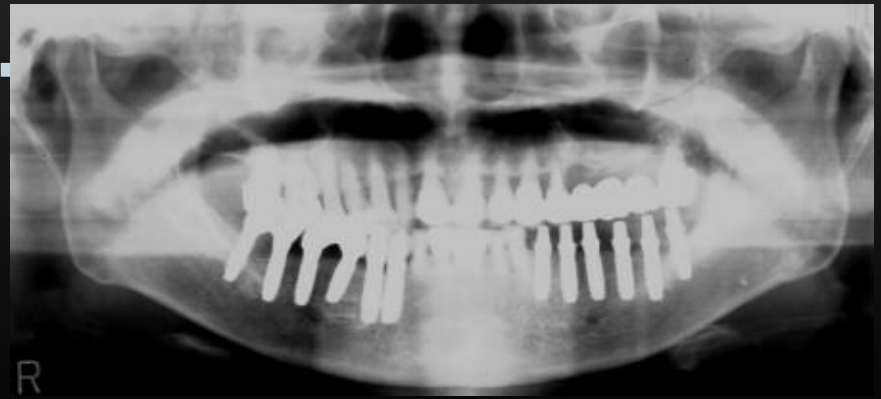


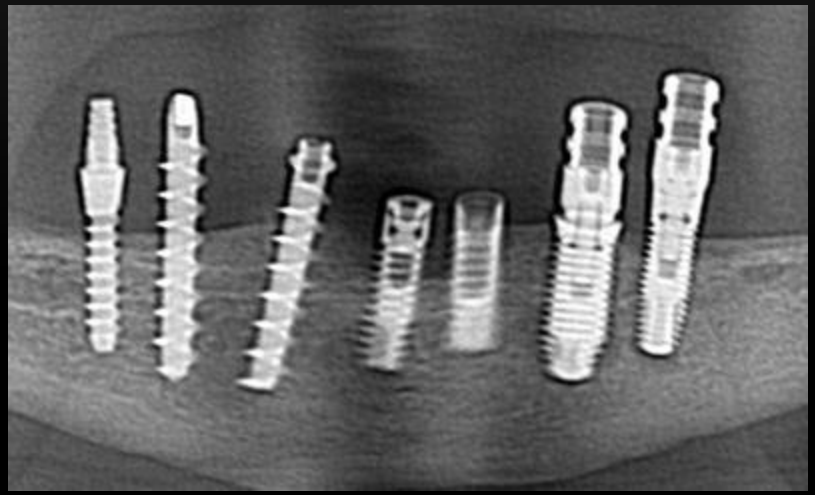


The Pessimists



And the undecided…





Nerve damage related to dental procedures are rare but have a significant impact on the patients involved

Nerve damage in dentistry

M. Anthony Pogrel, DDS, MD

Many forms of dental treatment have the potential to cause injury to the oral branches of the trigeminal nerve, including local anesthetic injections, root canal therapy, implant insertion, bone grafting, and dentoalveolar surgery. Based on the records of a referral center with more than 30 years' experience in managing 3200 of these injuries, this article reviews etiology and prevention, suggests criteria for referral of patients, and discusses treatment for the various types of injury and the results of such treatment.

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A number of dental procedures, including local anesthetic injections, endodontic treatment, implant insertion, bone grafting, and dentoalveolar surgery, have the ability to damage nerves (usually sensory nerves). Fortunately, most cases of nerve injury are temporary, but permanent cases of anesthesia, paresthesia (abnormal sensations), or dysesthesia (unpleasant sensations) do occur. This article looks at one regional referral center's experience, gained over 30 years of managing these problems, and observes emerging trends.

Setting

The Department of Oral and Maxillofacial Surgery (DOMS) at the University of California, San Francisco (UCSF), has acted as a regional referral center for patient swith nerve injuries associated with dental treatment for mor ethan 30 years. Since 1985, the department has seen more th an 3200 patients with iatrogenic injuries to the sensory nerves of the maxillofacial areas. This experience has presented the opportunity to make a number of observations and evaluate different management protocols.

The vast majority of referrals are for nerve injuries related to 5 types of dental procedure: local anesthetic injections; root canal therapy; osseointegrated implant therapy; bone grafting, including injuries from bone products and bone graft harvesting, and dentoalveolar surgery, primarily third molar removal. The discussion in the present article will be restricted to these 5 areas. A similar range of etiologies for nerve damage has been reported elsewhere.[1]The majority of injuries are related to the inferior alveolar and/or lingual nerves; there is only occasional involvement of the long buccal, mylohyoid, infraorbital, and maxillary nerve branches.

Causes of nerve damage

Local anesthetic injections

Since 1985, clinicians in the department have seen and examined 324 patients in whom the nerve injury could only have resulted from a dental injection. These experiences allowed a number of observations, including the facts that the lingual nerve is affected approximately twice as often as the inferior alveolar nerve and approximately one-third of patients suffered from dysesthesia (painful sensations) instead of pure anesthesia or paresthesia.[1]If recovery did occur, it normally occurred over a period of about 3 months, and late recoveries were rare.[2,3]

The vast majority of these injuries were associated with inferior alveolar nerve blocks.[4,5] Among the cases of permanent nerve damage from local anesthetics that have been observed over the last 30 years, only 5 of 324 resulted from any other type

Pogrel MA. Nerve damage in dentistry. Gen Dent. 2017 Mar-Apr;65(2):34-41

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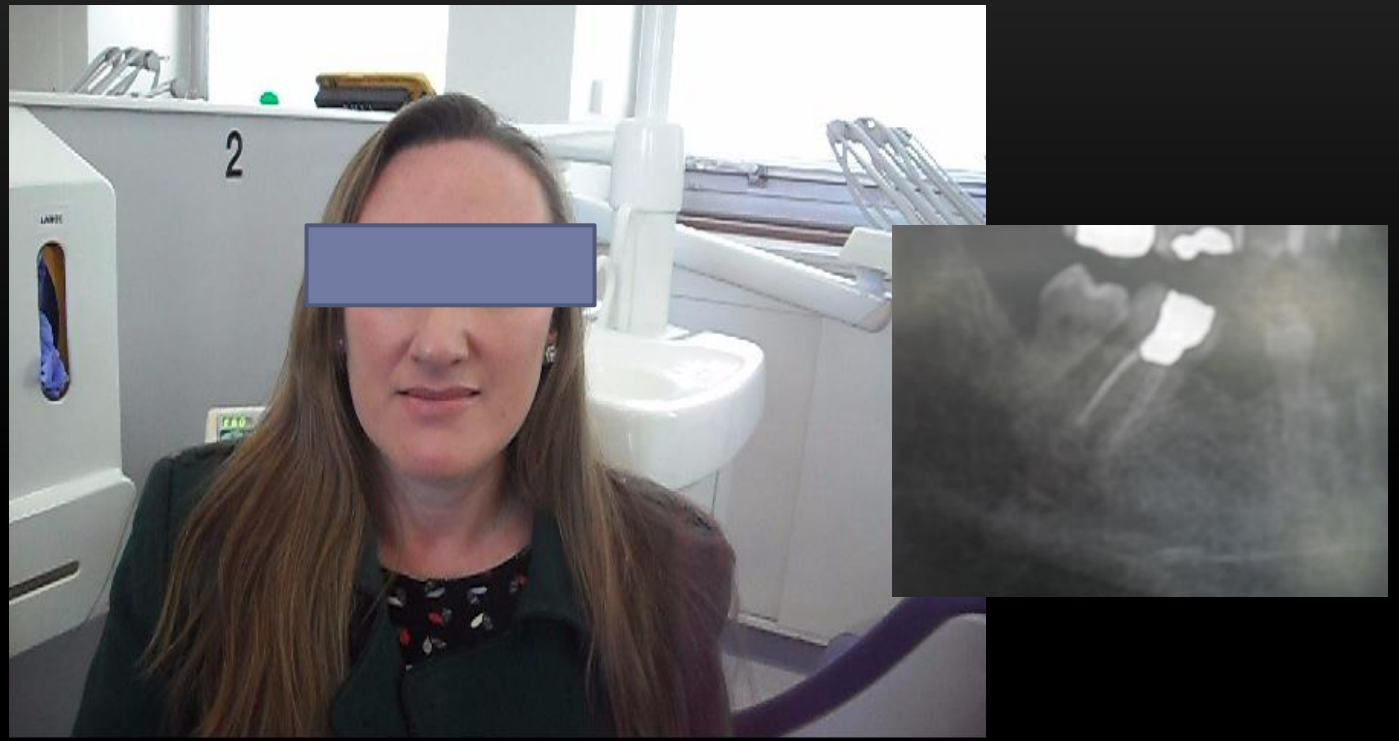
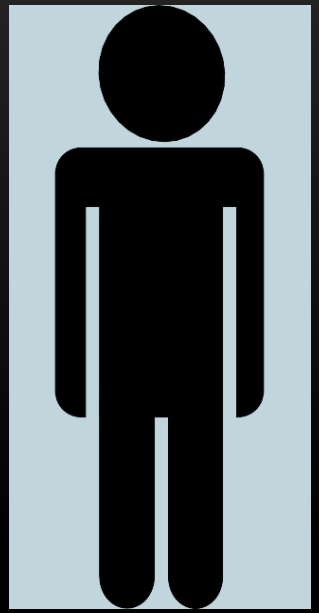
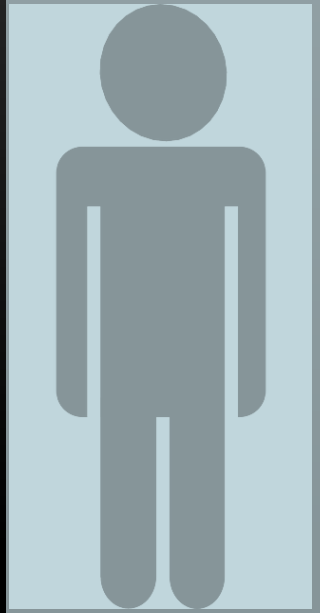
Late diagnosis of Endo PTN causing additional morbidity



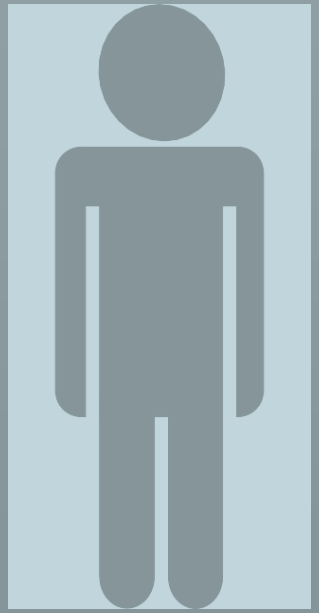
Overview



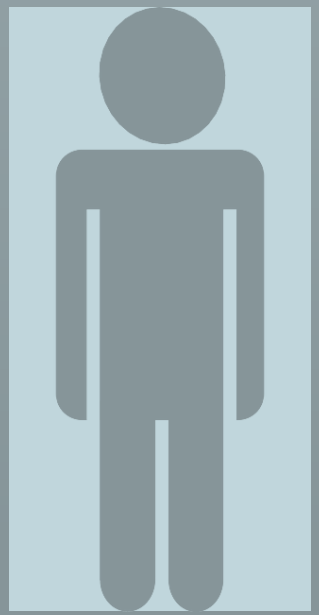
What is Neuropathic pain?



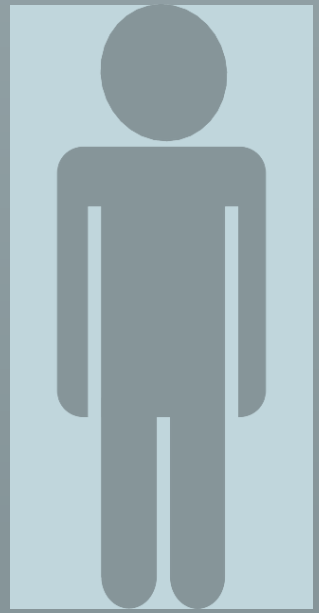
Who gets PTNP?



Why prevent PTNP?



How to prevent these injuries?



How to manage these injuries?

Aim This lecture will update participants in the prevention of trigeminal nerve injuries during dental surgery

Objectives The following will be discussed:

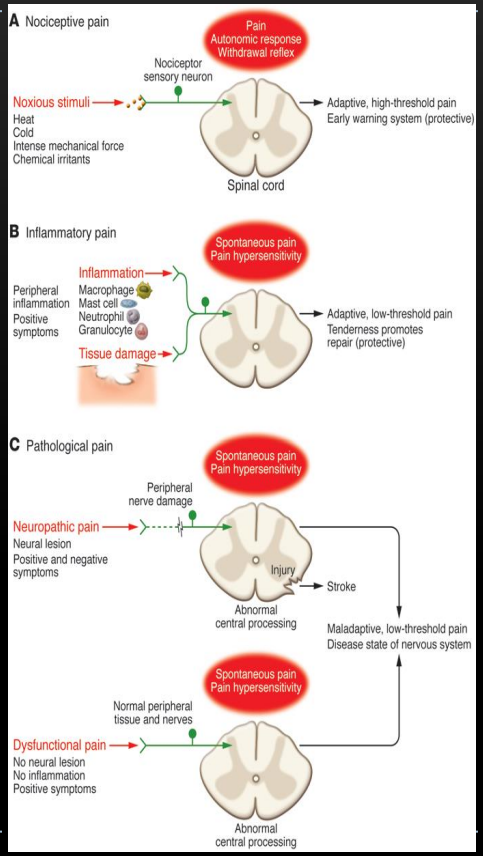
- assessment of the patient with M3M
- assessment of M3M surgical difficulty
- radiographic factors
- CBCT assessment
- Surgical modification to minimise nerve injuries
- follow up advice to identify nerve injuries and assist resolution of nerve injuries

Outcomes

By the end of the lecture participants will:

- be familiar with recognising and minimising risk to the trigeminal nerve when undertaking dental procedures;
- understand the importance of preventing nerve injuries and the impact on those patients affected;
- understand how to improve patient consent;
- be able to develop a better strategy for assessing and identifying patients at high risk;
- know When to refer or treat.

Types of pain



Types of pain
Healthy acute pain

Nociceptive
healthy feeling pain 'pain'

NOCICEPTIVE PAIN

Inflammatory pain
healthy short lived after insult

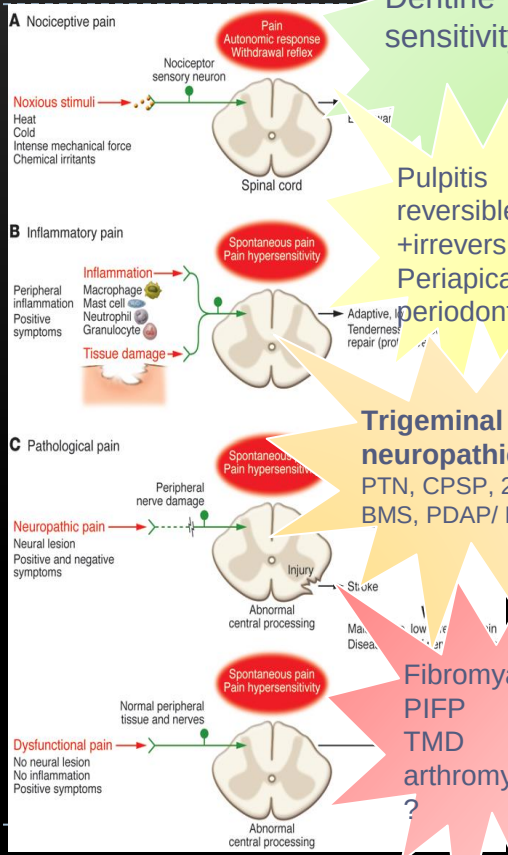
Chronic pain =
disease of neuromatrix

Neuropathic pain
Associated with nerve lesion

NEUROPATHIC PAIN

Dysfunctional or centralised pain
Unknown cause

NOCIPLASTIC PAIN



Dentine sensitivity

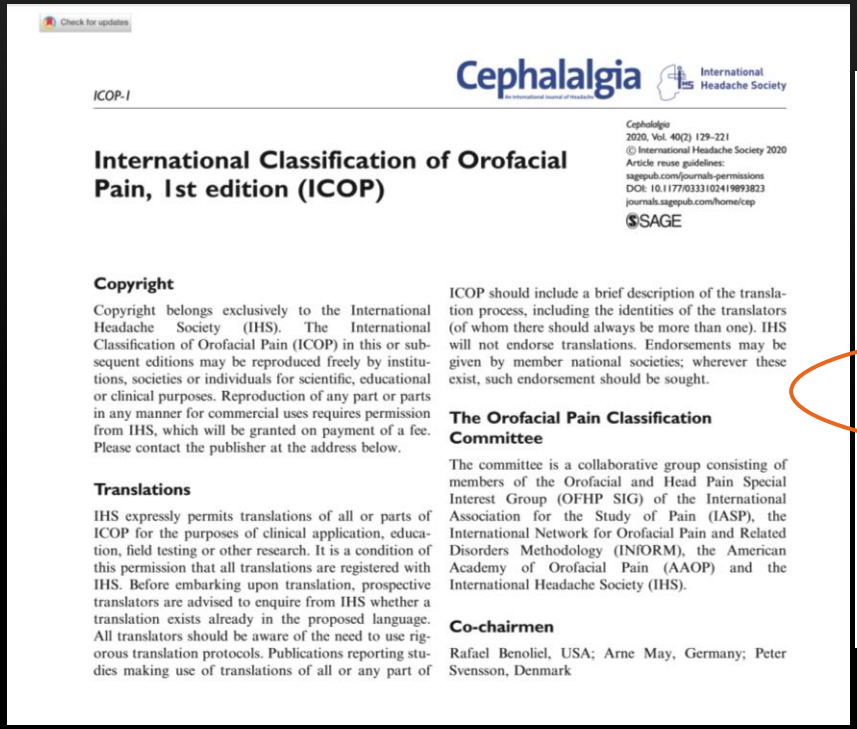
Pulpitis reversible +irreversible
Periapical periodontitis

Trigeminal neuropathic pain
PTN, CPSP, 2y TN, BMS, PDAP/ PHN

Fibromyalgia
PIFP
TMD
arthromyalgia
?

J Clin Invest. 2010 Nov 1; 120(11): 3742–3744. ***What is this thing called pain?*** *Clifford J. Woolf*

International Classification orofacial pain (ICOP)
Neuropathic Pain



Check for updates

ICOP-1

Cephalalgia
International Headache Society

Cephalalgia
2020, Vol. 40(2) 129–221

DOI: 10.1177/0333102419893823
journals.sagepub.com/home/cep
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International Classification of Orofacial Pain, 1st edition (ICOP)

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The Orofacial Pain Classification Committee

The committee is a collaborative group consisting of members of the Orofacial and Head Pain Special Interest Group (OFHP SIG) of the International Association for the Study of Pain (IASP), the International Network for Orofacial Pain and Related Disorders Methodology (INfORM), the American Academy of Orofacial Pain (AAOP) and the International Headache Society (IHS).

Co-chairmen

Rafael Benoliel, USA; Arne May, Germany; Peter Svensson, Denmark

1. Orofacial pain attributed to disorders of dentoalveolar and anatomically related structures
2. Myofascial orofacial pain
3. Temporomandibular joint (TMJ) pain
4. Orofacial pain attributed to lesion or disease of the cranial nerves
5. Orofacial pains resembling presentations of primary headaches
6. Idiopathic orofacial pain

ICOP 2020

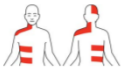
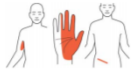
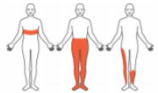
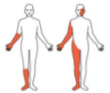
Orofacial pain attributed to lesion or disease of the cranial nerves Lene Baad-Hansen, Denmark (chairman); Eli Eliav, USA;

Types of neuropathic pain

- In 1994, the International Association for the Study of Pain (IASP) defined neuropathic pain as "pain initiated or caused by a primary lesion or dysfunction in the nervous system."
- In 2008, a task force initiated by the IASP Special Interest Group on Neuropathic Pain (NeuPSIG) noted the need to distinguish neuropathic pain from nociceptive pain arising indirectly from neurological disorders and pain conditions with secondary neuroplastic changes occurring in the nociceptive system, and proposed a new definition that omitted the term "dysfunction":
- "pain arising as a direct consequence of a lesion or disease affecting the somatosensory system."30
- A slightly modified version of this definition was proposed by the IASP Taxonomy Committee and accepted by the IASP: "**pain caused by a lesion or disease of the somatosensory nervous system."**

Table 1

Common neuropathic pain conditions and neuroanatomically plausible distribution of pain symptoms and sensory signs.

Neuropathic pain condition	Neuroanatomically plausible distribution of pain and sensory signs	Illustration of typical distribution
Trigeminal neuralgia	Within the facial or intraoral trigeminal territory.	
Postherpetic neuralgia	Unilateral distributed in one or more spinal dermatomes or the trigeminal ophthalmic division.	
Peripheral nerve injury pain	In the innervation territory of the lesioned nerve, typically distal to a trauma, surgery, or compression.	
Postamputation pain	In the missing body part and/or in the residual limb.	
Painful polyneuropathy	In feet, may extend to involve lower legs, thighs, and hands.	
Painful radiculopathy	Distribution consistent with the innervation territory of the nerve root.	
Neuropathic pain associated with spinal cord injury	At and/or below the level of the spinal cord lesion.	
Central poststroke pain	Contralateral to the stroke. In lateral medullary infarction, the distribution can also involve the ipsilateral side of the face.	
Central neuropathic pain associated with multiple sclerosis	Can be a combination of distributions seen in spinal cord injury and stroke.	

About 413 physicians completed a total of 3,956 patient records forms. Total annual direct health-care costs per patient ranged from €1,939 (Italy) to €3,131 (Spain).

Annual professional caregiver costs ranged from €393 (France) to €1,242 (UK), but this only represented a small proportion of total care because much care is provided by family or friends. Sick leave costs ranged from €5,492 (UK) to €7,098 (France), with 10%–32% patients prevented from working at some point by NP.

Total cost (including **direct and indirect costs**) of NP per patient was €10,313 in France (69% of the total cost), €14,446 in Germany (78%), €9,305 in Italy (69%), €10,597 in Spain (67%), and **€9,685 in the UK (57%).**

Indirect costs (ie, sick leave) constituted the majority of costs in all five countries: €7,098 in France, €11,232 in Germany, €6,382 in Italy, €7,066 in Spain, and **€5,492 in the UK**. In the subgroup analysis, total annual direct costs per patient were highest for neuropathic back pain and radiculopathy, and lowest for fibromyalgia.
Mean WPAI score range was 34.4–56.1; BPI interference was 4.1–4.8; and EQ-5D was 0.57–0.74. The results suggest that a significant proportion of the patient's work time in the previous week was affected by NP, and these are relatively high compared with other diseases such as diabetes, respiratory conditions, and arthritis.

The wider costs appear significantly higher to patients, carers/families, and society as a whole than to the health system alone.

ClinicoEconomics and Outcomes Research

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ORIGINAL RESEARCH

A burden of illness study for neuropathic pain in Europe

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Clinico Economics and Outcomes Research
27 April 2016
Number of times this article has been viewed

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Marko Obradovic[1]
Jonathan De Courcy[2]
Timothy Holbrook[2]
Rafal Jakubanis[2]

[1]Grunenthal, Aachen, Germany; [2]Adelphi Real World, Bollington, Cheshire, UK

Purpose: Neuropathic pain (NP) is often severe and represents a major humanistic and economic burden. This study aimed at providing insight on this burden across France, Germany, Italy, Spain, and the UK, considering direct and indirect costs, productivity loss, and humanistic impact on patients and their families.

Methods: Physician questionnaires provided data on patients presenting with NP covering demographics, sick leave and retirement, number of consultations, drug treatments, and surgical procedures. Patients provided further demographic and disease-related data and completed the Work Productivity and Activity Impairment (WPAI), the EuroQol 5-Dimension (EQ-5D), and the Brief Pain Inventory (BPI) questionnaires. All health-related direct unitary costs were collected from relevant country-specific sources and adjusted to 2012 prices (€) where necessary. A subgroup analysis of costs based on diabetic peripheral neuropathy (n=894), fibromyalgia (n=300), and low back pain (n=963) was performed.

Findings: About 413 physicians completed a total of 3,956 patient records forms. Total annual direct health-care costs per patient ranged from €1,939 (Italy) to €3,131 (Spain). Annual professional caregiver costs ranged from €393 (France) to €1,242 (UK), but this only represented a small proportion of total care because much care is provided by family or friends. Sick leave costs ranged from €5,492 (UK) to €7,098 (France), with 10%–32% patients prevented from working at some point by NP. Total cost (including direct and indirect costs) of NP per patient was €10,313 in France (69% of the total cost), €14,446 in Germany (78%), €9,305 in Italy (69%), €10,597 in Spain (67%), and €9,685 in the UK (57%). Indirect costs (ie, sick leave) constituted the majority of costs in all five countries: €7,098 in France, €11,232 in Germany, €6,382 in Italy, €7,066 in Spain, and €5,492 in the UK. In the subgroup analysis, total annual direct costs per patient were highest for neuropathic back pain and radiculopathy, and lowest for fibromyalgia. Mean WPAI score range was 34.4–56.1; BPI interference was 4.1–4.8; and EQ-5D was 0.57–0.74. The results suggest that a significant proportion of the patient's work time in the previous week was affected by NP, and these are relatively high compared with other diseases such as diabetes, respiratory conditions, and arthritis.

Implications: Despite differences in practice between countries, these findings suggest a high opportunity cost for society in terms of lost work and productivity due to NP. The wider costs appear significantly higher to patients, carers/families, and society as a whole than to the health system alone.

Keywords: neuropathic pain, burden of illness, chronic lower back pain, productivity

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Introduction

Chronic pain is a distinct and well-recognized condition ex
of the European adult population.[1] While the majority of c

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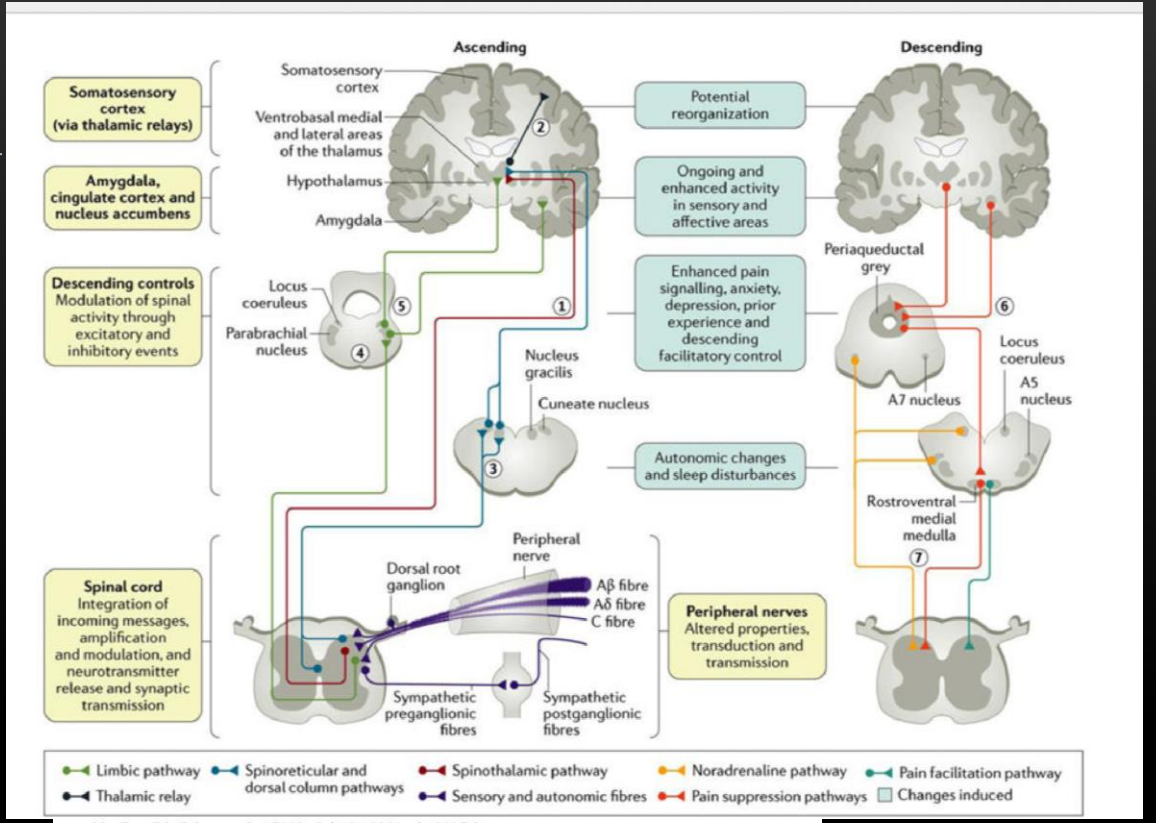
Pathophysiology

Figure 1. The peripheral and central changes induced by nerve injury or peripheral neuropathy Preclinical animal studies have shown that damage to all sensory peripheral fibres (namely, Aβ, Aδ and C fibres; BOX 1) alters transduction and transmission due to altered ion channel function. These alterations affect spinal cord activity, leading to an excess of excitation coupled with a loss of inhibition. In the ascending afferent pathways, the sensory components of pain are via the spinothalamic pathway to the ventrobasal medial and lateral areas (1), which then project to the somatosensory cortex allowing for the location and intensity of pain to be perceived (2). The spinal cord also has spinoreticular projections and the dorsal column pathway to the cuneate nucleus and nucleus gracilis (3). Other limbic projections relay in the parabrachial nucleus (4) before contacting the hypothalamus and amygdala, where central autonomic function, fear and «anxiety are altered (5). Descending efferent pathways from the amygdala and hypothalamus (6) drive the periaqueductal grey, the locus coeruleus, A5 and A7 nuclei and the rostroventral medial medulla. These brainstem areas then project to the spinal cord through descending noradrenaline (inhibition via α2 adrenoceptors), and, in neuropathy, there is a loss of this control and increased serotonin descending excitation via 5-HT3 receptors (7). The changes induced by peripheral neuropathy on peripheral and central functions are shown. Adapted with permission from REF. 38, Mechanisms and management of diabetic painful distal symmetrical polyneuropathy, American Diabetes Association, 2013. Copyright and all rights reserved. Material from this publication has been used with the permission of American Diabetes Association.



Nat Rev Dis Primers. ; 3: 17002. doi:10.1038/nrdp.2017.2.

Neuropathic pain

Luana Colloca[1], Taylor Ludman[1], Didier Bouhassira[2], Ralf Baron[3], Anthony H. Dickenson[4], David Yarnitsky[5], Roy Freeman[6], Andrea Truini[7], Nadine Attal[8], Nanna B. Finnerup[9], Christopher Eccleston[10,11], Eija Kalso[12], David L. Bennett[13], Robert H. Dworkin[14], and Srinivasa N. Raja[15]

Definitions – do not confuse nomenclature!

- **Neuralgia –** nerve pain
- **Neuropathic pain (IASP)**
  Pain caused by a lesion or disease of the somatosensory nervous system.
- **Neuropathy (IASP)**
  A disturbance of function or pathological change in a nerve: in one nerve, mononeuropathy; in several nerves, mononeuropathy multiplex; if diffuse and bilateral, polyneuropathy.
- *Note:* **Neuritis** (q.v.) is a special case of neuropathy and is now reserved for inflammatory processes affecting nerves.
  - sensory (touch, heat, pain)
  - motor (movement)

Chronic post surgical pain (CPSP) or NeP?

Haroutiunian S, Nikolajsen L, Finnerup NB, Jensen TS. The neuropathic component in persistent postsurgical pain: a systematic literature review. Pain. 2013 Jan;154(1):95-102. doi: 10.1016/j.pain.2012.09.010.

Persistent postsurgical pain (PPSP) is a frequent and often disabling complication of many surgical procedures.

Nerve injury-induced neuropathic pain (NeuP) has repeatedly been proposed as a major cause of PPSP. However, there is a lack of uniformity in NeuP assessment across studies, and the prevalence of NeuP may differ after various surgeries.

We performed a systematic search of the PubMed, CENTRAL, and Embase databases and assessed 281 studies that investigated PPSP after 11 types of surgery.

The prevalence of PPSP in each surgical group was examined. The prevalence of NeuP was determined by applying the recently published NeuP probability grading system. The prevalence of probable or definite NeuP was high in patients with persistent pain after thoracic and breast surgeries-66% and 68%, respectively. In patients with PPSP after groin hernia repair, the *prevalence of NeuP was 31%,* and after total hip or knee arthroplasty it was 6%.

The results suggest that the prevalence of NeuP among PPSP cases differs in various types of surgery, probably depending on the likelihood of surgical iatrogenic nerve injury. Because of large methodological variability across studies, a more uniform approach is desirable in future studies for evaluating persistent postsurgical NeuP.

	Estimated incidence of chronic pain	Estimated chronic severe (disabling) pain (>5 out of score of 10)	US surgical volumes (1000s)†
Amputation[2]	30–50%	5–10%	159 (lower limb only)
Breast surgery (lumpectomy and mastectomy)[3]	20–30%	5–10%	479
Thoracotomy[4–7]	30–40%	10%	Unknown
Inguinal hernia repair[8–10]	10%	2–4%	609
Coronary artery bypass surgery[11–13]	30–50%	5–10%	598
Caesarean section[14]	10%	4%	220

*Gall bladder surgery not included, since preoperative diagnosis of pain specifically from gall bladder is difficult and persistent postoperative pain could therefore be related to other intra-abdominal disorders. †National Center For Health Statistics, Ambulatory and Inpatients Procedures, USA, 1996.

Table 1: **Estimated incidence of chronic postoperative pain and disability after selected surgical procedures***

30% get persistent pain 10% are <u>severely</u> affected
Very few related to dentistry likely due to LA

Kehlet H *et al*, 2006 Lancet

Diagnostic Criteria

Table 3. Core Diagnostic Criteria for Persistent Posttraumatic Neuropathic Pain

1. History of traumatic nerve injury or surgery associated with known risk of nerve injury.* Traumatic event = onset
2. Pain lasting ≥3 mo, with onset showing a temporal relation to known nerve injury (onset within days to weeks after the injury).†
3. Positive and/or negative signs of sensory disturbance in the innervation of the injured nerve as evidenced by ≥1 of the following:
   a. Mixed areas of hypo- and hypersensitivity to various sensory modalities Neuropathic area
   b. Hyposensitivity to nonpainful warmth (with or without changes in cold sensation) Allodynia / Hyperalgesia = hyperaesthesia
   c. Hypersensitivity to brush or pinprick in or around the painful area
4. No other condition (eg, inflammation, tumor) better explains the pattern of the clinical features (eg, radiculopathy) that could plausibly account for persisting pain in the affected dermatome or dermatomes. Anaesthesia/paraesthesia = hypoaesthesia

*This pain may occur even if there was a deliberate attempt to spare the large nerves crossing the surgical area (eg, in breast surgery).
†There is a spontaneous decline in reporting of pain >12 mo after surgery/trauma. Relevant citations in support of these diagnostic criteria are Bruehl,[34] Duffy et al,[77] Guo et al,[107] Haldar et al,[109] Pappagallo et al,[187] Teerijoki-Oksa

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Focus Article

AAPT Diagnostic Criteria for Peripheral Neuropathic Pain: Focal and Segmental Disorders

Roy Freeman,* Robert Edwards,† Ralf Baron,‡ Stephen Bruehl,§ Giorgio Cruccu,¶ Robert H. Dworkin,‖ and Simon Haroutounian**
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**Department of Anesthesiology and Washington University Pain Center, Washington University School of Medicine, St Louis, MO

Abstract: Peripheral neuropathic pain is among the most prevalent types of neuropathic pain.

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The IASP classification of chronic pain for ICD-11: chronic neuropathic pain

Joachim Scholz[a], Nanna B. Finnerup[b,c], Nadine Attal[d], Qasim Aziz[e], Ralf Baron[f], Michael I. Bennett[g], Rafael Benoliel[h], Milton Cohen[i], Giorgio Cruccu[j], Karen D. Davis[k], Stefan Evers[l], Michael First[m], Maria Adele Giamberardino[n], Per Hansson[o], Stein Kaasa[p], Beatrice Korwisi[q], Eva Kosek[r], Patricia Lavand'homme[s], Michael Nicholas[t], Turo Nurmikko[u], Serge Perrot[v], Srinivasa N. Raja[w], Andrew S. C. Rice[x], Michael C. Rowbotham[y], Stephan Schug[z], David M. Simpson[aa], Blair H. Smith[ab], Peter Svensson[ac], Johan W.S. Vlaeyen[ad], Shuu-Jiun Wang[ae], Antonia Barke[q], Winfried Rief[q], Rolf-Detlef Treede[af], Classification Committee of the Neuropathic Pain Special Interest Group (NeuPSIG), and Task Force for the Classification of Chronic Pain of the International Association for the Study of Pain (IASP)

Post Traumatic neuropathic pain PTNP (ICOP)

4.1.2.3 Post-traumatic trigeminal neuropathic pain

- Previously used terms: Anaesthesia dolorosa; painful post-traumatic trigeminal neuropathy.
- Description: Unilateral or bilateral facial or oral pain following and caused by trauma to the trigeminal nerve(s), with other symptoms and/or clinical signs of trigeminal nerve dysfunction, and persisting or recurring for more than 3 months.
- *4.1.2.3.1 Probable post-traumatic trigeminal neuropathic pain*
- *Diagnostic criterion: A. Pain fulfilling all but criterion B2 for 4.1.2.3 Posttraumatic trigeminal neuropathic pain.*

4.1.2.4 Trigeminal neuropathic pain attributed to other disorder

4.1.2.5 Idiopathic trigeminal neuropathic pain

Description: Unilateral or bilateral facial pain in the distribution(s) of one or more branches of the trigeminal nerve

Diagnostic criteria:

A. Pain, in a neuroanatomically plausible area within the distribution(s) of one or both trigeminal nerve(s), persisting or recurring for >3 months and fulfilling criteria C and D

B. Both of the following:

1. history of a mechanical, thermal, radiation or chemical injury to the peripheral trigeminal nerve(s)
2. diagnostic test confirmation1 of a lesion of the peripheral trigeminal nerve(s) explaining the pain2

C. Onset within 6 months after the injury

D. Associated with somatosensory symptoms and/or signs4 in the same neuroanatomically plausible distribution

E. Not better accounted for by another ICOP or ICHD-3 diagnosis.

COLOR

Examination protocol for mechanosensory evaluation of the extraoral dermatome of V3. This protocol could also be applied to other dermatomes.

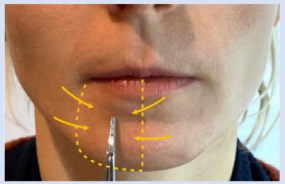
Area affected

Using forceps run over normal to neuropathic area warning the patient that there may be hypersensitivity as well as hyposensitivity.

Neuropathic area?

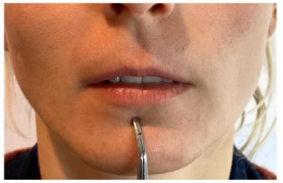
Map out the area and record pictorially or by photograph using pen marks on patient's face.
Estimate the % or extra-oral dermatome is affected by the neuropathy.

(yellow dotted lines indicate V3 dermatome and arrows indicate direction of testing from normal to neuropathic area)



Subjective function

Using forceps with beaks together firmly tap (minimum 5 times) the patient's hand several times explaining that is 'normal' 10 out of 10 subjective function. Then tap, with the same pressure, over the unaffected side of the face or tongue and repeat the stimulation explaining that should be 10 out of 10.
Move your forceps away and explain no stimulation at all is 0 out of 10. Repeat over neuropathic area that you have already confirmed and ask the patient to report the level of stimulus according to the NRS scale below.



Hypo or Hyperaesthetic?

This test can be repeated over different domains of the neuropathy (lip vermillion, lip skin and chin skin or over tongue)

Light touch

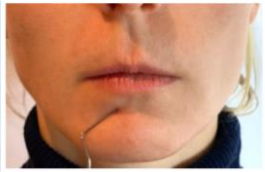
To evaluate light touch thresholds von Frey filaments are highly recommended. If these are not be available, a pledget can be used instead, placing repeated (minimum 5 times) on normal side first then repeated on affected side; ask the patient to report differences. If the patient is experiencing numbness on stimulation, they will have reduced light touch detection thresholds. However, if the patient is suffering from hyperaesthesia and possible allodynia (pain on touch) this test can be very uncomfortable.

