# Persistent post-surgical orofacial pain

Abstract

Delivery of pain-free dental treatment is the ultimate goal for clinicians, and the hoped-for result by patients. Thanks to the optimised use of local anaesthesia and high standards of clinical training, this goal is frequently achieved. Research also tells us that the incidence of persistent pain following dental procedures, while relatively low, is not zero. Given the number of procedures we perform as dentists, the number of patients affected with post-treatment pain is still substantial. Moreover, persistent pain is not exclusive to dentistry, but is a risk for all surgical interventions.

When this pain lasts over six months it has been labelled persistent or chronic post-surgical pain (CPSP), and as expected it has a detrimental effect on the patient's quality of life. While all persistent pain is vexing, it is especially true for persistent orofacial pain. It creates increased levels of stress, anxiety and confusion for the patient, which in turn may place a strain on the dentist-patient relationship. On occasions, patient dissatisfaction may even result in medicolegal litigation.

This article describes some of the common clinical scenarios associated with chronic pain after dental procedures. Known risk factors are also discussed and recommendations are made so that clinicians might identify those at risk prior to an invasive procedure, and then possibly prevent post-surgical pain.

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## Introduction

Pain signalling from the orofacial area is mediated through the trigeminal nervous system. This system bears much in common with pain signalling through spinal nerves but there are some important differences. The oral cavity is a highly sensitive organ in the body, and somatosensory information from the facial area occupies almost 50% of the somatosensory cortex. Many of the common pain disorders in the orofacial area (e.g., trigeminal neuralgia, burning mouth, headache, temporomandibular disorders, etc.) are unique to the trigeminal system. The classification of orofacial pain has traditionally been based on symptom description, but we now appreciate that if we understand the underlying mechanism of the pain, we can potentially manage it better.[1] Several clinical disorders may co-exist simultaneously or at different times in the orofacial region. Dental procedures may cause direct trigeminal nerve injury, but more commonly dental procedures provide a significant disturbance of sensory input into the trigeminal system, resulting in central neuronal sensitisation and persistent neuropathic pain disorders.

If a dentist could identify a patient with high risk for persistent post-surgical orofacial pain, it might be possible to reduce the odds of this happening. For example, Fillingim examined a cohort of 321 volunteers and found a hugely variable response to a standardised pain stimulus.[2] They concluded that this variability supported the theory that some patients are more susceptible to pain disorders, and speculated that an important risk factor for persistent post-treatment pain is the individual's susceptibility to pain stimulation (**Figure 1**). They suggested that this susceptibility may be genetic but it may also be associated with a myriad of other risk factors.[3] One clue to an increased susceptibility would be patients who exhibit other persistent pain disorders (e.g., unexplained back pain, gastrointestinal discomfort, headache, etc.). Such patients are more likely to have disorders of pain signalling or modulation, and thus are at increased risk of abnormal trigeminal responses.

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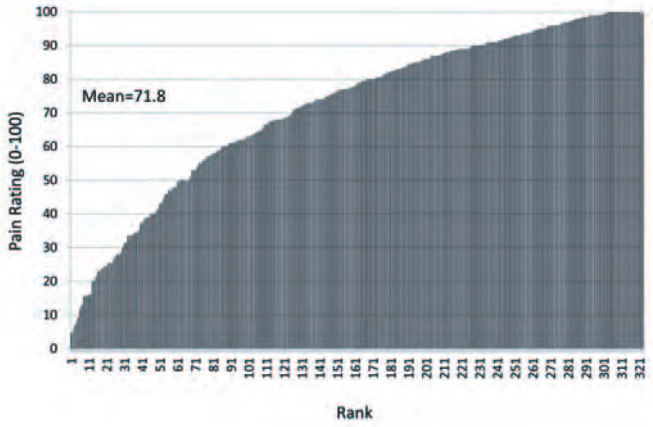


