

Phantom tooth pain: Cause-effect relationship with tooth manipulation, injury or extraction

By

WorkSafeBC Evidence-Based Practice Group

Dr. Craig W. Martin, Senior Medical Advisor

June 2008

About this report

Phantom Tooth Pain: Cause-effect relationship with tooth manipulation, injury or extraction

Published: June 2008

About the Evidence-Based Practice Group

The Evidence-Based Practice Group was established to address the many medical and policy issues that WorkSafeBC officers deal with on a regular basis. Members apply established techniques of critical appraisal and evidence-based review of topics solicited from both WorkSafeBC staff and other interested parties such as surgeons, medical specialists, and rehabilitation providers.

Suggested Citation

Martin CW. Phantom tooth pain. Richmond, BC: WorksafeBC Evidence-Based Practice Group; June 2008. Available at:

http://worksafebc.com/health_care_providers/Assets/PDF/phantom_tooth_pain.pdf

Contact Information

Evidence-Based Practice Group
WorkSafeBC
PO Box 5350 Stn Terminal
Vancouver BC V6B 5L5

Email • craig.martin@worksafebc.com
Phone • 604 279-7417
Toll-free • 1 888 967-5377 ext 7417

View other systematic reviews by the EBPG online at:

<http://worksafebc.com/evidence>

Table of contents

About this report	i
Background	1
Methods	2
Results	2
Summary and conclusion	4
References	5
Appendix 1	26

Background

Recently, the Evidence Based Practice Group (EBPG) was presented with a claim in which a worker, injured in a motor vehicle accident, sustained an injury to the right side of his face and eye. The clinical findings at that time included right retinal detachment, blow out fracture of the right lower orbit with an associated fractured zygoma, perforation of the left tympanic membrane and a clinical basal skull fracture. CT scan confirmed the diagnosis of left temporal extradural haemorrhage. Due to ongoing complaint of pain after various courses of treatment, the right maxillary nerve was then ablated. However, the worker still complained of pain in the distribution of supraorbital and supratrochlear nerves with some sensation over the right cheek and upper lip after the ablation. At some stage, it was thought that two teeth (upper right central and lateral incisivus) contributed to the pain. These two teeth received root canals. However, the pain was only 'a little bit better' for a short period. Hence, the teeth were 'repaired' again after recurrence of the pain and were then extracted. It was found that these were normal teeth. In 1996 (nine years post injury), the neurologist consultant wrote that in August 1994 (seven years post injury), the patient developed pain in the left mandible (as opposed to the right side of the actual injury) in relationship to three teeth. Multiple dental procedures had been done and one of the molars was eventually extracted. This had not made any major impact upon the pain. The other two teeth had been treated with various dental procedures including root canals. The patient felt a slight reduction in pain at that time (1996), and felt the maximum pain was about the area where the missing tooth was and the gum tended to be very uncomfortable. It should be noted that the EBPG could not find any dental report/information pertaining to these three, presumably left, teeth. Subsequently, the injured worker developed chronic pain and was diagnosed with persistent right infraorbital/hemifacial pain. The characteristics of the pain seemed to be neuropathic in nature. This claim related to phantom tooth pain was presented to the Board.

For a long time, teeth, and more recently, dental pulp tissues, have been among the most frequently amputated structures in humans. Regardless of this fact, there is little information available with regard to post amputation pain in the oral cavity, unlike that of phantom limb pain. The term phantom tooth pain (PTP) was introduced in 1978 by Marbach.¹⁶³ Prior to 1978, similar symptoms were known as idiopathic periodontalgia and atypical odontalgia.²⁶⁶ Marbach defined PTP as a syndrome of persistent pain or paresthesia in teeth and other oral tissues that might appear following dental or surgical procedures such as pulp extirpation, apicoectomy or tooth extraction, when nerves were injured by physical trauma or even after routine inferior alveolar nerve blocks if the needle pierced the nerve sheath.¹⁶³ It should be noted that other experts⁵¹ strictly define PTP as unexplained persistent pain at the site of an extracted tooth. Due to the lack of objective findings, Klausner¹³⁵ suggested that PTP was a diagnosis of exclusion.

Subsequent to his 1978 paper,¹⁶³ Marbach published several papers on PTP.^{158-162, 164-167} However, it should be noted that the only epidemiological data presented by him was limited to data coming from one study.¹⁶⁵ Further, it should be noted that the available evidence of PTP was based on subjective patient reporting rather than on clinical examination of orofacial pain problems.¹¹¹ At present, there is no objective method for assessing PTP.¹¹¹

Given these facts, the objective of this rapid systematic review is to investigate whether there is a causal relationship between tooth manipulation, injury or extraction and the subsequent development of phantom tooth pain.

Methods

A systematic literature search was conducted on May 20, 2008. The search, done on MEDLINE and MEDLINE Daily Update commercial medical databases available through Ovid Technologies, was done by employing keywords ((phantom pain) AND (tooth OR teeth OR dentistry)), which also included related terms. The search was not limited to any particular publication years but was limited to publications in the English language and studies involving human subjects.

This search yielded 277 articles.¹⁻²⁷⁷ Upon examination of titles and abstracts, 19 articles^{25,26,51,103,111,133,158-165,169,205,246,256,266} were retrieved in full and critically appraised. Of these 19 articles, 12^{51,103,133,158,160,162-164,205,246,256,266} were further excluded since these articles were expert reviews in nature and did not provide any data that could be employed in assessing association (such as to calculate odds ratios, relative risk or attributable risk). The findings of seven articles^{25,26,111,159,161,165,169} are presented below.

Results

Of the seven articles retained, 2 were case reports (n=1)^{26,169} (Level of Evidence 4. Appendix 1), one was a small size (n=10) ‘case control’¹¹¹ (Level of Evidence 3. Appendix 1), two were moderate size case series (n=25 and 30)^{25,161} (Level of Evidence 4. Appendix 1), one was a ‘case-control’ study¹⁵⁹ (Level of Evidence 3. Appendix 1), and one was a survey¹⁶⁵ (Level of Evidence 4. Appendix 1).

Matwychuk¹⁶⁹ and Battrum et al.²⁶ each presented a case to illustrate the clinical presentation of PTP as well as provide expert reviews on the potential etiology, diagnosis and treatment of PTP. However, given the nature of these reports, there is no information that can be used to calculate the size of the association (i.e. the denominator of the odds ratio or relative risk or attributable risk) between purported exposures and PTP.

Jacobs et al.¹¹¹ reported a ‘case-control’ study to determine whether patients with PTP had an altered sensory perception as compared with pain-free patients. This ‘case control’ was based on a survey of patients of the Department of Periodontology at a university in Belgium. Five hundred McGill Pain Questionnaire-based letters were sent and only 176 (35%) of the questionnaires were returned. Of these 176 participants, ten were identified with potential PTP based on their answers to certain questions. The authors selected ten age- and sex-matched, pain-free controls and explored the association between various psychophysical factors, such as anxiety, depression, agoraphobia, obsessive compulsive behaviour, light pressure sensation, and thermal sensation, with PTP. It should be noted that this is a small ‘case control’ study with a very low response rate exploring many potential associations between psychophysical factors and PTP without any clear hypothesis or statistical adjustment on this issue.