Tactile / mechanical allodynia?

Sharp blunt discrimination

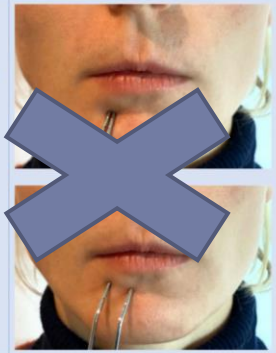
Using a dental probe sharp and blunt ends, the unaffected side is tested first. A minimum of five stimulations would be used and the number recognized by the patient (if less than 3 out of 5 then the test is negative). Whilst this test can illustrate hypoaesthesia with reduced sharp detection on the affected side, this test can also identify mechanical hyperalgesia (increased pain on sharp stimulation) which is often extremely uncomfortable for the patient. Sharp thresholds can be estimated using specially designed algometers not used in this study.

Tactile / mechanical hyperalgesia?



Two-point discrimination (TPD)

Using college forceps with beaks open and closed (both for five stimulations), TPD function can be estimated. Some authors prefer specially designed calipers which can be set to a specific distance. Normal TPD in the V3 dermatome extraorally ranges from 2-4mm on the lip vermillion to 6-8mm on the skin of the chin.



Apply Cold metal mirror back
Thermal allodynia

Figure 7

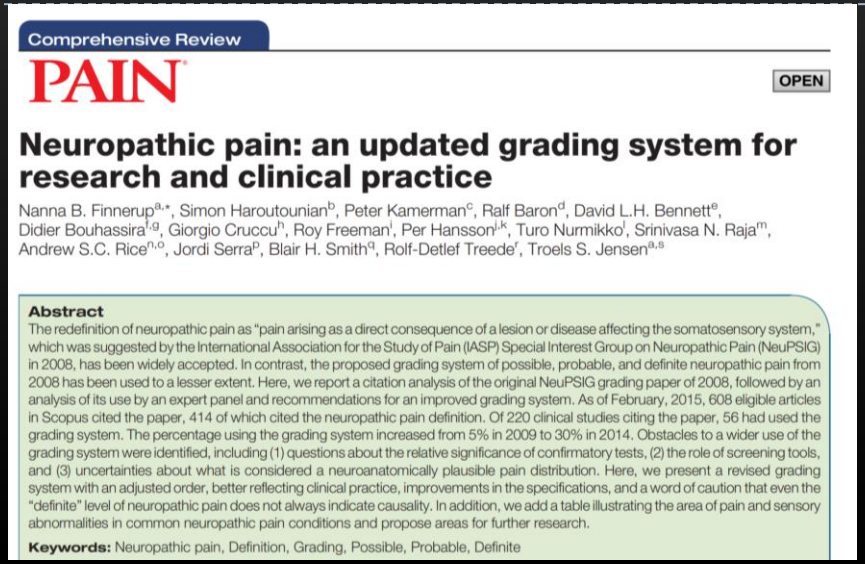
ORIGINAL ARTICLE

Diagnosis, pathophysiology, management and future issues of trigeminal surgical nerve injuries

T. Renton[1] & F. Van der Cruyssen[2,3]

[1]Department of Oral Surgery, Kings College London, Dental Hospital, Kings College Hospital Trust, London, UK
[2]Department of Oral & Maxillofacial Surgery, University Hospitals Leuven, Leuven, Belgium
[3]OMFS-IMPATH Research Group, Department of Imaging and Pathology, Faculty of Medicine, University Leuven, Leuven, Belgium

Grading of neuropathic pain



Comprehensive Review

PAIN

OPEN

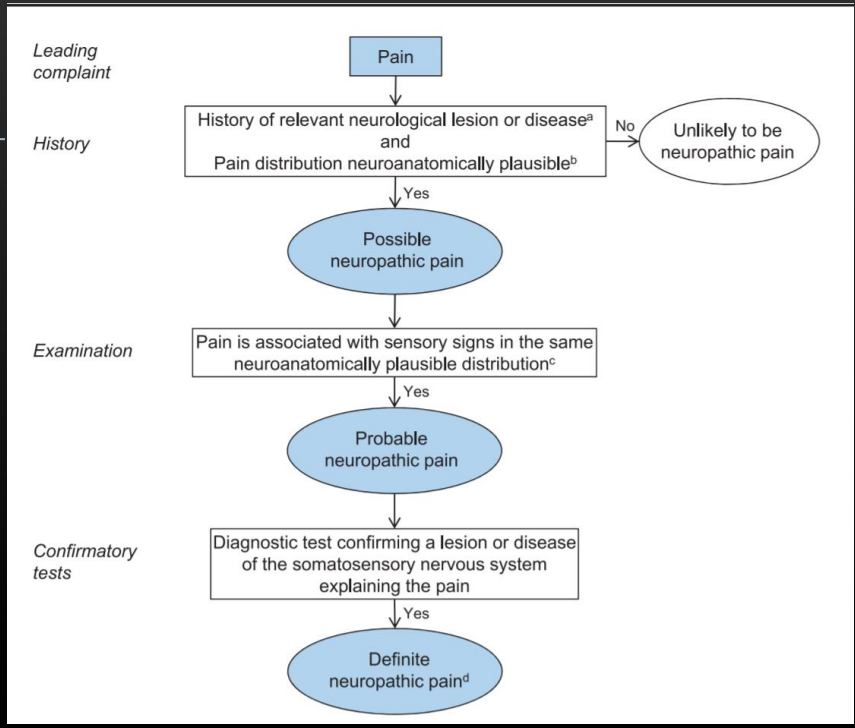
Neuropathic pain: an updated grading system for research and clinical practice

Nanna B. Finnerup[a,*], Simon Haroutounian[b], Peter Kamerman[c], Ralf Baron[d], David L.H. Bennett[e], Didier Bouhassira[f,g], Giorgio Cruccu[h], Roy Freeman[i], Per Hansson[j,k], Turo Nurmikko[l], Srinivasa N. Raja[m], Andrew S.C. Rice[n,o], Jordi Serra[p], Blair H. Smith[q], Rolf-Detlef Treede[r], Troels S. Jensen[a,s]

Abstract

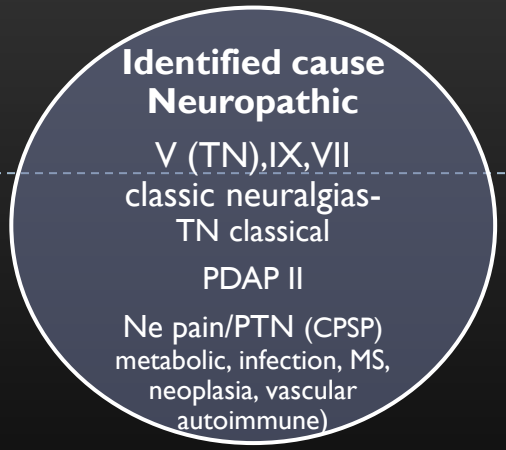
The redefinition of neuropathic pain as "pain arising as a direct consequence of a lesion or disease affecting the somatosensory system," which was suggested by the International Association for the Study of Pain (IASP) Special Interest Group on Neuropathic Pain (NeuPSIG) in 2008, has been widely accepted. In contrast, the proposed grading system of possible, probable, and definite neuropathic pain from 2008 has been used to a lesser extent. Here, we report a citation analysis of the original NeuPSIG grading paper of 2008, followed by an analysis of its use by an expert panel and recommendations for an improved grading system. As of February, 2015, 608 eligible articles in Scopus cited the paper, 414 of which cited the neuropathic pain definition. Of 220 clinical studies citing the paper, 56 had used the grading system. The percentage using the grading system increased from 5% in 2009 to 30% in 2014. Obstacles to a wider use of the grading system were identified, including (1) questions about the relative significance of confirmatory tests, (2) the role of screening tools, and (3) uncertainties about what is considered a neuroanatomically plausible pain distribution. Here, we present a revised grading system with an adjusted order, better reflecting clinical practice, improvements in the specifications, and a word of caution that even the "definite" level of neuropathic pain does not always indicate causality. In addition, we add a table illustrating the area of pain and sensory abnormalities in common neuropathic pain conditions and propose areas for further research.

Keywords: Neuropathic pain, Definition, Grading, Possible, Probable, Definite



Compared to the grading system published in 2008, we have (1) changed the order of the grading criteria to better reflect clinical practice. (2) annotated the terms used to improve clarity. (3) recognized the role of screening tools (questionnaires) in neuropathic pain evaluation. (4) emphasized that reaching the final level of certainty (definite neuropathic pain) confirms clinically that a lesion or disease of the somatosensory nervous system can explain the pain but, as often in neurology, it does not establish causality (ie, there may still be other causes of the pain such as a diabetic ulcer). The main purpose of the grading system is to help in the classification of the pain as neuropathic.

Exclude non-traumatic Neuropathic pain



Nutritional deficiencies
Fe, Ferritin, Zinc, Magnesium,
Vit B complex, D, E

Malignancy

Compression by a space occupying lesion centrally or peripherally NEOPLASIA

Metabolic Acromegaly, Hormonal neuropathy (Hypothyroidism, Diabetes),

Infarction (sickle cell hypoxic neural damage, giant cell arteritis)

Demyelination (Multiple sclerosis)

Infection Post viral neuropathy, Bacterial, Leprosy

Toxic Heavy metal poisoning (lead, mercury) radiation, thermal, chemotherapy, drugs

Auto immune problems: Lupus, Rheumatoid disease

Sarcoidosis and amyloidosis

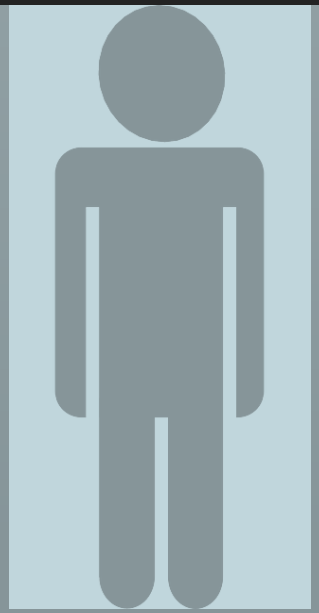
Any spontaneous neuropathy think Red flags of malignancy

- Over 50 years
- Previous history of Carcinoma
- Smoking /alcohol/ Betel nut/ Pan
- Night fevers
- Weight loss
- Blood loss/ aneamia

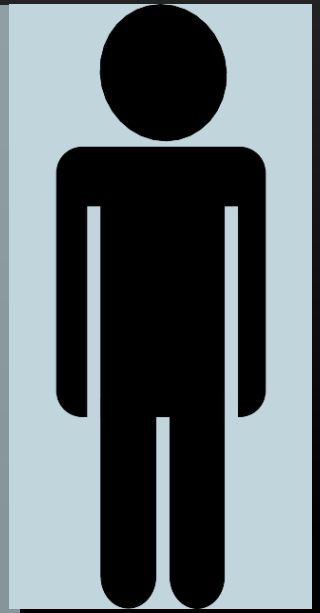
- Recent onset
- Rapid growth
- Neuropathy - sensory or motor
- Resorption of adjacent structures
- Localised mobility of teeth
- Progressive trismus
- Persistent painless ulcer
- Lymphadenopathy painless persistent
- Lack of response to conventional treatments:
  - Antibiotics
  - Endodontic surgery

NHS 2 (NICE 3) weeks Referral pathway

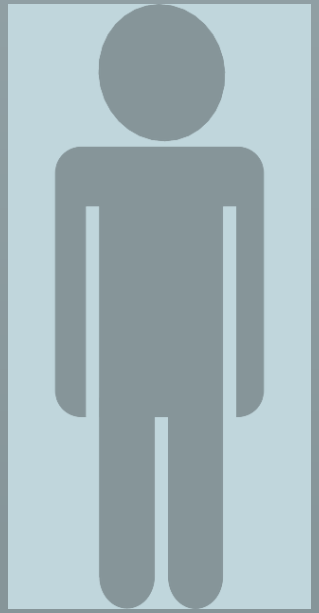
Overview



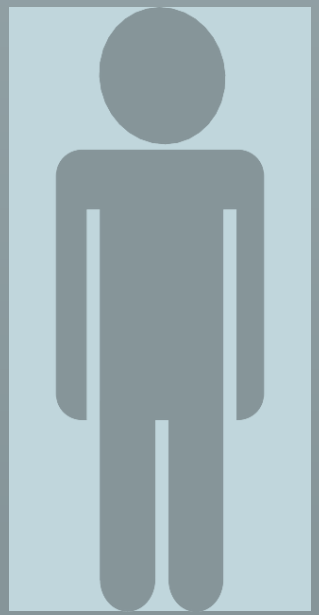
What is Neuropathic pain?



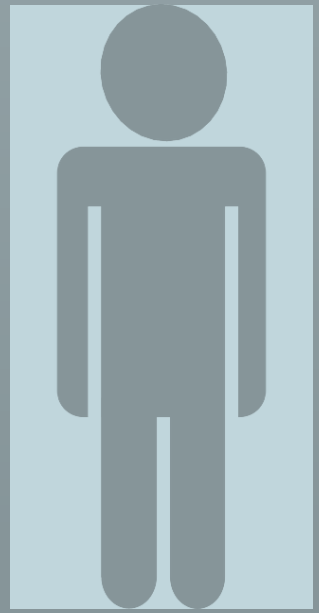
Who gets PTNP?



Why prevent PTNP?



How to prevent these injuries?



How to manage these injuries?

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When pain gets stuck: the evolution of pain chronification and treatment resistance

David Borsook[1,2], **Andrew M Youssef**[1], **Laura Simons**[3], **Igor Elman**[4], and **Christophe Eccleston**[5,6]

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(M
[2]D MGH)
[3]D
[4]V
[5]C
[6]D

REVIEW FOCUS ON PAIN
nature neuroscience

Pain vulnerability: a neurobiological perspective

Franziska Denk[1], Stephen B McMahon[1] & Irene Tracey[2]

There are many known risk factors for chronic pain conditions, yet the biological underpinnings that link these factors to abnormal processing of painful signals are only just beginning to be explored. This Review will discuss the potential mechanisms that have been proposed to underlie vulnerability and resilience toward developing chronic pain. Particular focus will be given to genetic and epigenetic processes, priming effects on a cellular level, and alterations in brain networks concerned with reward, motivation/learning and descending modulatory control. Although research in this area is still in its infancy, a better understanding of how pain vulnerability emerges has the potential to help identify individuals at risk and may open up new therapeutic avenues.

Considerable advances have been made in understanding the neurobiology of chronic pain over the last two decades. The molecular mechanisms leading to amplification of pain-related signals in chronic pain states have been dissected. An unexpected contribution of non-neuronal cells in the CNS has been discovered, and functional, as well as structural, neuroimaging studies have revealed a brain organization likely to develop certain chronic pain conditions, as are older people, although age may function as a protective factor in some instances. The influence of genetics is supported by twin and population-based studies, which clearly indicate that painful conditions and acute pain sensitivity *per se* are heritable (see ref. 5 for a recent review). Other

COMMENTARY

Check for updates

Pain chronification: what should a non-pain medicine specialist know?

Bart Morlion[a], Flaminia Coluzzi[b], Dominic Aldington[c], Magdalena Kocot-Kepska[d], Joseph Pergolizzi[e], Ana Cristina Mangas[f], Karsten Ahlbeck[g] and Eija Kalso[h]

[a]Leuven Centre for Algology & Pain Management, University Hospitals Leuven, KU Leuven, Belgium; [b]Department of Medical and Surgical Sciences and Biotechnologies Unit of Anaesthesia, Intensive Care and Pain Medicine, Sapienza University of Rome, Rome, Italy; [c]Royal Hampshire County Hospital, Winchester, UK; [d]Department of Pain Research and Treatment, Jagiellonian University Medical College, Kraków, Poland; [e]Global Pain Initiative, Golden, CO, USA and Naples Anesthesia and Pain Associates, Naples, FL, USA; [f]Hospital de Santo André, Leiria, Portugal; [g]Capio St Görans Hospital, Stockholm, Sweden; [h]Pain Clinic, Departments of Anaesthesiology, Intensive Care, and Pain Medicine, Helsinki University Central Hospital, Helsinki, Finland

ABSTRACT

Objective: Pain is one of the most common reasons for an individual to consult their primary care physician, with most chronic pain being treated in the primary care setting. However, many primary care physicians/non-pain medicine specialists lack enough awareness, education and skills to manage pain patients appropriately, and there is currently no clear, common consensus/formal definition of "pain chronification".

ARTICLE HISTORY
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KEYWORDS
Chronic pain; chronification; pain; non-pain medicine specialist

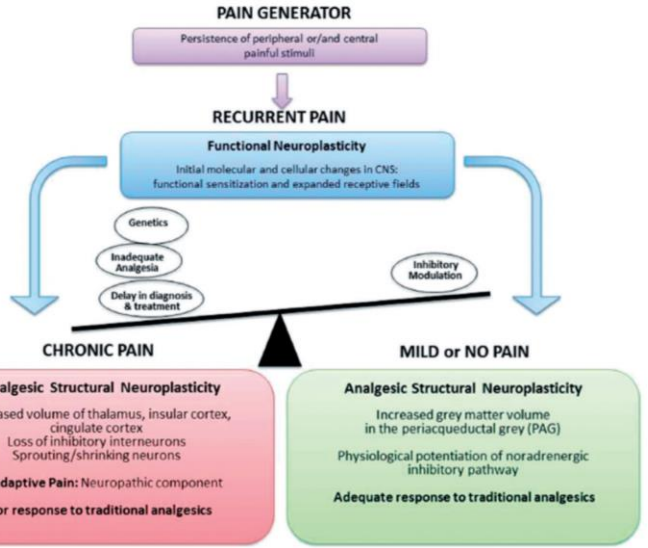
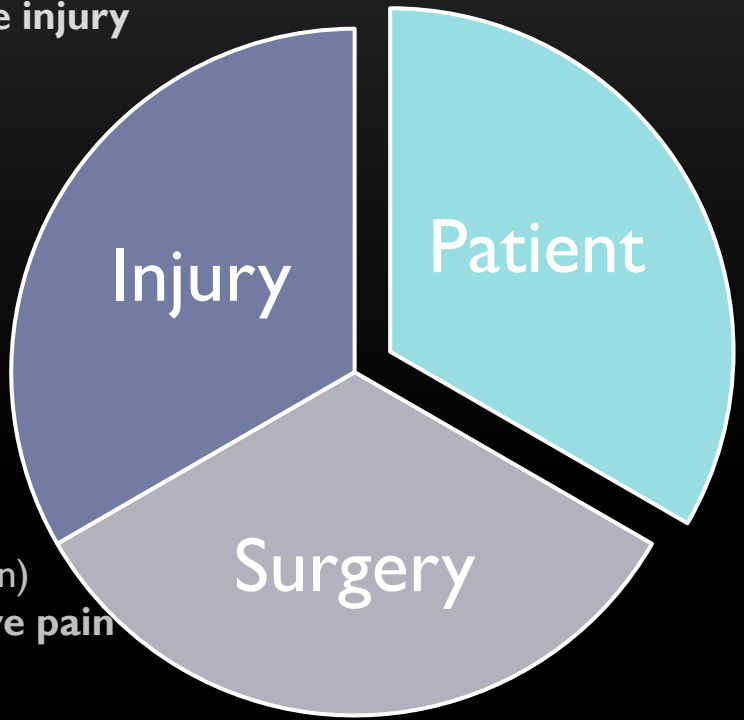


Figure 1. From the physiological perspective, an imbalance between enhanced ascending nociceptive inputs and inadequate inhibitory descending pathways is responsible for pain chronification[45]. Reproduced with permission from Coluzzi *et al.*[45]

Summary risk factors for PTPN /chronic post surgical pain

Resultant sensory nerve injury
Large neuropathic area
Thermal allodynia
Mechanical allodynia
Hyperalgesia



Age > 50 yrs
Female
Multiple pain conditions
Social Factors

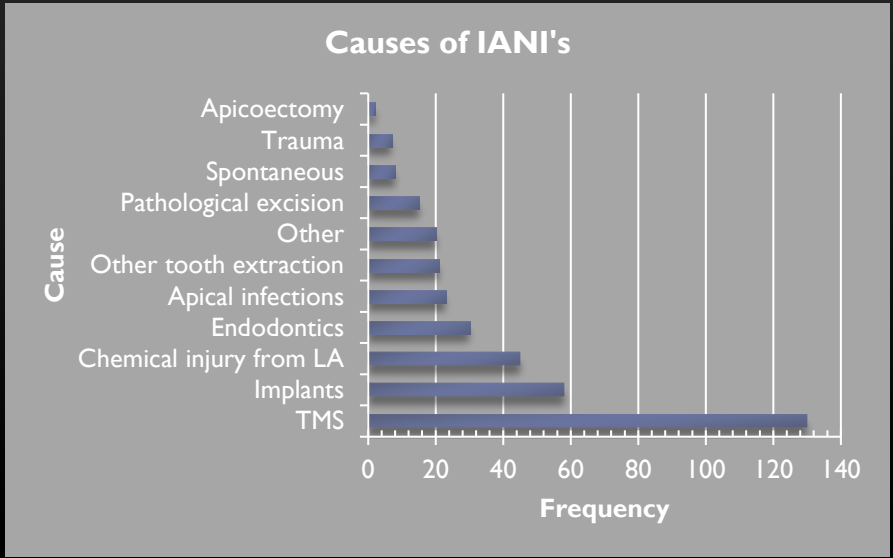
Axis II Psychological factors
Mood anxiety / depression
Introversion, neuroticism, hypervigilance, catastrophising
Fear of surgery
Fear of pain

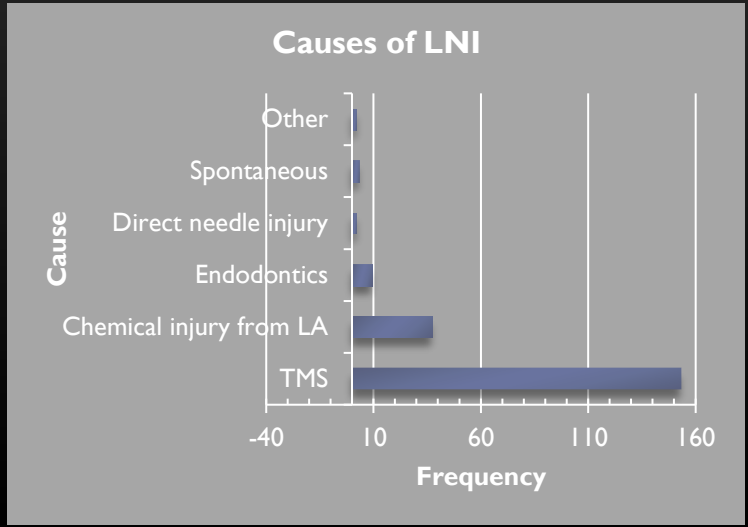
Poor pain modulation DNIC positive tests
Genetics
COMPT CA channels
Epigenetics
Prior abuse and neglect
OMICS ????

Surgical factors
Type of surgery
Site
Minimise nerve injury
(Tissue tension & Duration)
High level perioperative pain
(Lack of local anaesthesia)

Joel Katz & Ze'ev Seltzer Transition from acute to chronic postsurgical pain: risk factors and protective factors Expert Review of Neurotherapeutics Volume 9, 2009 - Issue 5

Dentistry causes of nerve injuries + neuropathic pain

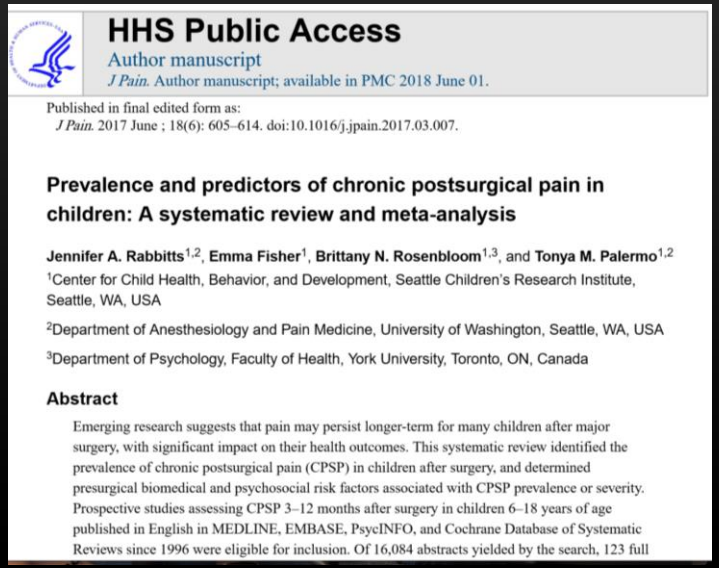




- **Summary of nerve injury patients** March 2008 –2016
- 400 IANI patients (73% F: 26.8% M; mean age = 46.5 years [range 18 – 85])
- 214 LNI patients (64.5% F: 34.6% M; mean age = 38.6 years [range 20 -73])

Predictive patient factors

- **Presurgical pain intensity, child anxiety, child pain coping efficacy, and parental pain catastrophizing** were the only presurgical factors identified as predictive of CPSP. Biological and medical factors assessed were not associated with CPSP in any study. Well-designed studies examining prevalence and predictors of CPSP are critically needed in children.
- The biopsychosocial model of pain is central to our understanding of factors involved in the development and maintenance of CPSP.
- **Several presurgical risk factors for CPSP have been consistently identified in adults undergoing surgery, including biological factors (older age, female sex), medical factors (greater presurgical pain), and psychosocial factors (higher levels of presurgical anxiety and pain catastrophizing)7–10.**



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Prevalence and predictors of chronic postsurgical pain in children: A systematic review and meta-analysis

Jennifer A. Rabbitts[1,2], **Emma Fisher**[1], **Brittany N. Rosenbloom**[1,3], and **Tonya M. Palermo**[1,2]

[1]Center for Child Health, Behavior, and Development, Seattle Children's Research Institute, Seattle, WA, USA

[2]Department of Anesthesiology and Pain Medicine, University of Washington, Seattle, WA, USA

[3]Department of Psychology, Faculty of Health, York University, Toronto, ON, Canada

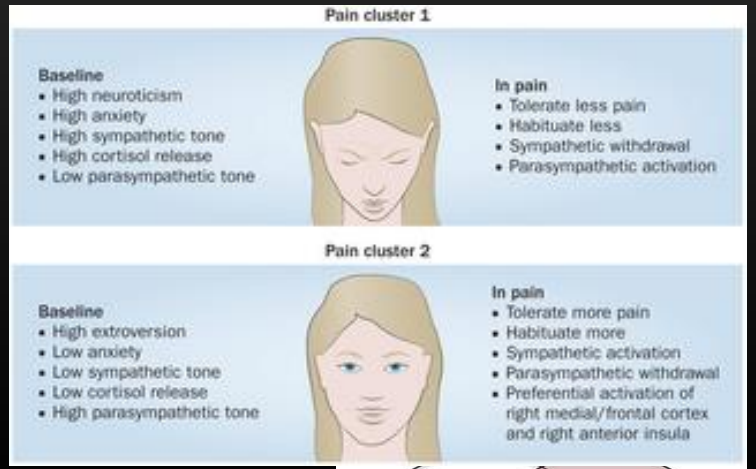
Abstract

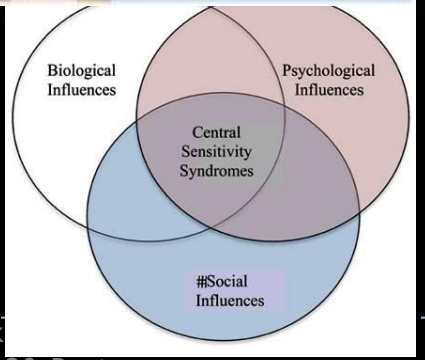
Emerging research suggests that pain may persist longer-term for many children after major surgery, with significant impact on their health outcomes. This systematic review identified the prevalence of chronic postsurgical pain (CPSP) in children after surgery, and determined presurgical biomedical and psychosocial risk factors associated with CPSP prevalence or severity. Prospective studies assessing CPSP 3–12 months after surgery in children 6–18 years of age published in English in MEDLINE, EMBASE, PsycINFO, and Cochrane Database of Systematic Reviews since 1996 were eligible for inclusion. Of 16,084 abstracts yielded by the search, 123 full

Hinrichs-Rocker A, Schulz K, Jarvinen I, Lefering R, Simanski C, Neugebauer EA. Psychosocial predictors and correlates for chronic post-surgical pain (CPSP) - a systematic review. Eur J Pain. 2009; 13:719–30. [PubMed: 18952472] 8. Katz J, Seltzer Z. Transition from acute to chronic postsurgical pain: risk factors and protective factors. Expert Rev Neurother. 2009; 9:723–44. [PubMed: 19402781] 9. Kehlet H, Jensen TS, Woolf CJ. Persistent postsurgical pain: risk factors and prevention. Lancet. 2006; 367:1618–25. [PubMed: 16698416] 10. Kehlet, H., Edwards, RR., Brennan, T. Persistent Postsurgical Pain: Pathogenic Mechanisms and Preventive Strategies, Pain 2014. In: Srinivasa, RN., Sommer, CL., editors. Refresher Courses, 15th World Congress of Pain. Washington, D.C: IASP Press; 2014.

Psychosocial risk factors predictive of CPSP

- Cognitive
  - Fear of surgery and anxiety
  - Fear of pain
- Personality disorder
  - increased preoperative anxiety
  - Introverted personality
  - Catastrophizing
  - Poor coping skills
  - Hypervigilance state
- Psychological vulnerability – pain related fear
- Social support
- Solicitous responding
  - Empathetic spouse encouraging negative behaviour
  - Munchausen





Katz J, **Seltzer Z**. Transition from acute to chronic postsurgical pain: risk factors. Expert Rev Neurother. 2009 May;9(5):723-44. doi: 10.1586/ern.09.20. Review.

Type of patient

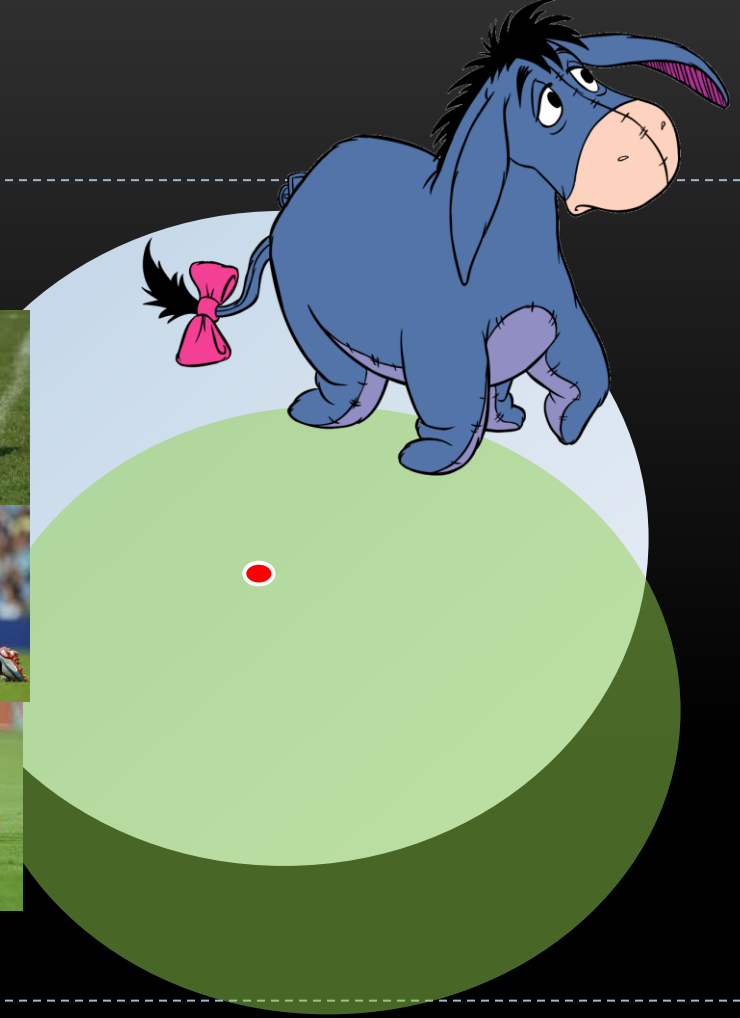
Nociception

Sensation

Behaviour

Suffering

Type of patient



W

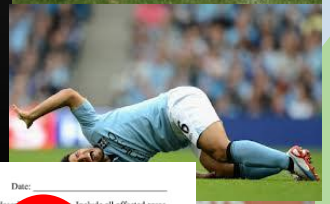
I

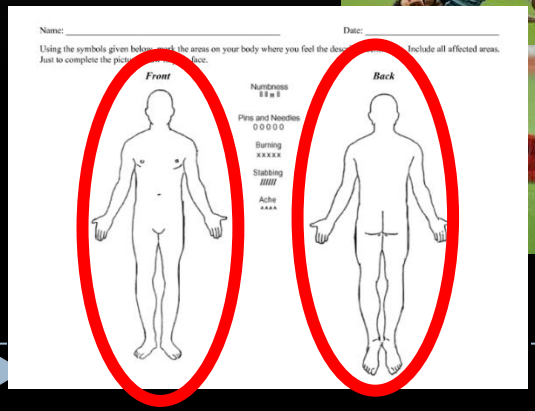
M

P

S

Type of patient





WW **Women**

~~GWAS~~

I I **Injury- PTSD**

Inhibition is poor with low pain modulation

M **Mood disorders**

Anxiety & Stress

PP **Personality disorders**

introspective, catastrophiser and hypervigilance

Prior abuse and neglect

S **Sleep deprivation**

Stress

Comorbid pain

Headaches, back, neck, joint, IBS etc

Determinants for onset and maintenance of chronic pain=AXIS

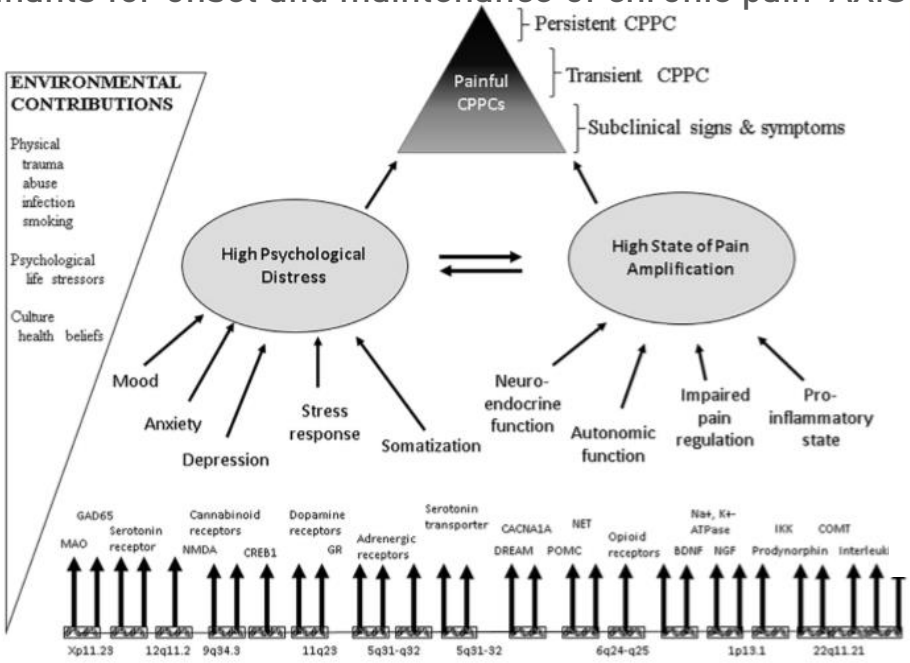


Figure 4. This model depicts likely determinants that contribute to the risk of onset and maintenance of common chronic overlapping pain conditions (COPCs). These factors are determined by genetic variability and environmental events that determine an individual's psychological profile and pain amplification status. These 2 primary domains are interactive and influence the risk of pain onset and persistence. Likely modifiers of the interaction between genetic and environmental factors include sex and ethnicity. Abbreviations: MAO, monoamine oxidase; GAD65, glutamate decarboxylase; NMDA, *N*-Methyl-D-aspartic acid; CREB1, CAMP responsive element binding protein 1; GR, glucocorticoid receptor; CACNA1, calcium channel, voltage-dependent, T type, alpha 1I subunit;

COMMENTARY

Check for updates

Pain chronification: what should a non-pain medicine specialist know?

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ABSTRACT

Objective: Pain is one of the most common reasons for an individual to consult their primary care physician, with most chronic pain being treated in the primary care setting. However, many primary

ARTICLE HISTORY

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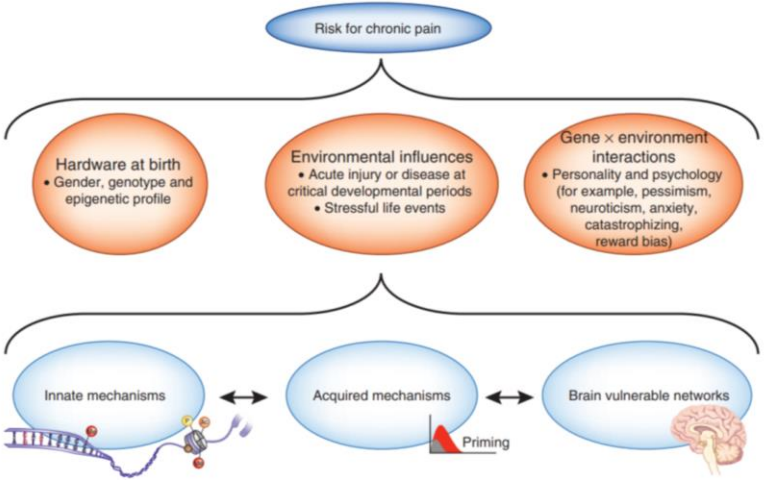

Den

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Pai

Neuron
Review

The Genetics of Neuropathic Pain from Model Organisms to Clinical Application

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[5]Department of Clinical Medicine, Danish Pain Research Center, Aarhus University, Aarhus 8000, Denmark
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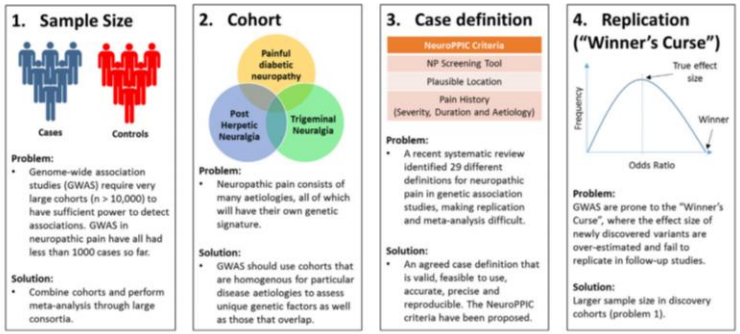
Glasgow, UK
[10]These authors contribu
*Correspondence: micha
https://doi.org/10.1016/j

Neuropathic pain (N
disabling, renderin
conservation of pai



2. The Challenges of Conducting Genome-wide Association Studies in NeuP

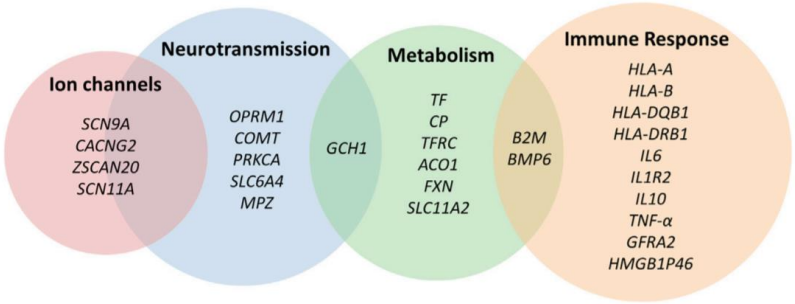
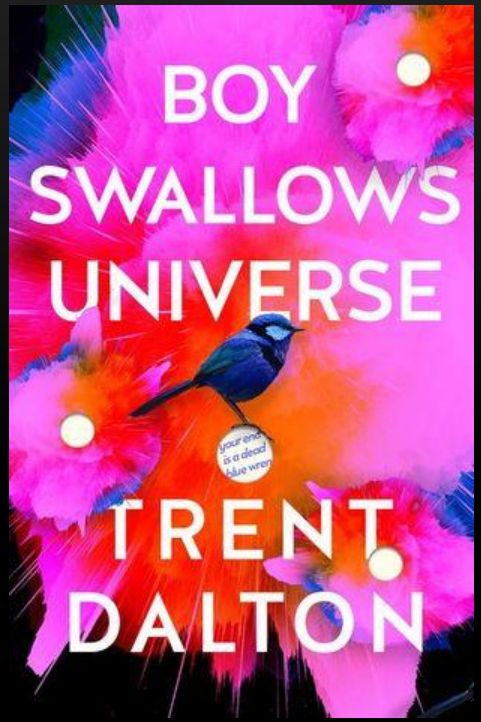


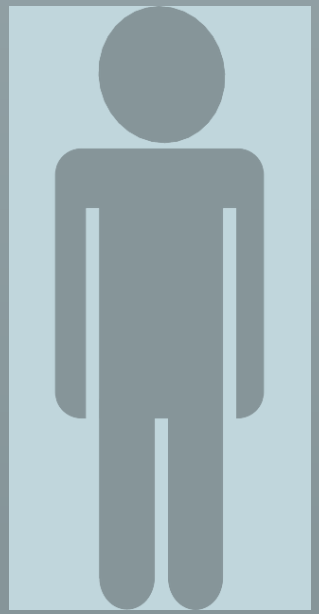
Figure 3. A Venn Diagram of Genes Reaching Study Specific or Suggestive Significance in Human Candidate Gene and Genome-wide Studies So Far in NeuP and the Overlap of Biological Pathways

These genes have been summarized in a recent systematic review of NeuP by Veluchamy et al. (2018), where the inclusion criteria were any study analyzing genetic variants in people with NeuP compared to people without NeuP. The number of genes and our understanding of their contribution within these pathways, in the context of NeuP, is likely to change as more studies are published.