*FIGURE 1: Pain ratings in response to a heat stimulus (48°C) by 321 healthy young adults. Each line represents the pain rating (from 0 [no pain] to 100 [most intense pain imaginable]) by a single person. As can be seen, the mean pain rating was 71.8, but ratings ranged from 4 to 100. These data illustrate dramatic interindividual differences in responses to a standardised experimental pain stimulus. (Reproduced with permission from publishers.)*

**Table 1: Incidence of CPSP, severe CPSP, and proportion of neuropathic pain in CPSP. Adapted from Schug, S., Bruce J (2017).[3]**

| Type of surgery | Incidence of CPSP | Incidence of severe CPSP (>5/10) | Proportion of neuropathic pain in CPSP |
|---|---|---|---|
| Amputation | 30-85% | 5-10% | 80% |
| Cholecystectomy | 3-50% | Not reported | Not reported |
| Coronary bypass | 30-50% | 5-10% | Not reported |
| Dental surgery | 5-13% | Not reported | Not reported |
| Dental implants[22] | 0.8% | Not reported | 0.3% |
| Hip arthroplasty | 27% | 6% | Not reported |
| Inguinal herniotomy | 5-63% | 2-4% | 80% |
| Knee arthroplasty | 13-44% | 15% | 6% |
| Mastectomy | 11-57% | 5-10% | 65% |
| Thoracotomy | 5-65% | 10% | 45% |

## Common clinical scenarios associated with persistent pain after dental procedures

### Neuropathic pains

The incidence of direct trigeminal nerve injuries resulting from surgical dental procedures is small, but given the number of dental procedures routinely carried out, the number of affected patients is still substantial.[4,5] The majority of these injuries are reported as altered sensation and resolve spontaneously over time. Unfortunately, a small minority (about 3%) are associated with severe (sometimes disabling) pain. In the dental literature persistent pain associated with nerve injury has been described as painful post-traumatic trigeminal neuropathy (PTTN). In analogous medical literature, this phenomenon is described as chronic post-surgical pain (CPSP). Research on CPSP is extensive and suggests that it is hugely under-reported.[3] This condition has extensive effects on patients' quality of life and healthcare costs are also significant. **Table 1** illustrates the extent to which persistent post-surgical pain presents following certain types of surgery. The variability in numbers is explained by differences in reported methodology, variations in definitions, study design and time frame used as a cut-off for inclusion. In **Table 1**, the third column indicates the percentage of chronic severe pains that are neuropathic in origin. Most definitions for CPSP indicate that pain must be present for at least three months after surgery. It excludes patients where the pain is associated with a previously existing disease process.

In dentistry, when persistent pain occurs after an otherwise successful dental procedure the mechanism is often assumed to be neuropathic. It is important to note that this is not always the case, as some patients may experience pain for other reasons. While the number of citations in the dental literature is sparse, there are multiple reviews describing persistent post-endodontic, post-surgical and post-implant pain. Such data is important in terms of documenting the extent of the problem and was highlighted by the International Association for the Study of Pain, which dedicated the year 2017 as the Global Year Against Pain After Surgery.

PTTN has been associated with facial injuries and dental procedures such as root canal therapy, extractions, bone cyst surgery, orthognathic surgery, and dental implant placement.[6] In addition, local anaesthetic injections have been implicated as a cause of both non-painful (altered sensation only) and painful neuropathies.[4] This occurs when a local anaesthetic procedure injures the nerve due to physical injury from the needle or chemical toxicity from the injected substance. Pain may be spontaneous or triggered, and generally resides in the dermatome of the involved peripheral nerve. Sensory symptoms arising from neuropathic pain disorders may be associated with partial or complete loss of sensation. Patients frequently use descriptors such as burning, stinging, aching or throbbing pain. Detailed clinical examination of the symptomatic area will typically show signs of sensory abnormalities (allodynia, hyperalgesia) in the soft tissues of the affected dermatome. In some patients these sensory abnormalities may be subtle and difficult to identify, and therefore underappreciated.