Bates and Stewart²⁵ reported 30 patients diagnosed with PTP. Ninety percent of these patients were female, mean age 58.4 years, and had PTP for an average of 4.4 years. It should be noted that no information is given as to how the diagnosis of PTP was established. Also, there is no information provided regarding the population from which these cases were drawn or potential causes of PTP among these patients. A case series of 25 patients diagnosed with PTP was reported by Marbach.¹⁶¹ This case series suffers the same problems as the other case series by Bates and Stewart.²⁵

Marbach et al,¹⁶⁵ in their article entitled “Incidence of phantom tooth pain”, tried to calculate, retrospectively, the incidence of PTP post endodontic procedures. Five endodontists practicing in five separate private practices were invited to participate in this study. Only one endodontist (20%) agreed to participate. A 10-item questionnaire was mailed to 732 former unselected patients of this participating endodontist (the authors did not provide any information about the study period). Five hundred and ten (70%) responded and only 463 questionnaires (63%) were deemed usable. Presumably, this study explored the association between any kind of endodontic therapy and the development of PTP. Given the information provided in this article we could not discern further the types of endodontic treatments involved. It should be noted that while the authors did not collect any data from general dentists, the data from the patients of the endodontist may have covered both endodontic work as well as any general dental procedures performed by the endodontist. The data cannot be employed to assess the association between any specific endodontic treatments or specific dental treatments and the development of PTP. Based on this data, Marbach et al.¹⁶⁵ estimated the incidence of PTP in this population to be between 3%-6%. It should be noted that, in addition to a high potential for selection bias and the limited variables provided, this study did not provide any data that would enable us to compute any size of association between certain exposures and the development of PTP.

In another article, Marbach¹⁵⁹ compared the psychological factors among patients with PTP with those of control and contrast groups. 115 patients diagnosed with PTP, 151 patients diagnosed

with temporomandibular joint pain dysfunction syndrome (TMPDS) and 137 non-pain controls drawn from the acquaintances of the TMPDS group were included in this study. It should be noted that there was no information on how these samples were drawn. There was also no information on the size of the population from which these samples were drawn. Further, this was an exploratory study in which there was no specific hypothesis to be tested and various potential outcomes were presented.

With regard to establishing causation between certain exposures and outcomes, Sir Bradford Hill's "criteria" are the "standard" employed in epidemiological studies.²⁷⁸ These "criteria" include assessing the strength of the association (as expressed by odds ratio or relative risk or attributable risk), consistency (across different study periods and/or populations), specificity, temporality, biological gradient (dose response relationship), plausibility, coherence, experimental evidence and analogy. At present, none of the studies published provide any data that can help us in investigating the association between certain dental procedures, such as tooth extraction, and the development of PTP.

Summary and conclusion

The EBPG conducted a systematic literature review to investigate the association between tooth manipulation, injury or extraction and the subsequent development of phantom tooth pain. At present, there is no published study that can support such a causal association.

References

1. Abdulhameed, S. M.; Feigal, R. J.; Rudney, J. D., and Kajander, K. C. Effect of peripheral electrical stimulation on measures of tooth pain threshold and oral soft tissue comfort in children. *Anesthesia Progress*. 36(2):52-7, 1989 Mar-Apr.
2. Al-Bahlani, S.; Sherriff, A., and Crawford, P. J. Tooth extraction, bleeding and pain control. *Journal of the Royal College of Surgeons of Edinburgh*. 46(5):261-4, 2001 Oct.
3. Al-Khateeb, T. H. and Alnahr, A. Pain experience after simple tooth extraction. *Journal of Oral & Maxillofacial Surgery*. 66(5):911-7, 2008 May.
4. Allen, G. D. The role of research in pain control for dentistry. *Anesthesia Progress*. 34(6):232-7, 1987 Nov-Dec.
5. Allen, G. D.; Everett, G. B.; Kennedy, W. F., and Forsyth, W. D. Individual response to total spectrum of pain control in dentistry. *Anesthesia Progress*. 22(5):144-7, 150, 1975 Sep-Oct.
6. Alonso, A. A. and Nixdorf, D. R. Case series of four different headache types presenting as tooth pain. *Journal of Endodontics*. 32(11):1110-3, 2006 Nov.
7. Anderson, D. J. Studies on sensory mechanisms in teeth. *Annals of the Royal College of Surgeons of England*. 43(6):331-40, 1968 Dec.
8. Anderson, D. J.; Hannam, A. G., and Mathews, B. Sensory mechanisms in mammalian teeth and their supporting structures. *Physiological Reviews*. 50(2):171-95, 1970 Apr.
9. Andersson, S. A.; Ericson, T.; Holmgren, E., and Lindqvist, G. Electro-acupuncture. Effect on pain threshold measured with electrical stimulation of teeth. *Brain Research*. 63:393-6, 1973 Dec 7.
10. Anonymous. AADS special report. Curricular guidelines for comprehensive control of pain and anxiety in dentistry. *Journal of Dental Education*. 44(5):279-86, 1980 May.
11. Anonymous. Case records of the Massachusetts General Hospital. Weekly clinicopathological exercises. Case 17-1988. A 40-year-old man with a cerebral mass one month after severe pain in the region of an upper tooth. *New England Journal of Medicine*. 318(17):1116-22, 1988 Apr 28.
12. Anonymous. Guidelines for teaching the comprehensive control of pain and anxiety in dentistry. American Dental Association, Council on Dental Education, May, 1971. *Journal of Dental Education*. 36(1):62-7, 1972 Jan.
13. Anonymous. Guidelines for teaching the Comprehensive Control of Pain and Anxiety in Dentistry. Council on Dental Education, American Dental Association. *Journal of Dental Education*. 53(5-6):305-10, 1989 May-Jun.

14. Anonymous. "I scream, you scream". Summer's cold confections can be a pain in the tooth. *Dentistry Today*. 20(9):34, 2001 Sep.
15. Anonymous. Pain ... it does not have to hurt! Anxiety control in dentistry. *Tic*. 45(12):3-5, 1986 Dec.
16. Apkarian, A. V.; Jyvasjarvi, E.; Kniffki, K. D.; Mengel, M. K., and Stiefenhofer, A. Activation of carotid sinus baroreceptors reduces pain sensations evoked by electrical and cold stimulation of human teeth. *Proceedings of the Finnish Dental Society*. 85(4-5):409-13, 1989.
17. Arora, R. Influence of pain-free dentistry and convenience of dental office on the choice of a dental practitioner: an experimental investigation. *Health Marketing Quarterly*. 16(3):43-54, 1999.
18. Arribas, A. R. and Muzyka, B. C. Pain control in dentistry. *Alpha Omegan*. 96(4):18-27, 2003 Dec.
19. Avellan, N. L.; Sorsa, T.; Tervahartiala, T.; Forster, C., and Kempainen, P. Experimental tooth pain elevates substance P and matrix metalloproteinase-8 levels in human gingival crevice fluid. *Acta Odontologica Scandinavica*. 66(1):18-22, 2008 Feb.
20. Awang, M. N.; Boon, L. C., and Nor, G. M. Suprofen: its usefulness in the control of pain following surgical removal of impacted wisdom tooth. *Indian Journal of Medical Sciences*. 44(8):205-8, 1990 Aug.
21. Bakke, M. Effect of acupuncture on the pain perception thresholds of human teeth. *Scandinavian Journal of Dental Research*. 84(6):404-8, 1976 Nov.
22. Bales, D. J. Pain and the cracked tooth. *Journal of the Indiana Dental Association*. 54(5):15-8, 1975 Sep-Oct.
23. Barber, J. and Mayer, D. Evaluation of the efficacy and neural mechanism of a hypnotic analgesia procedure in experimental and clinical dental pain. *Pain*. 4(1):41-8, 1977 Oct.
24. Bastian, H.; Soholm, B.; Marker, P., and Eckerdal, A. Comparative study of pain control by cryotherapy of exposed bone following extraction of wisdom teeth. *Journal of Oral Science*. 40(3):109-13, 1998 Sep.
25. Bates, R. E. Jr and Stewart, C. M. Atypical odontalgia: phantom tooth pain. *Oral Surgery, Oral Medicine, Oral Pathology*. 72(4):479-83, 1991 Oct.
26. Battrum, D. E. and Gutmann, J. L. Phantom tooth pain: a diagnosis of exclusion. *International Endodontic Journal*. 29(3):190-4, 1996 May.
27. Baxendale, B. R.; Vater, M., and Lavery, K. M. Dexamethasone reduces pain and swelling following extraction of third molar teeth. *Anaesthesia*. 48(11):961-4, 1993 Nov.