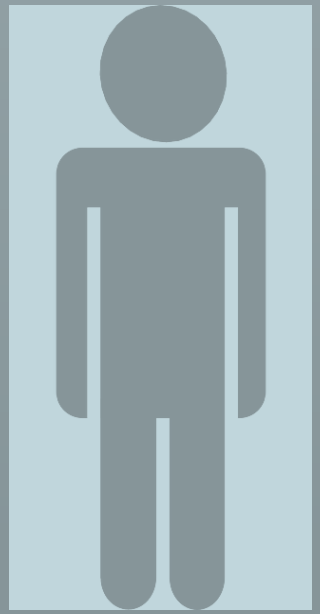
Past life events……



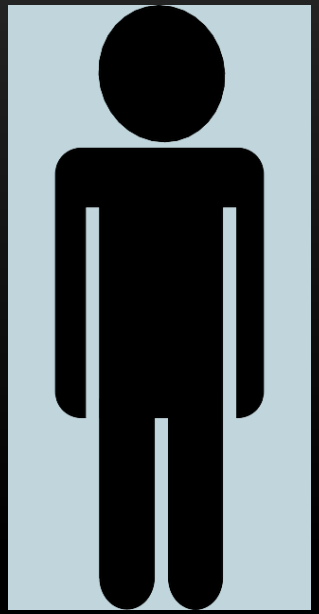
Overview



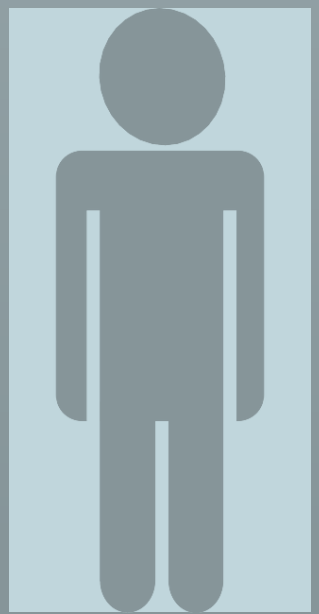
What is Neuropathic pain?



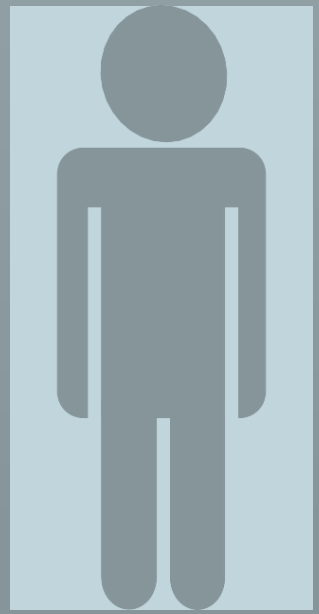
Who gets PTNP?



Why prevent PTNP?

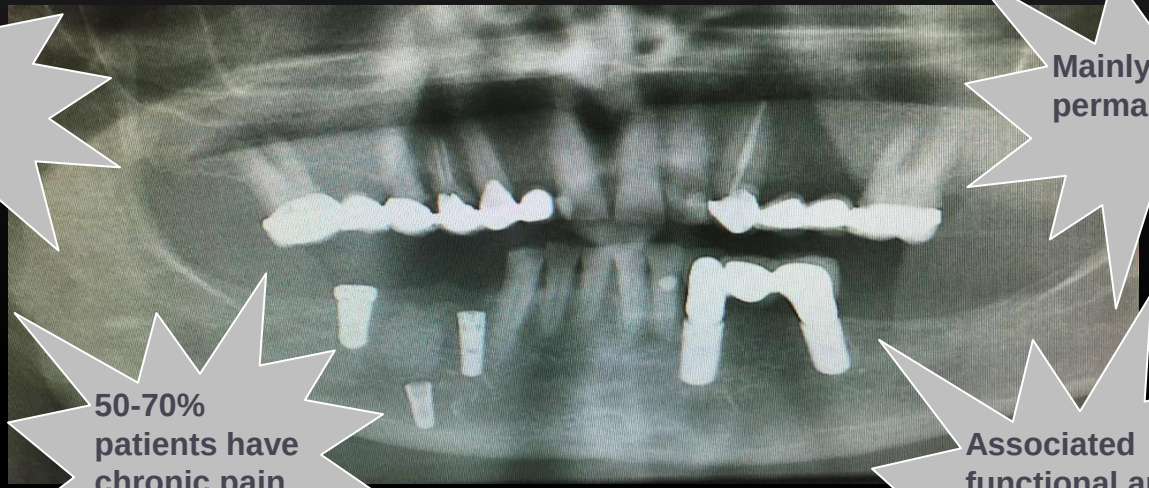


How to prevent these injuries?



How to manage these injuries?

Why are nerve injuries such a big deal ?



Avoidable / negligent

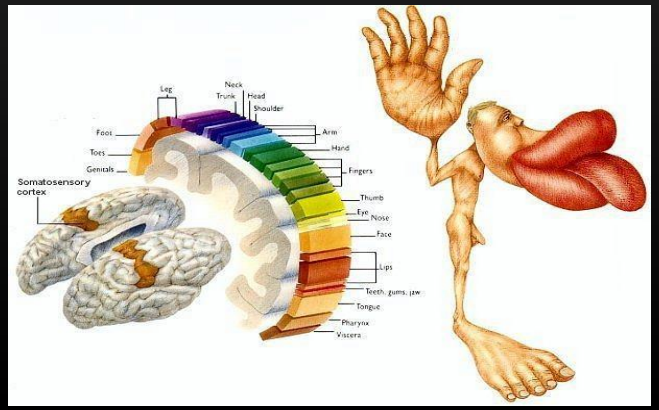
Mainly permanent

50-70% patients have chronic pain

Associated functional and psychological impact

Particular issues with Trigeminal pain?

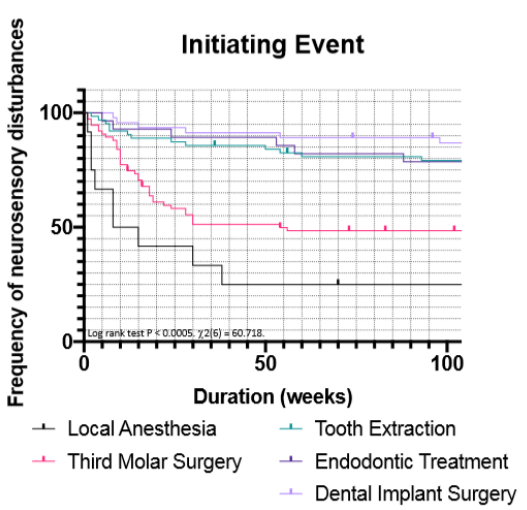
- Big part of our lives
- Underpins the primordial survival instincts
- Constant unavoidable activity
- Underpins daily pleasure in health
  - Eating
  - Drinking
  - Speaking
  - Smiling
  - Sexual interaction
- **Underpins our identity!**

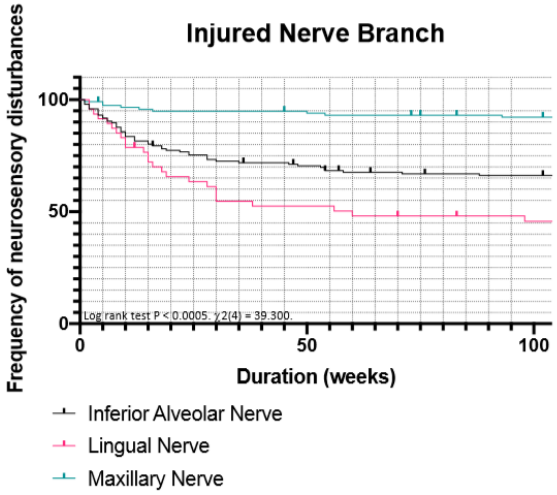


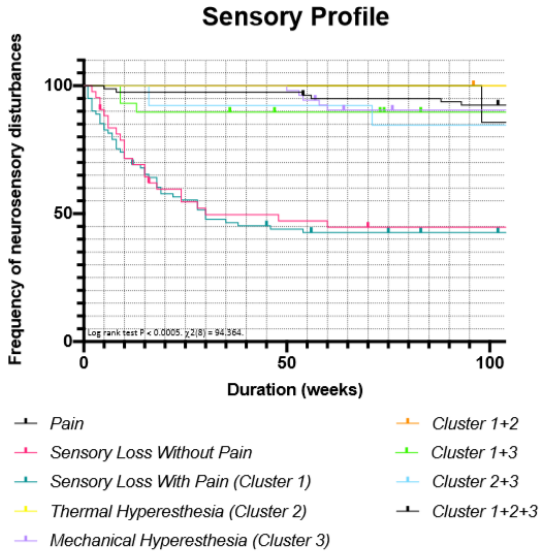
Most nerve injuries are permanent and cannot be fixed

Prognosis V Nerve injuries N=1331

Kaplan–Meier analysis of neurosensory disturbances over time comparing the injured nerve branch (A), initiating event (B), and sensory profile (C).

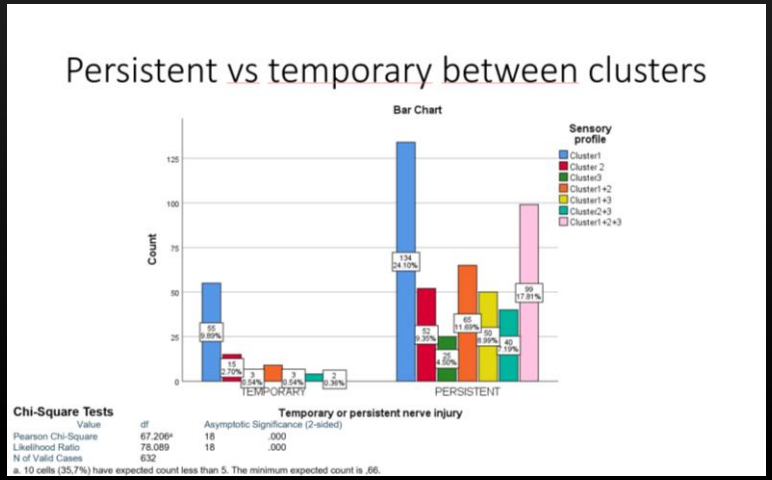






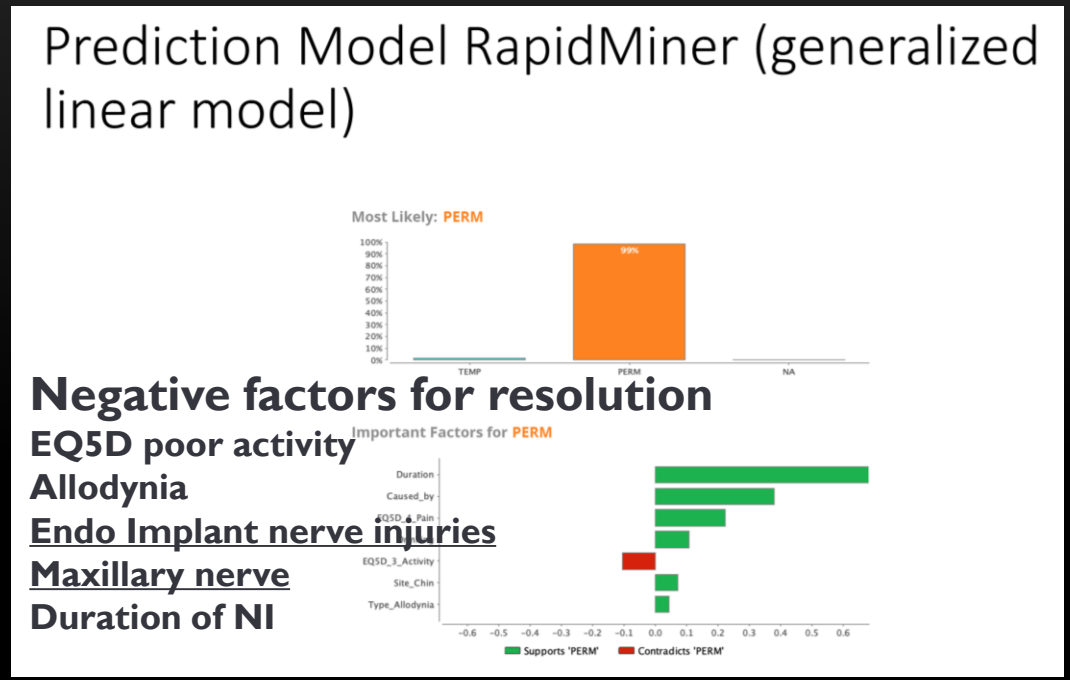
Van der Cruyssen F, Peeters F, De Laat A, Jacobs R, Politis C, Renton T. Factors affecting evolution of symptoms and quality of life in patients referred for iatrogenic post-traumatic trigeminal neuropathy: a longitudinal study in two tertiary referral centers in UK and Belgium. Pain 2020 in press.

Predictive prognosis by clustering n=1331



Positive factors for resolution

LA or M3M cause
EQ5D low pain
Lingual nerve
Sensory loss with or without pain

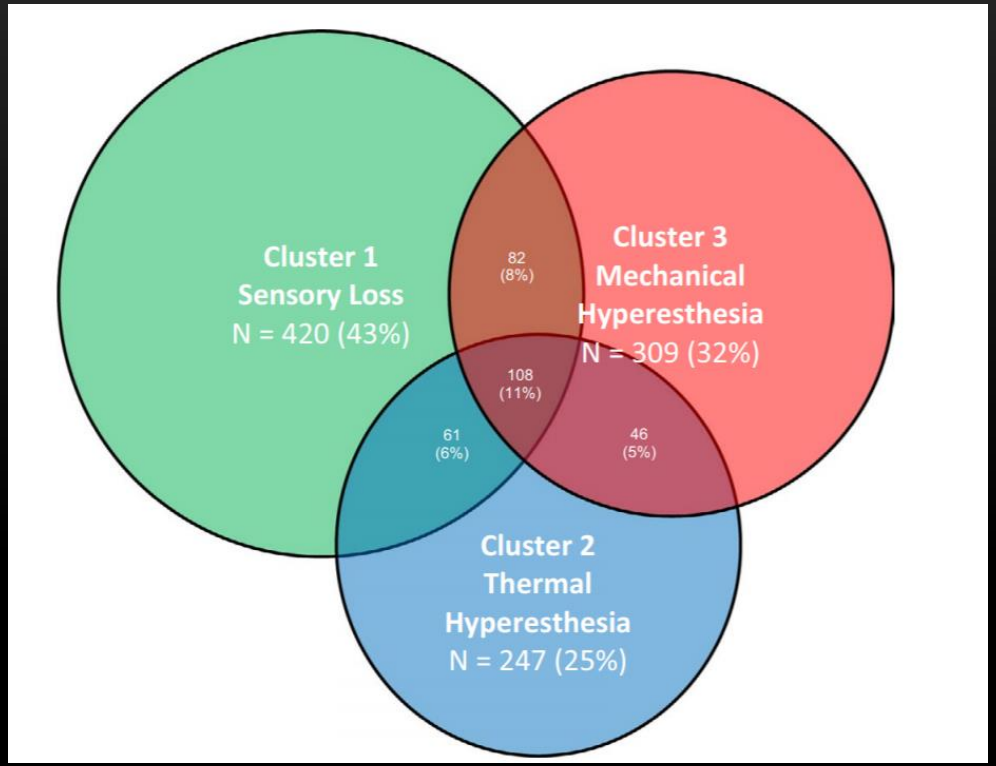


Negative factors for resolution

EQ5D poor activity
Allodynia
Endo Implant nerve injuries
Maxillary nerve
Duration of NI

Collaboration with University of Leuven
Fréderic Van de Cruyssen

Consequences trigeminal PTN
63% of patients have pain! (n=1331)



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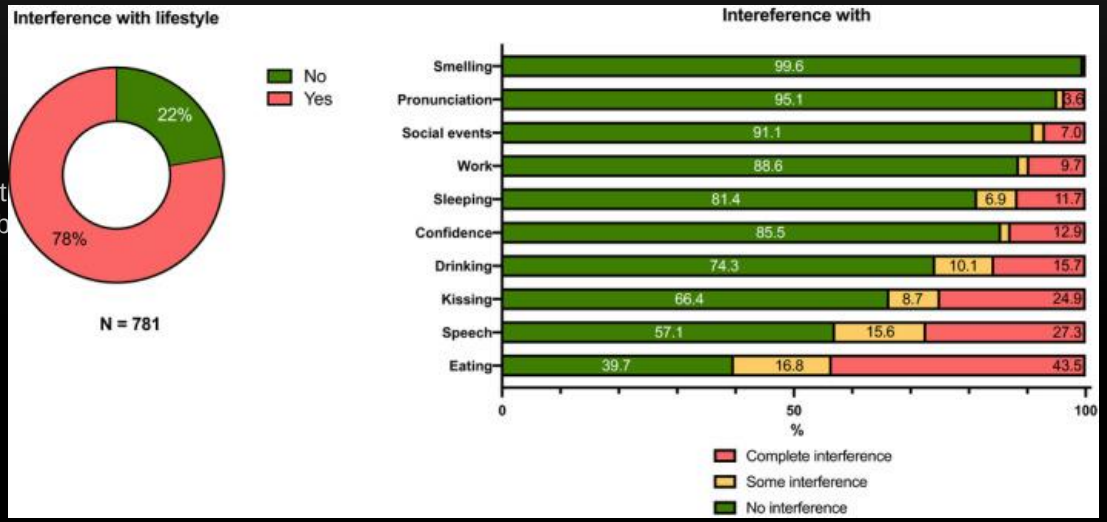
Consequences
PT Neuropathy and pain causing functional problems

78% of patients have significant functional problems
Recent study @ KCL on 100 implant nerve injury patients
95% of implant nerve injury neuropathic pain
92% permanent
Functional and psychological impact

Renton T, Dawood A, Shah A, Searson L, Yilmaz Z. Post-implant
case series. Br Dent J. 2012 Jun 8;212(11):E17. doi: 10.1038/sj.b



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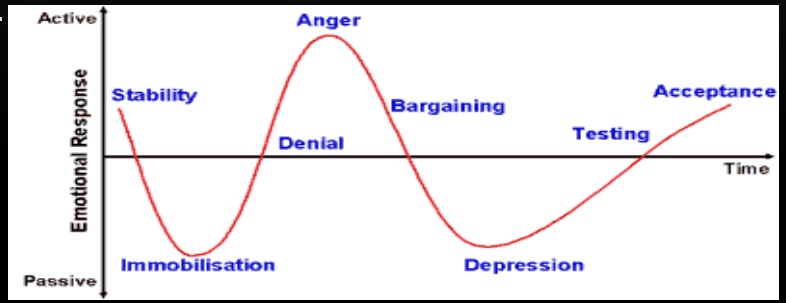
Psychological consequences

- Depression
- Anger
- Post traumatic stress disorder 68%
- Victim of abuse
- Loss of ability to trust

Kubler Ross

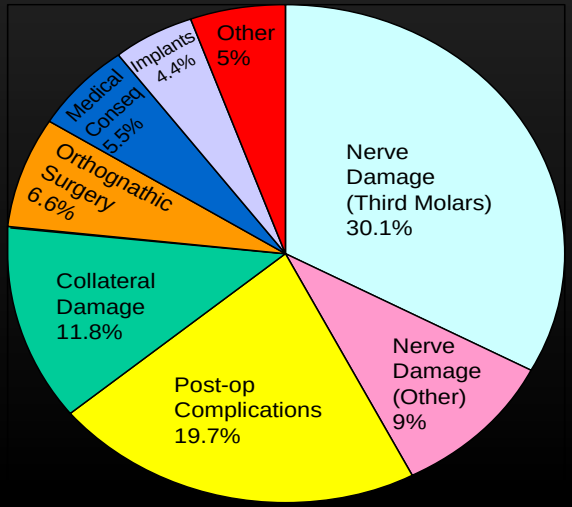


The psychosocial and affective burden of posttraumatic neuropathy following injuries to the trigeminal nerve. **Smith** JG, **Elias** LA, **Yilmaz** Z, Barker S, Shah K, Shah S, **Renton** T. J Orofac Pain. 2013 Fall;27(4):293-303. doi: 10.11607/jop.105 Sullivan MJ et al. Catastrophizing and perceived injustice: risk factors for the transition to chronicity after whiplash injury. Spine (Phila Pa 1976). 2011 Dec 1;36(25 Suppl):S244-9 Dec;92(12):2041-56. Review

Medicolegal consequences

Nerve damage related to dental procedures are often NEGLIGENT as they are elective surgery and damage is avoidable.

- This results in litigation and Settlements getting more expensive
  - Implant related cases settlements $1-3 million (2011)



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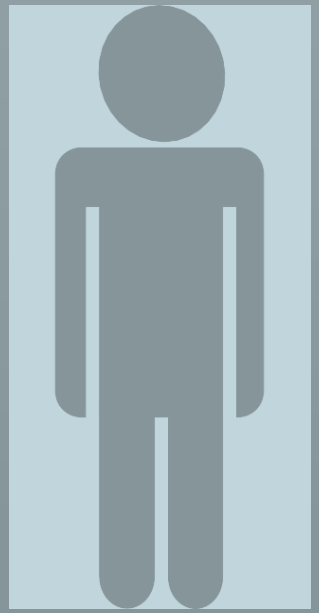

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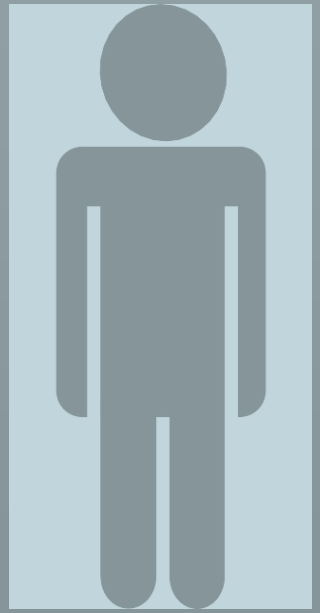

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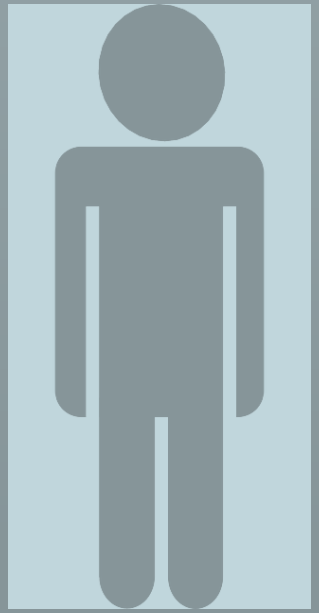
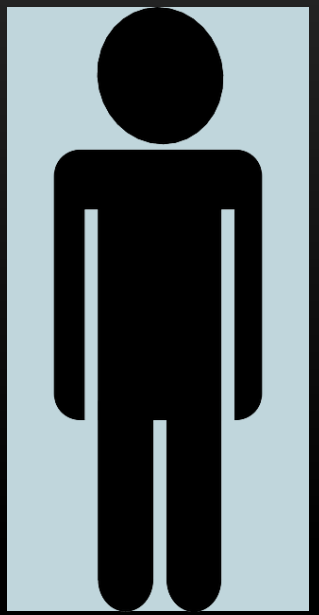
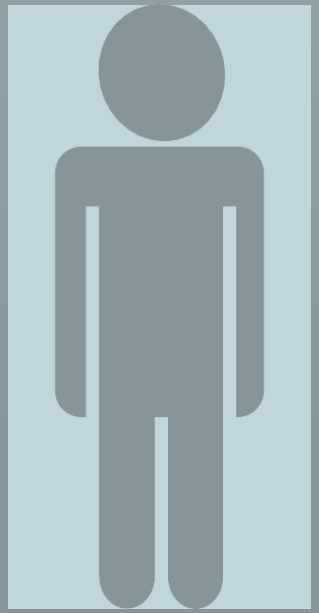


Why prevent PTNP?

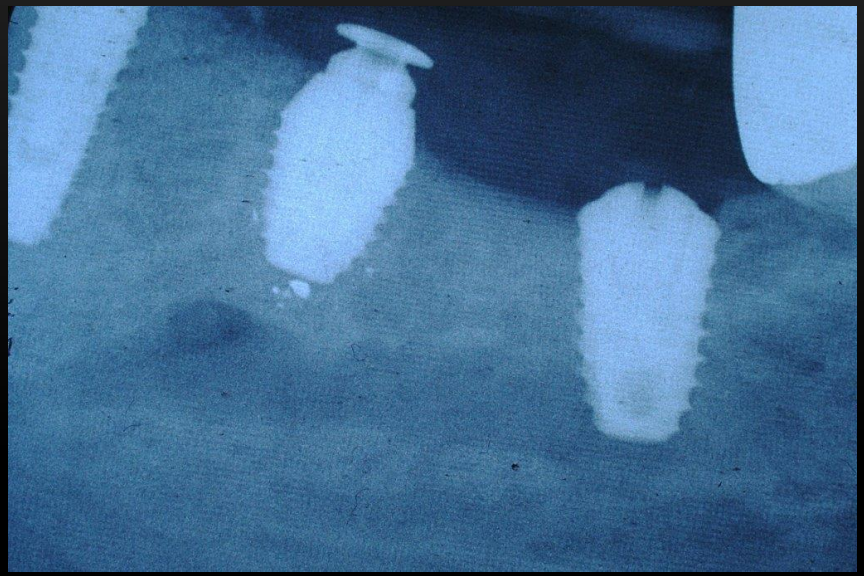


How to prevent these injuries?



How to manage these injuries?

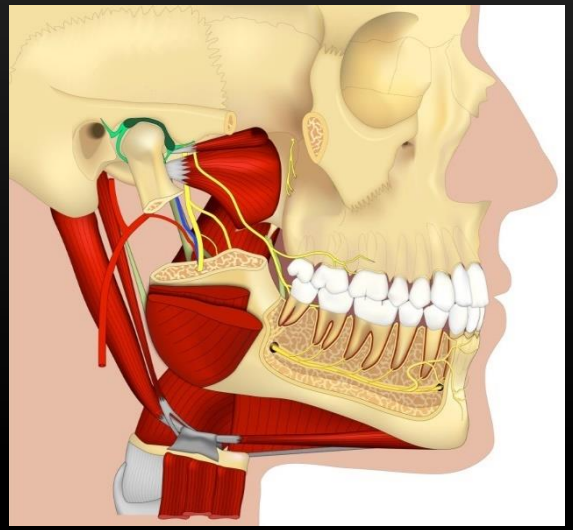
Preventing dentistry related nerve injury and PTNP

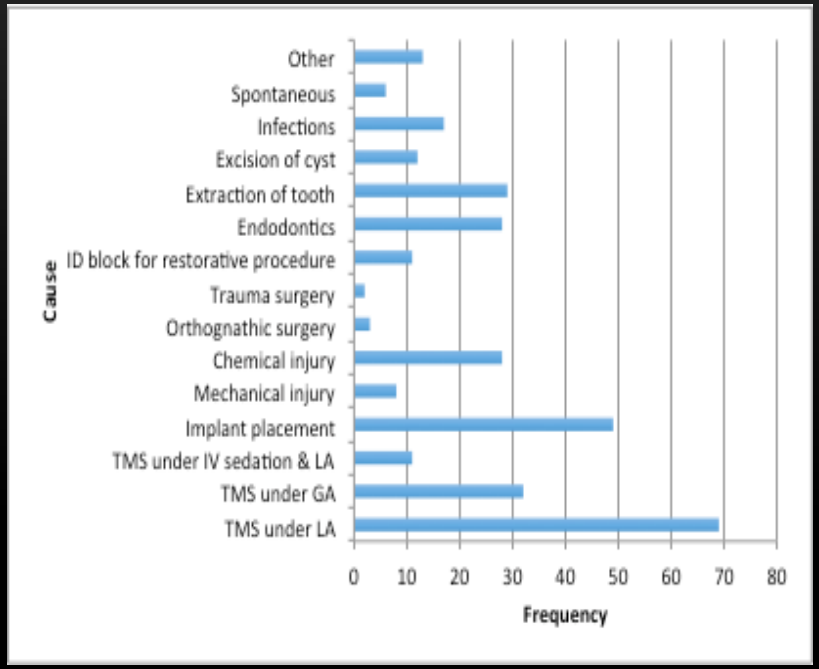


How do we prevent these injuries?

- Managing patients expectations
- Risk assessment and management
- Operative technique
- Post op follow up
- Recognition and early medical and or surgical intervention (if indicated)

Prevention of Trigeminal Post Traumatic Painful Neuropathy?





Local anaesthesia
Dental Implants
Endodontics
M3M surgery

Risk factors for persistent neuropathy related to IDBs
In order to minimise complications related to dental LA you need to consider modifying the following risks;

- **Block anaesthesia** Nerve block injections should be undertaken without intent on direct 'hit' of the nerve. 60% of patients who experience the 'funny bone' neuralgia due to the IDB needle being placed too close t… lingual or inferior alveolar nerves experience persistent neuropathy (20)
- **Lingual nerve > IAN** Is this technique related or anatomically related (less fascicles in … or recovery). Perhaps the direct IDB approach may place the lingual nerve at increased … indirect technique. (14)
- **Concentration of LA** Any increased concentration of any agent leads to increased ne… eurd…
- **Volume of LA** There is no evidence to support this sugge… s are neu…otoxic, dependent upon the proximity, LA concentration, neural damage additi… add to potential neurotoxicity.
- **Multiple injections** Second or subsequent injections that impede direct… not be associated with the usual 'funny bone' neuralgic pain. Thus the patient does no… rendering the nerves more at risk of direct damage.
- **Severe pain on injection** 60% increased occurrence of persistent neuropathy after IDBs (…
- **Type of LA Agent** Bupivicaine most neurotoxic of all LA agents
- **Type of vasoconstrictor?** The role of vasoconstrictor in nerve damage is unknown
- **Sedated or anaesthetized patients?** There is no evidence to support unresponsive patie… s likely to pr…tect themselves when neuralgia (funny bone reaction) occurs as the IDB needle encr… nerve.
- **Lack of LA aspiration?** Again there is no evidence to support that aspiration dur… er persistent neuropathies but a pragmatic view may infer less chemical injected intra neu… mical nerve injury.

Block injections

Multiple injections

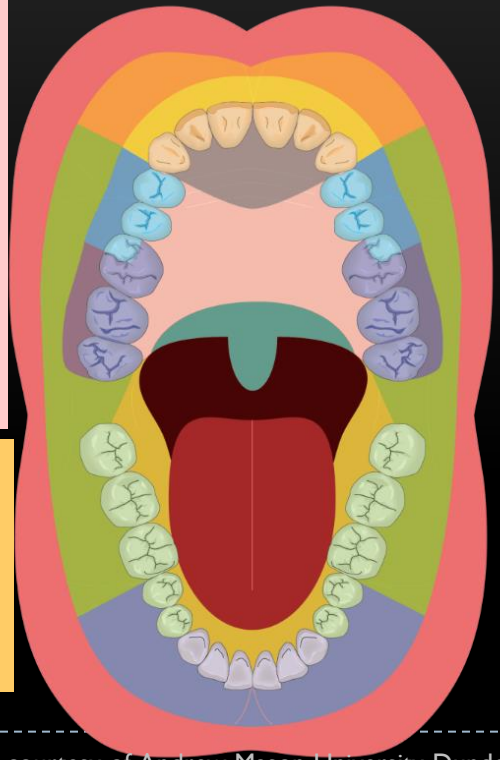
Type and concentration of LA agents

Extreme pain during injections

Infiltration dentistry is dependant upon the site and procedure

Maxillary dentistry can be performed entirely using Lidocaine 2% with adrenaline for all procedures
Buccal infiltration with intra-septal injections
No additional benefit using 4% Articaine
No palatal or incisal blocks are indicated

IDBS needed for
Posterior mandibular molar
Endodontic procedures may require IDBs or higher techniques (Gow Gates or Akinosi)



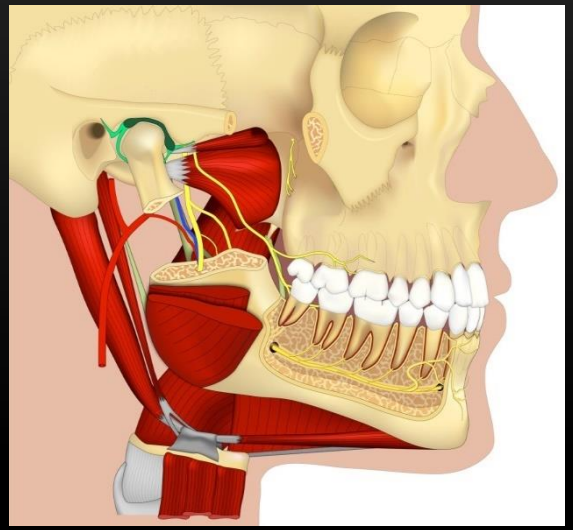
Mandibular 7s and 8s for **perio, restorations or implants**
Articaine 4% buccal infiltration and Lidocaine 2% lingual infiltrations OR for **extractions** intraligamental
If fails may need lidocaine IDB

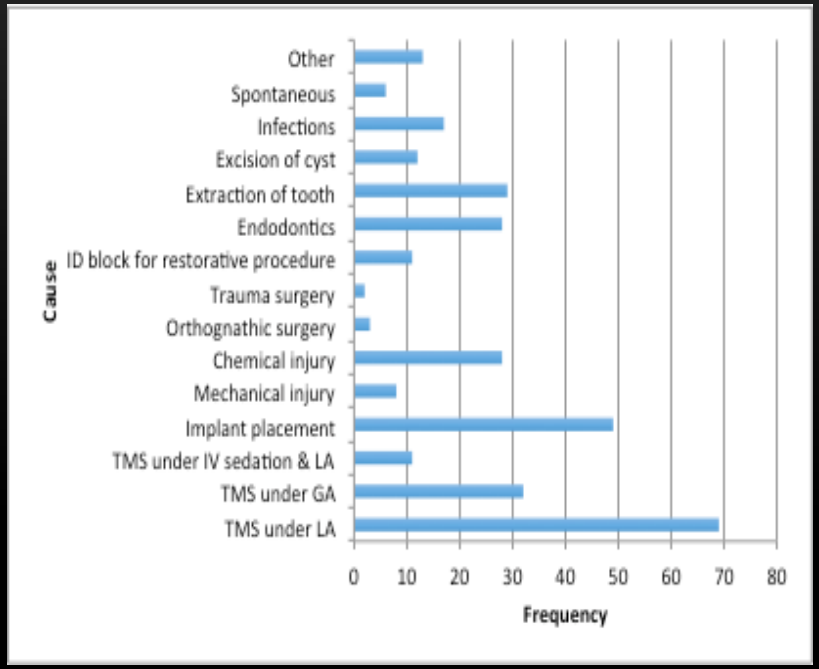
Mandibular 1st molars for **perio, restorations or implants**
Articaine 4% buccal +/- Lidocaine 2% crestal or lingual infiltration s OR for **extractions** add lidocaine lingual **of** intra-ligamental

Mandibular premolars, canines incisors for **perio, restorations or implants**
Articaine buccal infiltration (incisal nerve block using 30% cartridge) adjacent not in the mental foramen and massage over region. If fails repeat or add crestal or lingual infiltration OR for **extractions**, intra-ligamental

Illustration modified from figure courtesy of Andrew Mason University Dundee

Prevention of Trigeminal Post Traumatic Painful Neuropathy?





Local anaesthesia
Dental Implants
Endodontics
M3M surgery

Metanalysis Incidence Implant Nerve injuries

- 1589 articles; a total of nine articles were selected for the meta-analysis.
- The risk of neurosensory disturbance **13.50/100 person-years** (95% confidence interval (CI): 10.98–16.03),
- Greater risk with anteriorly placed implants: −0.02 (95% CI: −0.21–0.16) (*P* = 0.05).
- The overall recovery rate was estimated at **51.30/100 person-years** (95% CI: 31.2–71.4).
- **=49% permanent**

THE JOURNAL OF INDIAN PROSTHODONTIC SOCIETY
Official Publication of Indian Prosthodontic Society

REVIEW

Year : 2020 | Volume : 20 | Issue : 1 | Page : 17-26

Incidence of neurosensory disturbance in mandibular implant surgery – A meta-analysis

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Aim: Implantology has been widely accepted as the mainstay treatment for rehabilitating complete and partial edentulism. However, it is associated with some failures and complications, the most concerning being neurosensory disturbance. Although neurosensory disturbance has been extensively studied, the incidence and cause remains largely variable. Thus, the aim of this systematic review and meta-analysis was to evaluate the incidence, distribution, and recovery rate of neurosensory disturbance.

Settings and Design: This systematic review was conducted as per the Preferred Reporting Items for Systematic Reviews and Meta-analyses statement. A structured literature review was conducted using the following databases: PubMed, Science Direct, Cochrane, Ovid, and Google Scholar for reports related to neurosensory disturbance experienced after implant placement in the mandible.

Statistical Analysis Used: Incidence and recovery rate for 100 person-years was calculated using the Poisson regression model. The risk difference of incidence between anterior and posterior implants was calculated with a random effects model.

Results: Electronic database search yielded 1589 articles; a total of nine articles were selected for the meta-analysis. The risk of neurosensory disturbance was estimated at 13.50/100 person-years (95% confidence interval (CI): 10.98–16.03), with a greater risk with anteriorly placed implants: −0.02 (95% CI: −0.21–0.16) (*P* = 0.05). The overall recovery rate was estimated at 51.30/100 person-years (95% CI: 31.2–71.4).

Conclusions: Within the limitations of the study, it can be concluded that mandibular implant placement is associated with a considerable risk of neurosensory disturbance. A large proportion of these patients present with spontaneous recove... necessary precautions to avoid such complications. More randomized controlled trials are required to quar... altered sensation during implant placement.