### Pain after root canal treatment

A study by Philpott *et al.* initially reviewed 264 teeth that had non-surgical root canal treatment over a period of five to 14 months.[7] They found that 24% of those teeth presented with persistent post-treatment pain or discomfort. Periapical healing was further monitored at intervals of six months, four years, and ten years later. Interestingly, long-term follow-up showed that the majority of those patients experienced a reduction in symptom intensity over time. These authors also concluded that another risk factor for persistent pain was a previous history of chronic pain (temporomandibular disorder [TMD], chronic neck or back pain, chronic preoperative pain, etc.). Local dental factors including the presence of periapical radiolucency and/or tooth fracture were associated with those treated teeth that ultimately failed to resolve. Other endodontic studies have identified additional risk factors for persistent post-treatment pain, including the intensity and duration of preoperative pain at the treatment site, previous chronic pain experiences and female gender.[8]

### Pain after implant placement

Certainly, the risk of direct nerve injury associated with dental implant placement has been well documented. Most injuries are merely altered

sensation but some result in intense, debilitating pain. Typically, the affected area is exquisitely sensitive and pain is aggravated by simple actions like speaking, eating, smiling, and kissing.[6] Neuropathic pains do not respond fully to conventional analgesics but specific neuropathic pain protocols are available, involving drugs that reduce nerve transmission. Unfortunately for those with the most severe pains, the success rate is disappointing as nerve conduction cannot be stopped without inducing substantial side effects. Studies have shown that other potential risk factors for chronic pain after dental implant placement include the presence of prolonged preoperative pain at the site of placement, the experience of intense pain during implant placement and severe discomfort in the immediate postoperative period. Removal of the offending implant is an option but not always helpful. One research report suggested that if the implant is not removed within the first 48 to 72 hours, removal is unlikely to help.[9] The belief is that central changes in pain pathways occur quickly with nerve injuries. In some cases, removal of the implant may actually cause further inflammation and nerve sensitisation.

Although it is assumed that neuropathic disturbances following dental implant placement are due to direct mechanical injury of a peripheral nerve, this is not always the case. Other possible explanations include thermal or chemical injury during the procedure. Anatomical anomalies with accessory or supplemental innervation may also be a factor. The reality is that adverse events can occur with dental implant placement, even with careful planning and the use of skilled clinicians. Problems may arise in the absence of obvious organic pathology and neuropathic pain may exist in the absence of neurosensory deficits. Studies would seem to suggest that nerve injury/disturbance is more likely to occur in the mandible, but reports of problems in the maxilla after dental implant placement have also been documented.[10] Chronic periapical infections around natural teeth have also been documented as a potential source of trigeminal neuropathic pain.[11] In that paper half of the trigeminal nerve injuries were associated with first molar teeth.

**Pre-existing pain issues**

Although patients may understandably relate their pain experience to a recently performed dental procedure, there are many situations in which the problem was pre existing. For example, dental pain can be due to the activation or aggravation of trigeminal neuralgia (TN). Trigeminal neuralgia is a neurological disorder of uncertain aetiology.[12,13] It is characterised by intermittent sharp shooting pains of severe intensity but brief duration in the mandible or maxilla (or both). It is almost always unilateral and rarely affects the ophthalmic division of the trigeminal nerve. It is often misdiagnosed as pulpal pain. The average age of onset is 55 years and the distribution between males and females is roughly equal. It is not unusual for patients to remain convinced that a dental procedure precipitated the problem, particularly if the procedure was in close temporal relationship to the onset of symptoms. However, given our knowledge of the putative mechanisms, it seems likely that the stimulation from the procedure merely aggravated the underlying problem. There is evidence that vascular compression of the trigeminal nerve root may be the cause of TN but this is not always the case. The classification of orofacial pain by the International Headache Society includes vascular compression in the criteria for 'classical' TN.[1] Similar symptoms can arise secondary to underlying neurological disease such as multiple sclerosis or intracranial tumour. However, in the majority of cases there is no identifiable underlying disease. TN is thought to be an episodic disorder for most patients, often with lengthy intervals of remission from the pain. There is a risk that dental treatment carried out during these pain-free periods could reactivate the patient's pain problem.