28. Berland, L. Immediate bridgework can ease the pain of removing unwanted teeth. *Dentistry Today*. 14(5):68-9, 72-3, 1995 May.
29. Bonkowsky, J. L.; Johnson, J.; Carey, J. C.; Smith, A. G., and Swoboda, K. J. An infant with primary tooth loss and palmar hyperkeratosis: a novel mutation in the NTRK1 gene causing congenital insensitivity to pain with anhidrosis. *Pediatrics*. 112(3 Pt 1):e237-41, 2003 Sep.
30. Breytenbach, H. S. Effects of tanderil (oxyphenbutazone), chymoral (proteolytic enzymes) and placebo in the control of swelling, trismus and pain after the removal of impacted wisdom teeth. *Journal of the Dental Association of South Africa*. 31(2):61-3, 1976 Feb.
31. Brown, A. C.; Beeler, W. J.; Kloka, A. C., and Fields, R. W. Spatial summation of pre-pain and pain in human teeth. *Pain*. 21(1):1-16, 1985 Jan.
32. Brown, C. Pain management in dentistry. *Dentistry Today*. 15(11):56, 58-9, 1996 Dec.
33. Brown, C. R. Pain management in dentistry: an introduction. *Practical Periodontics & Aesthetic Dentistry*. 8(2):195, 1996 Mar.
34. Brown, K. H. Vital tooth transplants: report of cases. *Journal of the American Dental Association*. 87(3):655-60, 1973 Sep.
35. Brynjulfson, A.; Fristad, I.; Grevstad, T., and Hals-Kvinnslund, I. Incompletely fractured teeth associated with diffuse longstanding orofacial pain: diagnosis and treatment outcome. *International Endodontic Journal*. 35(5):461-6, 2002 May.
36. Campbell, R. L.; Parks, K. W., and Dodds, R. N. Chronic facial pain associated with endodontic therapy. *Oral Surgery, Oral Medicine, Oral Pathology*. 69(3):287-90, 1990 Mar.
37. Carter, G. T.; Jensen, M. P.; Galer, B. S.; Kraft, G. H.; Crabtree, L. D.; Beardsley, R. M.; Abresch, R. T., and Bird, T. D. Neuropathic pain in Charcot-Marie-Tooth disease. *Archives of Physical Medicine & Rehabilitation*. 79(12):1560-4, 1998 Dec.
38. Chambiras, P. G. Sedation in dentistry: some pharmacological aspects of pain control. *Australian Dental Journal*. 15(4):294-8, 1970 Aug.
39. Chapman, C. R. Acupuncture: some considerations for the control of pain in dentistry. *Journal of Prosthetic Dentistry*. 31(4):441-51, 1974 Apr.
40. Chapman, C. R.; Benedetti, C.; Colpitts, Y. H., and Gerlach, R. Naloxone fails to reverse pain thresholds elevated by acupuncture: acupuncture analgesia reconsidered. *Pain*. 16(1):13-31, 1983 May.
41. Chapman, C. R.; Chen, A. C., and Bonica, J. J. Effects of intrasegmental electrical acupuncture on dental pain: evaluation by threshold estimation and sensory decision theory. *Pain*. 3(3):213-27, 1977 Jun.

42. Chase, P. The future of dentistry and dentistry's involvement in the diagnosis and treatment of nonodontogenic pain problems involving the stomatognathic system (jaw and related structures). *Cranio*. 15(2):97-8, 1997 Apr.
43. Chatrian, G. E.; Canfield, R. C.; Knauss, T. A., and Eegt, E. L. Cerebral responses to electrical tooth pulp stimulation in man. An objective correlate of acute experimental pain. *Neurology*. 25(8):745-57, 1975 Aug.
44. Chen, A. C.; Chapman, C. R., and Harkins, S. W. Brain evoked potentials are functional correlates of induced pain in man. *Pain*. 6(3):365-74, 1979 Jun.
45. Chen, C. Y.; Palla, S.; Erni, S.; Sieber, M., and Gallo, L. M. Nonfunctional tooth contact in healthy controls and patients with myogenous facial pain. *Journal of Orofacial Pain*. 21(3):185-93, 2007.
46. Christensen, L. V. Experimental teeth clenching in man. *Swedish Dental Journal - Supplement*. 60:1-66, 1989.
47. Christensen, L. V. Facial pain from experimental tooth clenching. *Tandlaegebladet*. 74(2):175-82, 1970 Feb.
48. Christensen, L. V. Influence of muscle pain tolerance on muscle pain threshold in experimental tooth clenching in man. *Journal of Oral Rehabilitation*. 6(3):211-7, 1979 Jul.
49. Christensen, L. V. Jaw muscle fatigue and pains induced by experimental tooth clenching: a review. *Journal of Oral Rehabilitation*. 8(1):27-36, 1981 Jan.
50. Christensen, L. V.; Mohamed, S. E., and Harrison, J. D. Delayed onset of masseter muscle pain in experimental tooth clenching. *Journal of Prosthetic Dentistry*. 48(5):579-84, 1982 Nov.
51. Clark, G. T. Persistent orodental pain, atypical odontalgia, and phantom tooth pain: when are they neuropathic disorders? *Journal of the California Dental Association*. 34(8):599-609, 2006 Aug.
52. Coffey, J. P.; Mahan, P. E.; Gibbs, C. H., and Welsch, B. B. A preliminary study of the effects of tooth guidance on working-side condylar movement. *Journal of Prosthetic Dentistry*. 62(2):157-62, 1989 Aug.
53. Cohn, S. A. Clinical update--the teeth and the maxillary sinus: the mutual impact of clinical procedures, disease conditions and their treatment implications. Part 1. The differential diagnosis of tooth sinus pain--the dentist's view. *Australian Endodontic Journal: the Journal of the Australian Society of Endodontology*. 25(1):29-31, 1999 Apr.
54. Condes-Lara, M.; Calvo, J. M., and Fernandez-Guardiola, A. Habituation to bearable experimental pain elicited by tooth pulp electrical stimulation. *Pain*. 11(2):185-200, 1981 Oct.

55. Cook-Norris, R. H. and Stetson, C. L. Electrocoagulation-induced tooth pain in a patient with dental work despite local anesthesia. *Journal of the American Academy of Dermatology*. 53(4):741-2, 2005 Oct.
56. Cruccu, G.; Fornarelli, M.; Inghilleri, M., and Manfredi, M. The limits of tooth pulp evoked potentials for pain quantitation. *Physiology & Behavior*. 31(3):339-42, 1983 Sep.
57. Curro, F. A. Tooth hypersensitivity in the spectrum of pain. *Dental Clinics of North America*. 34(3):429-37, 1990 Jul.
58. Dionne, R. A. Pain control in dentistry: the basis for rational therapy. *Compendium of Continuing Education in Dentistry*. 6(1):15-6, 18, 20-2 passim, 1985 Jan.
59. Donaldson, D. Canadian guidelines for the teaching of pain and apprehension control in dentistry. *Dental Journal - Journal Dentaire*. 43(11):532-5, 1977 Nov.
60. Dons, R. F. and Shakir, K. M. Changes in triiodothyronine mark severe pain syndrome: a case report. *Military Medicine*. 159(6):465-6, 1994 Jun.
61. Dubner, R. Pain control in dentistry: the anatomic and physiologic basis of orofacial pain. *Compendium of Continuing Education in Dentistry*. 7(6):408, 410-6, 418, 1986 Jun.
62. Dworkin, S. F. Behavioral dentistry: a renewed paradigm for the future. *Journal of the Indiana Dental Association*. 79(4):11-5, 2000-2001.
63. Ehrich, E. W.; Dallob, A.; De Lepeleire, I.; Van Hecken, A.; Riendeau, D.; Yuan, W.; Porras, A.; Wittreich, J.; Seibold, J. R.; De Schepper, P.; Mehlich, D. R., and Gertz, B. J. Characterization of rofecoxib as a cyclooxygenase-2 isoform inhibitor and demonstration of analgesia in the dental pain model. *Clinical Pharmacology & Therapeutics*. 65(3):336-47, 1999 Mar.
64. Ekblom, A. and Hansson, P. Effects of conditioning vibratory stimulation on pain threshold of the human tooth. *Acta Physiologica Scandinavica*. 114(4):601-4, 1982 Apr.
65. Fagade, O. O. and Oginni, F. O. Intra-operative pain perception in tooth extraction--possible causes. *International Dental Journal*. 55(4):242-6, 2005 Aug.
66. Farber, J. P. History taking relating to tooth pain. *New York State Dental Journal*. 47(6):324-5, 1981 Jun-Jul.
67. Firestone, M. P. Public education. Pain control in dentistry. *New York Journal of Dentistry*. 45(7):223, 1975 Aug-Sep.
68. Fisher, S. E.; Frame, J. W.; Rout, P. G., and McEntegart, D. J. Factors affecting the onset and severity of pain following the surgical removal of unilateral impacted mandibular third molar teeth. *British Dental Journal*. 164(11):351-4, 1988 Jun 11.
69. Ford, R. T. Equilibration and restorative dentistry as treatment for facial pain. *General*