Keywords: Implant surgery, incidence, neurosensory disturbance, paresthesia

KING'S College LONDON

Permanence Implant Post traumatic neuropathy

- 13% of 1331 cases implant related
- 173 cases
- **96% permanency**

Van der Cruyssen F, Peeters F, De Laat A, Jacobs R, Politis C, Renton T. Factors affecting evolution of symptoms and quality of life in patients referred for iatrogenic post-traumatic trigeminal neuropathy: a longitudinal study in two tertiary referral centers in UK and Belgium. Pain 2020

Van der Cruyssen F, Peeters F, Gill T, De Laat A, Jacobs R, Politis C, Renton T. Signs and symptoms, quality of life and psychosocial data in 1331 post-traumatic trigeminal neuropathy patients seen in two tertiary referral centres in two countries. J Oral Rehabil. 2020 Oct;47(10):1212-1221. doi: 10.1111/joor.13058. Epub 2020 Aug 2. PMID: 32687637; PMCID: PMC7540026

DOI: 10.1111/joor.13058

ORIGINAL ARTICLE

JOURNAL OF ORAL REHABILITATION WILEY

Signs and symptoms, quality of life and psychosocial data in 1331 post-traumatic trigeminal neuropathy patients seen in two tertiary referral centres in two countries

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Abstract

Background: Post-traumatic trigeminal neuropathy (PTN) is a disturbance of function or pathological change of the trigeminal nerve branches following trauma and has an important impact on patient's quality of life (QoL).

Objectives: To provide diagnostic data on PTN and illustrate differences in aetiology, injured nerve, pain distribution, sensory profile and QoL between PTN subgroups.

Methods: 1331 patients with painful or non-painful PTN were retrospectively re-viewed in two centres, extracting demographic data, time and cause of trauma, clinical findings including signs and symptoms, basic neurosensory testing, imaging modalities, treatments, and QoL or psychosocial assessment.

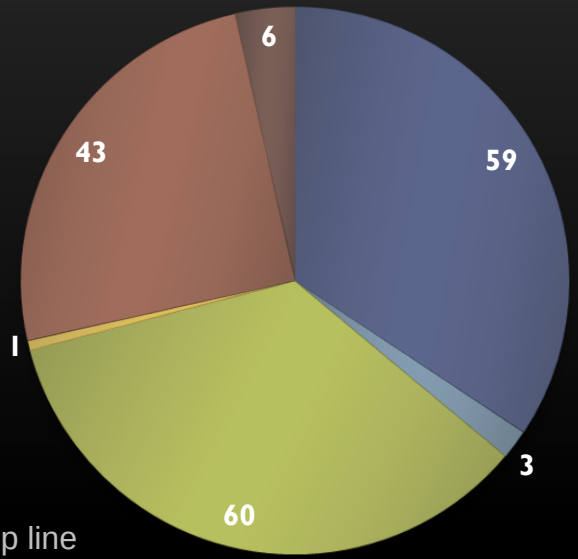
Results: More females were represented (70%) than males. The inferior alveolar nerve was most frequently damaged (60%) followed by the lingual nerve (28%). Wisdom teeth removal was considered the main cause (48%). Pain was reported in 63% of patients and pain frequency increased with age without clinically significant gender differences. Numbness was reported in 50% of PTN patients. Neurosensory testing showed larger affected dermatome involvement in persistent injuries, with no differences between the non-painful and painful PTN groups. Patient clustering indicated different sensory profile distributions when stratified according to aetiol-ogy or affected nerve branch. High interference with lifestyle was reported (78%), and patients suffering from painful PTN had worse QoL and psychosocial outcomes.

Conclusion: Patients with painful PTN had different clinical profiles and lower QoL scores than those with non-painful PTN. Sensory profiles may provide important prognostic and therapeutic information; however, more research is needed to assess the clustering procedure and link these clusters to therapeutic guidelines.

KEYWORDS
diagnosis, neuropathic pain, quality of life, trigeminal nerve, trigeminal nerve disorder

Preventing implant related nerve injury -Is there a need?

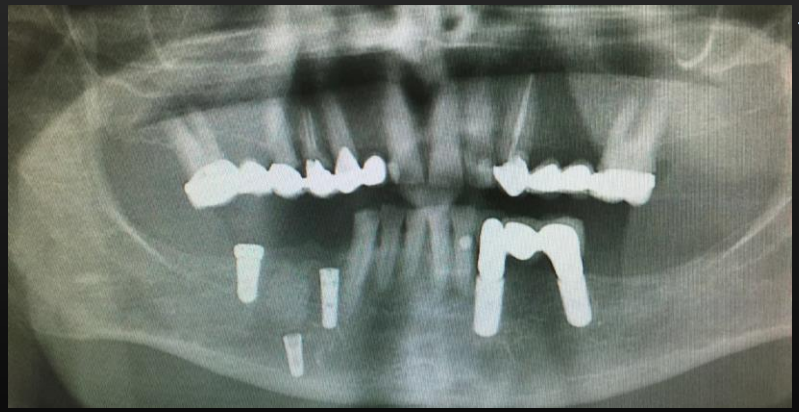
- Explore patients expectations
- Medical History
  - Smoker
  - Compromised immunity
  - MRONJ risk
- Clinical
  - Poor Oral hygiene
  - Periodontal disease
  - Bone mapping aesthetics, soft tissue, lip line
- Consent

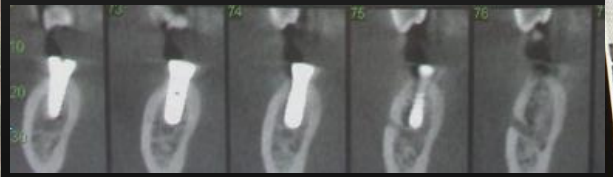


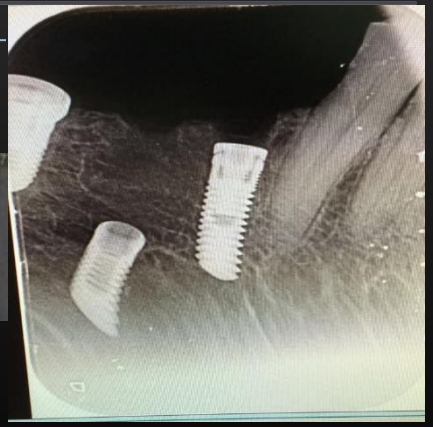
Contraindicated in patients with periodontal disease, smokers, bruxists, immunosuppressed. The reality is only 57% of implants survive 10 years

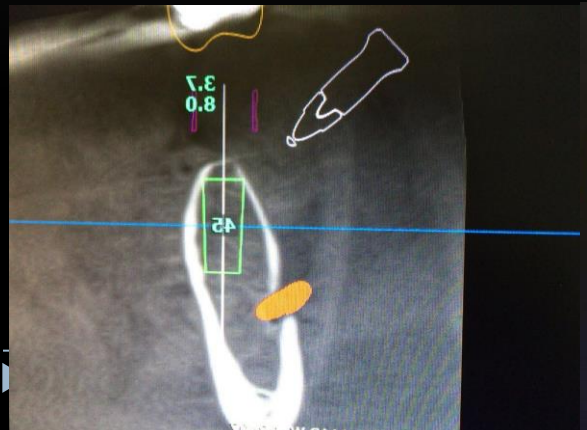
Chanavaz M. Patient screening and medical evaluation for implant and preprosthetic surgery.J Oral Implantol. 1998;24(4):222-9. Revie

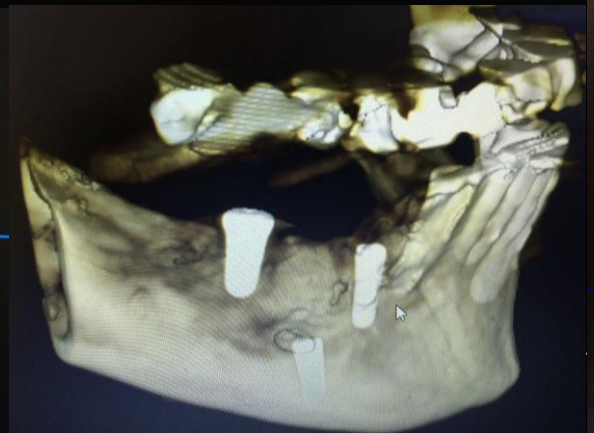
How does the injury happen?

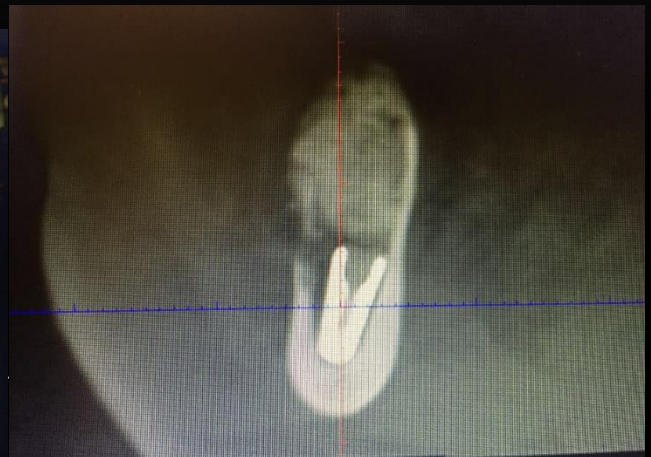












Aetiological factors in implant related PTN

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Hom-Lay Wang
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Inferior alveolar nerve injury associated with implant surgery

Table 1. **Etiological factors and mechanism of traumatic inferior alveolar nerve (IAN) injury**

Intraoperative etiological factor	Indirect or direct and injury mechanism	Post-operative etiological factor	Indirect and injury mechanism
Traumatic local anesthesia			
Chemical (cytotoxic) injury by local anesthetic	Indirect; endoneurial edema, compression and secondary ischemia Direct; IAN degeneration	Injection needle trauma to epineurial blood vessels or inferior alveolar artery	Indirect; hematoma with reactive fibrosis and scar formation, compression and secondary ischemia
Injection needle	Direct; transection of multiple IAN fibers and entire fascicles		
Implant drill			
Partial intrusion into MC	Indirect; hematoma and secondary ischemia	Thermal injury	Indirect; inflammation of bone and IAN with secondary ischemia
Full intrusion into MC	Direct; mechanical trauma – encroach, transection, or laceration and/or compression and primary ischemia of IAN		
Chemical (cytotoxic) injury	Direct; IAN degeneration		
Thermal injury	Direct; IAN degeneration		
Dental implant			
Partial intrusion into MC	Indirect; hematoma or/and deposition of debris, compression and secondary ischemia	Infection	Indirect; inflammation of bone and IAN with secondary ischemia
Full intrusion into MC	Direct; mechanical trauma – encroach, transection, or laceration and/or compression and primary ischemia of IAN	Implant is too close to MC	Indirect; bone and IAN stress, compression with secondary ischemia
		Chronic stimulation	Indirect; implant is situated aside of or on top of the nerve with chronic neuropathy formation
Wrong operation technique			
Scalpel	Direct; mental nerve injury or transection	Soft tissue swelling	Indirect; mental nerve compression caused by soft tissue edema
Soft tissue reflection and retraction	Direct; mental nerve injury caused by reflection, retraction and pressure		
Soft tissue suturing	Direct; mental nerve compression caused by suture material		

MC, mandibular canal.

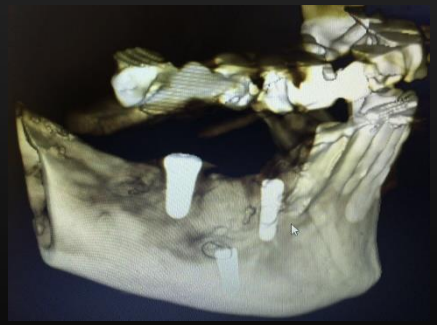
During Implant bed drill preparation =
Insufficient safety zone

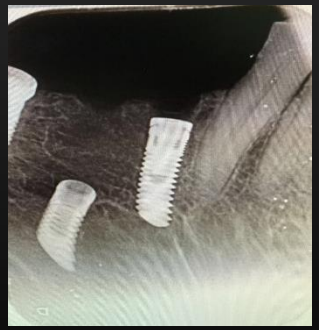
Prevention of Implant nerve injury

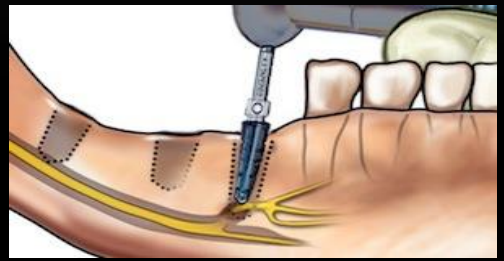
Risk factors

Most nerve injuries occur:

- **In patients over 47 years**
- **In the parasymphyseal region**
- **During preparation of implant bed**
- **Using Implants >10mm**
- **When the patient experiences severe pain**
  - during prep or implant placement
  - severe pain post surgery
  - Intraoperative bleed during prepping



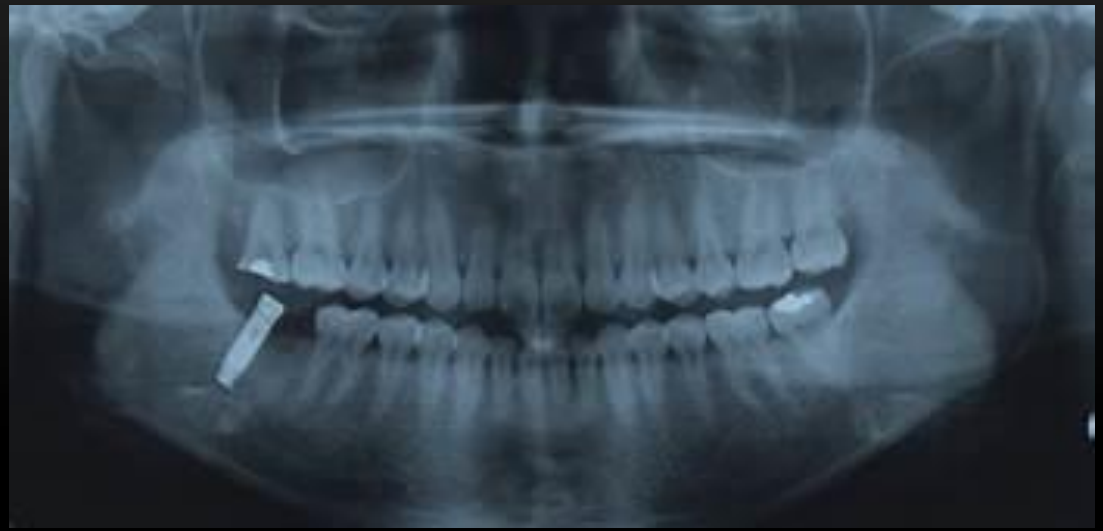




Yilmaz Z, Ucer C, Scher E, Suzuki J, **Renton T**. A Survey of the Opinion and Experience of UK Dentists: Part 1: The Incidence and Cause of Iatrogenic Trigeminal Nerve Injuries Related to Dental Implant Surgery. Implant Dent. 2016 Oct;25(5):638-45.

Indications/ need?

Do patients really need posterior mandibular implants?



Risk factors 1

A. Poor risk assessment - Inadequate preoperative assessment and planning due to;

Lack of knowledge/inexperience

Inadequate informed consent and management of patient expectations

Lack of identification of existing pre-surgical neuropathy.

Additional risk assessment of mandibular premolars and m

Poor planning

Know where the nerve is. Nerve localisation, risk factors when assessi
(Mental loop, characteristics of IAN position in various sites of mandible)

Parasymphyseal zone high risk.

The accuracy of estimating the position o
or CT scans is highlighted in the radiograph

Insufficient Safety zone- Risk perf
to the nerve.

Poor surgical technique

Poor recognition of intraoperative problems

Poor implant placement

Selection of implants 10mm plus

(evidence supports shorter implants **-**short impla
procedure and minimise morbidity**)**

Poor Planning

Insufficient Safety zone

Inappropriate radiographs

Inability to read CBCT

Using implants > 8mm

Operative

Poor technique reducing Safety zone/ lack use drill stops, guides/ intraoperative LCPAs

Lack of recognition risks bleeding/ drill sink

Post operative

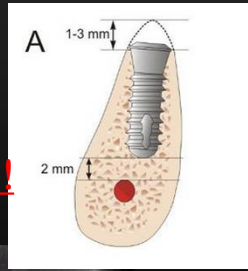
Late recognition of nerve injury

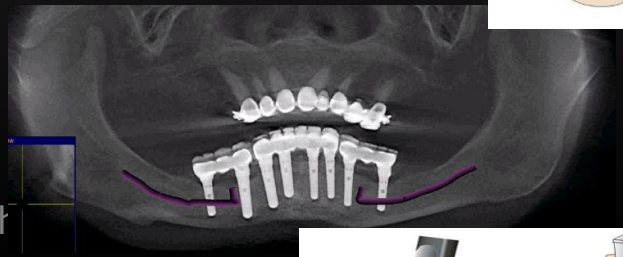
Lack removal implant within 30 hours

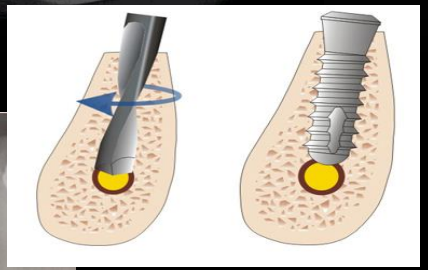
Evidence for prevention of implant related nerve injuries

- Computer guided surgery (**none**)
- Use surgical guides (**moderate**)
  - (Chan, Chik, Pow, & Chow, 2013; Van Assche et al., 2007).
- Drill stops stock or tailored **(none)**
- ITI recommendation **(moderate)**
  - PAUSE after 60% planned depth OR 6mm
  - Take LCPA and check position
- **USE SHORT IMPLANTS** less than 10 mm for parasympl
(**strong**) Implants should not need to be longer than 8 mm

Safety zone of 2mm is insufficient with implant drills 1.5mm longer than the implants = resultant safety zone of 0.5mm!!! 4mm!

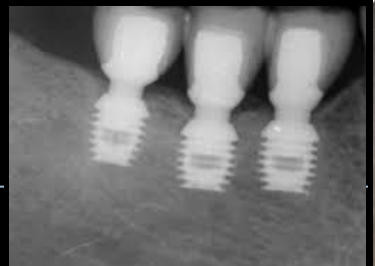


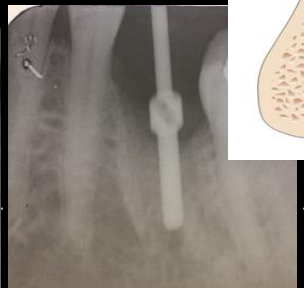




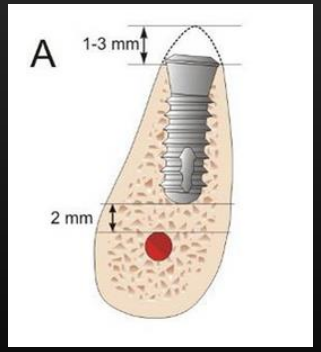
Short Implants (5 to 8 mm) Versus Longer Implants (>8 mm) with Sinus Lifting in Atrophic Posterior Maxilla: A Meta-Analysis of RCTs

Tengfei Fan;* Yicun Li;* Wei-Wei Deng;* Tianfu Wu;* Wenfeng Zhang*,†

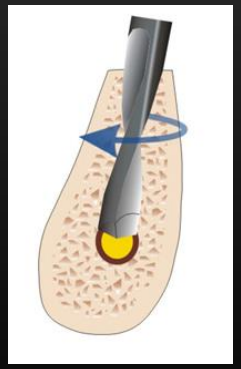




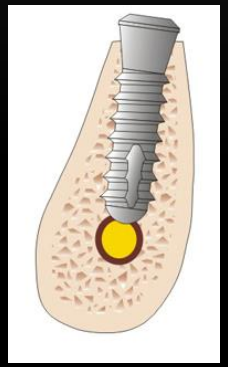
Ideal safety zone = 4mm



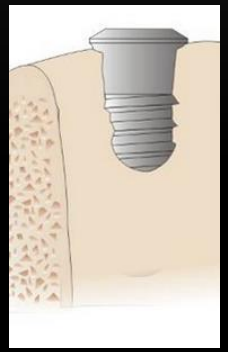
Is 2mm safety zone enough?



NOT if the implant drill is 1.5mm longer than the planned implant!

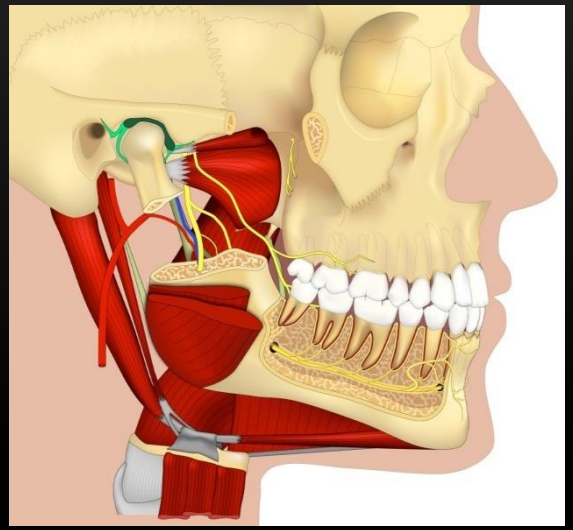


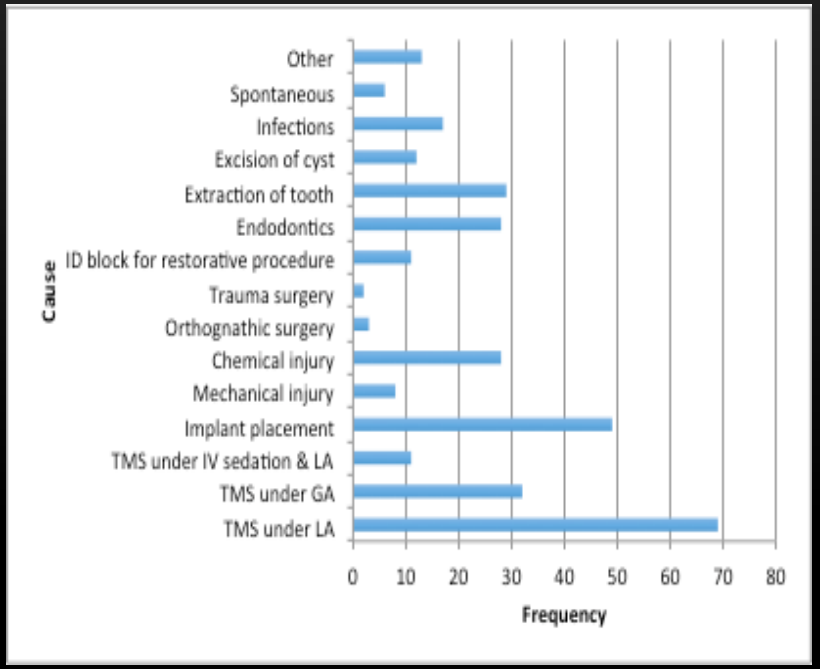
Planning to place implant in upper Lamina Dura of the inferior alveolar canal is irresponsible as cracking of the bone may cause haemorrhage into the IAC and subsequent nerve injury?



Consider short implants
High success rates and avoid bone grafting

Prevention of Trigeminal Post Traumatic Painful Neuropathy?

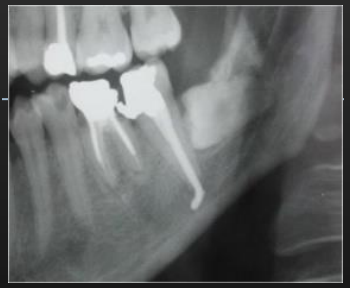


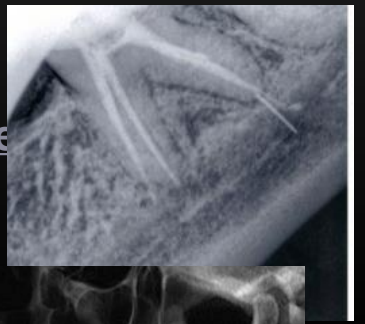


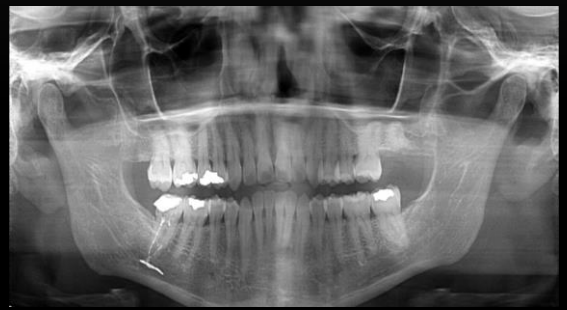
Local anaesthesia
Dental Implants
Endodontics
M3M surgery

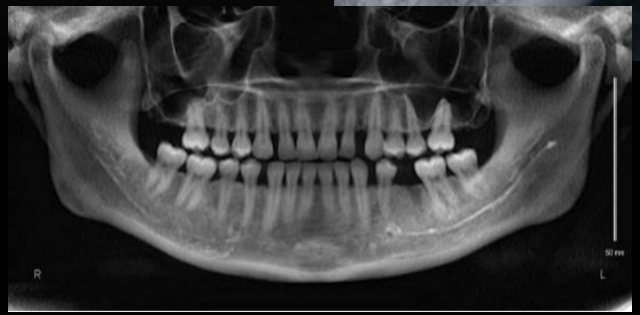
Endodontic related nerve injuries mechanisms

- Mechanical compression canal due to overfill
- Direct mechanical damage due to over instrumentation
- Haemorrhage with direct and indirect neural ischaemia
- **Loss of apical seal and CHEMICAL leakage and damage**
- Inflammation / infection









Fanibunda K, Whitworth J, Steele J (1998) The management of thermomechanically compacted gutta percha extrusion in the inferior dental canal. Br Dent J. 1998 Apr 11;184(7):330-2

Prevention of Endodontic related neuropathy: Risk factors

A. Inadequate preoperative assessment and planning due to;

- Lack of knowledge
  - GDP (80% of referrals) GDP endodontic success rates are significan… …vs 85%)
  - The American Association of Endodontists have made several recc… …ral of these patients
- Inability to read the radiographs or CBCT
- Inadequate informed consent-all options provided and related risk benef…
- Lack of identification of existing pre-surgical neuropathy (periapical lesions)

Tooth apex position
Proximity to IDC
Related root morphology

B. Premolar teeth & Proximity of tooth apex to IDC – 90% of the mandibular teeth in this series, were close to the IAN canal or premolars adjacent to the mental foramen. Proximity to the apex to the IAN/ breach a… seal and over chemical or instrumentation

- Tantanapornkul et al (33) reported the specificity and sensitivity of … …the IAN to the tooth roots in 161 mandibular third molars 161; for it was … …70% and 63% which were not significantly different.
- Patel et al (34) have reported on the use of CBCT in managi… cone periapicals.

Poor technique
Lack apical seal
Over instrumentation
Over filling

C. Poor technique

- Breach of apex causing pain during surgery on irrigation or during instrumentati… …damage to periapical t…es
- Over instrumentation
- Overfill Detectable overfill occurred in 60% of cases and over instrumentation during preparation

D. Early recognition and intervention for Endodontic related nerve injuries

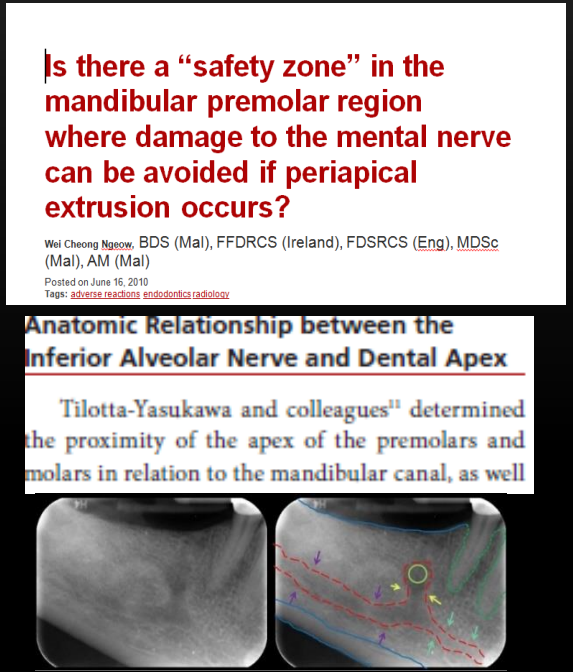
- ALWAYS undertake HOMECHECK , review patient and confirm neuropat…
- Neuropathy related to endodontics can be delayed and the patient must h… 3-4 days post treatment (Renton et al unpublished).
- If nerve injury is suspected, you will already be aware of the proximity of th… …was likely breach of apex, over instrumentation or deposition of endodontic material in…
- If there is suspected the material, the apex and or tooth must be removed within 4… …of placement in orde… …maximise recovery from nerve injury (9). If the patient is insistent on keeping the tooth urgent referral of the patient may be indicated for

Postoperative
Late recognition and late tooth or overfill removal

Key Risk factors

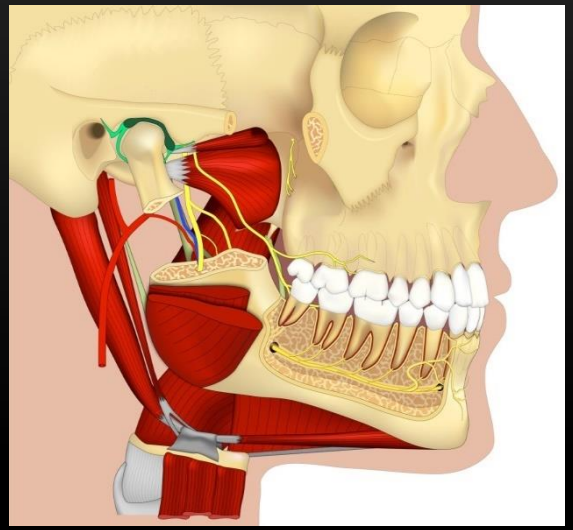
Mandibular teeth proximal to the IAN canal

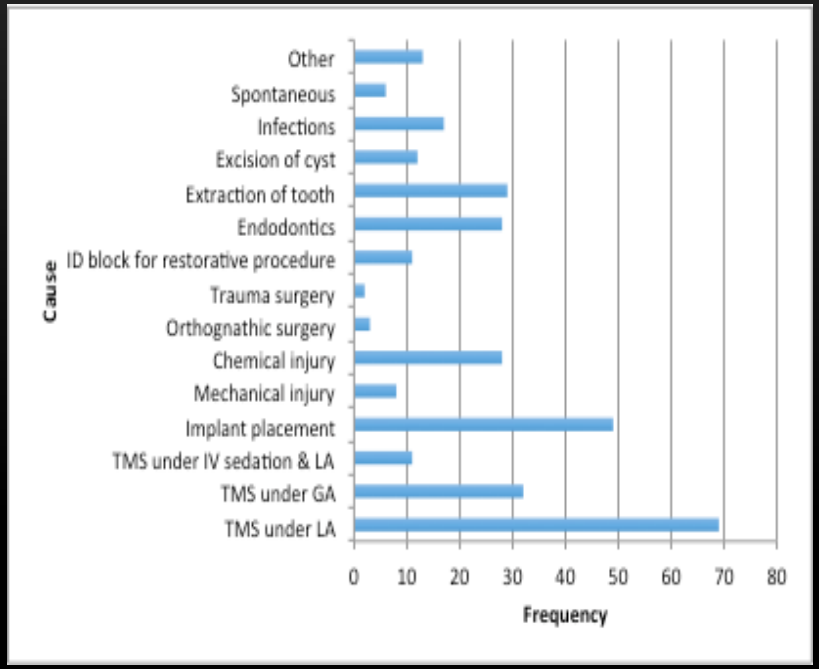
- Proximity to the Inferior dental canal (IDC)
  - Apex of the tooth may be adjacent or intruding into the IDC canal and any small degree of leakage or overfilling may compromise the IAN.
  - Assessment of the proximity of the tooth apex to the IAN canal has become significantly improved with Cone Beam CT scanning (CBCT) with the attendant risk of additional radiation and may not provide significantly more information than a plane long cone radiograph.
- Maintaining apical seal during endodontic treatment to prevent leakage of chemicals (NaCl and CaOH)



Tilotta-Yasukawa F, Millot S, El Haddioui A, Bravetti P, Gaudy JF.Labiomandibular paresthesia caused by endodontic treatment: an anatomic and clinical study. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2006 Oct;102(4):e47-59.

Prevention of Trigeminal Post Traumatic Painful Neuropathy?

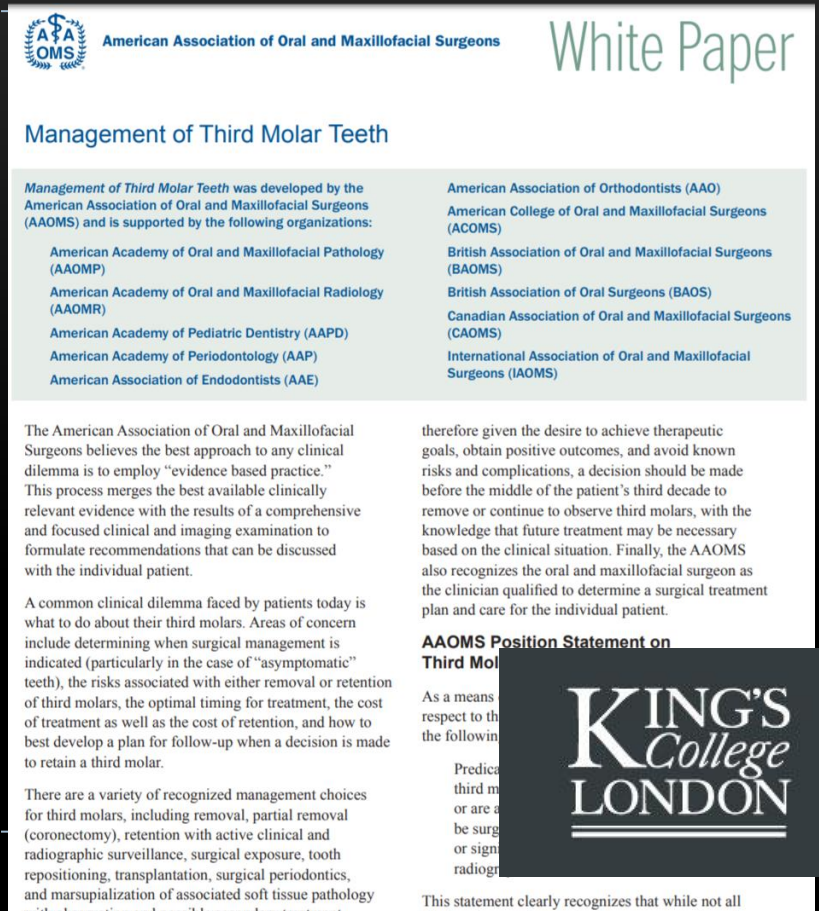




Local anaesthesia
Dental Implants
Endodontics
~~Third molar surgery~~

There must be in an indication to remove the M3M!

https://www.rcseng.ac.uk/dental-faculties/fds/publications-guidelines/clinical-guidelines/



American Association of Oral and Maxillofacial Surgeons

White Paper

Management of Third Molar Teeth

Management of Third Molar Teeth was developed by the American Association of Oral and Maxillofacial Surgeons (AAOMS) and is supported by the following organizations:

- American Academy of Oral and Maxillofacial Pathology (AAOMP)
- American Academy of Oral and Maxillofacial Radiology (AAOMR)
- American Academy of Pediatric Dentistry (AAPD)
- American Academy of Periodontology (AAP)
- American Association of Endodontists (AAE)
- American Association of Orthodontists (AAO)
- American College of Oral and Maxillofacial Surgeons (ACOMS)
- British Association of Oral and Maxillofacial Surgeons (BAOMS)
- British Association of Oral Surgeons (BAOS)
- Canadian Association of Oral and Maxillofacial Surgeons (CAOMS)
- International Association of Oral and Maxillofacial Surgeons (IAOMS)

The American Association of Oral and Maxillofacial Surgeons believes the best approach to any clinical dilemma is to employ "evidence based practice." This process merges the best available clinically relevant evidence with the results of a comprehensive and focused clinical and imaging examination to formulate recommendations that can be discussed with the individual patient.

A common clinical dilemma faced by patients today is what to do about their third molars. Areas of concern include determining when surgical management is indicated (particularly in the case of "asymptomatic" teeth), the risks associated with either removal or retention of third molars, the optimal timing for treatment, the cost of treatment as well as the cost of retention, and how to best develop a plan for follow-up when a decision is made to retain a third molar.

There are a variety of recognized management choices for third molars, including removal, partial removal (coronectomy), retention with active clinical and radiographic surveillance, surgical exposure, tooth repositioning, transplantation, surgical periodontics, and marsupialization of associated soft tissue pathology

therefore given the desire to achieve therapeutic goals, obtain positive outcomes, and avoid known risks and complications, a decision should be made before the middle of the patient's third decade to remove or continue to observe third molars, with the knowledge that future treatment may be necessary based on the clinical situation. Finally, the AAOMS also recognizes the oral and maxillofacial surgeon as the clinician qualified to determine a surgical treatment plan and care for the individual patient.

AAOMS Position Statement on Third Mol

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This statement clearly recognizes that while not all

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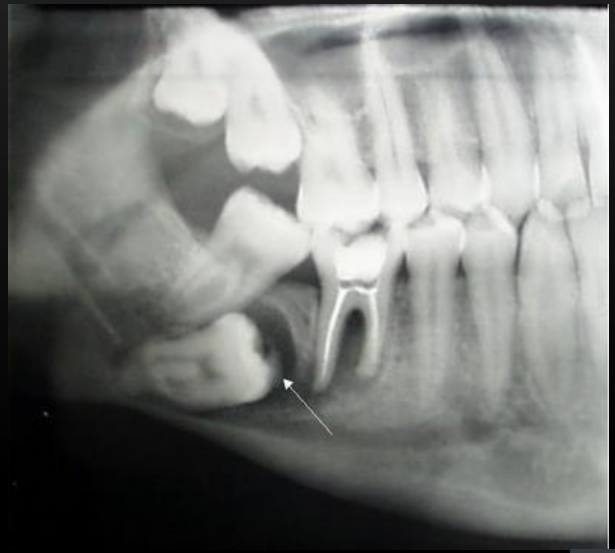
Diagnosis? Get it right!

- Listen
- Patient factors
- Systemic risks



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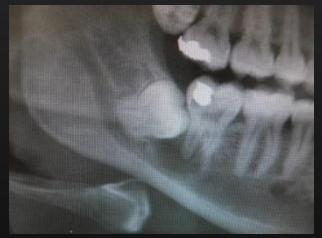
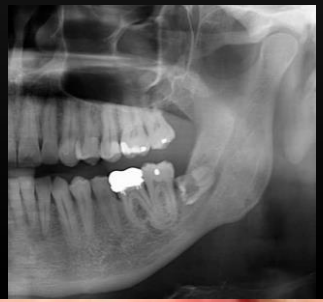
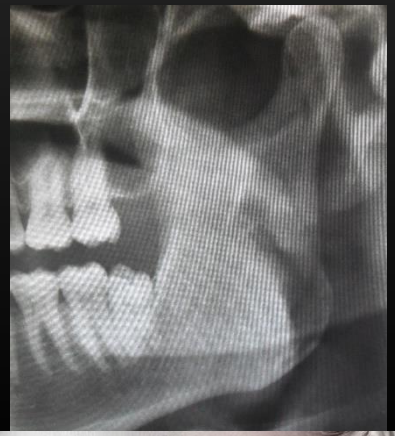
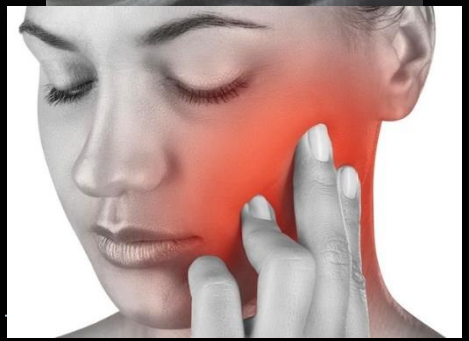
4 possible clinical M3M presentation scenarios





Possible treatment and diagnostic indications	**<u>Interventional removal of M3M communicating with the mouth</u>** **Earlier age -less morbidity** Quiescent pathology may include; Periodontal disease, caries, resorption, tooth fracture, jaw fracture, cysts or other pathology	**<u>Leave M3M OR Prophylactic removal of M3M</u> indications include;** Pre radiotherapy Pre medication for osteoporosis or metastatic bone disease (Bisphosphonates, antiangiogenics M3M removal in line of surgery for jaw fracture, orthognathic or cancer surgery
Asymptomatic	**Diseased**	**Non Diseased**
Symptomatic	**Diseased**	**Non Diseased** **M3M healthy but disease in adjacent tissues causing pain**
Possible Treatment and diagnostic indications	**<u>Therapeutic removal of M3M</u>** **Treat pathology may include;** pathology may include; Periodontal disease, caries, resorption, tooth fracture, cysts or other pathology	**<u>No removal of M3M</u>** **Treat pathology may include;** TMD, mucosal disease, adjacent tooth pathology, salivary gland disease

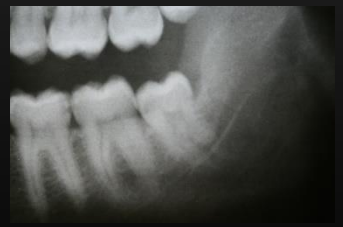


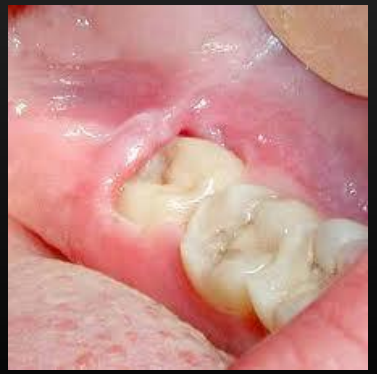


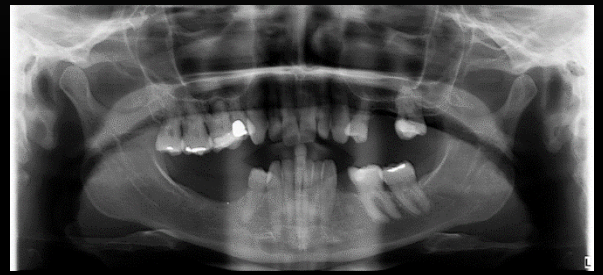
Consent
Why not Ask the same questions as the lawyers?