**Table 2: Clinical characteristics of orofacial migraine as per the International Classification of Orofacial Pain.[1]**

| | |
|---|---|
| Location | Confined to orofacial area |
| Duration | 4-72 hours |
| Laterality | Typically unilateral but not always so |
| Quality | Throbbing, pulsating pain |
| Intensity | Moderate to severe |
| Aggravating factors | Routine physical activity |
| Associated symptoms | Nausea, vomiting, photophobia, phonophobia |

In addition to TN, several other types of trigeminal neuropathic pains exist. Previously used terminology included atypical odontalgia and idiopathic facial pain. These are continuous pain disorders mostly experienced in the mandible and maxilla. They are often difficult to diagnose and may have characteristics suggestive of odontogenic pain. The aetiology of these disorders is uncertain and, unfortunately, these disorders are often aggravated by routine dental procedures.[14] If the pain persists, it is not uncommon for the patient to suspect a failed dental procedure as the causation.

**Headache presenting as facial pain**

Orofacial pain complaints that arise following dental procedures may be headache related. Primary headache disorders including migraine, cluster headache, tension-type headache, and headache syndromes with autonomic features are known to affect the face and orofacial regions.[15] This is not surprising as the pathophysiology of headache pain is mediated by branches of the trigeminal nerve. Headache mechanisms are complex but one important feature from a dental perspective is the elevated and prolonged hyperexcitability to stimuli within the trigeminal system. The very nature of dental procedures generates a significant degree of activation of nociceptive and non-nociceptive neurons in the oral cavity. This response may be modified to a certain degree by the use of local anaesthesia.

Many patients will describe their pain as facial or dental in location, which arose only after dental treatment.[16] It should be noted that for the majority of migraineurs the pain location may vary between attacks. Poor localisation of migraine pain increases the diagnostic challenge. It is recognised that migraine pain may be experienced in the midface, eyes, ears, head, and neck. A carefully taken history will in many cases highlight the fact that the patient had a pre-existing headache disorder. For some patients the headache problem may have been inactive for some time prior to the dental treatment. Apart from unexplained orofacial pain, migraine may also be responsible for unexplained ear pain.[17]

The diagnosis of orofacial migraine is based on identification of the clinical characteristics, as per **Table 2**.

Patients with trigeminal nerve injury as a result of external trauma or dental procedures will sometimes note that their existing headache pain changes in location. This has been described as 'pain remapping'. It implies that the migraine pain shifts to the region where the trigeminal nerve injury has

**Table 3: Risk factors for chronic trigeminal neuropathic pain.**

| Chronic pain disorders | Medical conditions | Factors associated with previous dental treatment | Individual characteristics |
|---|---|---|---|
| Chronic headaches | Diabetes | Chronic preoperative pain | Gender |
| Chronic neck or back pain | Autoimmune disorders | Acute postoperative pain | Anxiety |
| Irritable bowel syndrome | | Chronic pain following previous dental procedures | Depression |
| Fibromyalgia | | | Tendency to catastrophise |

occurred. Failure to recognise the headache disorder in the symptomatic area may lead to unnecessary and unhelpful treatments.[4]

**Temporomandibular disorders**

The term TMD refers to a diverse group of painful and non-painful conditions affecting the jaw joints and masticatory muscles. These disorders are characterised by an array of symptoms, which may include pain with function (chewing, yawning, talking, etc.), joint noises, and limitation of movement or locking. The aetiology is known to be complex and multifactorial.[18] The onset of orofacial pain after dental treatment may be associated with aggravation of a pre-existing condition or the sudden onset of a TMD. Potential aetiological factors for TMDs include gender, genetics, systemic illness, stress, depression, bruxism, and trauma.