- Dentistry. 36(5):424-7, 1988 Sep-Oct.
70. Foreman, P. A. Control of the anxiety-pain complex in dentistry. Intravenous psychosedation with techniques using diazepam. *Oral Surgery, Oral Medicine, Oral Pathology*. 37(3):337-49, 1974 Mar.
 71. Foreman, P. A. Intravenous sedation. A technique of pain control for conservative dentistry and minor oral surgery. *Australian Dental Journal*. 12(4):332-8, 1967 Aug.
 72. Foreman, P. A. Pain control and patient management in dentistry--a review of current intravenous technics. *Journal of the American Dental Association*. 80(1):101-11, 1970 Jan.
 73. Fors, U. G.; Ahlquist, M. L.; Edwall, L. G., and Haegerstam, G. A. Evaluation of a mathematical model analysing the relation between intradental nerve impulse activity and perceived pain in man. *International Journal of Bio-Medical Computing*. 19(3-4):261-77, 1986 Nov.
 74. Fors, U. G.; Sandberg, H. H.; Edwall, L. G., and Haegerstam, G. A. A comparison between different models of the relation between recorded intradental nerve impulse activity and reported pain in man. *International Journal of Bio-Medical Computing*. 24(1):17-28, 1989 Mar.
 75. Fowler, K. E. The placebo effect as an aid to pain control in dentistry. *Dental Student*. 52(8):35 passim, 1974 May.
 76. Frame, J. W.; Evans, C. R.; Flaum, G. R.; Langford, R., and Rout, P. G. A comparison of ibuprofen and dihydrocodeine in relieving pain following wisdom teeth removal. *British Dental Journal*. 166(4):121-4, 1989 Feb 25.
 77. Fried, K.; Lillesaar, C.; Sime, W.; Kaukua, N., and Patarroyo, M. Target finding of pain nerve fibers: neural growth mechanisms in the tooth pulp. *Physiology & Behavior*. 92(1-2):40-5, 2007 Sep 10.
 78. Fujii, K.; Motohashi, K., and Umino, M. Heterotopic ischemic pain attenuates somatosensory evoked potentials induced by electrical tooth stimulation: diffuse noxious inhibitory controls in the trigeminal nerve territory. *European Journal of Pain: Ejp*. 10(6):495-504, 2006 Aug.
 79. Gangarosa, L. P. Sr; Ciarlone, A. E.; Neaverth, E. J.; Johnston, C. A.; Snowden, J. D., and Thompson, W. O. Use of verbal descriptors, thermal scores and electrical pulp testing as predictors of tooth pain before and after application of benzocaine gels into cavities of teeth with pulpitis. *Anesthesia Progress*. 36(6):272-5, 1989 Nov-Dec.
 80. Geffner, I. and Porteous, J. R. Haemorrhage and pain control in conservative dentistry for haemophiliacs. *British Dental Journal*. 151(8):256-8, 1981 Oct 20.
 81. Gerschman, J. A. Chronicity of orofacial pain. *Annals of the Royal Australasian College of Dental Surgeons*. 15:199-202, 2000 Oct.

82. Gerschman, J. A. and Giebartowski, J. Effect of electronic dental anesthesia on pain threshold and pain tolerance levels of human teeth subjected to stimulation with an electric pulp tester. *Anesthesia Progress*. 38(2):45-9, 1991 Mar-Apr.
83. Ghione, S.; Rosa, C.; Panattoni, E.; Nuti, M.; Mezzasalma, L., and Giuliano, G. Comparison of sensory and pain threshold in tooth pulp stimulation in normotensive man and essential hypertension. *Journal of Hypertension - Supplement*. 3(3):S113-5, 1985 Dec.
84. Giovannitti, J. A. Jr. Pain control in dentistry: oral premedication and nitrous oxide. *Compendium of Continuing Education in Dentistry*. 6(9):647-8, 650, 652-6, 1985 Oct.
85. Glassman, G.; Krasner, P.; Morse, D. R.; Rankow, H.; Lang, J., and Furst, M. L. A prospective randomized double-blind trial on efficacy of dexamethasone for endodontic interappointment pain in teeth with asymptomatic inflamed pulps. *Oral Surgery, Oral Medicine, Oral Pathology*. 67(1):96-100, 1989 Jan.
86. Glenny, A. M.; Esposito, M.; Coulthard, P., and Worthington, H. V. The assessment of systematic reviews in dentistry. *European Journal of Oral Sciences*. 111(2):85-92, 2003 Apr.
87. Grainger, J. K.; Johnson, A.; Kingon, A., and Klineberg, I. Development of the Diploma in Clinical Dentistry (Conscious Sedation and Pain Control) Faculty of Dentistry, University of Sydney. *Australian Dental Journal*. 39(6):382-8, 1994 Dec.
88. Guasti, L.; Zanotta, D.; Petrozzino, M. R.; Grimoldi, P.; Diolisi, A.; Garganico, D.; Gaudio, G.; Grandi, A. M.; Bertolini, A., and Venco, A. Relationship between dental pain perception and 24 hour ambulatory blood pressure: a study on 181 subjects. *Journal of Hypertension*. 17(12 Pt 2):1799-804, 1999 Dec.
89. Gurian, B. and Shub, J. L. Modification of attitudes toward preventive dentistry through pain control. *Journal of Preventive Dentistry*. 5(1):22-4, 1978 Jan-Feb.
90. Hargreaves, K. and Abbott, P. V. Drugs for pain management in dentistry. *Australian Dental Journal*. 50(4 Suppl 2):S14-22, 2005 Dec.
91. Hassett, L. C. Summary of the scientific literature for pain and anxiety control in dentistry. *Anesthesia Progress*. 41(2):48-57, 1994.
92. Hassett, L. C. Summary of the scientific literature for pain and anxiety control in dentistry. *Anesthesia Progress*. 40(2):46-54, 1993.
93. Hassett, L. C. Summary of the scientific literature for pain and anxiety control in dentistry. *Anesthesia Progress*. 39(3):97-103, 1992.
94. Hassett, L. C. Summary of the scientific literature for pain and anxiety control in dentistry. *Anesthesia Progress*. 36(3):117-25, 1989 May-Jun.
95. Hassett, L. C. Summary of the scientific literature for pain and anxiety control in dentistry