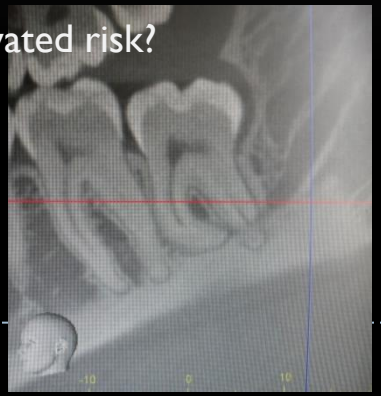
Taking a good history ensures medical issues avoided

- Was there a good indication to remove the tooth?
- Did these indications concur with national guidance?
- Was the patient warned/ consented?
- Was there an elevated risk?
- Was additional assessment undertaken to assess heightened risk?
- Was the patient warned and further assessed with elevated risk?
- Was alternative treatment offered in light of elevated risk?
- Was the patient followed up in 24 hours?
- Was complication /nerve injury recognised?
- Was patient referred early for specialist care?









Risk factors for M3M nerve injury

- Lingual nerve
- Age of the patient
- Poor surgical technique
  - Junior surgeons
  - Duration of surgery
  - Lingual access surgery
  - Distal bone removal and lingual nerve injury
    - Use Buccal approach
    - Minimal access
  - 'aberrant' Lingual nerve anatomy
    - 11-18% of lingual nerve above alveolar crest distal to M3Ms

- Inferior alveolar nerve
- Age of the patient
- ○Intra-operatory exposure of the nerve
- ○Un-erupted tooth
- Poor Radiographic risk assessment
  - Perforation of tooth roots by IDC
  - Proximity of tooth roots to inferior dental canal (IDC)
  - Plain film
    - IDC loss LD
    - Darkening of roots
    - Deviation of IDC
  - CBCT lack cortication, distortion of canal.
  - Lingual IDC

Acta Odontol Scand. 2013 Jul 4. The importance of a good evaluation in order to prevent oral nerve injuries: A review.Céspedes-Sánchez JM, Ayuso-Montero R, Marí-Roig A, Arranz-Obispo C, López-López J. 662 were obtained from the search, from which 25 were selected accomplishing the inclusion criteria. Moreover, seven important articles were selected from the references of the ones mentioned, obtaining a total of 32 articles for the review.
Renton T, McGurk M. Brit J Oral Maxillofac Surg 2001; 39: 423-428 Acta Odontol Scand. 2013 Jul 4. [Epub ahead of print]

The importance of a good evaluation in order to prevent oral nerve injuries: A review.Céspedes-Sánchez JM, Ayuso-Montero R, Marí-Roig A, Arranz-Obispo C, López-López J. 662 were obtained from the search, from which 25 were selected accomplishing the inclusion criteria. Moreover, seven important articles were selected from the references of the ones mentioned, obtaining a total of 32 articles for the review.

Patient factors associated with higher M3M surgery morbidity?

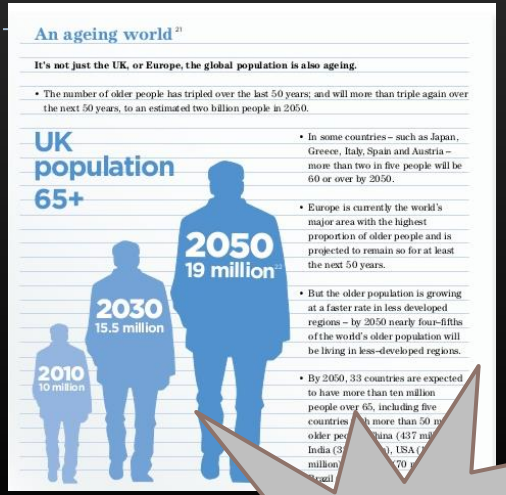
- **All complications related to**

Age of the patient > 25 years

- Duration of surgery
- Intra-operatory exposure of the nerve
- Un-erupted tooth

- LNI
- Technique access for the lower third molar extraction
- the surgeon's inexperience.

- IANI
- hnique



Relevant studies have been identified and are reported for the following complications and their relationship to the patient's age:

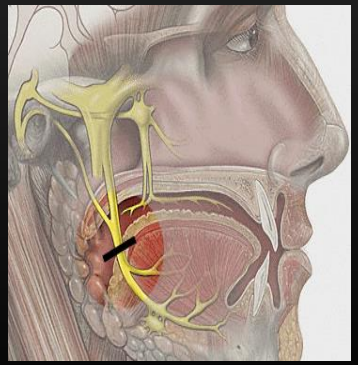
- **time to recovery**
- **incidence of fractures**
- **rates of infection**
- **periodontal complications**
- **temporomandibular joint complications**
- **nerve injury**
- **sinus-related complications.**

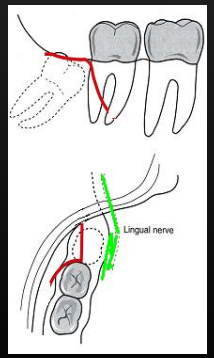
Pogrel MA. What is the effect of timing of removal on the incidence severity of complications? J Oral Maxillofac Surg. 2012 Sep;70(9 S 1):S37-40. doi: 10.1016/j.joms.2012.04.028. Epub 2012 Jun 16.

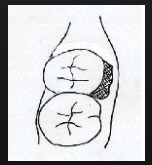
High evidence level

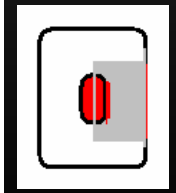
Acta Odontol Scand. 2013 Jul 4.The importance of a good evaluation in order to prevent oral nerve injuries: A review.Céspedes-Sánchez JM, Ayuso-Montero R, Marí-Roig A, Arranz-Obispo C, López-López J. 662 were obtained from the search, from which 25 were selected accomplishing the inclusion criteria. Moreover, seven important articles were selected from the references of the ones mentioned, obtaining a total of 32 articles for the review.

PREVENTION OF LINGUAL NERVE
BUCCAL APPROACH -MINIMAL ACCESS PREVENTS Lingual Nerve Injury

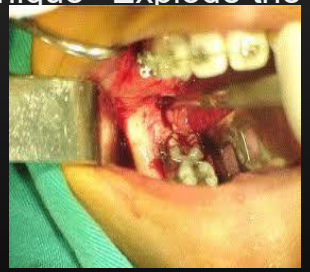




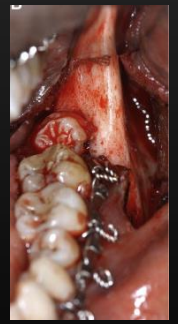


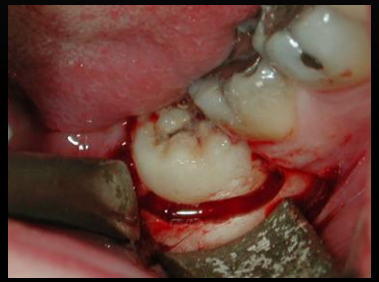


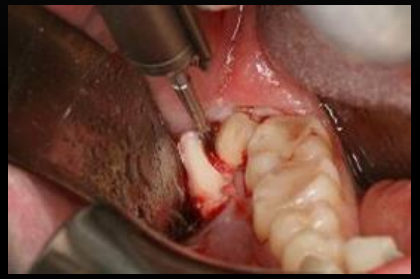
Old Technique ‘Explode the patient’



New technique minimal access







Evaluation of trigeminal nerve injuries in relation to third molar surgery in a prospective patient cohort. Recommendations for prevention. **Renton T**, Yilmaz Z, Gaballah K. Int J Oral Maxillofac Surg. 2012 Dec;41(12):1509-18.

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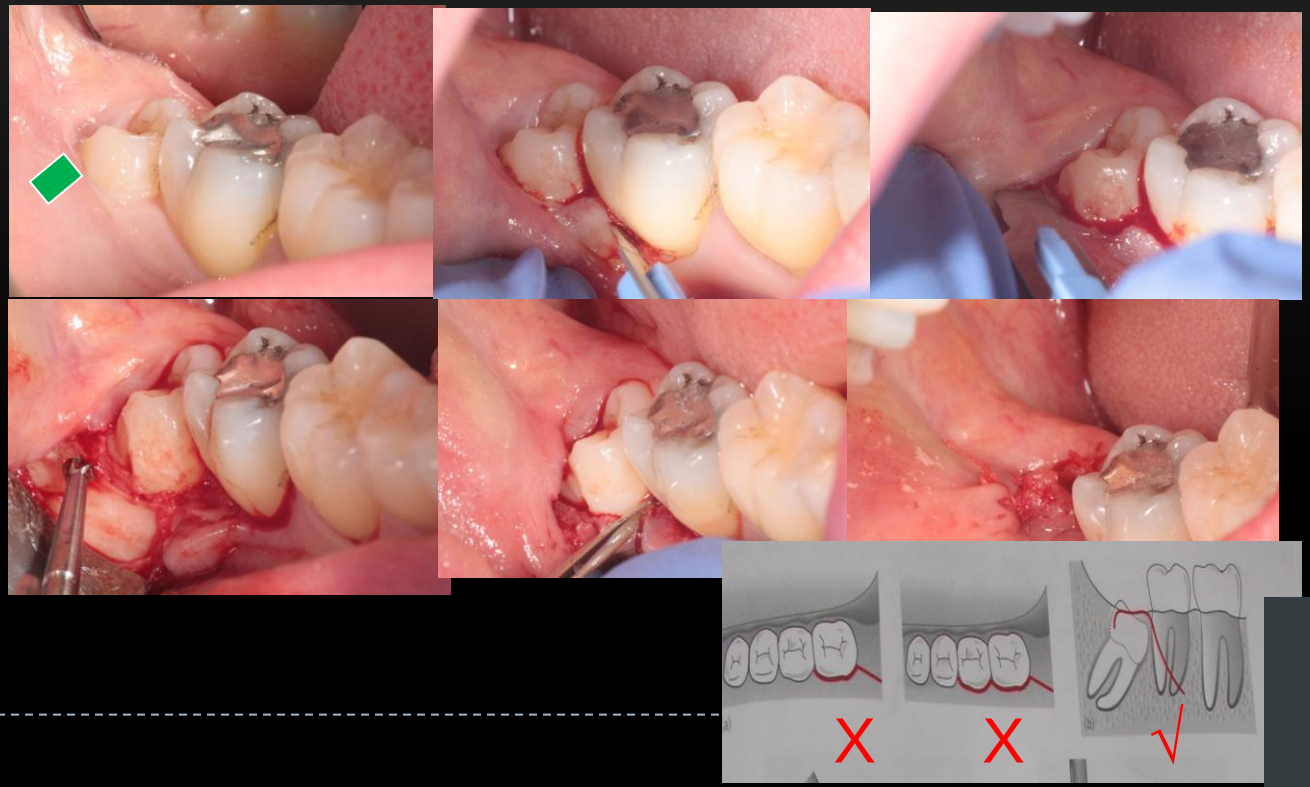
PREVENTION LNI RELATED TO M3M SURGERY

BUCCAL MINIMAL ACCESS SURGERY



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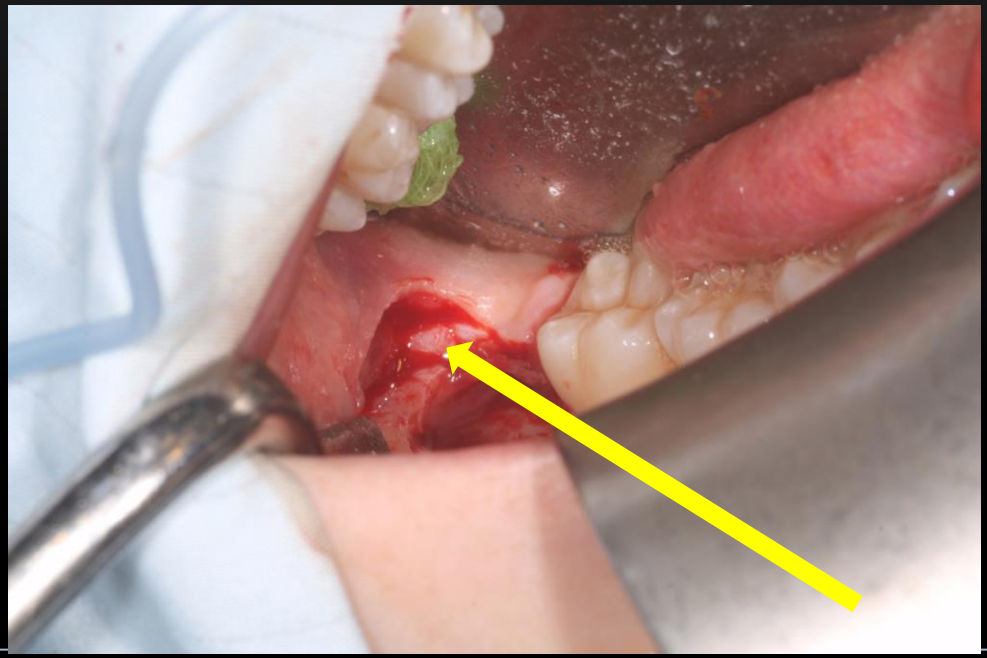
Prevention of M3M surgery related nerve injury

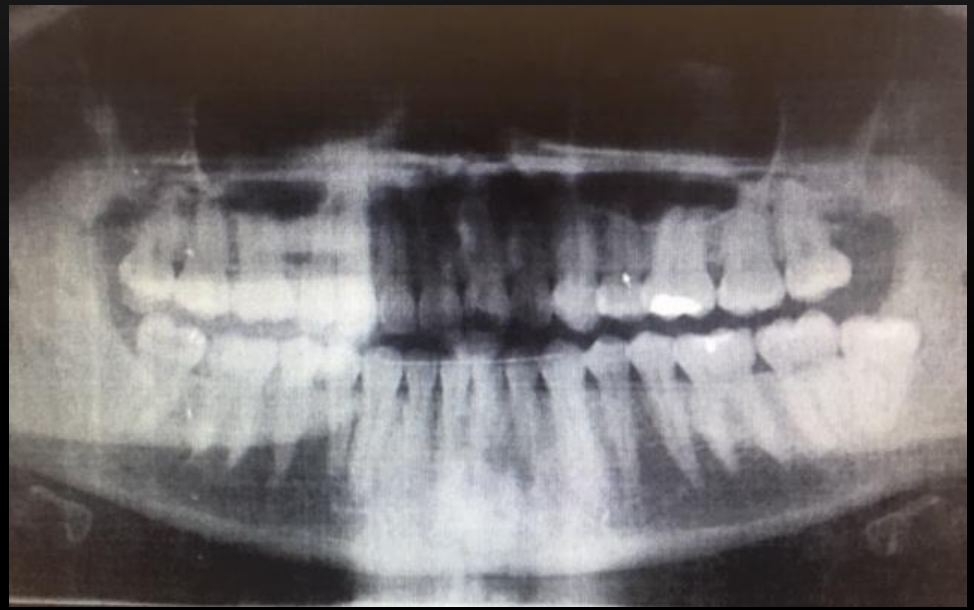
Avoid distal bone removal

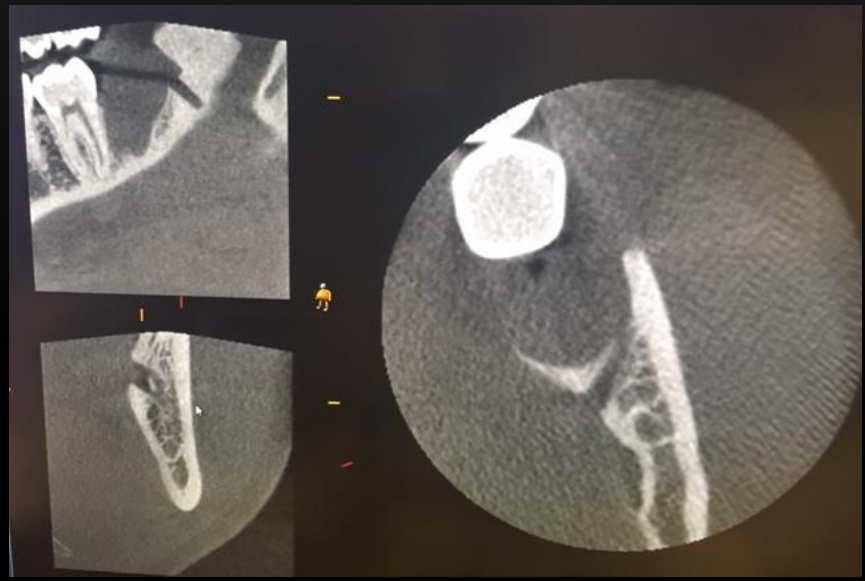
Spot the lingual nerve!



Early assessment of potential Lingual nerve injury using CBCT

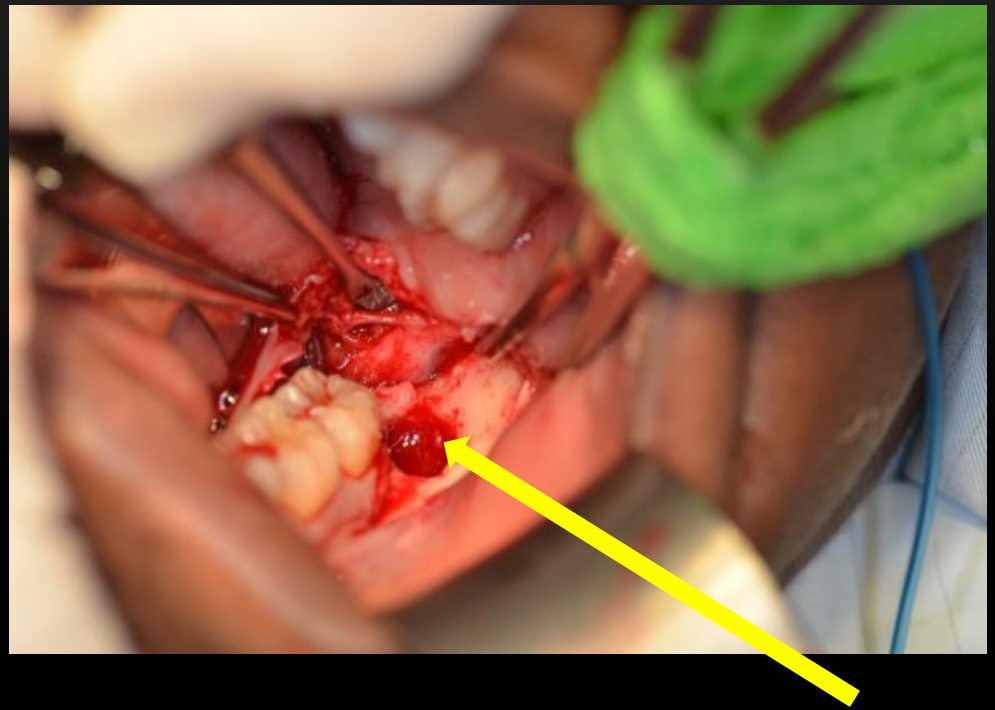
Spot the toller bur mark in the lingual cortex!





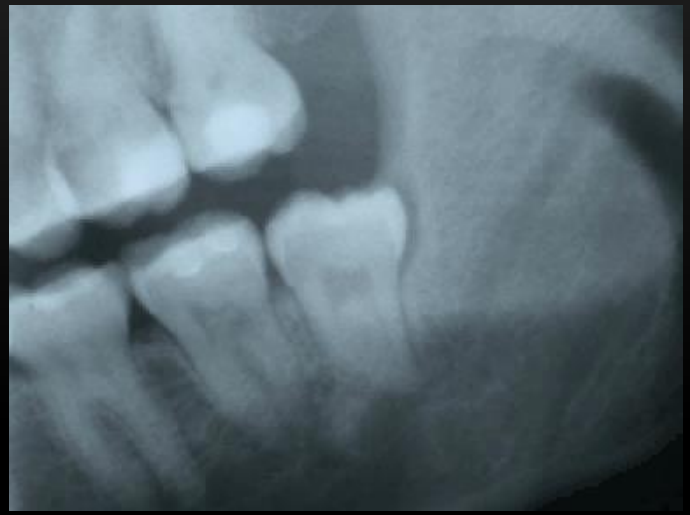
Prevention of lingual nerve injury

Lingual nerve damage due to distal bone removal



PREVENTION OF LINGUAL NERVE INJURY

The Buccal approach



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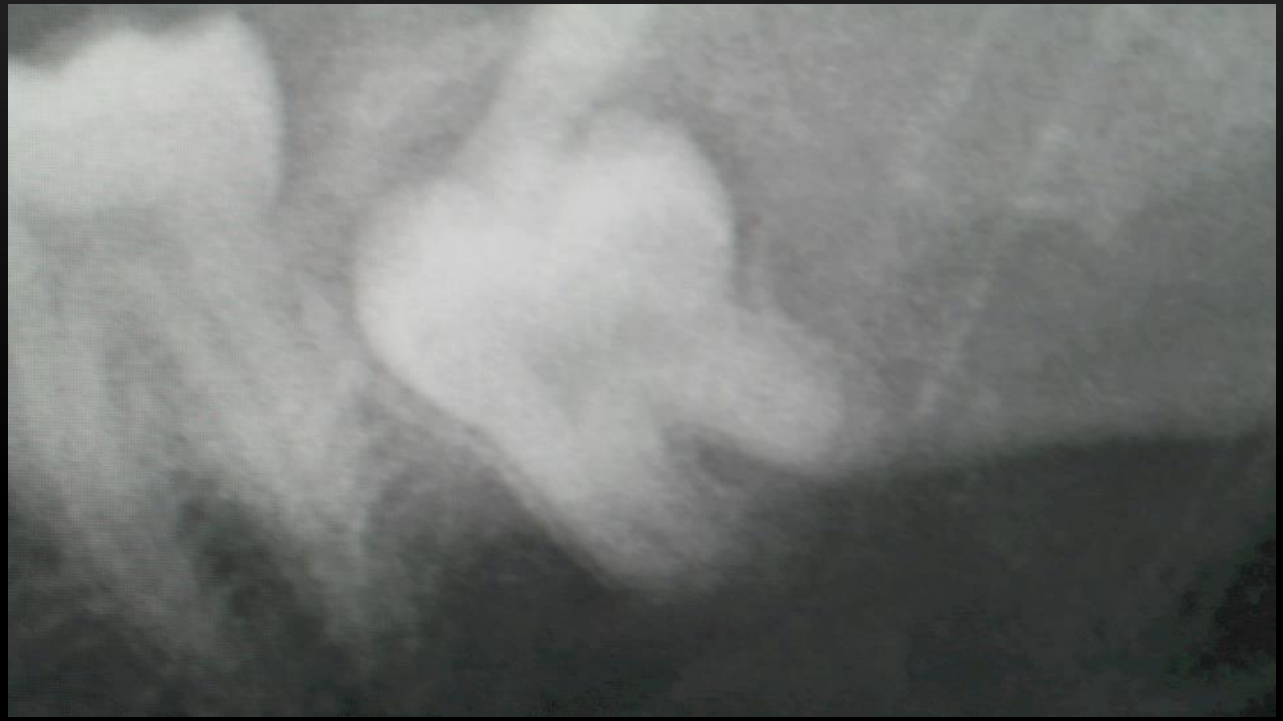
PREVENTION OF LINGUAL NERVE INJURY

The Buccal approach



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Prevention of Lingual Nerve Injury in Third Molar Surgery: Literature Review

Roberto Pippi, MD, DDS, Andrea Spota, MD, DDS,† and Marcello Santoro, DDS‡*

Purpose: To identify any factors that could aid the surgeon in preventing or minimizing the risk of lingual nerve injury during third molar surgery.

Materials and Methods: Electronic research was carried out on the correlation between lingual nerve damage and lower third molar surgery (topographic anatomy, surgical technique, and regional anesthesia) using PubMed, Scopus, and Cochrane central databases. The research included only articles published in English up to February 2016.

Results: Lingual nerve anatomy varied greatly: direct contact between the lingual nerve and the third molar alveolar wall was reported in a wide range of cases (0 to 62%) and the nerve was located at the same level or above the top of the ridge in 0 to 17.6% of cases. No detailed data were found on the actual incidence of lingual nerve injury resulting from local anesthesia by injection. Permanent lingual nerve damage did not show statistically relevant differences between the simple buccal approach and the buccal approach plus lingual flap retraction, although the latter was statistically associated with an increased risk of temporary damage. Lingual spit technique was statistically associated with an increased risk of temporary nerve damage than the buccal approach with or without lingual flap retraction. For permanent damage, no statistically relevant differences were found between the lingual split technique and the buccal approach with lingual flap retraction. Compared with tooth sectioning, the ostectomy was strongly statistically associated with permanent lingual nerve damage.

Conclusions: Results should be interpreted with extreme caution because of the considerable heterogeneity of the data and the considerable influence of several anatomic and surgical variables that were closely related, but difficult to analyze independently. It seems preferable to avoid lingual flap elevation, except in selected cases in which the presence of more than 1 unfavorable surgical variable predicts a high risk of nerve injury. Tooth sectioning could decrease the extent of the ostectomy or even, in some cases, prevent it, potentially acting as a protective factor against lingual nerve injury.

J Oral Maxillofac Surg 75:890-900, 2017

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†Researcher.

‡PhD Student.

Conflict of Interest Disclosures: None of the authors have any relevant financial relationship(s) with a commercial interest.

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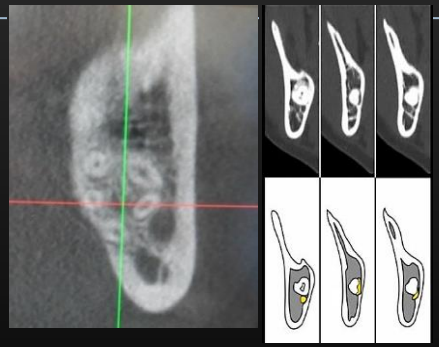
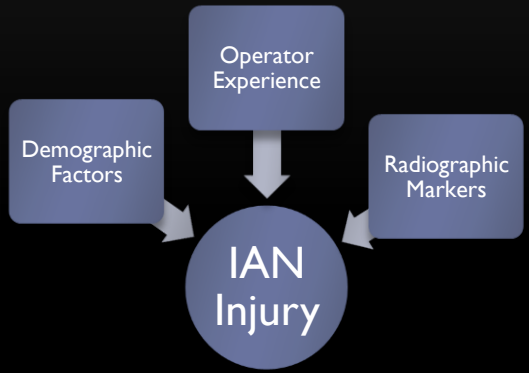
http://dx.doi.org/10.1016/j.joms.2016.12.040

Risk inferior alveolar nerve injury (IANI) general risk factors

- **Age of the patient**
- **Intra-operatory exposition of the nerve**
- **Intraoperative reported pain during surgery**
- **Surgeon's inexperience.**
- **<u>Dental factors proximity to nerve</u>**
- **Radiographic markers (CBCT):**
- Cortical perforation of the IAC by the root or crown of the 3rd molar correlated with darkening of the root seen on the panoramic radiograph.
- A cortical defect 3mm long or more in the IAC was associated with an increased risk of operative exposure of the IAN.

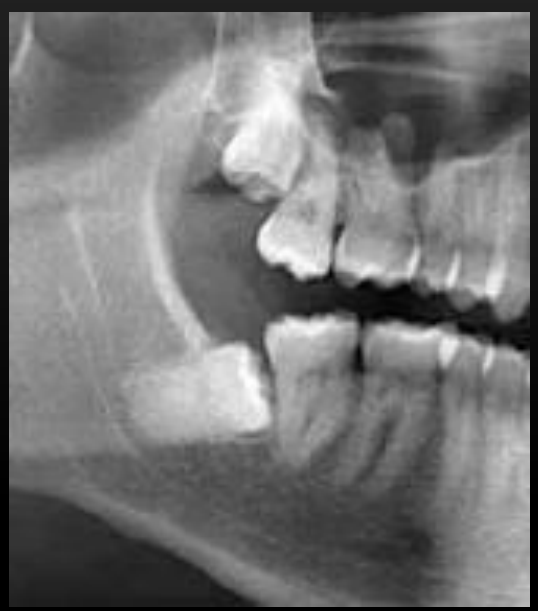


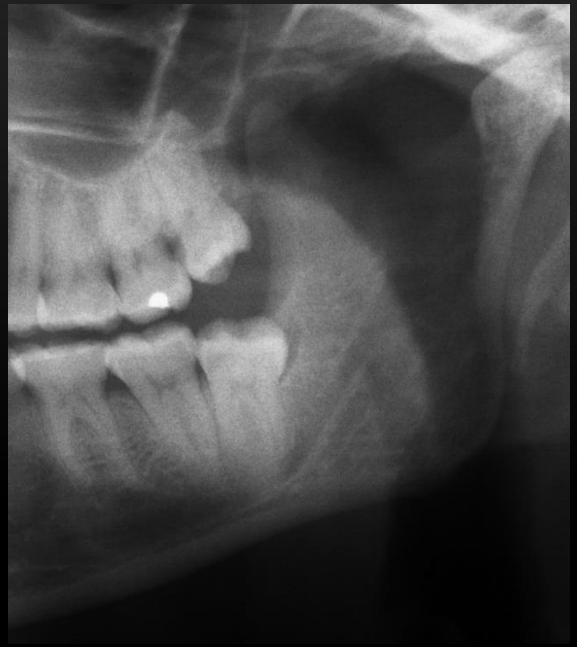


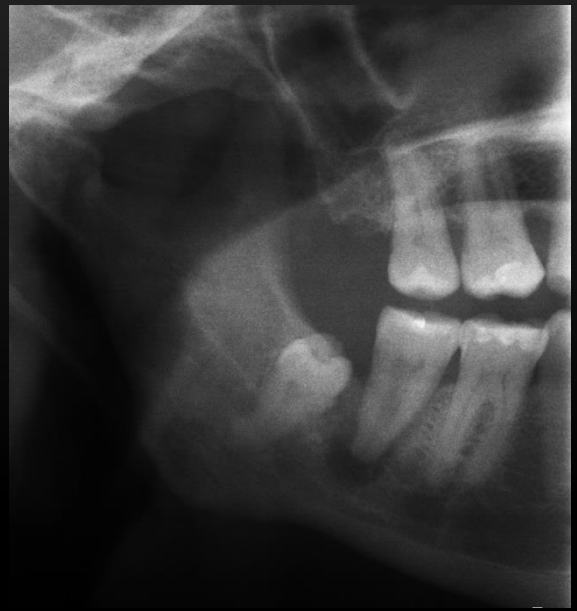
Céspedes-Sánchez JM, Ayuso-Montero R, Marí-Roig A, Arranz-Obispo C, López-López J **The importance of a good evaluation in order to prevent oral nerve injuries: A review.** Acta Odontol Scand 2013 Jul 4.

Factors that are associated with injury to the IAN in high-risk patients after removal of third Molars. Selvi, Dodson, Nattestad, Robertson, Tolstunov. BJOMS 51 (2013) 868–873. with permission.

How do we prevent Inferior alveolar nerve injuries? **By risk assessment and modified technique M3M root into IDC**







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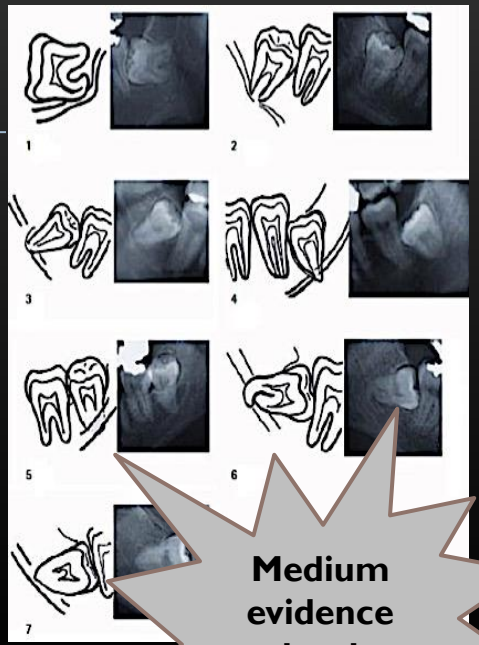
Radiographic Assessment for increased risk of IANI- Plain film signs

What are the plain film indicators of IAN risk?

- IAN plain film risk factors include:
  - Diversion of the canal
  - Darkening of the root
  - Narrowing of the root/canal
  - Interruption of the canal lamina dura.
  - Interruption of the juxta-apical area.



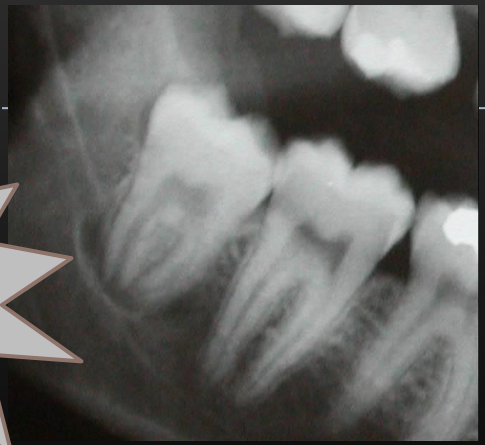
Medium evidence level

Y. Hatano, K. Kurita, Y.Kuroiwa, H. Yuasa [illegible] 14.Clinical evaluations of coronectomy (intentional [illegible] mandibular third molars using dental computed tom[illegible]graph[illegible] c[illegible]ontro[illegible] study, copyright (2009), with permission from Elsevier)

Howe J. et Poyton H: Prevention of damage to the inferior alveolar dental nerve during the extraction of mandibular third molars. Br. Dent J. 1960; 109:355 Rud J. The split-bone technique for removal of impacted mandibular third molars. J Oral Surg 1970; 28:416-421. Kipp D et al.: Dysesthesia after mandibular third molar surgery: A retrospective study and analysis o 1,377 surgical procedures. J Am Dent Assoc. 1980; 100: 185. Rood JP. Lingual Split Technique: Damage to Inferior Alveolar and Lingual Nerves during Removal of Impacted Mandibular Third Molars. Br Dent J 1983; 154: 402-403. Rud J. Re-evaluation of the lingual split bone technique for the removal of impacted mandibular third molars. J Oral Maxillofac Surg. 1984; 42: 114.

What's the risk of nerve injury?

When tooth roots are proximal to Inferior dental canal (IDC)



Medium evidence level

Low risk extraction

- **2% of temporary**
- **0.2% of permanent**

High risk extraction

(teeth are superimposed on the IAN canal)

- **20% temporary**
- **2% permanent**

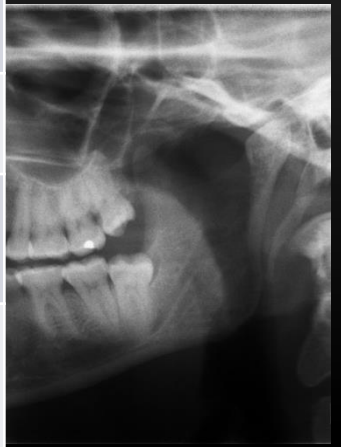
Risk factors

- increased age
- difficulty of surgery
- proximity to the IAN canal

10 x

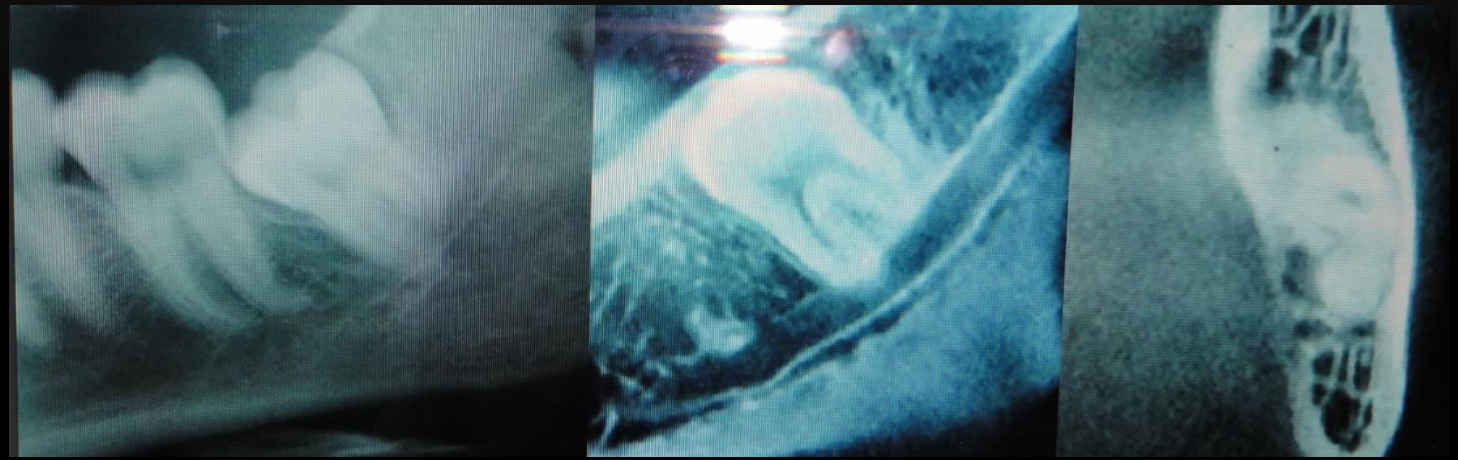
- Renton T, Hankins M, Sproate C, McGurk M.A randomised controlled clinical trial to compare the incidence of injury to the inferior alveolar nerve as a result of coronectomy and removal of mandibular third molars. Br J Oral Maxillofac Surg. 2005 Feb;43(1):7-12
- Rood JP, Shehab BA.The radiological prediction of inferior alveolar nerve injury during third molar surgery.Br J Oral Maxillofac Surg. 1990 Feb;28(1):20-5
- Rud J.Third molar surgery: perforation of the inferior dental nerve through the root. Tandlaegebladet. 1983 Oct;87(19):659-67. No abstract available.