Most studies examining the relationship between trauma and TMD are retrospective. The limitations of such studies include recall bias. Obvious jaw or facial injury is usually recorded but many of these studies overlook more subtle forms of injury such as prolonged mouth opening. A recent prospective study assessed the relationship between injury, temporomandibular joint (TMJ) disorders and pain sensitivity.[19] A total of 409 adults who did not have a TMD were followed over a five-year period. Sensitivity to pinprick and thermal stimuli was recorded as a measure of susceptibility to pain. Over the five-year period, 233 cases of TMD incidents were noted. Of these cases, 8.1% documented injury at the onset of their symptoms. Within this trauma group the majority described either yawning (22.3%) or sustained mouth opening (24.5%) as the initiating event. The risk of jaw injury was amplified in those patients who had high levels of pain sensitivity at the start of the study.

Thus, it is not surprising that patients will sometimes complain of muscle or joint pain after dental procedures.[20] Prolonged mouth opening is a vulnerable jaw posture in a masticatory system that is essentially designed for maximum chewing efficiency and strong biting forces. The diagnosis of a painful TMD is based on careful review of the patient's history and findings from the clinical examination.

## Can we assess the level of risk for our patients and, if so, can we prevent pain?

Currently there is no simple blood or saliva test that will help us to determine the extent to which our patients are liable to develop persistent pain following oral surgery and dental treatment. However, our knowledge of the risk factors associated with medical and dental interventions is growing rapidly.[3] It is also clear that some individuals carry a high level of vulnerability to persistent pain for a variety of reasons (including genetic susceptibility). At present, our ability to identify those most at risk is largely dependent on taking a detailed personal, dental, medical and family history.

Identification of comorbid conditions such as migraine, back pain and irritable bowel syndrome may signal an enhanced susceptibility to persistent pain.[21] Systemic illnesses, including diabetes, disorders of the immune system and fibromyalgia, are associated with increased risk of neuropathic pain and other chronic pain states.

The phrase 'pain predicts pain' has been used to highlight the fact that chronic preoperative pain and acute postoperative pain are strong predictors of chronic pain after surgery. A previous history of persistent pain after dental procedures or surgery should therefore be considered a red flag for future pain problems.[8] Many studies identify female gender as a risk factor. A history of chronic anxiety, depression, and/or chronic sleep disturbance is considered a significant risk factor for persistent pain. Poor coping skills and a tendency to catastrophise are strongly associated with high levels of functional impairment after injury.[3] Early life experiences, including adverse life experiences in childhood and adolescence, have been shown to increase susceptibility to persistent pain.

Finally, our growing knowledge of pain mechanisms and chronic pain states has brought substantial improvement in the diagnosis and management of these challenging disorders. However, in the absence of specific clinical testing for pain vulnerability, we are still dependent on taking a detailed and careful history as part of our preoperative assessment.

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## CPD questions

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CPD

**1. In relation to risk factors that might signal a patient's susceptibility to persistent pain, which of the following statements is true?**

- ○ A: Comorbid conditions such as migraine, back pain, and irritable bowel syndrome may signal an enhanced susceptibility to persistent pain
- ○ B:The patient's gender is irrelevant
- ○ C: The intensity and duration of pre-existing pain has no influence on the outcome of the procedure

**2 In a recent prospective study on the development of TMDs in patients over a five-year period, what percentage of patients attributed the onset of TMD symptoms to trauma?**

- ○ A: 50%
- ○ B: 25.6%
- ○ C: 8.1%

**3. Which of the following is not a feature of orofacial migraine?**

- ○ A: Pulsating pain in the orofacial region
- ○ B: An area of permanent numbness in the face
- ○ C: Pain aggravated by routine physical activity