- journal literature, January 1986-December 1987. *Anesthesia Progress*. 35(6):247-65, 1988 Nov-Dec.
96. Henry, I. E. Pain of erupting teeth. *Journal of the American Dental Association*. 105(4):608, 1982 Oct.
 97. Henry, M.; Reader, A., and Beck, M. Effect of penicillin on postoperative endodontic pain and swelling in symptomatic necrotic teeth. *Journal of Endodontics*. 27(2):117-23, 2001 Feb.
 98. Herod, E. L. Psychophysical pain control during tooth extraction. *General Dentistry*. 43(3):267-9, 1995 May-Jun.
 99. High, A. S.; Macgregor, A. J.; Tomlinson, G. E., and Salkouskis, P. M. A gnathodynamometer as an objective means of pain assessment following wisdom tooth removal. *British Journal of Oral & Maxillofacial Surgery*. 26(4):284-91, 1988 Aug.
 100. Hirsch, C.; John, M. T.; Lobbezoo, F.; Setz, J. M., and Schaller, H. G. Incisal tooth wear and self-reported TMD pain in children and adolescents. *International Journal of Prosthodontics*. 17(2):205-10, 2004 Mar-Apr.
 101. Hodosh, A. J.; Hodosh, S., and Hodosh, M. Potassium nitrate-zinc oxide eugenol temporary cement for provisional crowns to diminish postpreparation tooth pain. *Journal of Prosthetic Dentistry*. 70(6):493-5, 1993 Dec.
 102. Homewood, C. I. Aspects of dentinal and pulpal pain. Force, cracks and restorative dentistry. *Annals of the Royal Australasian College of Dental Surgeons*. 12:153-9, 1994 Apr.
 103. Horowitz, L. G.; Kehoe, L., and Jacobe, E. Multidisciplinary patient care in preventive dentistry: idiopathic dental pain reconsidered. *Clinical Preventive Dentistry*. 13(6):23-9, 1991 Nov-Dec.
 104. Houck, V.; Reader, A.; Beck, M.; Nist, R., and Weaver, J. Effect of trephination on postoperative pain and swelling in symptomatic necrotic teeth. *Oral Surgery Oral Medicine Oral Pathology Oral Radiology & Endodontics*. 90(4):507-13, 2000 Oct.
 105. Houle, M.; McGrath, P. A.; Moran, G., and Garrett, O. J. The efficacy of hypnosis- and relaxation-induced analgesia on two dimensions of pain for cold pressor and electrical tooth pulp stimulation. *Pain*. 33(2):241-51, 1988 May.
 106. Hu, J. W. Is tooth extraction a good model for dental pain? A critic to Sabino et al. (*Pain* 2002;95:175-86). *Pain*. 99(3):605-6; author reply 606-7, 2002 Oct.
 107. Ihalainen, U.; Perkki, K., and Oikarinen, V. J. The effect of transcutaneous nerve stimulation on the tooth pain threshold. *Proceedings of the Finnish Dental Society*. 73(5-6):212-5, 1977 Oct-Dec.

108. Ikeda, T.; Nakano, M.; Bando, E., and Suzuki, A. The effect of light premature occlusal contact on tooth pain threshold in humans. *Journal of Oral Rehabilitation*. 25(8):589-95, 1998 Aug.
109. Irvine, G. H.; Lutterloch, M. J., and Bowerman, J. E. Comparison of diflunisal and paracetamol in the management of pain following wisdom teeth removal. *British Dental Journal*. 152(1):18-20, 1982 Jan 5.
110. Iwata, K.; Tsuboi, Y.; Yagi, J.; Toda, K.; Furukawa, T.; Yoshimoto, A., and Sumino, R. Effect of interstimulus interval on perceived sensation and intradental nerve activity during thermal tooth stimulation in man. *Brain Research*. 635(1-2):211-6, 1994 Jan 28.
111. Jacobs, R.; Wu, C. H.; Goossens, K.; De Laat, A.; Van Loven, K.; Antonis, Y.; Lambrechts, P., and van Steenberghe, D. A case-control study on the psychophysical and psychological characteristics of the phantom tooth phenomenon. *Clinical Oral Investigations*. 6(1):58-64, 2002 Mar.
112. Jacobson, R. C.; Chapman, C. R., and Gerlach, R. Stimulus intensity and inter-stimulus interval effects on pain-related cerebral potentials. *Electroencephalography & Clinical Neurophysiology*. 62(5):352-63, 1985 Sep.
113. Jacome, D. E. Dracula's teeth syndrome. *Headache*. 41(9):892-4, 2001 Oct.
114. Janal, M. N.; Raphael, K. G.; Klausner, J., and Teaford, M. The role of tooth-grinding in the maintenance of myofascial face pain: a test of alternate models. *Pain Medicine*. 8(6):486-96, 2007 Sep.
115. Janal, M. N.; Raphael, K. G.; Klausner, J., and Teaford, M. The role of tooth-grinding in the maintenance of myofascial face pain: a test of alternate models. *Pain Medicine*. 8(6):486-96, 2007 Sep.
116. Janhunen, M. P. and Narhi, M. V. Effect of electroacupuncture on the pain perception threshold of human teeth. *Proceedings of the Finnish Dental Society*. 73(5-6):216-9, 1977 Oct-Dec.
117. Janhunen, M. P. and Narhi, M. V. Effect of electroacupuncture on the pain perception threshold of human teeth. *Proceedings of the Finnish Dental Society*. 73(5-6):216-9, 1977 Oct-Dec.
118. Jantsch, H. H.; Kempainen, P.; Ringler, R.; Handwerker, H. O., and Forster, C. Cortical representation of experimental tooth pain in humans. *Pain*. 118(3):390-9, 2005 Dec 5.
119. Jeske, A. H. Pharmacology at the beginning of the 21st century: implications of several new developments for dentistry and current status of the major 20th century dental drugs. *Texas Dental Journal*. 117(2):40-7, 2000 Feb.
120. Johnson, G. and Brannstrom, M. Pain reaction to cold stimulus in teeth with experimental fillings. *Acta Odontologica Scandinavica*. 29(6):639-47, 1971 Dec.

121. Jones, M. L. and Richmond, S. Initial tooth movement: force application and pain--a relationship? *American Journal of Orthodontics*. 88(2):111-6, 1985 Aug.
122. Kant, K. S. Pain referred to teeth as the sole discomfort in undiagnosed mediastinal lymphoma: report of case. *Journal of the American Dental Association*. 118(5):587-8, 1989 May.
123. Kaufmann, T.; Bloch, C.; Schmidt, W., and Jonas, L. Chronic inflammation and pain inside the mandibular jaw and a 10-year forgotten amalgam filling in an alveolar cavity of an extracted molar tooth. *Ultrastructural Pathology*. 29(5):405-13, 2005 Sep-Oct.
124. Kempainen, P. Modification of human dental pain thresholds by conditioning vibrotactile stimulation at high frequency. *Archives of Oral Biology*. 28(10):959-62, 1983.
125. Kempainen, P.; Forster, C.; Koppert, W., and Handwerker, H. O. Blood flow increase in the human lip after high-intensity tooth stimulation is not based on cholinergic mechanisms. *Neuroscience Letters*. 315(1-2):109-11, 2001 Nov 23.
126. Kempainen, P.; Vaalamo, I.; Leppala, N., and Pertovaara, A. Changes in tooth pulpal detection and pain thresholds in relation to jaw movement in man. *Archives of Oral Biology*. 46(1):33-7, 2001 Jan.
127. Kerr, N. W. Dental pain and suffering prior to the advent of modern dentistry. *British Dental Journal*. 184(8):397-9, 1998 Apr 25.
128. Khabbaz, M. G.; Anastasiadis, P. L., and Sykaras, S. N. Determination of endotoxins in the vital pulp of human carious teeth: association with pulpal pain. *Oral Surgery Oral Medicine Oral Pathology Oral Radiology & Endodontics*. 91(5):587-93, 2001 May.
129. Kim, H. W. The prevention and treatment of postoperative pain in dentistry. *Odonto-Stomatologie Tropicale*. 10(3-4):161-6, 1987 Sep-Dec.
130. Kimata, N.; Nakagaki, H.; Ishino, M.; Tanaka, D.; Toyama, A.; Prendergast, M. J., and Williams, S. A. Social images of medicine and dentistry in Japan. An exploratory study using correspondence analysis. *International Dental Journal*. 50(5):257-61, 2000 Oct.
131. Kitade, T.; Odahara, Y.; Shinohara, S.; Ikeuchi, T.; Sakai, T.; Morikawa, K.; Minamikawa, M.; Toyota, S.; Kawachi, A.; Hyodo, M. and others. Studies on the enhanced effect of acupuncture analgesia and acupuncture anesthesia by D-phenylalanine (2nd report)--schedule of administration and clinical effects in low back pain and tooth extraction. *Acupuncture & Electro-Therapeutics Research*. 15(2):121-35, 1990.
132. Kitade, T. and Ohyabu, H. Analgesic effects of acupuncture on pain after mandibular wisdom tooth extraction. *Acupuncture & Electro-Therapeutics Research*. 25(2):109-15, 2000.
133. Klausner, J. J. Epidemiology of chronic facial pain: diagnostic usefulness in patient care. *Journal of the American Dental Association*. 125(12):1604-11, 1994 Dec.