Fate	M3Ms	% of sub group of M3Ms	% of all M3Ms high risk	Reference
Missing	8/100	8 (0.15% and 16.2%)	8	Rakhshan V Congenitally missing teeth (hypodontia): A review of the literature concerning the etiology, prevalence, risk factors, patterns and treatment Dent Res J (Isfahan). 2015 Jan-Feb; 12(1): 1–13.
Impacted non communicating with mouth= retain	8-18/92	7-13%	6 15	Jung JH Cho BH. Prevalence of missing and impacted third molars in adults aged 25 years and above Imaging Sci Dent 2013 Dec; 43(4): 219–225. Dodson T Impacted wisdom teeth BMJ Clin Evid 2010; 2010: 1302.
Requiring removal or coronectomy at some stage			2 11	No evidence but 2% risk of permanent IANI Howe J, Poyton H. Prevention of damage to the inferior alveolar dental nerve during the extraction of mandibular third molars. Br. Dent J. 1960; 109:355
High risk based upon panoral radiography	35/80	(7.5% /80) 36% 32.1% 29&	**11** **39** **35**	Howe J, Poyton H. Prevention of damage to the inferior alveolar dental nerve during the extraction of mandibular third molars. Br. Dent J. 1960; 109:355 Sedaghatfar M, August MA, Dodson T. Panoramic Radiographic Findings as Predictors of Inferior Alveolar Nerve Exposure Following Third Molar Extraction. American Association of Oral and Maxillofacial Surgeons J Oral Maxillofac Surg 63:3-7, 2005 Smith Aus Dent J 2012
High risk based upon CBCT	30/35	46.7% direct contact IDC	**42**	Schneider T et al Variations in the anatomical positioning of impacted mandibular wisdom teeth and their practical implications. Swiss dental Journal. 124: 520–529 (2014)
High risk requiring coronectomy	/35	5.6%	3.5	Peker Y, Sarikir S, Alkurt MT, Zor ZF.Panoramic radiography and cone-beam computed tomography findings in preoperative examination of



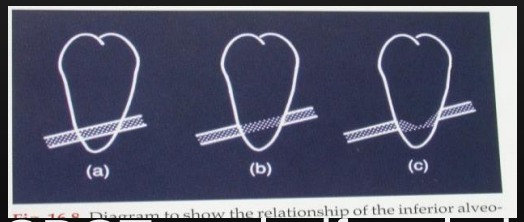
Assessment nerve ‘at risk’. Is the M3M high risk? When do we order a CBCT?

- Crossing lamina dura of IAN canal on plain film?
- With associated radiographic signs?

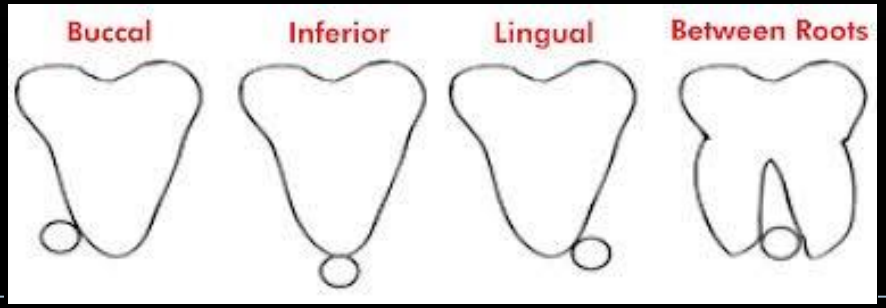


Using CBCT we can assess the position of m3m roots related to IDC?

- Associated radiographic signs?



- Consider CBCT to clarify relationship



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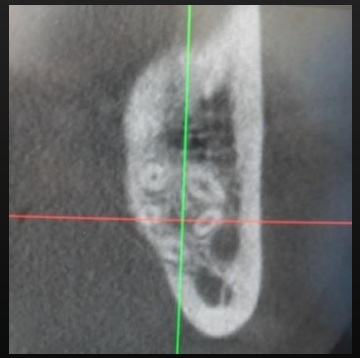
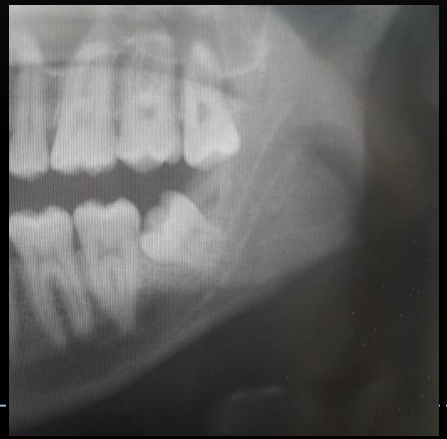
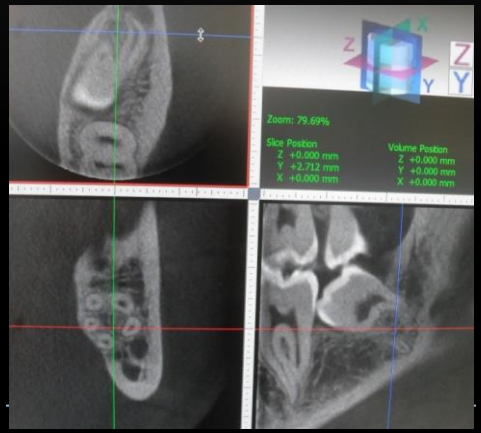
RISK IANI
Assessing with CBCT M3M root relationship

- Between 20-48% of M3Ms are at high risk based upon panoral assessment
- Removal or coronectomy?







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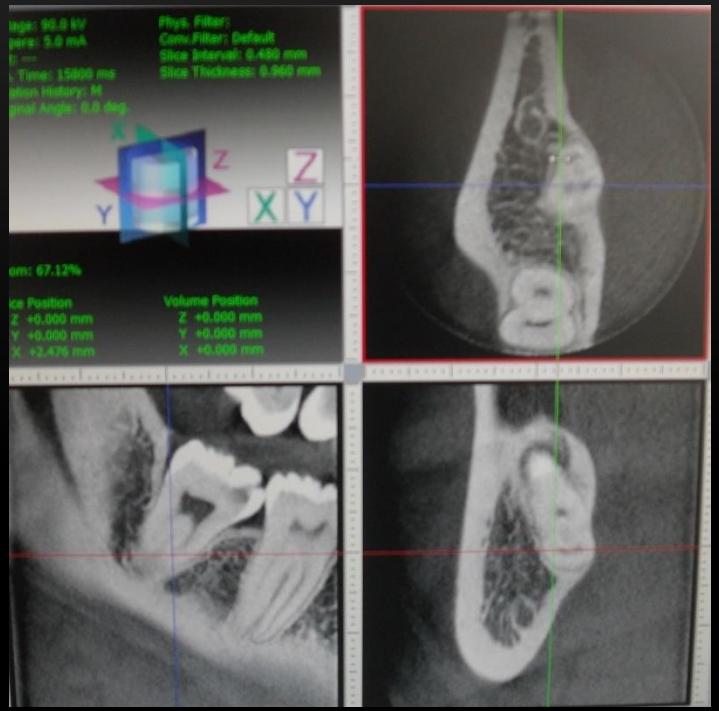
Decision on risk assessment
Low risk - removal



- ~~IAN~~ IDC distant
- IDC Buccal to M3M roots
- IDC inferior to roots

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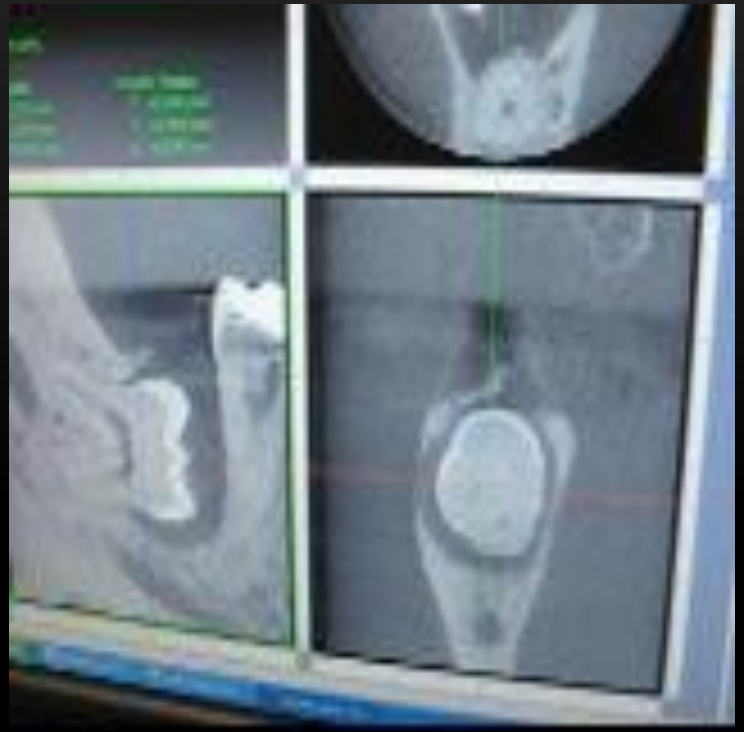
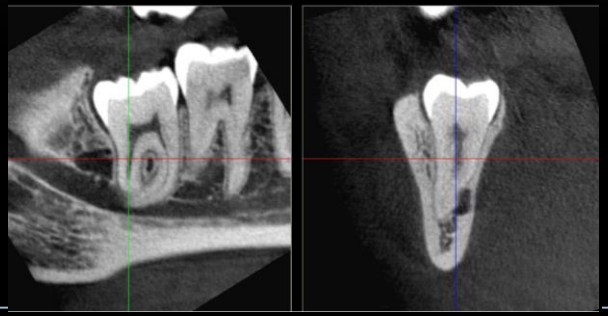
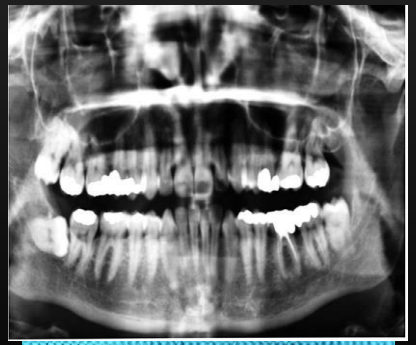
Decision on risk assessment
Low risk - coronectomy

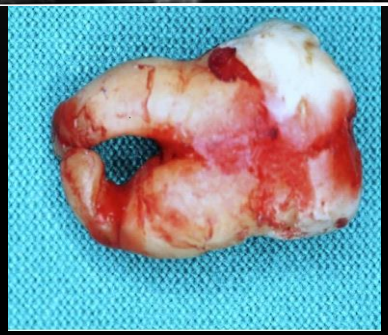


- Risk factors
  - Decortication of canal > 3mm
  - Distortion of the IDC – dumbbell shape
  - IDC lingual to roots
  - Bifid nerve
  - Roots sandwiched between lack of lingual plate and IDC



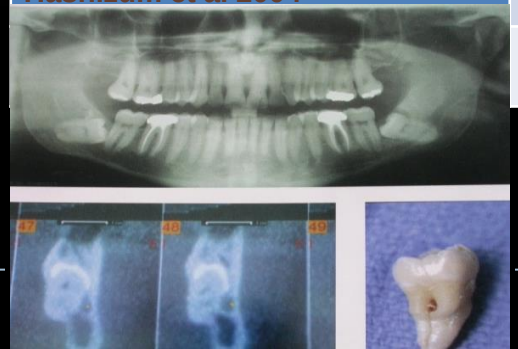
Decision
Perforation is the only ‘Absolute’ indication for coronectomy

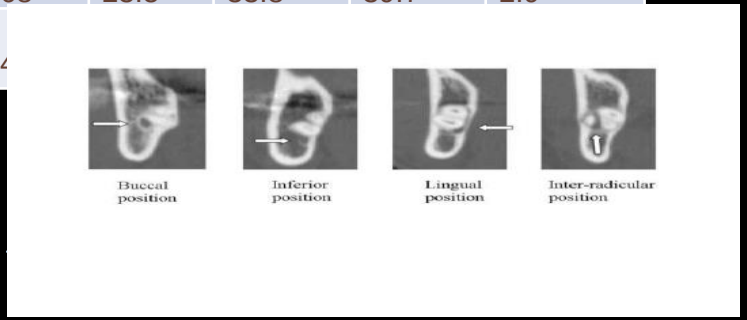




Perforation is rare more likely ‘intimately’ associated

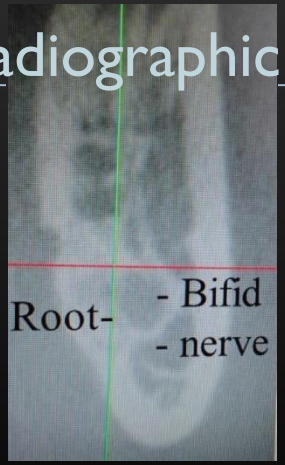
Reference	cases	Buccal	Inferior	Lingual	Inter radicular
Kaeppler et al 2000	345	53.6	6	13	26.8
Mahasantipiy 2000	202	15.3	42.6	30.2	12.4
Ito et al1994	47	55.3	36.2	2.1	6.4
Tanaka et al 2000	209	39.2	47.4	10	3.3
Hashizum et al 2004	68	23.5	33.8	39.7	2.9

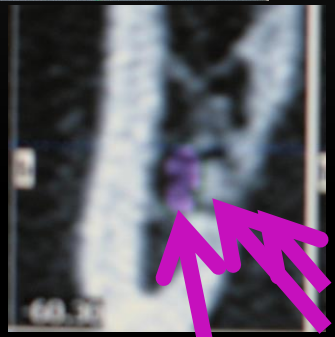




Roberto Pippi. Inferior Alveolar Nerve Entrapment. J Oral Maxillofac Surg 68:1173-1178, 2010

Risk IANI
Other radiographic factors cbct





- IAN canal cortication loss
- Distortion of IDC

- Lingual IDC to M3M roots
- Bifid IDC
- Loss of lingual plate

30%

Loss of lingual plate
Tooth root
Inf Alveolar nerve

. Notes on coronectomy. **Renton T**. Br Dent J. 2012 Apr 13;212(7):323-6

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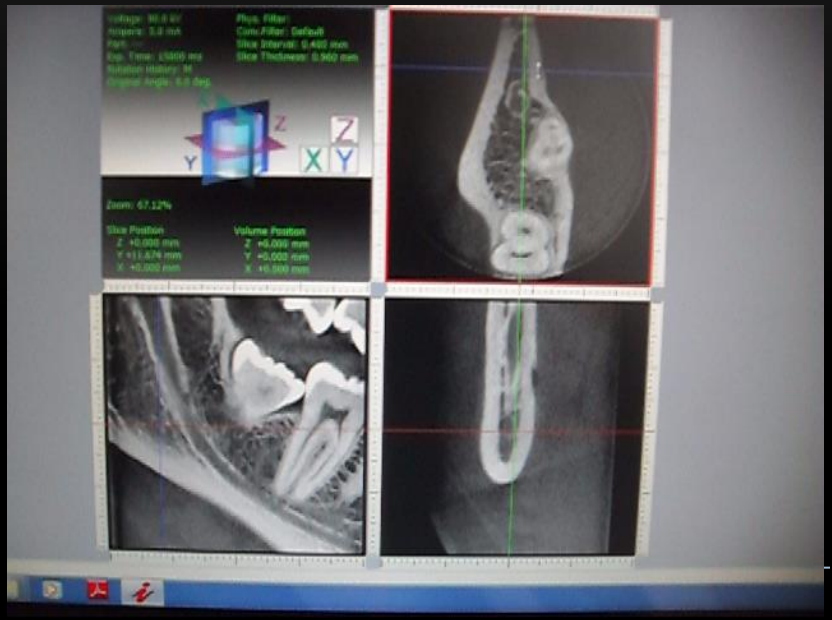
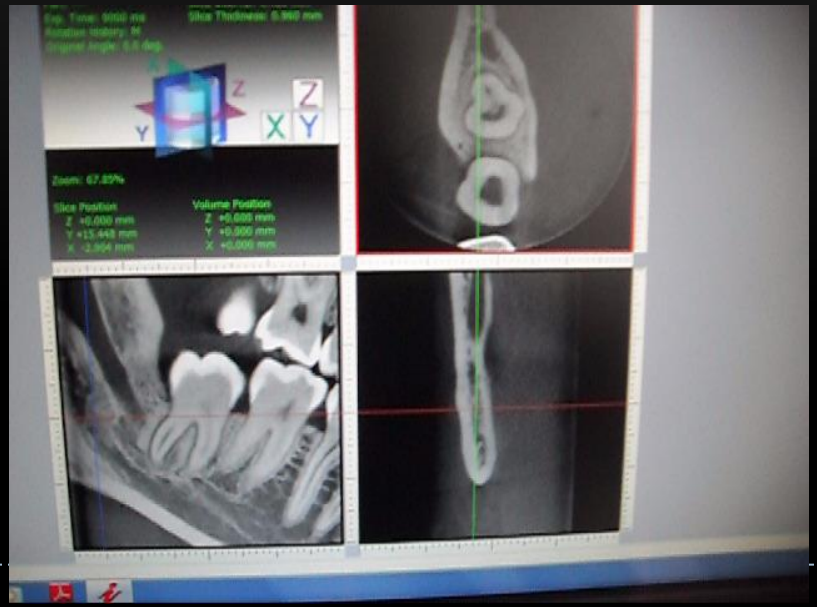
Risk IANI
Proximity of M3M roots to IDC

Remove the tooth or coronectomy?

Distant- remove

‘Snake like’ or Perf-Coronectomy





Double jeopardy!
Friend and dentist

- Risks
  - IDC lingual to tooth
  - Compression of IDC
  - Decortication IDC
- Mitigation
  - IDC whole and independent
  - IDC not winding between multiple roots of M3M
  - Will use buccal access and not pressurise in lingual direction

What is a coronectomy?

- Coronectomy has been defined as a method of removing the crown of a tooth but leaving the roots untouched, which may be intimately related with the IAN, so that the possibility of nerve injury is reduced.
- Alternative Terminology:
  - Partial root removal
  - Deliberate vital root retention
  - Partial odontectomy

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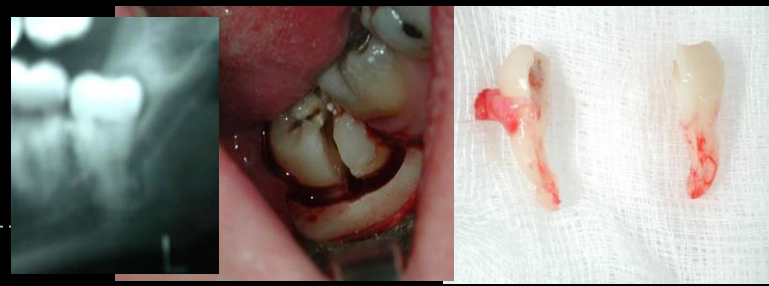
Contraindications

When should we NOT consider undertaking a coronectomy?

- Dental factors
  - **TOOTH NOT AT HIGH RISK of IANI**
  - Non vital tooth
  - Active caries into the pulp, or demonstrating periapical abnormality.
  - Teeth that are mobile should be excluded as they act as a mobile foreign body and become a nidus for infection or migration.
  - Teeth associated with tumors **
  - Horizontally impacted teeth more difficult
- Medical history
  - Immunocompromised patients (chemo- therapy, AIDS, radiation therapy, immunomodulating drug therapy, poorly controlled diabetics). Bisphosphonate medication
- Social psychological
  - Patient understanding is compromised
  - Travelling / difficult access to healthcare
- Other planned treatment
  - Patients scheduled for an osteotomy in the future.
  - Patients who are to undergo radiation therapy.

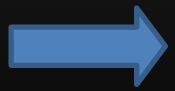
Still undertake CBCT and section roots to minimise damage to nerve



M3M Removal or Coronectomy?

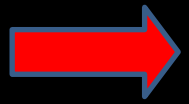
- Patient healthy?
- Patient reliable?
- Tooth vital?
- Tooth high risk- confirmed on CBCT inter radicular IAN?

- Yes to all



Coronectomy

- No to any?



Removal

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THE EVIDENCE

Coronectomy does prevent IANI

3 Systematic reviews

4 prospective randomised studies ***GRADE A evidence**

- July 2014 Cochrane SYSTEMATIC review stated that likely that coronectomies reduce the risk of IANI

Coulthard P[1], Bailey E, Esposito M, Furness S, Renton TF, Worthington HV. Surgical techniques for the removal of mandibular wisdom teeth. Cochrane Database Syst Rev. 2014 Jul 29;(7):CD004345. doi: 10.1002/14651858.CD004345.pub2

- Efficacy of coronectomy in reducing nerve injury

Long H, Zhou Y, Liao L, Pyakurel U, Wang Y, Lai W. Coronectomy vs. Total Removal for Third Molar Extraction: A Systematic Review. J Dent Res. 2012 May 23*Cervera-Espert J[1], Pérez-Martínez S, Cervera-Ballester J, Peñarrocha-Oltra D, Peñarrocha-Diago M. Coronectomy of impacted mandibular third molars: A meta-analysis and systematic review of the literature. Med Oral Patol Oral Cir Bucal. 2016 Jul 1;21(4):e505-13.*

Szalma J[1], Lempel E[2]. Protecting the inferior alveolar nerve: coronectomy of lower third molars. Review. Orv Hetil. 2017 Nov;158(45):1787-1793. doi: 10.1556/650.2017.30913.

Ali AS[1], Benton JA[1], Yates JM[1]. Risk of inferior alveolar nerve injury with coronectomy vs surgical extraction of mandibular third molars-A comparison of two techniques and review of the literature. J Oral Rehabil. 2018 Mar;45(3):250-257. doi: 10.1111/joor.12589. Epub 2017 Dec 11.

There is a case NHS Legal Authority admitted t

patient with high risk M3M a coronectomy if ass


Martin et al. Head & Face Medicine (2015) 11:9
DOI 10.1186/s13005-015-0068-7

HEAD & FACE MEDICINE

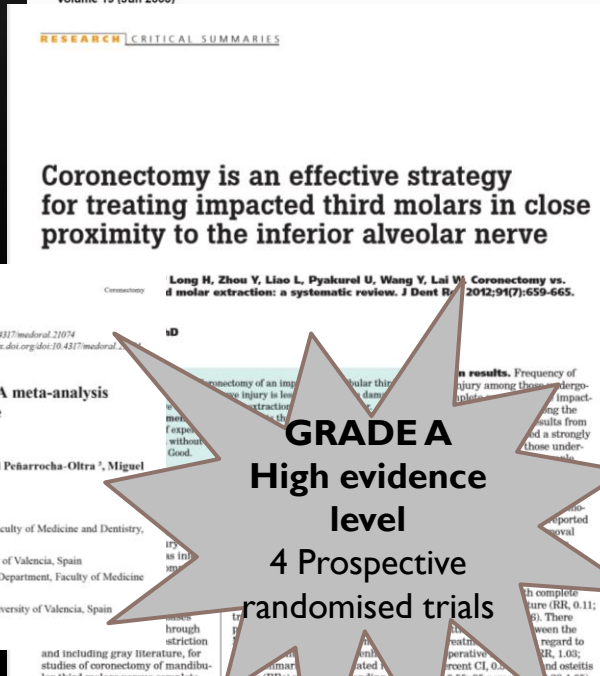
REVIEW Open Access

Coronectomy as a surgical approach to impacted mandibular third molars: a systematic review

Andrea Martin, Giuseppe Perinetti, Fulvia Costantinides* and Michele Maglione


Can Coronectomy of Wisdom Teeth Reduce the Incidence of Inferior Dental Nerve Injury?

Annals of the Royal Australasian College of Dental Surgeons
Volume 19 (Jun 2008)


RESEARCH CRITICAL SUMMARIES

Coronectomy is an effective strategy for treating impacted third molars in close proximity to the inferior alveolar nerve


Med Oral Patol Oral Cir Bucal. 2016 Jul 1;21 (4):e505-13. Coronectomy

Journal section: Oral Surgery
Publication Types: Review

doi:10.4317/medoral.21074
http://dx.doi.org/doi:10.4317/medoral.

Coronectomy of impacted mandibular third molars: A meta-analysis and systematic review of the literature

Juan Cervera-Espert* [1], Sara Pérez-Martínez* [2], Juan Cervera-Ballester [3], David Peñarrocha-Oltra [3], Miguel Peñarrocha-Diago [4]

[1] Resident of the Master in Oral Surgery and Implant Dentistry, Stomatology Department, Faculty of Medicine and Dentistry, University of Valencia, Spain
[2] Master in Oral Surgery and Implant Dentistry, Faculty of Medicine and Dentistry, University of Valencia, Spain
[3] Collaborating Professor of the Master in Oral Surgery and Implant Dentistry, Stomatology Department, Faculty of Medicine and Dentistry, University of Valencia, Spain
[4] Chairman of Oral Surgery, Stomatology Department, Faculty of Medicine and Dentistry, University of Valencia, Spain

Long H, Zhou Y, Liao L, Pyakurel U, Wang Y, Lai W. Coronectomy vs. d molar extraction: a systematic review. J Dent R 2012;91(7):659-665.

GRADE A
High evidence level
4 Prospective randomised trials

Should we undertake a coronectomy based upon plain films ONLY and not progress to CBCT?

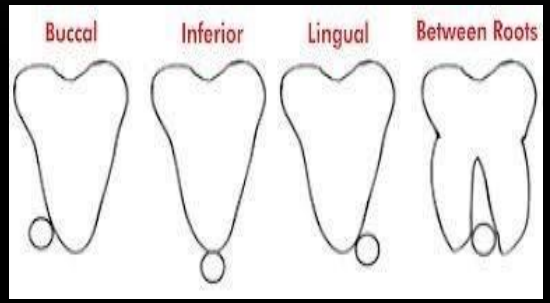
No

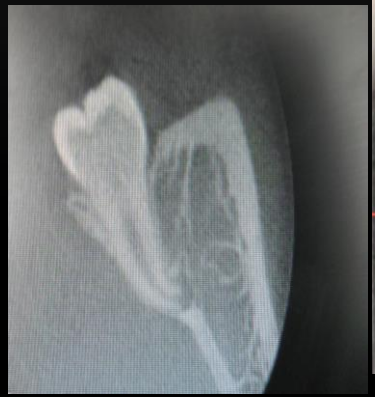
because 96-98% of patients can have removal of their M3Ms with CBCT risk assessment (if you proceed with coronectomy for all cases 96-98% of patients get the wrong surgery and are exposed to additional complications)

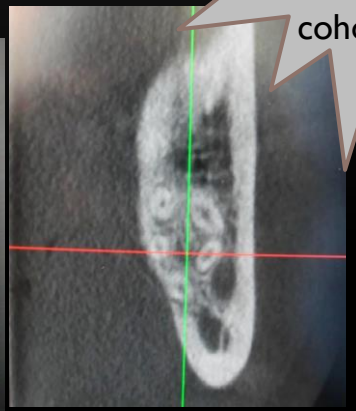
Only 2% of patients with high risk M3Ms need coronectomy

Does CBCT provide necessary additional information to enhance decision for Coronectomy and protection of the IAN?

- What about radiation exposure?
- Reduction of exposure
  - high speed
  - half rotation
  - Reduced field of view







Low -Mod evidence level
4 Prospective cohort trials

Technique

- Consent
- Stages of technique
  - LA
  - Flap
  - Bone removal
  - Tooth section
  - Lavage
  - Closure
- Follow up

Consent (Shared decision making)

- ComplicationsPatient needs to understand potential complications including;
  - Mobilisation of roots intraoperatively
    - Remove roots
  - Early post operative infection >2 episodes of ‘dry socket’
    - Treat as dry socket
    - ABs if spreading infection likley paraesthesia and neuropathy Remove roots
  - Late eruption <3% 3 years (Leung et al 2013; < 25 @ 5 years (Renton et al 2011)

Access consent sheet from Trigeminalnerve.org.uk

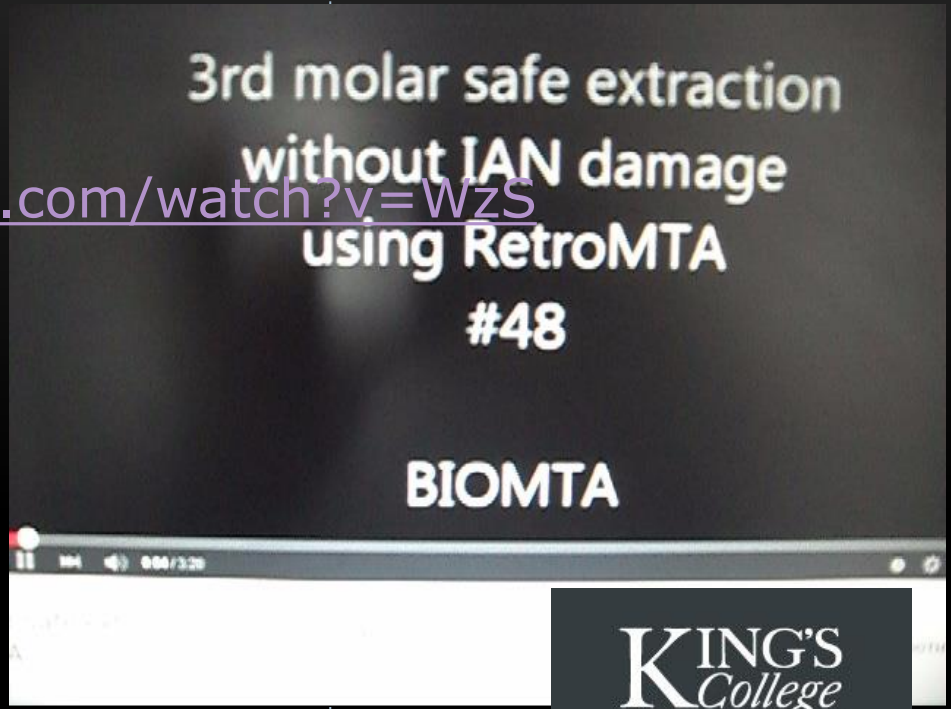
- Consent for coronectomy is complicated and difficult for the patient to understand
  - *Link to leaflet*

▶ Effect of explaining radiographic information to the patient before third molar surgery. J Christensen, Louise Hauge Matzen, A Wenzel Dentomaxillofacial Radiology (Impact Factor: 1.27). 03/2010; 39(3):176-8. DOI: 10.1259/bjr/31553484

Technique
How NOT to undertake coronectomy?

Videos of how to and how NOT to undertake coronectomy

- https://www.youtube.com/watch?v=WzSbL5KJfrM



Surgical emphysema and pneumomediastinum after coronectomy

C. Wong, J. Collin, C. Hughes, S. Thomas

Rooftop Offices, Bristol Dental Hospital, Lower Maudlin Street, Bristol BS2 1LY, United Kingdom

Accepted: May 10, 2015; Published Online: June 03, 2015

DOI: http://dx.doi.org/10.1016/j.bjoms.2015.05.008

Abstract

We report a case of surgical emphysema and pneumomediastinum after coronectomy of the lower right third molar. Surgical emphysema related to dental extractions is well- reported, but not after coronectomy. This case emphasises the importance of avoiding the use of air turbine drills during oral surgery

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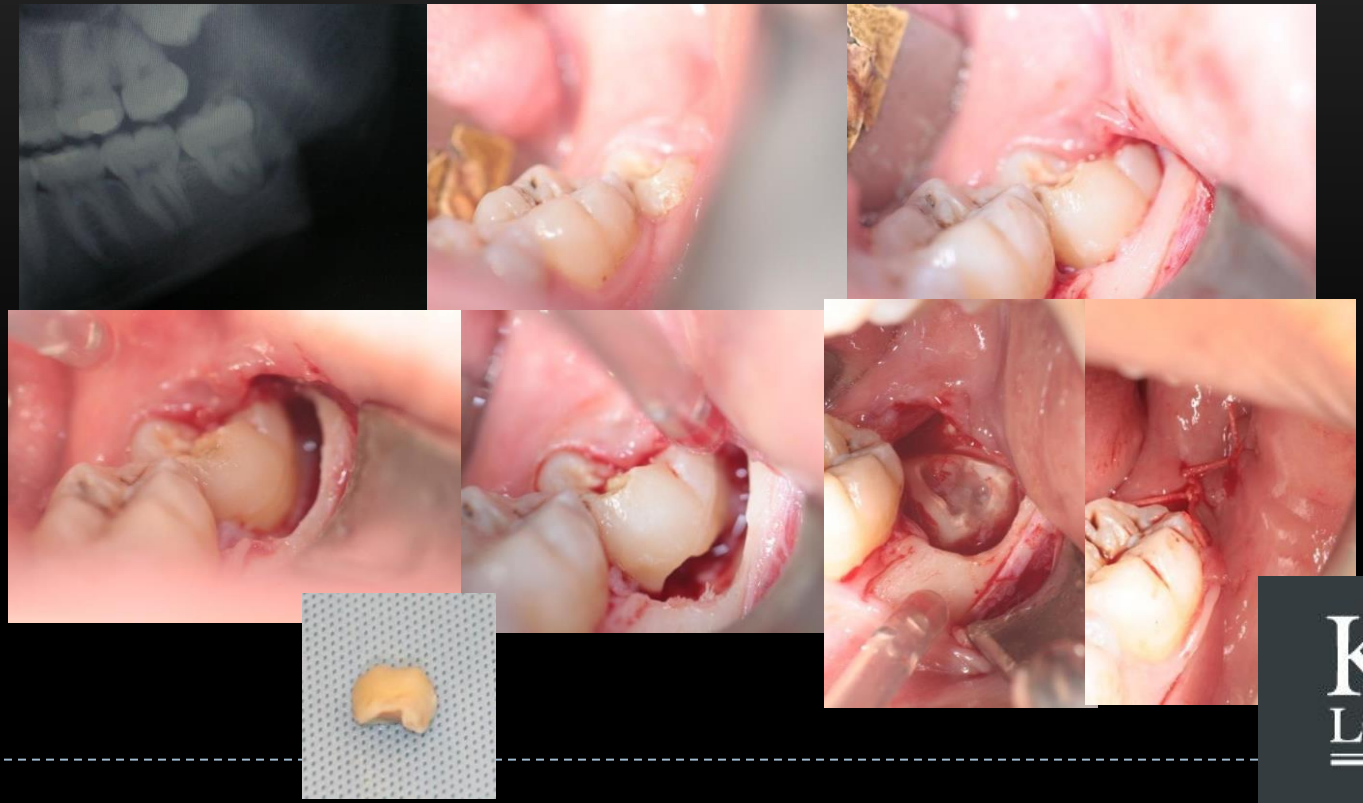
Less than 2% of high risk M3Ms need a coronectomy



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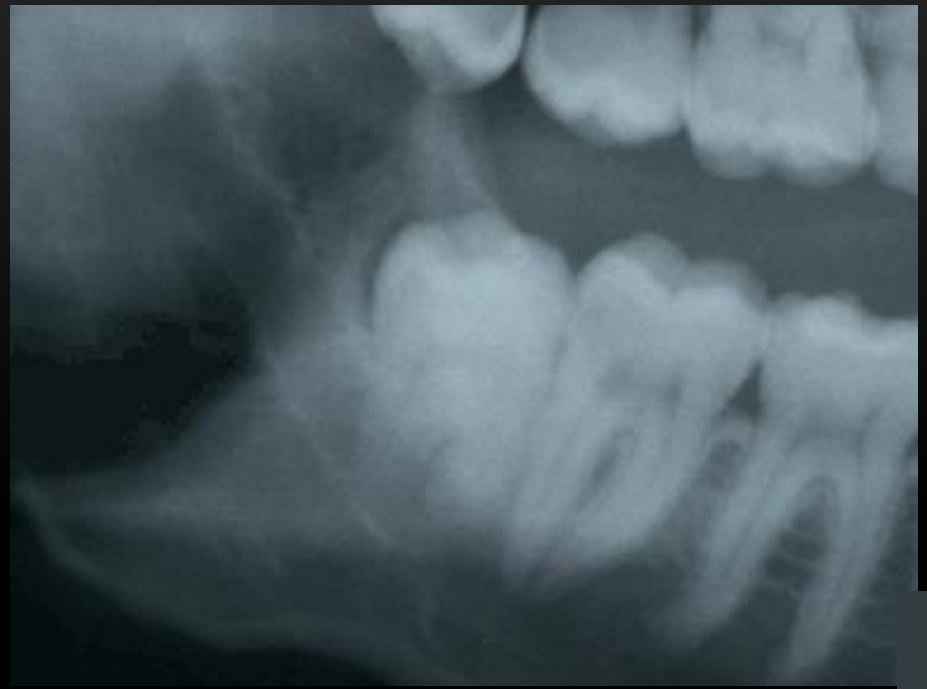
Coronectomy Surgical technique



Notes on coronectomy. **Renton T.** Br Dent J. 2012 Apr 13;212(7):323-6

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Follow up

- **Home check essential**
  - Quality outcome assessment
  - Surgical audit
  - Patient satisfaction improved
  - Proactivity in picking up complications less complaints and claims

  - **NO radiographic follow up required**

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Adjunctive needs?

- Antibiotic cover?
- Bone Graft?
- Pulp treatment?
- Closure?
- Repeat coronectomy with enamel retention?

Hindawi Publishing Corporation
Case Reports in Dentistry
Volume 2013, Article ID 914173, 7 pages
http://dx.doi.org/10.1155/2013/914173

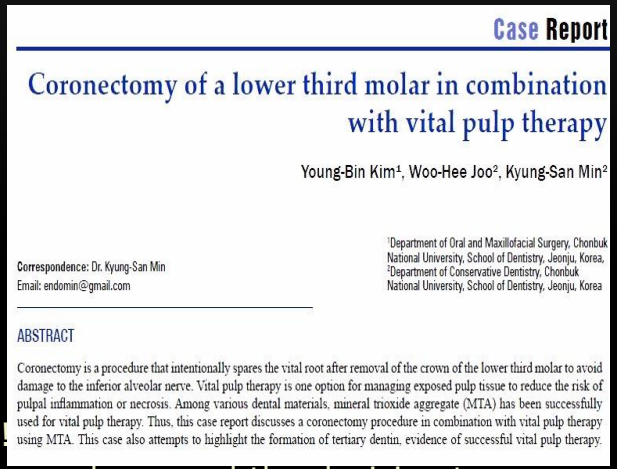
Hindawi

Case Report

Modified and Grafted Coronectomy: A New Technique and a Case Report with Two-Year Followup

Michael Leizerovitz and Olga Leizerovitz

UCLA School of Dentistry, 10833 Le Conte Avenue, Los Angeles, CA 90095-1668, USA



Case Report

Coronectomy of a lower third molar in combination with vital pulp therapy

Young-Bin Kim[1], Woo-Hee Joo[2], Kyung-San Min[2]

[1]Department of Oral and Maxillofacial Surgery, Chonbuk National University, School of Dentistry, Jeonju, Korea,
[2]Department of Conservative Dentistry, Chonbuk National University, School of Dentistry, Jeonju, Korea

Correspondence: Dr. Kyung-San Min
Email: endomin@gmail.com

ABSTRACT

Coronectomy is a procedure that intentionally spares the vital root after removal of the crown of the lower third molar to avoid damage to the inferior alveolar nerve. Vital pulp therapy is one option for managing exposed pulp tissue to reduce the risk of pulpal inflammation or necrosis. Among various dental materials, mineral trioxide aggregate (MTA) has been successfully used for vital pulp therapy. Thus, this case report discusses a coronectomy procedure in combination with vital pulp therapy using MTA. This case also attempts to highlight the formation of tertiary dentin, evidence of successful vital pulp therapy.

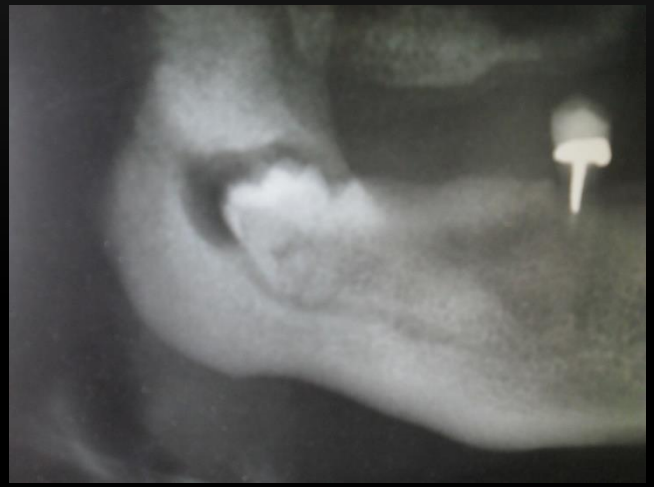
Early repeat coronectomy for 10 of 185 cases successful
Should NOT be necessary if technique is correct in first instance!!!