134. Kleinknecht, R. A.; Klepac, R. K., and Alexander, L. D. Origins and characteristics of fear of dentistry. *Journal of the American Dental Association*. 86(4):842-8, 1973 Apr.
135. Klepac, R. K.; Dowling, J.; Hauge, G., and McDonald, M. Reports of pain after dental treatment, electrical tooth pulp stimulation, and cutaneous shock. *Journal of the American Dental Association*. 100(5):692-5, 1980 May.
136. Kohjitani, A.; Miyawaki, T.; Kasuya, K., and Shimada, M. Sympathetic activity-mediated neuropathic facial pain following simple tooth extraction: a case report. *Cranio*. 20(2):135-8, 2002 Apr.
137. Konzelman, J. L. Jr; Herman, W. W., and Comer, R. W. Enigmatic pain referred to the teeth and jaws. *General Dentistry*. 49(2):182-6; quiz 187-8, 2001 Mar-Apr.
138. Kopel, H. M. An update on anxiety and pain control in dentistry for children. Part I. Control of anxiety. *Alpha Omegan*. 72(2):25-8, 1979 Sep.
139. Koyess, E. and Fares, M. Referred pain: a confusing case of differential diagnosis between two teeth presenting with endo-perio problems. *International Endodontic Journal*. 39(9):724-9, 2006 Sep.
140. Kraintz, L. Research in physiology of interest to dentistry. *Journal of the American Dental Association*. 78(6):1336-42, 1969 Jun.
141. Ladov, M. J.; Precheur, H. V.; Rauch, D. M.; Engel, P. S., and Stern, R. K. An open-label evaluation of the efficacy and safety of Stadol NS with ibuprofen in the treatment of pain after removal of impacted wisdom teeth. *Journal of Oral & Maxillofacial Surgery*. 58(10 Suppl 2):15-8, 2000 Oct.
142. Leavitt, A. H.; King, G. J.; Ramsay, D. S., and Jackson, D. L. A longitudinal evaluation of pulpal pain during orthodontic tooth movement. *Orthodontics & Craniofacial Research*. 5(1):29-37, 2002 Feb.
143. Lee, M. H.; Zarestsky, H. H.; Ernst, M.; Dworkin, B., and Jonas, R. The analgesic effects of aspirin and placebo on experimentally induced tooth pulp pain. *Journal of Medicine*. 16(4):417-28, 1985.
144. Leggat, P. A.; Kedjarune, U., and Smith, D. R. Occupational health problems in modern dentistry: a review. *Industrial Health*. 45(5):611-21, 2007 Oct.
145. Leitch, J. and Macpherson, A. Current state of sedation/analgesia care in dentistry. *Current Opinion in Anaesthesiology*. 20(4):384-7, 2007 Aug.
146. Lekic, D. and Cenic, D. Pain and tooth pulp evoked potentials. *Clinical Electroencephalography*. 23(1):37-46, 1992 Jan.
147. Lemmer, B. and Wiemers, R. Circadian changes in stimulus threshold and in the effect of a local anaesthetic drug in human teeth: studies with an electronic pulptester. *Chronobiology*

- International. 6(2):157-62, 1989.
148. Levine, R. S.; Nugent, Z. J., and Pitts, N. B. Pain prediction for preventive non-operative management of dentinal caries in primary teeth in general dental practice. *British Dental Journal*. 195(4):202-6; discussion 197, 2003 Aug 23.
 149. Lindsay, S. J.; Roberts, G. J.; Wardle, J.; Woolgrove, J., and Yates, J. Fear and pain in routine dentistry. *British Dental Journal*. 152(1):3-4, 1982 Jan 5.
 150. Littlejohn, I. H.; Tarling, M. M.; Flynn, P. J.; Ordman, A. J., and Aiken, A. Post-operative pain relief in children following extraction of carious deciduous teeth under general anaesthesia: a comparison of nalbuphine and diclofenac. *European Journal of Anaesthesiology*. 13(4):359-63, 1996 Jul.
 151. Locker, D. The symptom iceberg in dentistry. Treatment-seeking in relation to oral and facial pain. *Journal (Canadian Dental Association)*. 54(4):271-4, 1988 Apr.
 152. Lytle, J. J. Indications and contraindications for removal of the impacted tooth. *Dental Clinics of North America*. 23(3):333-46, 1979 Jul.
 153. Mackenzie, D. W. and Patel, M. F. Local anaesthesia for pain relief following wisdom teeth extraction under general anaesthesia. *Anaesthesia*. 51(2):200-1, 1996 Feb.
 154. Malamed, S. F. Pain and anxiety control in dentistry. *Journal of the California Dental Association*. 21(10):35-8, 40-1, 1993 Oct.
 155. Malamed, S. F. An update on pain and anxiety control in pediatric dentistry. Part II. Inhalation sedation and local anesthesia. *Alpha Omegan*. 72(2):29-33, 1979 Sep.
 156. Malamed, S. F. and Pallasch, T. J. U.S.C. School of Dentistry--guidelines for the control of pain and anxiety. *Anesthesia Progress*. 21(4):99-102, 1974 Jul-Aug.
 157. Mansour, M. H. and Cox, S. C. Patients presenting to the general practitioner with pain of dental origin. *Medical Journal of Australia*. 185(2):64-7, 2006 Jul 17.
 158. Marbach, J. J. Is phantom tooth pain a deafferentation (neuropathic) syndrome? Part I: Evidence derived from pathophysiology and treatment. *Oral Surgery, Oral Medicine, Oral Pathology*. 75(1):95-105, 1993 Jan.
 159. Marbach, J. J. Is phantom tooth pain a deafferentation (neuropathic) syndrome? Part II: Psychosocial considerations. *Oral Surgery, Oral Medicine, Oral Pathology*. 75(2):225-32, 1993 Feb.
 160. Marbach, J. J. Orofacial phantom pain: theory and phenomenology. *Journal of the American Dental Association*. 127(2):221-9, 1996 Feb.
 161. Marbach, J. J. Phantom tooth pain. *Journal of Endodontics*. 4(12):362-72, 1978 Dec.