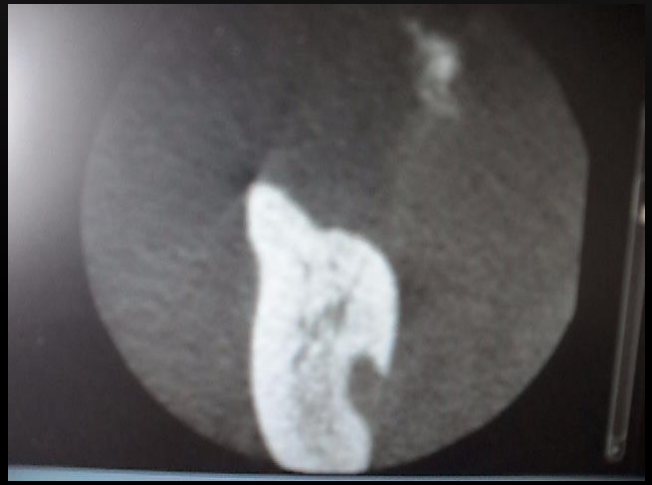
Coronectomy of the mandibular third molar: a retrospective study of 185 procedures and the decision to repeat the coronectomy in cases of failure. J Oral Maxillofac Surg 2015 Apr 22;73(4):587-94. Epub 2014 Oct 22. Boaz Frenkel, Navot Givol Yitzhak Shoshani

Coronectomy does prevent nerve injury in selected cases

However Unfortunate case:

Booked for coronectomy but had M3M removal
Now patient has a permanent painful IANI





Success of coronectomy

- ONLY do coronectomy on appropriate cases
- Thorough consent
- Minimal access **no lingual retraction or distal bone removal**
- Accessible review
- Always remove all of enamel
- No pulpal treatments necessary
- The success of coronectomy depends on the survival of the retained root fragments with the successful formation of osteocementum and bone over the root

Vol. 121 No. 1 January 2016

Long-term morbidities of coronectomy on lower third molar

Yiu Yan Leung, BDS, MDS, PhD,[a] and Lim Kwong Cheung, BDS, PhD[b]

Objective. To monitor the long-term morbidity of retained roots up to 5 years following lower third molars coronectomy with close proximity to the inferior alveolar nerve (IAN).
Study Design. A prospective study on long-term morbidities after lower third molar coronectomy.
Results. This study included 612 lower third molar coronectomies in 458 patients. The prevalence of IAN injury was 0.16% (1/612) and was temporary. Long-term postoperative infection occurred in 1 case at 6 months following surgery and another at 12 months. No infection was found after 12 months. The incidence rates of pain at 6 months, 12 months, 24 months after surgery were 0.50% (3/596), 0.38% (2/529), 0.49% (2/411), respectively. Root exposure was noted in 2.3% of cases (14/612). Reoperation to remove the exposed root did not cause any IAN deficit.
Conclusions. Lower third molar coronectomy is safe in the long term. (Oral Surg Oral Med Oral Pathol Oral Radiol 2016;121:5-11)

Lower third molar impaction is a common finding in the population, and pericoronitis and dental caries are commonly associated with impacted third molars. Lower third molar surgery is therefore the most common surgical procedure performed in the oral cavity. A rare but significant risk from lower third molar surgery is injury to the inferior alveolar nerve (IAN), leading to paresthesia or even anesthesia of the lower lip and chin region on the affected side. The incidence of IAN deficit ranges from 0.3% to 8.4%, and a significant proportion could be permanent.[1] Injury to the IAN has been found by an evidence-based review to be associated with increased age, deep impaction, and proximity of the root to the inferior dental canal associated with specific radiographic signs and intraoperative IAN exposure.[2] Since the risks are mostly inherent to third molar impaction, this may not be totally avoidable even in the hands of experienced surgeons.[2]

Coronectomy of the lower third molar is a new surgical option to manage symptomatic lower third molar impaction. It is a surgical procedure that intentionally removes only the crown of an impacted mandibular third molar, leaving the root undisturbed, thus avoiding possible direct or indirect damage to the IAN.[3] Our center has published the finding of a phase 3 randomized controlled trial (RCT) comparing coronectomy and total removal of the mandibular third molar in close proximity to IAN and confirmed that coronectomy was superior to traditional third molar surgery, with a much smaller risk of postoperative IAN deficit.[4] However, reports of well-designed, prospective, phase 4 long-term studies of coronectomy are lacking in the literature. The long-term safety of coronectomy and the behavior of the retained roots following of lower impacted wisdom teeth following surgery are unknown. We published the pilot data of 135 coronectomies and showed that the technique is safe within the first 3 years.[5] This study serves to present the complete longitudinal data of a large sample of coronectomized teeth up to 5 postoperative years.

The aim of this study was to monitor the long-term morbidities of retained roots following coronectomy of impacted lower third molars up to 5 postoperative years.

MATERIALS AND METHODS

This was a prospective study on the long-term safety of coronectomy and the behavior of the retained roots of the impacted lower third molars following surgery. The study followed the guideline of the Helsinki Declaration. Ethic approval was granted by the local institutional review board (HKU/HA HKW IRB UW 10-001). This study provides further evidence from a phase 3 RCT on the long-term safety of coronectomy with

Statement of Clinical Relevance

This study is, by far, the largest prospective long-term study on coronectomy of lower third molar with high inferior alveolar nerve risk and showed that the technique carried very low morbidity in 5 years.

The study was presented as oral presentation in the 11th Asian Congress in Oral and Maxillofacial Surgery, 2014, in Xi'an, China. This study was based on a thesis submitted to the University of Hong Kong, in partial fulfillment of the requirements for the PhD degree. A preliminary report was published in the *Journal of Oral and Maxillofacial Surgery* (Leung YY, Cheung LK. Coronectomy of lower third molar is safe within the first 3 years. *J Oral Maxillofac Surg.* 2012;70:1515-1522).

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http://dx.doi.org/10.1016/j.oooo.2015.07.012

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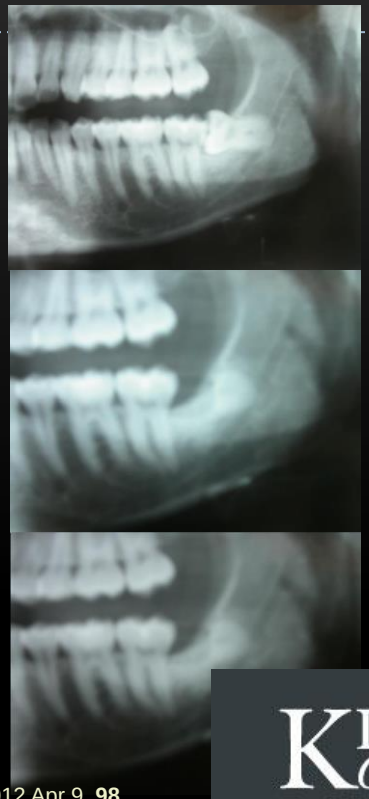
Coronectomy complications

Recent case complications

- Mobilisation of roots intraoperatively
  - Remove roots
- Early post operative infection >2 episodes of ‘dry socket’
  - Treat as dry socket
  - ABs if spreading infection likley paraesthesia and neuropathy
    Remove roots
- Late eruption <3% 3 years (Leung et al 2013; < 25 @ 5 years (Renton et al 2011)

Increased likelihood of eruption in younger patients



Leung YY, Cheung LK **Coronectomy of the Lower Third Molar Is Safe Within the First 3 Years** J Oral Maxillofac Surg. 2012 Apr 9. **98 pts 3 years 3% eruotion rate:**

Renton T, Thexton A, Hankins M, Sproate C, McGurk M. A prospective randomised study assessing coronectomy versus removal in third molar surgery. BJOMS 2005;43:7-12

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ScienceDirect
British Journal of Oral and Maxillofacial Surgery 55 (2017) 892–898
BRITISH Journal of Oral and Maxillofacial Surgery
www.bjoms.com

Systematic review

Injury to the inferior alveolar and lingual nerves in successful and failed coronectomies: systematic review

M. Dalle Carbonare [a,*], A. Zavattini [b], M. Duncan [a], M. Williams [a], A. Moody [a]

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Available online 20 October 2017

Abstract

The aim of this systematic review was to evaluate the incidence of damage to the inferior alveolar (IAN) and dental nerves in successful coronectomies, and to compare the results with coronectomies that failed. To the best of our knowledge no such analyses have been reported. Between January 1990 and October 2016 we surveyed published papers to find those that examined clinical outcomes after coronectomy. Fourteen met the criteria for final inclusion. Of 2087 coronectomies, 152 failed (7%). Successful procedures were associated with a low overall incidence of injury to the IAN (0.5%) and lingual nerve (0.05%). The incidence of injury to the IAN in failed coronectomies was 2.6%. The incidence of permanent paraesthesia was 0.05% in successful coronectomies and 1.3% in those that failed. No permanent injury to the lingual nerve was reported. Mobility (36%, 55/152) and migration or exposure (33%, 50/152) of roots were the most common underlying causes of failure. Coronectomy seems to be safe, but it depends on the patient and the technique used. To ensure adequate assessment of postoperative

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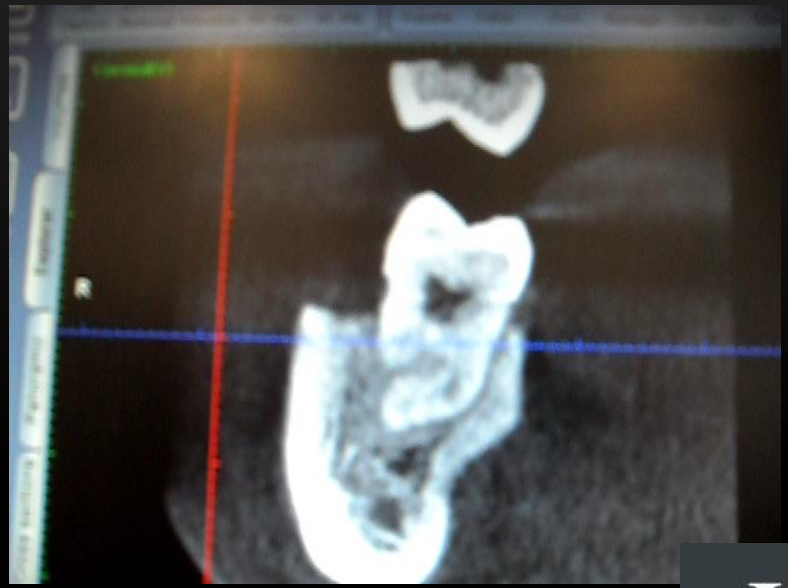
ing damage to the IAN.[3] Pogrel et al[3] and Gleeson et al[6] described two approaches that aimed to section the crown either completely or partially.

http://dx.doi.org/10.1016/j.bjoms.2017.09.006

Lingual nerve injury risk related to coronectomy

- Attempted coronectomy
- Low risk M3M no need for a coronectomy!!!!
- Cbct provided additional confirmation of retained enamel and lingual plate perforation by drill
- Allowing for earlier exploration



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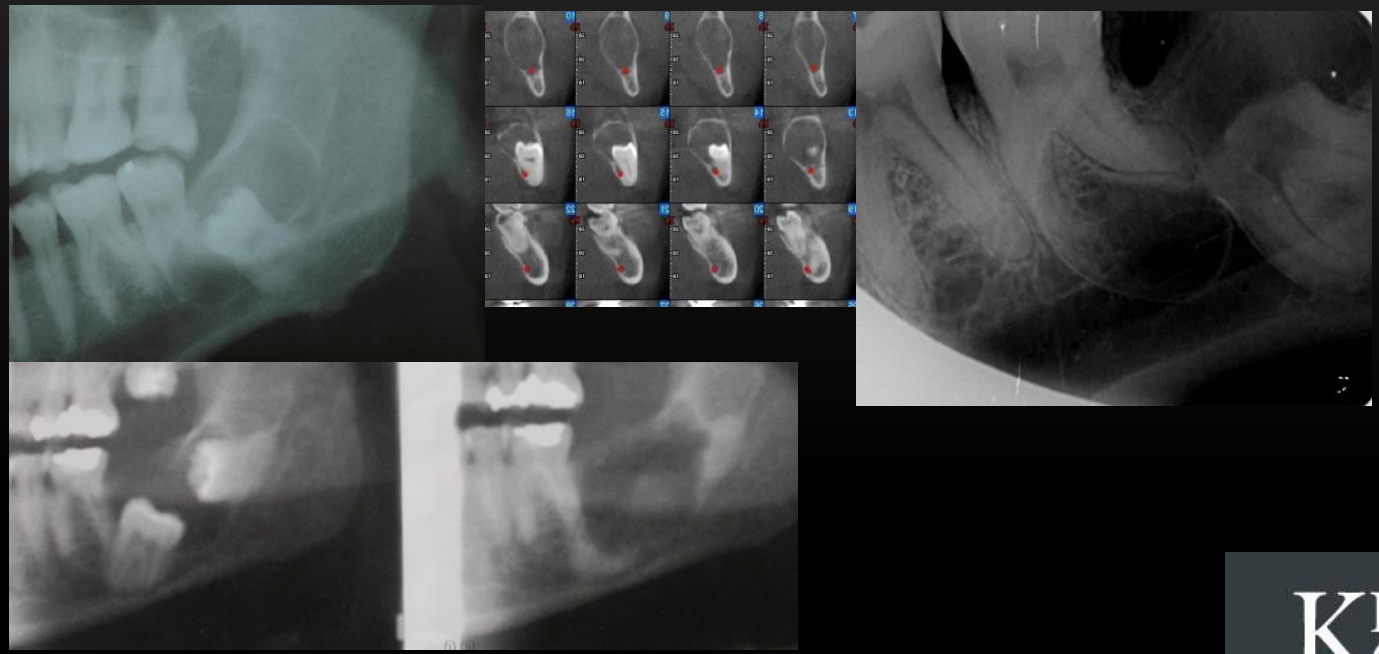
Coronectomy other applications – benign cysts



Patel V, **Sproat** C, Samani M, **Kwok** J, McGurk M. Unerupted teeth associated with dentigerous cysts and treated with coronectomy: mini case series. Br J Oral Maxillofac Surg. 2013 Oct;51(7):644-9

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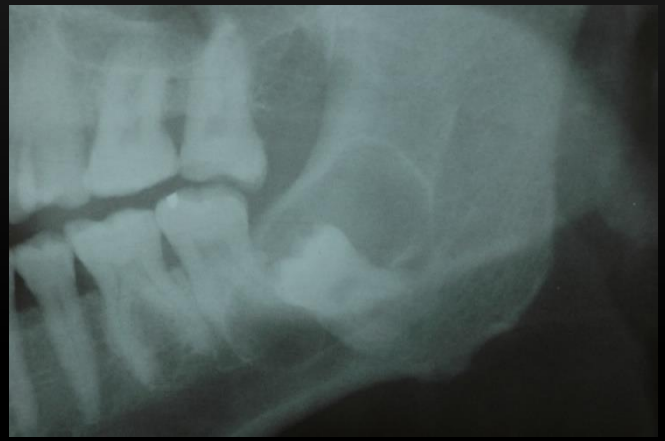
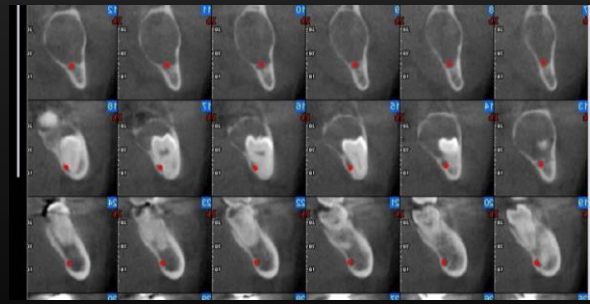
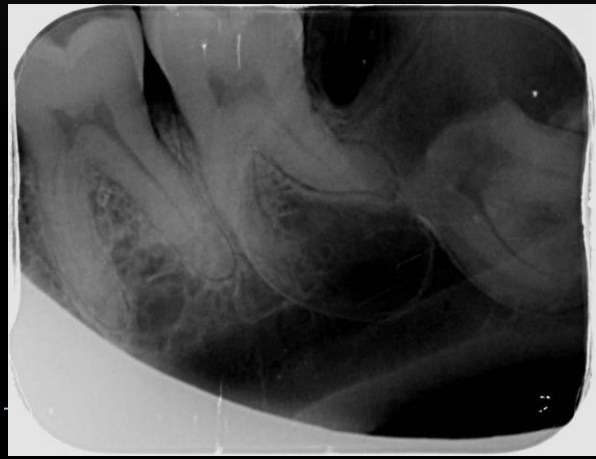
Tailor your surgery minimise harm!

Coronectomy

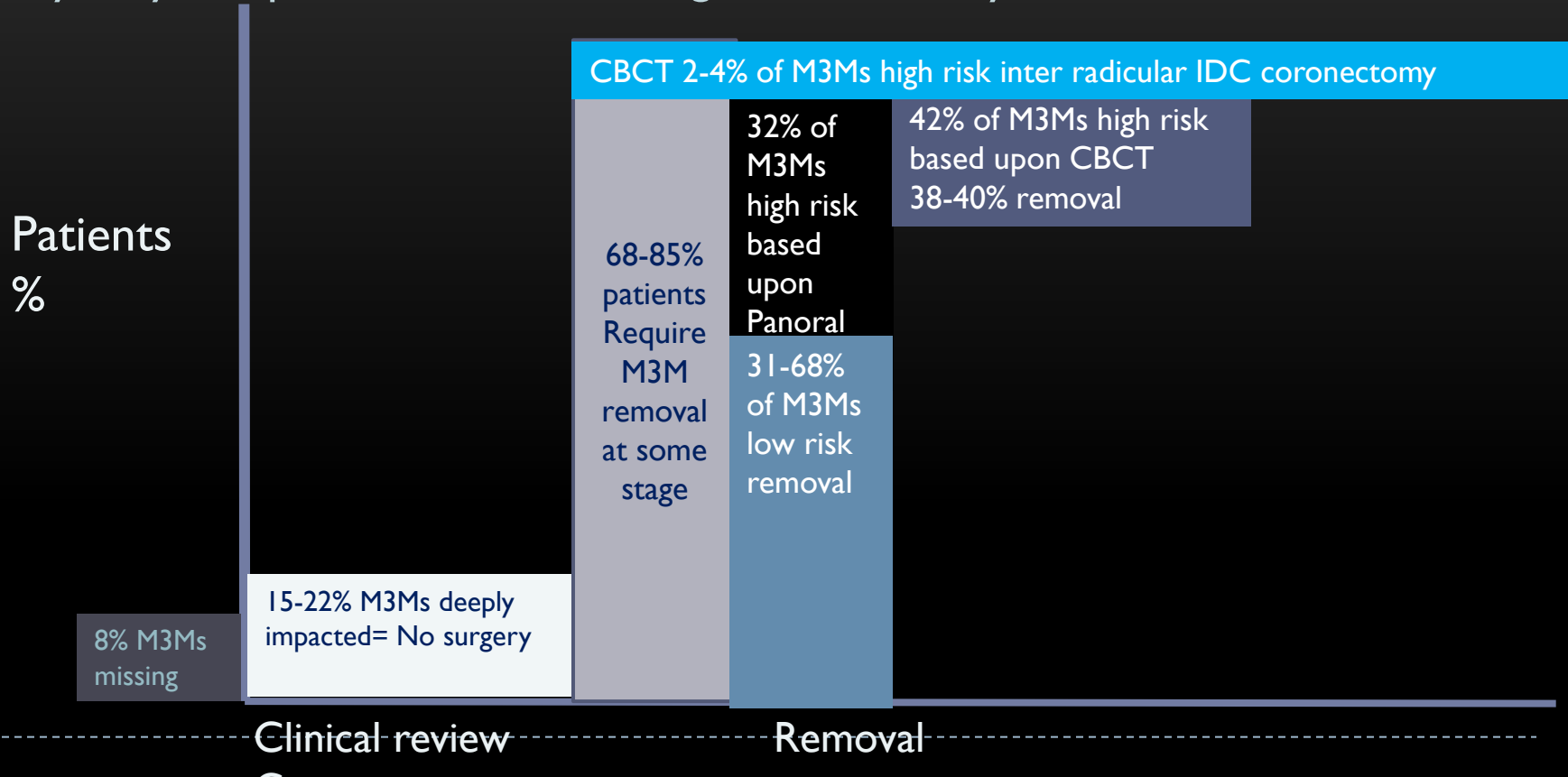




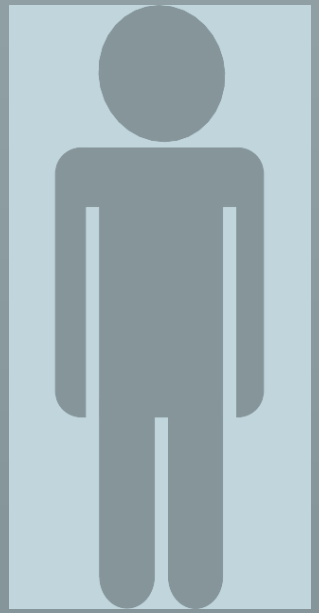


Should this be the fate of M3Ms?

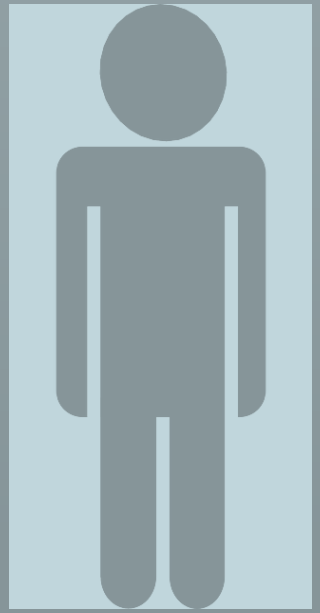
Only very few patients should undergo coronectomy



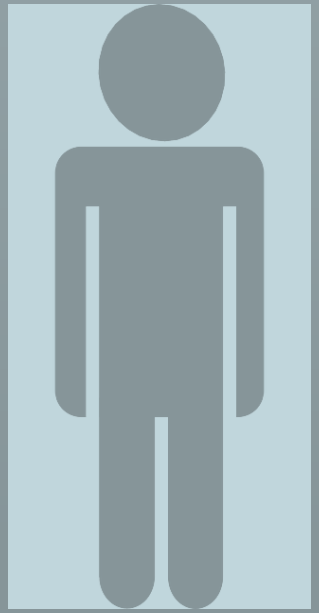
Overview



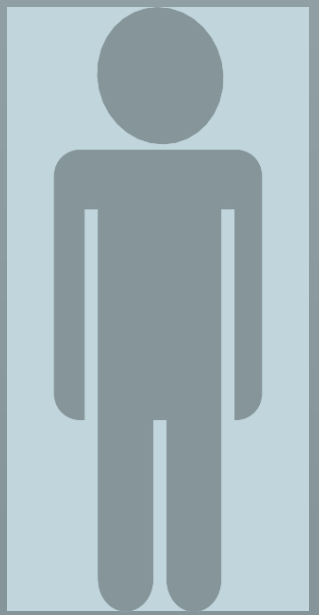
What is Neuropathic pain?



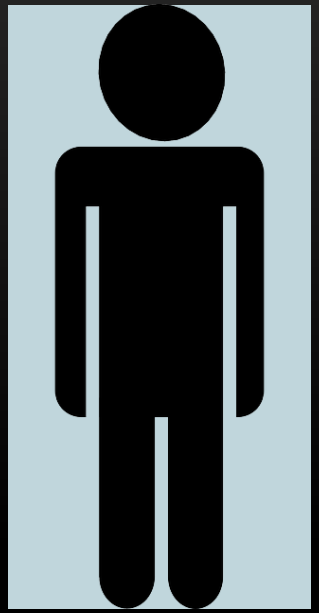
Who gets PTNP?



Why prevent PTNP?



How to prevent these injuries?



How to manage these injuries?

Diagnostic Criteria
Confirm post traumatic neuropathy

Table 3. Core Diagnostic Criteria for Persistent Posttraumatic Neuropathic Pain

1. History of traumatic nerve injury or surgery associated with known risk of nerve injury.* Traumatic event = onset
2. Pain lasting ≥3 mo, with onset showing a temporal relation to known nerve injury (onset within days to weeks after the injury).†
3. Positive and/or negative signs of sensory disturbance in the innervation of the injured nerve as evidenced by ≥1 of the following:
   a. Mixed areas of hypo- and hypersensitivity to various sensory modalities Neuropathic area
   b. Hyposensitivity to nonpainful warmth (with or without changes in cold sensation) Allodynia / Hyperalgesia = hyperaesthesia
   c. Hypersensitivity to brush or pinprick in or around the painful area
4. No other condition (eg, inflammation, tumor) better explains the pattern of the clinical features (eg, radiculopathy) that could plausibly account for persisting pain in the affected dermatome or dermatomes. Anaesthesia/paraesthesia = hypoaesthesia

*This pain may occur even if there was a deliberate attempt to spare the large nerves crossing the surgical area (eg, in breast surgery).
†There is a spontaneous decline in reporting of pain >12 mo after surgery/trauma. Relevant citations in support of these diagnostic criteria are Bruehl,[34] Duffy et al,[77] Guo et al,[107] Haldar et al,[109] Pappagallo et al,[187] Teerijoki-Oksa

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Focus Article

AAPT Diagnostic Criteria for Peripheral Neuropathic Pain: Focal and Segmental Disorders

Roy Freeman,* Robert Edwards,† Ralf Baron,‡ Stephen Bruehl,§ Giorgio Cruccu,¶ Robert H. Dworkin,‖ and Simon Haroutounian**
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†Department of Anesthesiology, Brigham & Women's Hospital, Harvard University School of Medicine, Boston, MA
‡University of Kiel, Division of Neurological Pain Research and Therapy, Department of Neurology, Kiel, Germany
§Department of Anesthesiology, Vanderbilt University Medical Center, Nashville, TN
¶Department Human Neuroscience, Sapienza University, Rome, Italy
‖Department of Anesthesiology and Perioperative Medicine, University of Rochester School of Medicine and Dentistry, Rochester, NY
**Department of Anesthesiology and Washington University Pain Center, Washington University School of Medicine, St Louis, MO

Abstract: Peripheral neuropathic pain is among the most prevalent types of neuropathic pain.

Published in final edited form as:
Pain. 2019 January ; 160(1): 53–59. doi:10.1097/j.pain.0000000000001365.

The IASP classification of chronic pain for ICD-11: chronic neuropathic pain

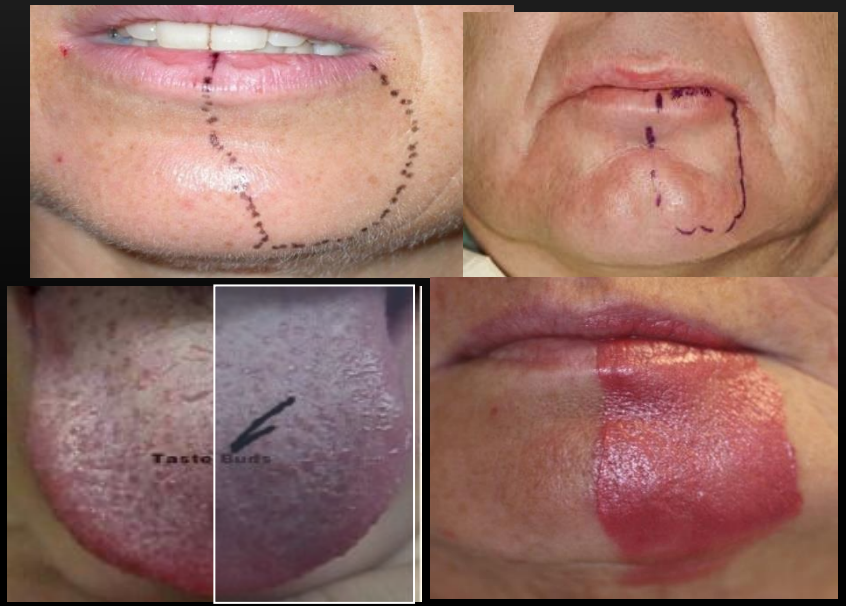
Joachim Scholz[a], Nanna B. Finnerup[b,c], Nadine Attal[d], Qasim Aziz[e], Ralf Baron[f], Michael I. Bennett[g], Rafael Benoliel[h], Milton Cohen[i], Giorgio Cruccu[j], Karen D. Davis[k], Stefan Evers[l], Michael First[m], Maria Adele Giamberardino[n], Per Hansson[o], Stein Kaasa[p], Beatrice Korwisi[q], Eva Kosek[r], Patricia Lavand'homme[s], Michael Nicholas[t], Turo Nurmikko[u], Serge Perrot[v], Srinivasa N. Raja[w], Andrew S. C. Rice[x], Michael C. Rowbotham[y], Stephan Schug[z], David M. Simpson[aa], Blair H. Smith[ab], Peter Svensson[ac], Johan W.S. Vlaeyen[ad], Shuu-Jiun Wang[ae], Antonia Barke[q], Winfried Rief[q], Rolf-Detlef Treede[af], Classification Committee of the Neuropathic Pain Special Interest Group (NeuPSIG), and Task Force for the Classification of Chronic Pain of the International Association for the Study of Pain (IASP)

Management of Implant nerve injury

Confirm Nerve injury

Temporary or permanent?

- **Mechanism**
- **Duration**
- Identify the extent of injury
  - Size neuropathic area
  - Subjective function
  - Mechanosensory function
  - Disability
  - Pain / discomfort
    - Allodynia
    - Hyperalgesia
    - Spontaneous or elicited?



Patient's story and expectations?

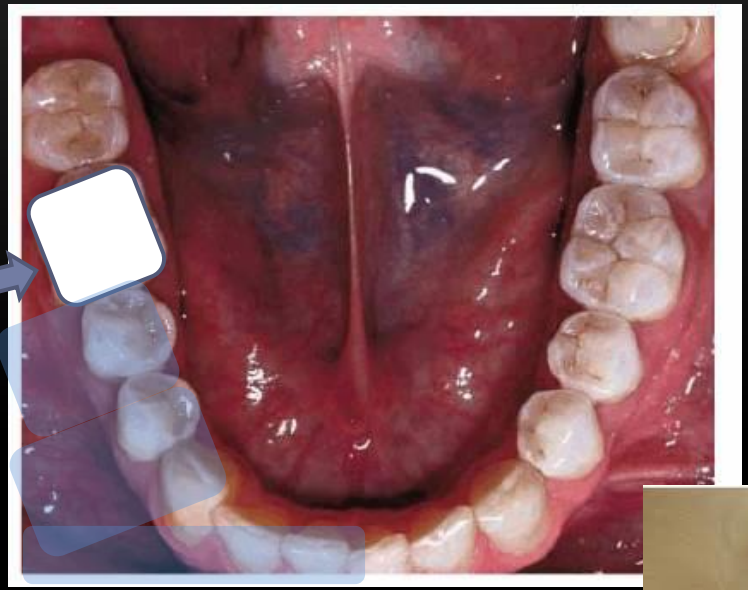
Renton T, Thexton A, SJ Crean, Hankins M. Simplifying assessment of recovery of the lingual nerve from injury. BDJ 2006 10:569-573 **Renton T**, Thexton A, Mcgurk M. New method for the objective evaluation of injury to the lingual nerve after operation on third molars.Br J Oral Maxillofac

Assessment of neuropathic area
Know your anatomy!

Implant extraction or endodontic procedure undertaken with resultant numbness of mouth& lip with pain

Neuropathic area should affect 'DISTAL' domain of dermatome

In some cases only socket area can be affected with localised hypersensitivity



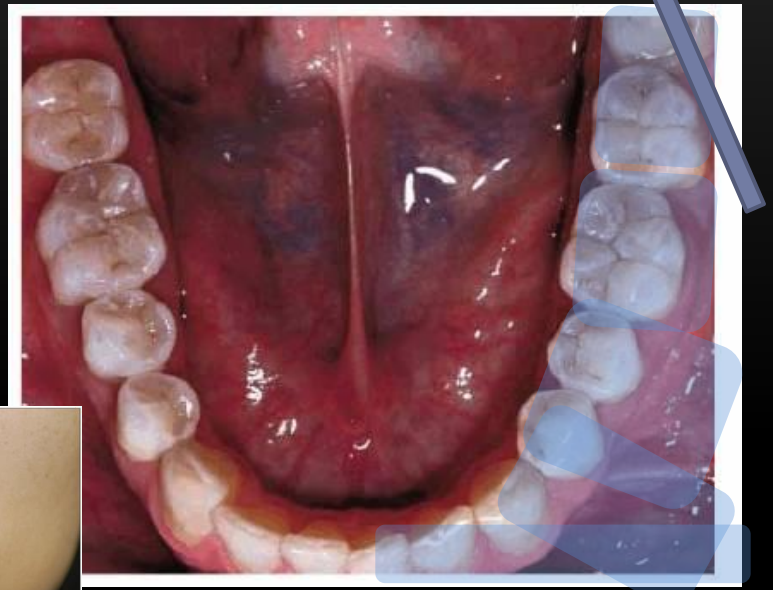
Neuropathic area you can use dental vitality tests but not very reliable

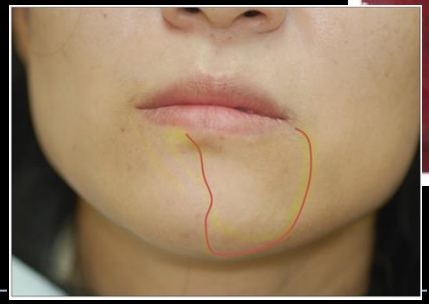
Extraoral area may be complete **or partial Below illustrates 40% affected**

Assessment of neuropathic area
Know your anatomy!

Neuropathic area you can use dental vitality tests but not very reliable

Extraoral neuropathy affecting 9 of area0%





Inferior dental block undertaken with resultant numbness of mouth&lip with pain

Neuropathic area should affect ‘DISTAL’ domain of dermatome

Management of PTPN
Cause and duration

URGENT treatment < 30 hours

- Any known or Suspected nerve trauma
- Implants
- Endodontics (neuropathy may develop 2-3 days post treatment)

- **Within 2 weeks**
- Buccal approach causing Lingual nerve
- Inferior alveolar nerve injuries related to third molar surgery

- **> 2 weeks**
- Not ideal

Consent patient properly…forearmed is for warned
Risk assessment in planning
Check on patients post operatively HOMECHECK
Acknowledge problem
No sit and WAIT !!!!!
You MUST reassure your patient but don't give them false expectations!
Seek advice- Trigeminalnerve.org.uk- Medication and REFERRAL

Wait for resolution

- Lingual nerve injuries related to LINGUAL ACCESS third molar surgery (consider explore @ 12 weeks)
- LA
- Trauma
- Orthognathic

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Management of PTN
Cause and duration

- Confirm neuropathy and PTN diagnosis
  - Reassure the patient- say sorry
  - If patient in pain
    - Consider Nortriptyline / Pregabalin
  - Early medication
    - NSAIDs
    - Step down steroids –GMP
    - Vitamin B complex
- Monitor
- Refer lingual access M3M cases if NO resolution before 12 weeks
- Seek advice- Trigeminalnerve.org.uk

Wait for resolution

- Lingual nerve injuries related to LINGUAL ACCESS third molar surgery (consider explore @ 12 weeks)
- LA
- Trauma
- Orthognathic

- OR Implant Endo injuries > 30 hours old
- OR M3M nerve injuries > 6 months old
- OR patients with hypothesia and minimal problem with injury

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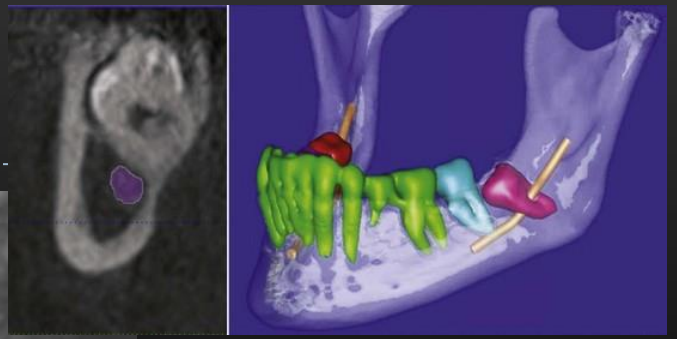
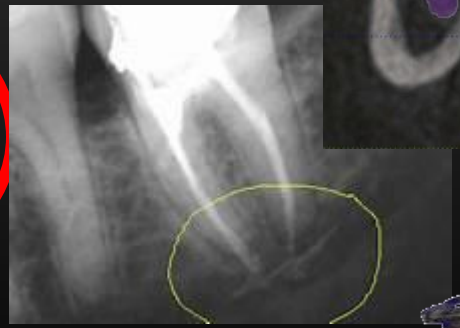
Management of PTN

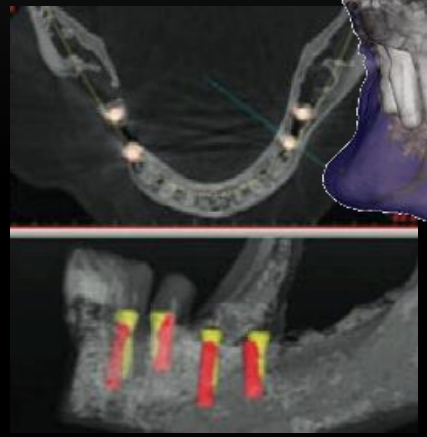
Cause and duration

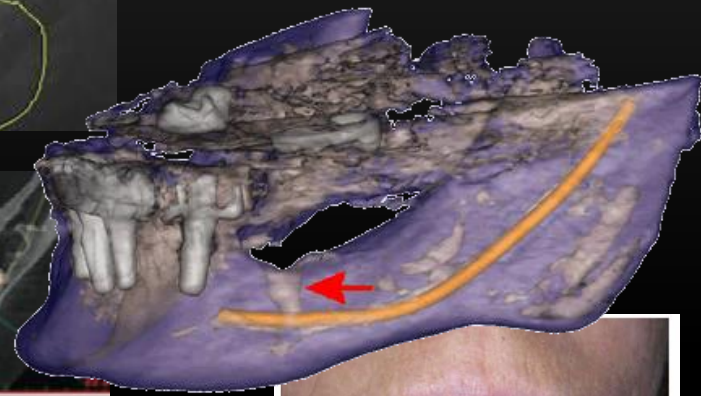
URGENT treatment < 30 hours

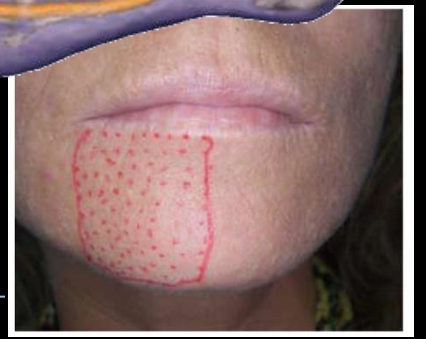
- Any known or Suspected nerve trauma
- Implants
- Endodontics (neuropathy may develop 2-3 days post treatment)











< 30 hours

Confirm neuropathy and PTN

Remove implant or endo

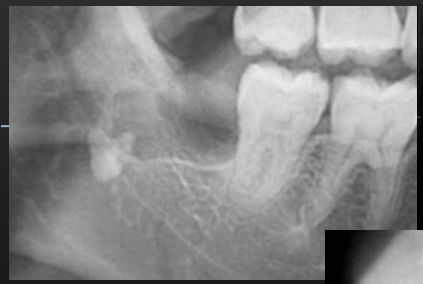
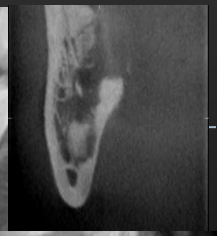
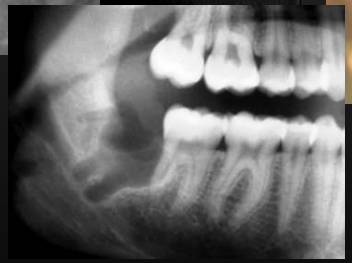
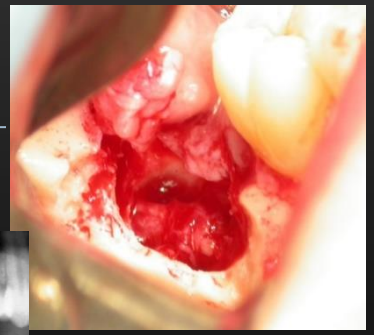
Early post op med

- Early medication
  - NSAIDs
  - Step down steroids –GMP
  - Vitamin B complex

Seek advice- Trigeminalnerve.org.uk

Management of PTPN
Cause and duration

- **Within 2 weeks**
- Buccal approach causing Lingual nerve
- Inferior alveolar nerve injuries related to third molar surgery

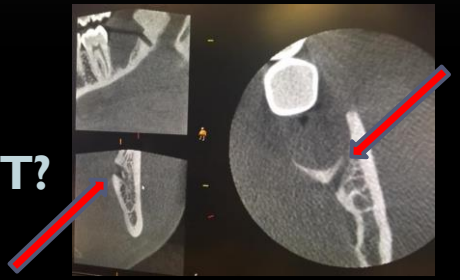





IANI or LNI
< 2 weeks ideal
Roots present DPT get CBCT
Operate to remove roots and repair nerve as necessary

< 2 weeks ideal
Confirm neuropathy and PTN
If patient in pain consider nortriptyline or pregabalin (GMP)
Early post op med
- Early medication
  - NSAIDs
  - Step down steroids (GMP)
  - Vitamin B complex

Seek advice- Trigeminalnerve.org.uk

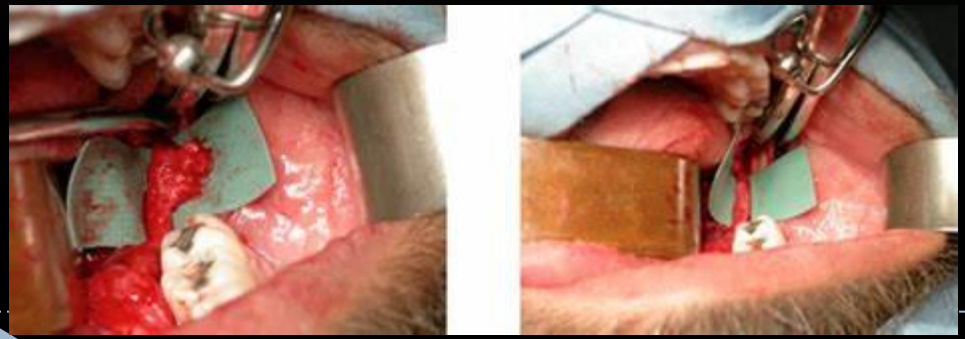
Roots NOT present
But lingual scoring on CBCT?
Yes operate explore
No
Follow up for max 12 weeks

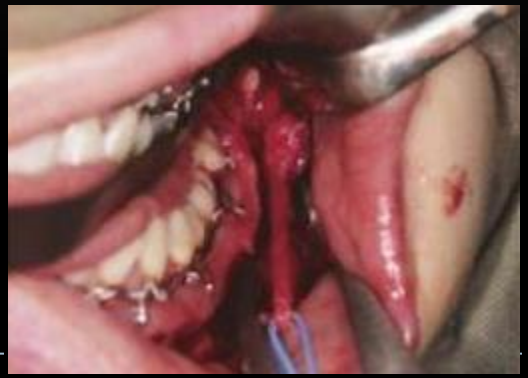


Management of PTPN
Cause and duration

Late surgery for IANI and LNI injuries

- Ideally before12 weeks
- Neuropathic pain does not respond to surgery
- Always a risk of causing neuropathic pain in a patient with hypoaesthesia!



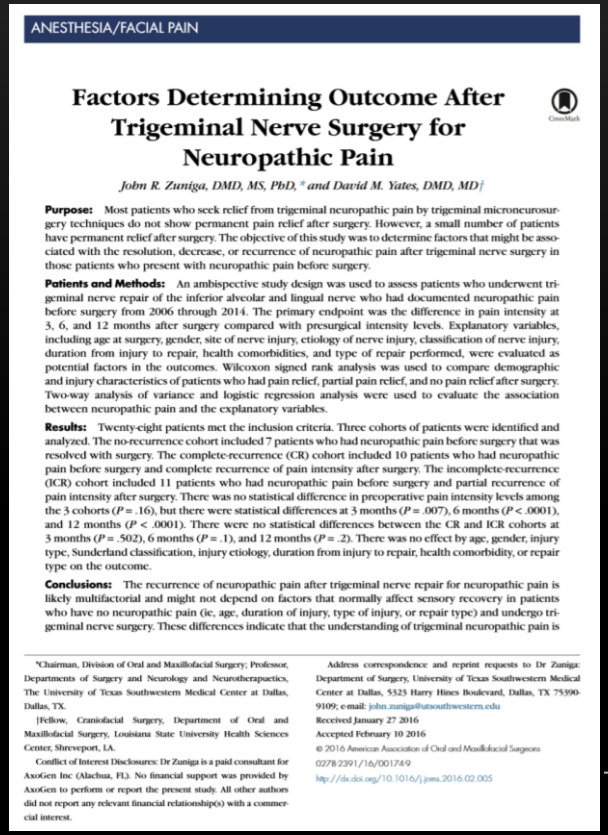


However neuropathic pain does not respond to surgery

Surgical impact on NP

~~**Lingual nerve repair** and recurrence of neuropathic pain~~

27 patients Various procedures



ANESTHESIA/FACIAL PAIN

Factors Determining Outcome After Trigeminal Nerve Surgery for Neuropathic Pain

John R. Zuniga, DMD, MS, PhD, and David M. Yates, DMD, MD†*

Purpose: Most patients who seek relief from trigeminal neuropathic pain by trigeminal microneurosurgery techniques do not show permanent pain relief after surgery. However, a small number of patients have permanent relief after surgery. The objective of this study was to determine factors that might be associated with the resolution, decrease, or recurrence of neuropathic pain after trigeminal nerve surgery in those patients who present with neuropathic pain before surgery.

Patients and Methods: An ambispective study design was used to assess patients who underwent trigeminal nerve repair of the inferior alveolar and lingual nerve who had documented neuropathic pain before surgery from 2006 through 2014. The primary endpoint was the difference in pain intensity at 3, 6, and 12 months after surgery compared with presurgical intensity levels. Explanatory variables, including age at surgery, gender, site of nerve injury, etiology of nerve injury, classification of nerve injury, duration from injury to repair, health comorbidities, and type of repair performed, were evaluated as potential factors in the outcomes. Wilcoxon signed rank analysis was used to compare demographic and injury characteristics of patients who had pain relief, partial pain relief, and no pain relief after surgery. Two-way analysis of variance and logistic regression analysis were used to evaluate the association between neuropathic pain and the explanatory variables.

Results: Twenty-eight patients met the inclusion criteria. Three cohorts of patients were identified and analyzed. The no-recurrence cohort included 7 patients who had neuropathic pain before surgery that was resolved with surgery. The complete-recurrence (CR) cohort included 10 patients who had neuropathic pain before surgery and complete recurrence of pain intensity after surgery. The incomplete-recurrence (ICR) cohort included 11 patients who had neuropathic pain before surgery and partial recurrence of pain intensity after surgery. There was no statistical difference in preoperative pain intensity levels among the 3 cohorts ($P = .16$), but there were statistical differences at 3 months ($P = .007$), 6 months ($P < .0001$), and 12 months ($P < .0001$). There were no statistical differences between the CR and ICR cohorts at 3 months ($P = .502$), 6 months ($P = .1$), and 12 months ($P = .2$). There was no effect by age, gender, injury type, Sunderland classification, injury etiology, duration from injury to repair, health comorbidity, or repair type on the outcome.

Conclusions: The recurrence of neuropathic pain after trigeminal nerve repair for neuropathic pain is likely multifactorial and might not depend on factors that normally affect sensory recovery in patients who have no neuropathic pain (ie, age, duration of injury, type of injury, or repair type) and undergo trigeminal nerve surgery. These differences indicate that the understanding of trigeminal neuropathic pain is

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Conflict of Interest Disclosures: Dr Zuniga is a paid consultant for AxoGen Inc (Alachua, FL). No financial support was provided by AxoGen to perform or report the present study. All other authors did not report any relevant financial relationship(s) with a commercial interest.

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If surgical reconstruction is used to treat allodynia, this often results in a decrease of complaints but symptoms almost never completely resolve.[10] Zuniga[26] reported only 3% of patients with neuropathic pain before surgery will completely recover following surgery. Occasionally, reconstruction can worsen complaints.[9,26]

9. Pogrel MA. The results of microneurosurgery of the inferior alveolar and lingual nerve. *J Oral Maxillofac Surg* 2002;60:485–489
10. Coulthard P, Kushnerev E, Yates JM, et al. Interventions for iatrogenic inferior alveolar and lingual nerve injury. *Cochrane Database Syst Rev* 2014:4:CD005293
26. Zuniga JR. Sensory outcomes after reconstruction of lingual and inferior alveolar nerve discontinuities using processed nerve allograft—a case series. *J Oral Maxillofac Surg* 2015;73:734–744

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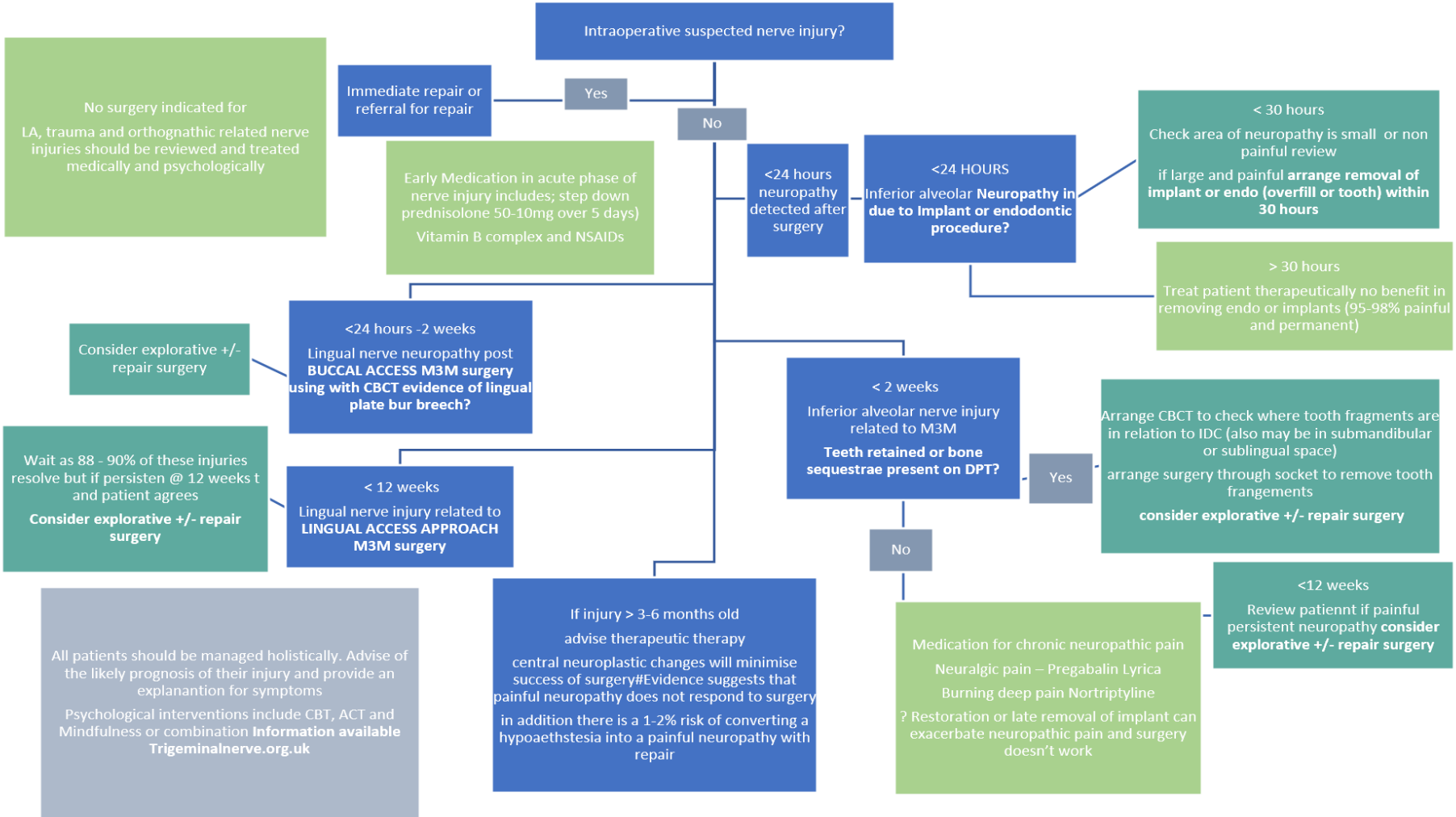
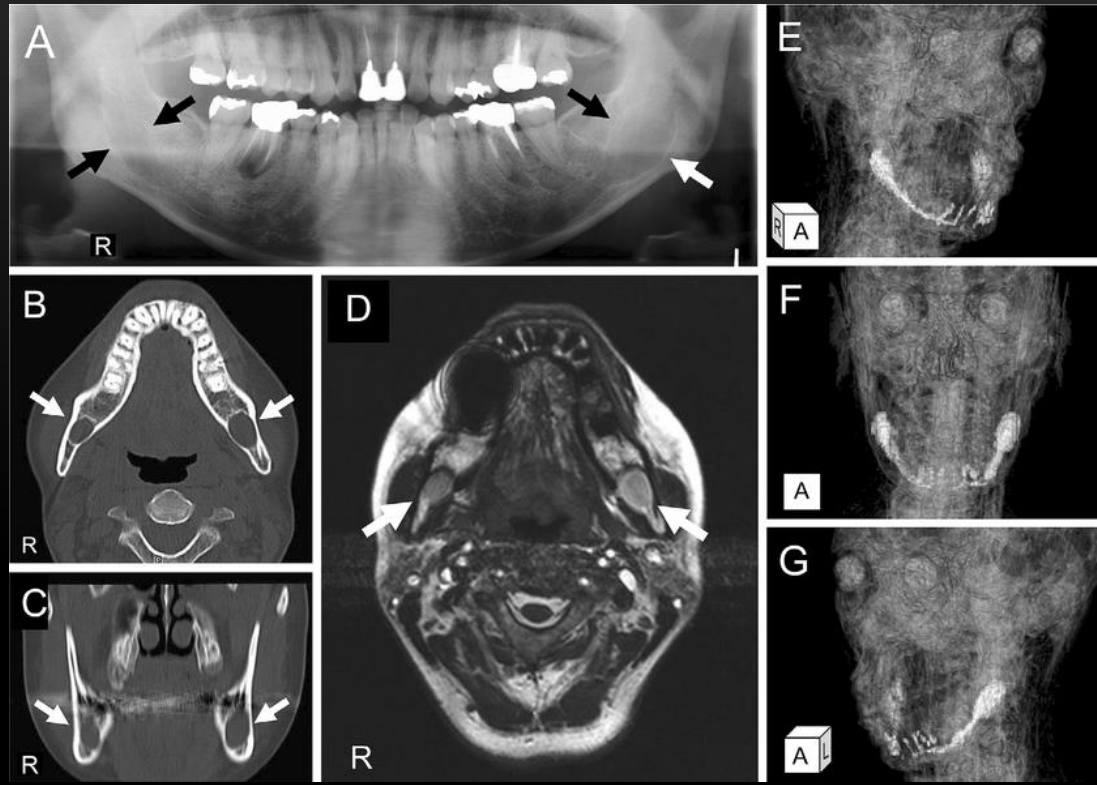

Intraoperative suspected nerve injury?
Yes
Immediate repair or referral for repair
No
No surgery indicated for
LA, trauma and orthognathic related nerve injuries should be reviewed and treated medically and psychologically
Early Medication in acute phase of nerve injury includes; step down prednisolone 50-10mg over 5 days)
Vitamin B complex and NSAIDs
<24 hours neuropathy detected after surgery
<24 HOURS
Inferior alveolar Neuropathy in due to Implant or endodontic procedure?
< 30 hours
Check area of neuropathy is small or non painful review
if large and painful arrange removal of implant or endo (overfill or tooth) within 30 hours
> 30 hours
Treat patient therapeutically no benefit in removing endo or implants (95-98% painful and permanent)
<24 hours -2 weeks
Lingual nerve neuropathy post BUCCAL ACCESS M3M surgery using with CBCT evidence of lingual plate bur breech?
Consider explorative +/- repair surgery
< 2 weeks
Inferior alveolar nerve injury related to M3M
Teeth retained or bone sequestrae present on DPT?
Yes
Arrange CBCT to check where tooth fragments are in relation to IDC (also may be in submandibular or sublingual space)
arrange surgery through socket to remove tooth frangements
consider explorative +/- repair surgery
No
Wait as 88 - 90% of these injuries resolve but if persisten @ 12 weeks t and patient agrees
Consider explorative +/- repair surgery
< 12 weeks
Lingual nerve injury related to LINGUAL ACCESS APPROACH M3M surgery
If injury > 3-6 months old
advise therapeutic therapy
central neuroplastic changes will minimise success of surgery#Evidence suggests that painful neuropathy does not respond to surgery
in addition there is a 1-2% risk of converting a hypoaethstesia into a painful neuropathy with repair
Medication for chronic neuropathic pain
Neuralgic pain – Pregabalin Lyrica
Burning deep pain Nortriptyline
? Restoration or late removal of implant can exacerbate neuropathic pain and surgery doesn't work
<12 weeks
Review patiennt if painful persistent neuropathy consider explorative +/- repair surgery
All patients should be managed holistically. Advise of the likely prognosis of their injury and provide an explanantion for symptoms
Psychological interventions include CBT, ACT and Mindfulness or combination Information available Trigeminalnerve.org.uk

New developments

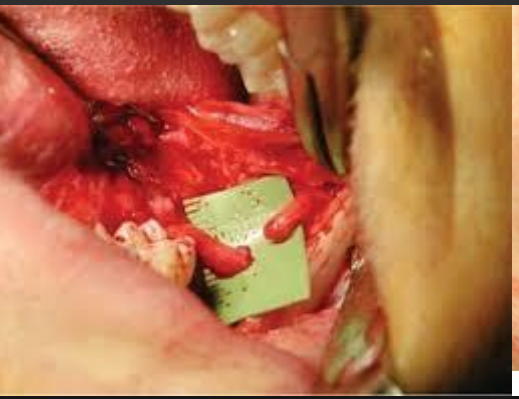
Zuniga JR, Mistry C, Tikhonov I, Dessouky R, **Chhabra** A Magnetic Resonance Neurography of Traumatic and Nontraumatic Peripheral Trigeminal Neuropathies. J Oral Maxillofac Surg. 2018 Apr;76(4):725-736. doi: 10.1016/j.joms.2017.11.007. Epub 2017 Nov 16.

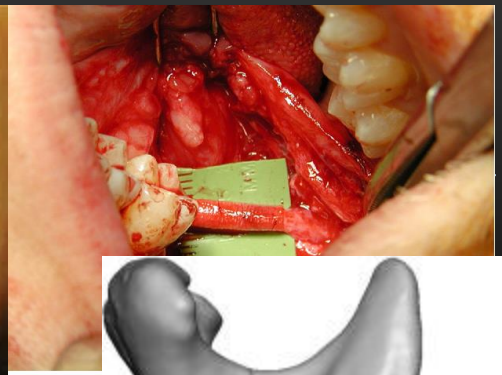
Dessouky R, Xi Y, **Zuniga J**, **Chhabra** A. Role of MR Neurography for the Diagnosis of Peripheral Trigeminal Nerve Injuries in Patients with Prior Molar Tooth Extraction. AJNR Am J Neuroradiol. 2018 Jan;39(1):162-169.

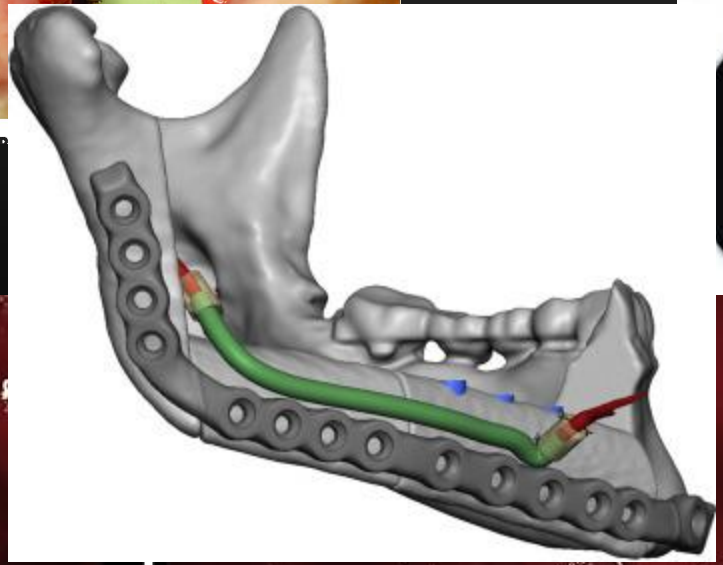
Cox B, Zuniga JR, Panchal N, Cheng J, **Chhabra** A. Magnetic resonance neurography in the management of peripheral trigeminal neuropathy: experience in a tertiary care centre. Eur Radiol. 2016 Oct;26(10):3392-400. doi: 10.1007/s00330-015-4182-5. Epub 2016 Jan 21

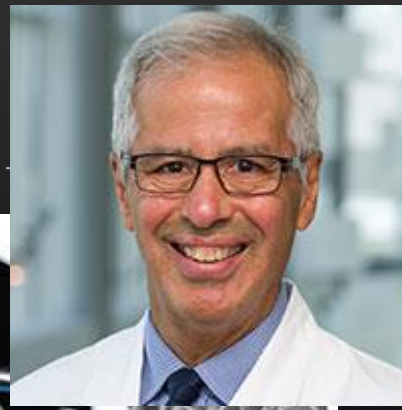


John Zuniga

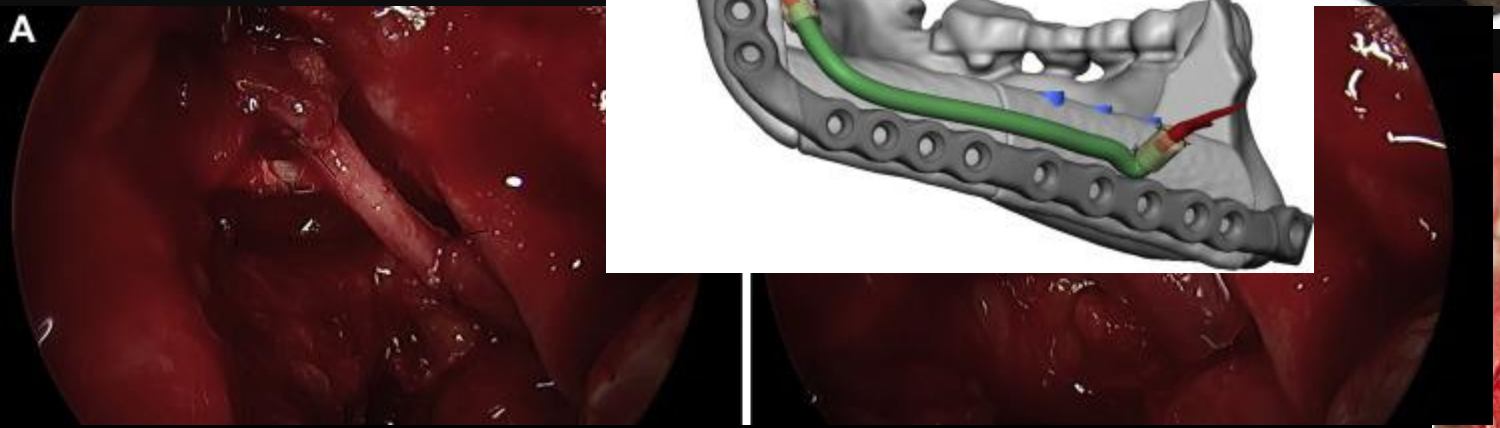









Axons grow through multi-tubular structure of Avance® Nerve Graft.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Key messages on prevention and management…

Prevention of nerve injuries and related neuropathic pain is essential and possible

- Patient selection – preoperative psych assessment / pain comorbidity /age/ gender
- Good planning and risk assessment - Awareness of intraoperative risk factors
- Good surgical technique –minimal access avoid nerve injury and minimise pain

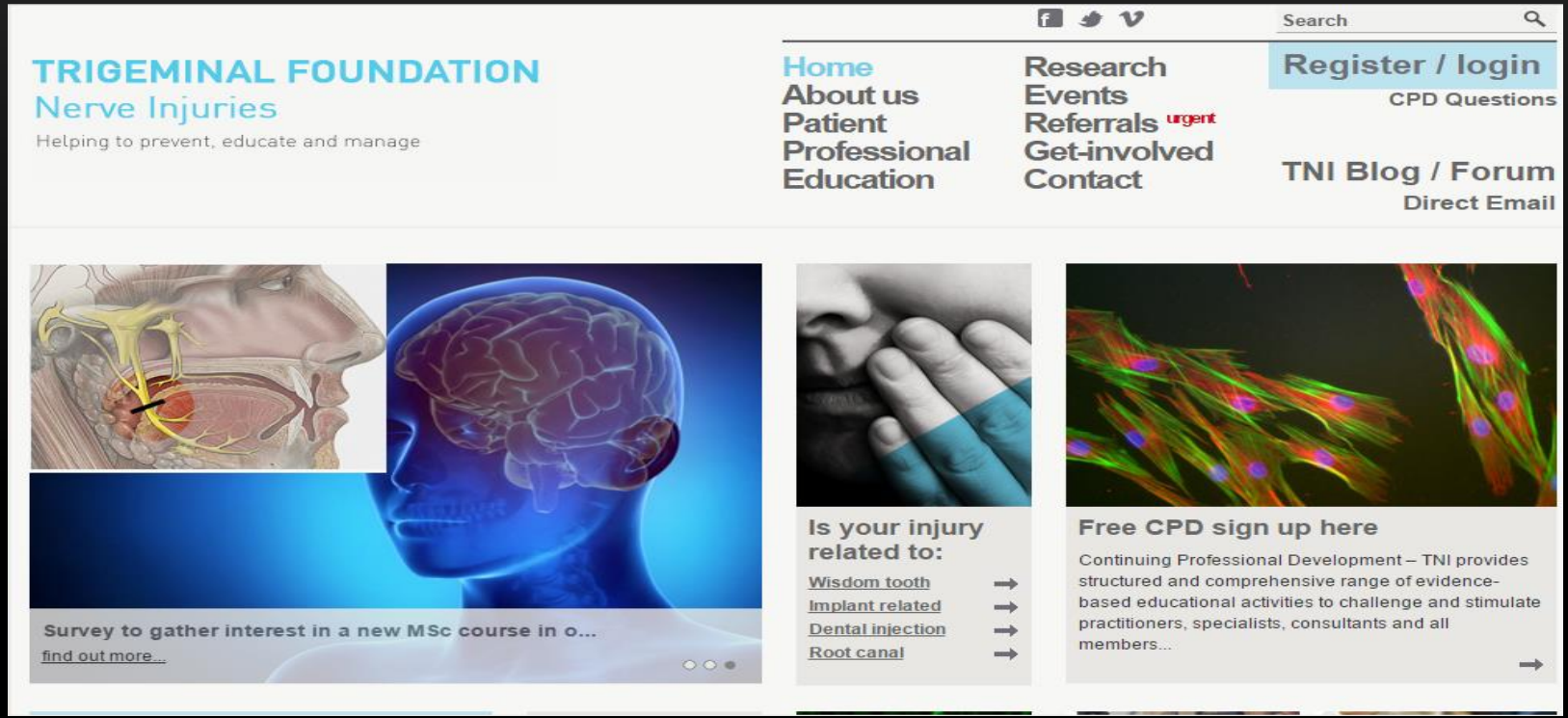
Manage the patients expectations

- **Surgery does not fix neuropathic pain**
- Most patients have pain with related functional, social and psychological sequelae
- We cannot 'fix' the patients with nerve injuries

DO NOT SIT AND WAIT for resolution

- Home check will facilitate timely urgent intervention < 24-30 hours
- Refer to resources at **Trigeminalnerve.org.uk**

Trigeminalnerve.org.uk



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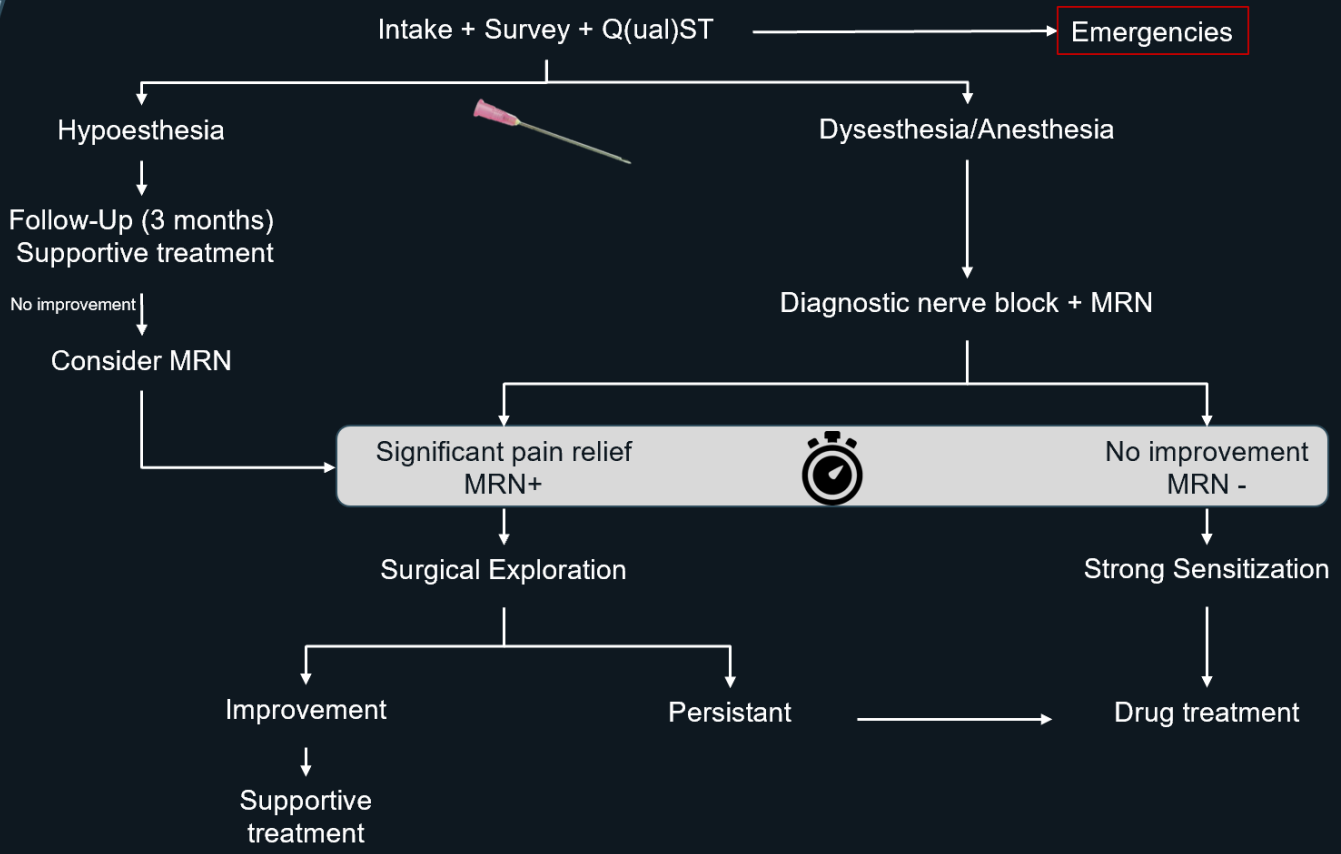
Workflow



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MRN: magnetic resonance neurography

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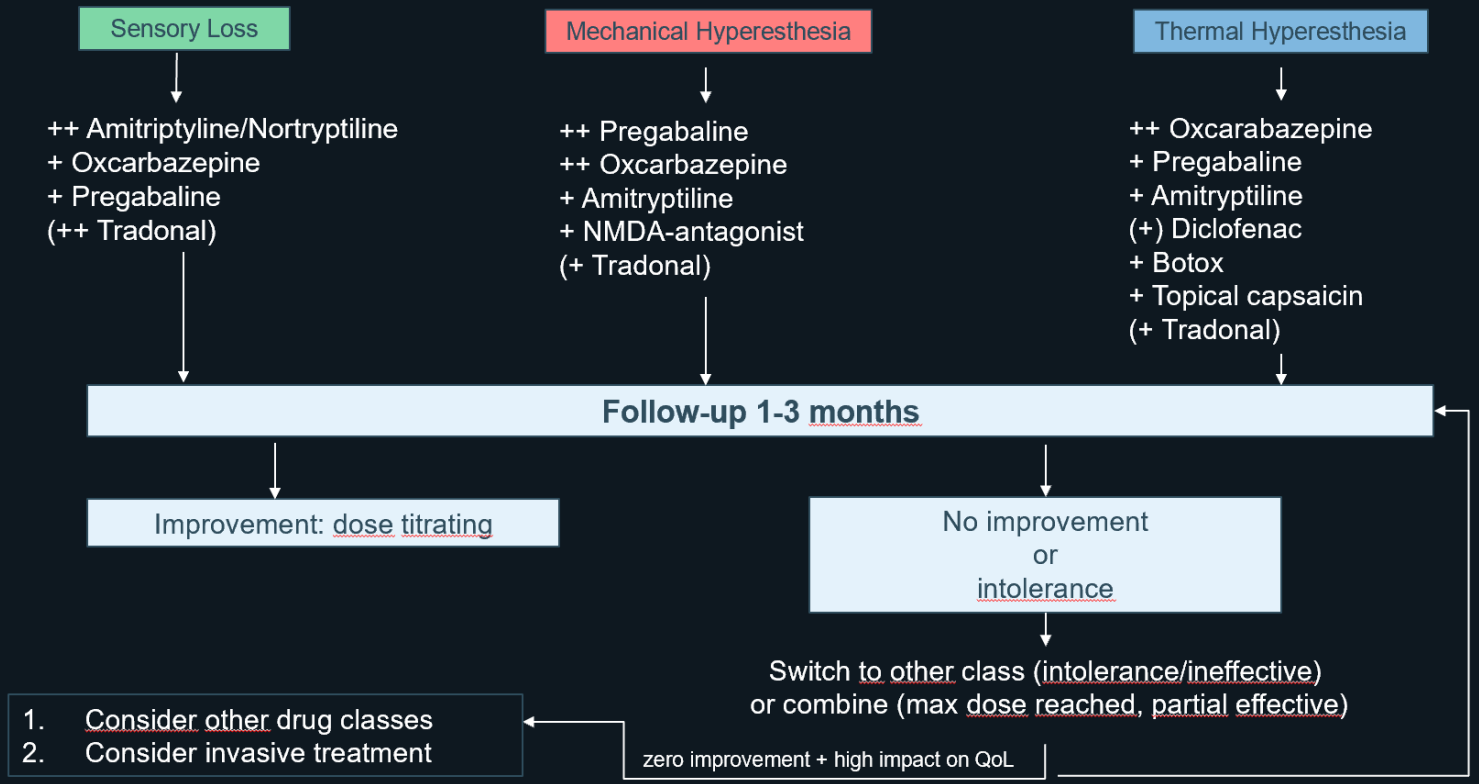
Medical treatment if persistent



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Estellon (2018). "Individualized neuropathic pain therapy based on phenotyping: are we there yet?" Pain 159(3): 569-575.

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Oral Surgery to OFP

- Ed Justin Durham

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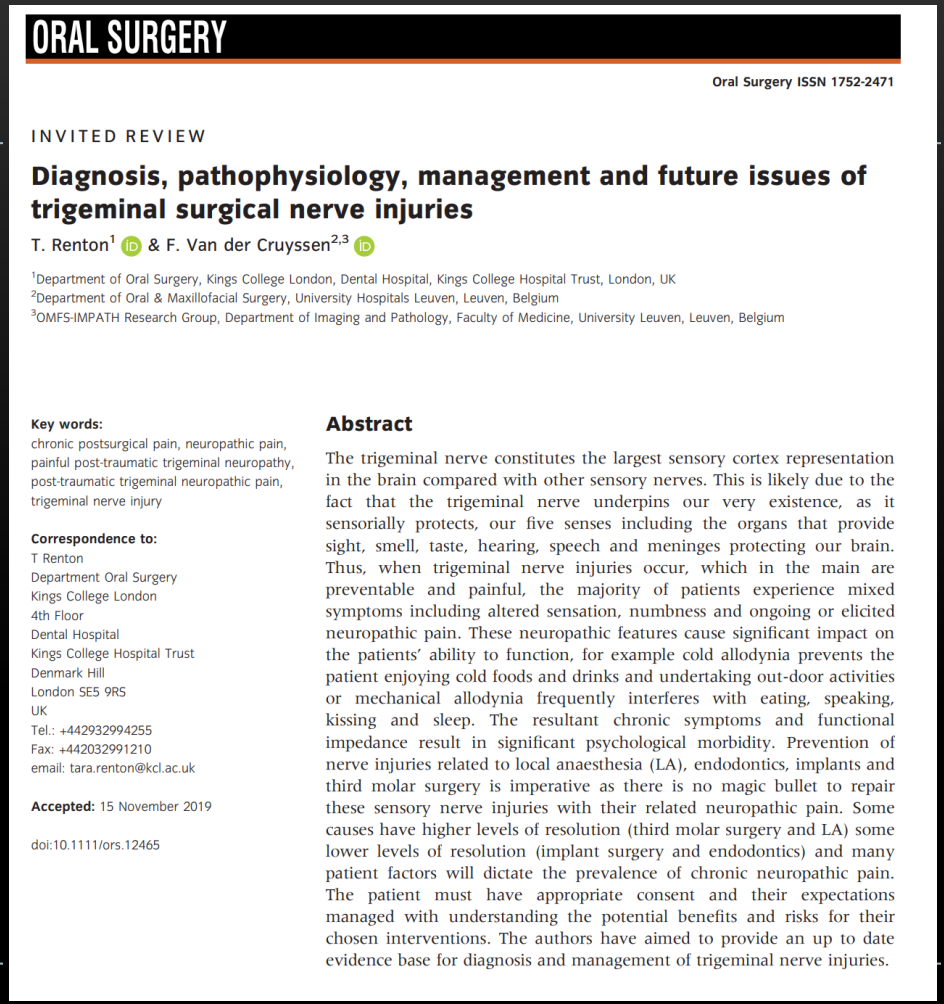

ORAL SURGERY

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INVITED REVIEW

Diagnosis, pathophysiology, management and future issues of trigeminal surgical nerve injuries

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Key words:
chronic postsurgical pain, neuropathic pain, painful post-traumatic trigeminal neuropathy, post-traumatic trigeminal neuropathic pain, trigeminal nerve injury

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Abstract

The trigeminal nerve constitutes the largest sensory cortex representation in the brain compared with other sensory nerves. This is likely due to the fact that the trigeminal nerve underpins our very existence, as it sensorially protects, our five senses including the organs that provide sight, smell, taste, hearing, speech and meninges protecting our brain. Thus, when trigeminal nerve injuries occur, which in the main are preventable and painful, the majority of patients experience mixed symptoms including altered sensation, numbness and ongoing or elicited neuropathic pain. These neuropathic features cause significant impact on the patients' ability to function, for example cold allodynia prevents the patient enjoying cold foods and drinks and undertaking out-door activities or mechanical allodynia frequently interferes with eating, speaking, kissing and sleep. The resultant chronic symptoms and functional impedance result in significant psychological morbidity. Prevention of nerve injuries related to local anaesthesia (LA), endodontics, implants and third molar surgery is imperative as there is no magic bullet to repair these sensory nerve injuries with their related neuropathic pain. Some causes have higher levels of resolution (third molar surgery and LA) some lower levels of resolution (implant surgery and endodontics) and many patient factors will dictate the prevalence of chronic neuropathic pain. The patient must have appropriate consent and their expectations managed with understanding the potential benefits and risks for their chosen interventions. The authors have aimed to provide an up to date evidence base for diagnosis and management of trigeminal nerve injuries.