162. Marbach, J. J. Phantom tooth pain: deafferentation pain. *Pennsylvania Dental Journal*. 51(6):32-3, 1984 Nov-Dec.
163. Marbach, J. J. Phantom tooth pain: differential diagnosis and treatment. *New York State Dental Journal*. 59(10):28-33, 1993 Dec.
164. Marbach, J. J. Phantom tooth pain: differential diagnosis and treatment. *Journal of the Massachusetts Dental Society*. 44(4):14-8, 1996.
165. Marbach, J. J.; Hulbrock, J.; Hohn, C., and Segal, A. G. Incidence of phantom tooth pain: an atypical facial neuralgia. *Oral Surgery, Oral Medicine, Oral Pathology*. 53(2):190-3, 1982 Feb.
166. Marbach, J. J. and Lipton, J. A. Biopsychosocial factors of the temporomandibular pain dysfunction syndrome. Relevance to restorative dentistry. *Dental Clinics of North America*. 31(3):473-86, 1987 Jul.
167. Marbach, J. J.; Raphael, K. G.; Dohrenwend, B. P., and Lennon, M. C. The validity of tooth grinding measures: etiology of pain dysfunction syndrome revisited. *Journal of the American Dental Association*. 120(3):327-33, 1990 Mar.
168. Margolis, F. S. The erbium laser: the "Star Wars" of dentistry. *Alpha Omegan*. 99(3):128-31, 2006.
169. Matwychuk, M. J. Diagnostic challenges of neuropathic tooth pain. *Journal (Canadian Dental Association)*. 70(8):542-6, 2004 Sep.
170. McAlister, G. L. and Richardson, C. L. Bibliography for the control of anxiety, fear and pain in dentistry. *Anesthesia Progress*. 29(6):11pp, 1982 Nov-Dec.
171. McAlister, G. L. and Richardson, C. L. Summary of the 1982 scientific literature for pain and anxiety control in dentistry. *Anesthesia Progress*. 31(1):31-40, 1984 Jan-Feb.
172. McAlister, G. L. and Richardson, C. L. Summary of the scientific literature for pain and anxiety control in dentistry. *Journal literature, January-December, 1985. Anesthesia Progress*. 33(5):268-77, 1986 Sep-Oct.
173. McGrath, P. A. Pain control in dentistry: psychologic factors that modify the perception of pain. *Compendium of Continuing Education in Dentistry*. 6(8):574, 576-7, 580-5, 1985 Sep.
174. McGrath, P. A.; Gracely, R. H.; Dubner, R., and Heft, M. W. Non-pain and pain sensations evoked by tooth pulp stimulation. *Pain*. 15(4):377-88, 1983 Apr.
175. McMillan, A. S. and Lawson, E. T. Effect of tooth clenching and jaw opening on pain-pressure thresholds in the human jaw muscles. *Journal of Orofacial Pain*. 8(3):250-7, 1994.
176. Mengel, M. K.; Stiefenhofer, A. E.; Jyvasjarvi, E., and Kniffki, K. D. Pain sensation during

- cold stimulation of the teeth: differential reflection of A delta and C fibre activity? *Pain*. 55(2):159-69, 1993 Nov.
177. Michalek-Sauberer, A.; Heinzl, H.; Sator-Katzenschlager, S. M.; Monov, G.; Knolle, E., and Kress, H. G. Perioperative auricular electroacupuncture has no effect on pain and analgesic consumption after third molar tooth extraction. *Anesthesia & Analgesia*. 104(3):542-7, 2007 Mar.
 178. Milam, S. B. Pain control in dentistry: general anesthesia. *Compendium of Continuing Education in Dentistry*. 7(1):80-1, 84-7, 1986 Jan.
 179. Miller, D. B. Yesterday's dentistry--today's chronic pain. How three seconds of outdated technique turned a healthy dentist into a chronic pain patient. *Functional Orthodontist*. 14(3):30-3, 1997 May-Jul.
 180. Misch, C. E. and Moore, P. Steroids and the reduction of pain, edema and dysfunction in implant dentistry. *International Journal of Oral Implantology*. 6(1):27-31, 1989.
 181. Mohd Sulong, M. Z. The incidence of postoperative pain after canal preparation of open teeth using two irrigation regimes. *International Endodontic Journal*. 22(5):248-51, 1989 Sep.
 182. Momoi, Y.; Asanuma, A.; Kohno, A., and Yanagisawa, K. A measurement of galvanic current and electrical potential in extracted human teeth. *Journal of Dental Research*. 65(12):1441-4, 1986 Dec.
 183. Moore, P. A. Pain control in dentistry: pediatric pharmacosedation. *Compendium*. 8(1):28, 30-6, 38-9, 1987 Jan.
 184. Moore, R.; Brodsgaard, I.; Mao, T. K.; Miller, M. L., and Dworkin, S. F. Acute pain and use of local anesthesia: tooth drilling and childbirth labor pain beliefs among Anglo-Americans, Chinese, and Scandinavians. *Anesthesia Progress*. 45(1):29-37, 1998.
 185. Morgan, C. R.; Rodd, H. D.; Clayton, N.; Davis, J. B., and Boissonade, F. M. Vanilloid receptor 1 expression in human tooth pulp in relation to caries and pain. *Journal of Orofacial Pain*. 19(3):248-60, 2005.
 186. Motohashi, K. and Umino, M. Heterotopic painful stimulation decreases the late component of somatosensory evoked potentials induced by electrical tooth stimulation. *Cognitive Brain Research*. 11(1):39-46, 2001 Mar.
 187. Mulhern, J. M.; Patterson, S. S.; Newton, C. W., and Ringel, A. M. Incidence of postoperative pain after one-appointment endodontic treatment of asymptomatic pulpal necrosis in single-rooted teeth. *Journal of Endodontics*. 8(8):370-5, 1982 Aug.
 188. Mumford, J. M. Pain perception threshold and adaptation of normal human teeth. *Archives of Oral Biology*. 10(6):957-68, 1965 Nov-Dec.

189. Mumford, J. M. Pain perception threshold of retained deciduous teeth. *Journal of Dental Research*. 50(2):506, 1971 Mar-Apr.
190. Mumford, J. M. Pain perception threshold on stimulating human teeth and the histological condition of the pulp. *British Dental Journal*. 123(9):427-33, 1967 Nov 7.
191. Mumford, J. M. Stimulus-evoked pain in teeth. *Frontiers of Oral Physiology*. 2:51-77, 1976.
192. Mumford, J. M. and Bowsher, D. Pain and protopathic sensibility. A review with particular reference to the teeth. *Pain*. 2(3):223-43, 1976 Sep.
193. Mumford, J. M. and Lewis, D. G. Electronic tooth stimulator for pain research. *Bio-Medical Engineering*. 11(1):22-3, 1976 Jan.
194. Mumford, J. M. and Newton, A. V. Convergence in the trigeminal system following stimulation of human teeth. *Archives of Oral Biology*. 16(9):1089-98, 1971 Sep.
195. Mumford, J. M. and Newton, A. V. Spatial summation of pre-pain and pain in human teeth. *Pain*. 22(3):320-1, 1985 Jul.
196. Mumford, J. M. and Newton, A. V. Stimulus convergence in human teeth. *Archives of Oral Biology*. 15(10):953-9, 1970 Oct.
197. Mumford, J. M. and Newton, A. V. Trigeminal convergence from human teeth: influence of contralateral stimulation and stimulus frequency on the pain perception threshold. *Archives of Oral Biology*. 19(2):145-9, 1974 Feb.
198. Natkin, E.; Harrington, G. W., and Mandel, M. A. Anginal pain referred to the teeth. Report of a case. *Oral Surgery, Oral Medicine, Oral Pathology*. 40(5):678-80, 1975 Nov.
199. Nethander, G. Autogenous free tooth transplantation by the two-stage operation technique. An analysis of treatment factors. *Acta Odontologica Scandinavica*. 56(2):110-5, 1998 Apr.
200. Nethander, G. Autogenous free tooth transplantation with a two-stage operation technique. *Swedish Dental Journal - Supplement*. (161):1-51, 2003.
201. Nettleton, S. Power and pain: the location of pain and fear in dentistry and the creation of a dental subject. *Social Science & Medicine*. 29(10):1183-90, 1989.
202. Newton, J. T. and Buck, D. J. Anxiety and pain measures in dentistry: a guide to their quality and application. *Journal of the American Dental Association*. 131(10):1449-57, 2000 Oct.
203. Ngassapa, D. N. Comparison of functional characteristics of intradental A- and C-nerve fibres in dental pain. *East African Medical Journal*. 73(3):207-9, 1996 Mar.
204. Nicolodi, M.; Frezzotti, R.; Diadori, A.; Nuti, A., and Sicuteri, F. Phantom eye: features

- and prevalence. The predisposing role of headache. *Cephalalgia*. 17(4):501-4, 1997 Jun.
205. Nicolodi, M. and Sicuteri, F. Phantom tooth diagnosis and an anamnestic focus on headache. *New York State Dental Journal*. 59(10):35-7, 1993 Dec.
206. Nist, E.; Reader, A., and Beck, M. Effect of apical trephination on postoperative pain and swelling in symptomatic necrotic teeth. *Journal of Endodontics*. 27(6):415-20, 2001 Jun.
207. Nusstein, J. M. and Beck, M. Comparison of preoperative pain and medication use in emergency patients presenting with irreversible pulpitis or teeth with necrotic pulps. *Oral Surgery Oral Medicine Oral Pathology Oral Radiology & Endodontics*. 96(2):207-14, 2003 Aug.
208. Nusstein, J. M.; Reader, A., and Beck, M. Effect of drainage upon access on postoperative endodontic pain and swelling in symptomatic necrotic teeth. *Journal of Endodontics*. 28(8):584-8, 2002 Aug.
209. O'Donnell, A.; Henderson, M.; Fearne, J., and O'Donnell, D. Management of postoperative pain in children following extractions of primary teeth under general anaesthesia: a comparison of paracetamol, Voltarol and no analgesia. *International Journal of Paediatric Dentistry*. 17(2):110-5, 2007 Mar.
210. Olausson, B.; Eriksson, E.; Ellmarker, L.; Rydenhag, B.; Shyu, B. C., and Andersson, S. A. Effects of naloxone on dental pain threshold following muscle exercise and low frequency transcutaneous nerve stimulation: a comparative study in man. *Acta Physiologica Scandinavica*. 126(2):299-305, 1986 Feb.
211. Olausson, B. and Sagvik, J. Pain threshold changes following acupuncture, measured with cutaneous argon laser and electrical tooth pulp stimulation, a comparative study. *Progress in Neuro-Psychopharmacology & Biological Psychiatry*. 24(3):385-95, 2000 Apr.
212. Olmsted, J. S. Pain medications for dentistry. *SCADA Journal*. 2:33-43, 1982.
213. Otasevic, M.; Naini, F. B.; Gill, D. S., and Lee, R. T. Prospective randomized clinical trial comparing the effects of a masticatory bite wafer and avoidance of hard food on pain associated with initial orthodontic tooth movement. *American Journal of Orthodontics & Dentofacial Orthopedics*. 130(1):6.e9-15, 2006 Jul.
214. Oztas, N.; Olmez, A., and Yel, B. Clinical evaluation of transcutaneous electronic nerve stimulation for pain control during tooth preparation. *Quintessence International*. 28(9):603-8, 1997 Sep.
215. Pajari, U.; Raustia, A.; Pyhtinen, J., and Lanning, M. Influence of antineoplastic therapy on function of the masticatory system, tooth development, and cariogenic status: a case report. *Medical & Pediatric Oncology*. 27(2):108-13, 1996 Aug.
216. Panopoulos, P. Factors influencing the occurrence of pain in carious teeth. *Proceedings of the Finnish Dental Society*. 88 Suppl 1:155-60, 1992.

217. Pertovaara, A.; Huopaniemi, T.; Virtanen, A., and Johansson, G. The influence of exercise on dental pain thresholds and the release of stress hormones. *Physiology & Behavior*. 33(6):923-6, 1984 Dec.
218. Pollmann, L. and Harris, P. H. Rhythmic changes in pain sensitivity in teeth. *International Journal of Chronobiology*. 5(3):459-64, 1978.
219. Pollmann, L. and Hildebrandt, G. Circadian variations of potency of placebos on pain threshold in healthy teeth. *International Journal of Oral Surgery*. 10(Suppl 1):208-11, 1981.
220. Racey, G. L. Selected pain states and the use of anesthesia in dentistry. *Dental Clinics of North America*. 22(1):89-99, 1978 Jan.
221. Randow, K. and Glantz, P. O. On cantilever loading of vital and non-vital teeth. An experimental clinical study. *Acta Odontologica Scandinavica*. 44(5):271-7, 1986 Oct.
222. Raphael, K. and Marbach, J. J. Evidence-based care of musculoskeletal facial pain: implications for the clinical science of dentistry. *Journal of the American Dental Association*. 128(1):73-9, 1997 Jan.
223. Ring, M. E. Dentistry: a look backward and a peek into the future. *New York State Dental Journal*. 63(1):40-5, 1997 Jan.
224. Ringsdorf, W. M. Jr and Cheraskin, E. Letter: Painful teeth and dysglycemia. *JAMA*. 231(1):23-4, 1975 Jan 6.
225. Robertson, A. and Noren, J. G. Subjective aspects of patients with traumatized teeth. A 15-year follow-up study. *Acta Odontologica Scandinavica*. 55(3):142-7, 1997 Jun.
226. Rodd, H. D. and Boissonade, F. M. Substance P expression in human tooth pulp in relation to caries and pain experience. *European Journal of Oral Sciences*. 108(6):467-74, 2000 Dec.
227. Roistacher, S. L. The challenge to dentistry of chronic pain. *TMJ Update*. 6(5):81-3, 1988 Sep-Oct.
228. Rooney, J. and Tronstad, L. Effect of transcutaneous electrical nerve stimulation on pain perception threshold and pain tolerance level of human teeth subjected to electrical stimulation. *Endodontics & Dental Traumatology*. 2(3):109-12, 1986 Jun.
229. Rosa, C.; Ghione, S.; Panattoni, E.; Mezzasalma, L., and Giuliano, G. Comparison of pain perception in normotensives and borderline hypertensives by means of a tooth pulp-stimulation test. *Journal of Cardiovascular Pharmacology*. 8 Suppl 5:S125-7, 1986.
230. Rosa, C.; Vignocchi, G.; Panattoni, E.; Rossi, B., and Ghione, S. Relationship between increased blood pressure and hypoalgesia: additional evidence for the existence of an abnormality of pain perception in arterial hypertension in humans. *Journal of Human Hypertension*. 8(2):119-26, 1994 Feb.

231. Rosted, P. Introduction to acupuncture in dentistry. *British Dental Journal*. 189(3):136-40, 2000 Aug 12.
232. Roth, P. M. and Thrash, W. J. Effect of transcutaneous electrical nerve stimulation for controlling pain associated with orthodontic tooth movement. *American Journal of Orthodontics & Dentofacial Orthopedics*. 90(2):132-8, 1986 Aug.
233. Sato, F.; Kino, K.; Sugisaki, M.; Haketa, T.; Amemori, Y.; Ishikawa, T.; Shibuya, T.; Amagasa, T.; Shibuya, T.; Tanabe, H.; Yoda, T.; Sakamoto, I.; Omura, K., and Miyaoka, H. Teeth contacting habit as a contributing factor to chronic pain in patients with temporomandibular disorders. *Journal of Medical & Dental Sciences*. 53(2):103-9, 2006 Jun.
234. Schafer, E.; Finkensiep, H., and Kaup, M. Effect of transcutaneous electrical nerve stimulation on pain perception threshold of human teeth: a double-blind, placebo-controlled study. *Clinical Oral Investigations*. 4(2):81-6, 2000 Jun.
235. Schierz, O.; John, M. T.; Schroeder, E., and Lobbezoo, F. Association between anterior tooth wear and temporomandibular disorder pain in a German population. *Journal of Prosthetic Dentistry*. 97(5):305-9, 2007 May.
236. Schmelzeisen, R. and Frolich, J. C. Prevention of postoperative swelling and pain by dexamethasone after operative removal of impacted third molar teeth. *European Journal of Clinical Pharmacology*. 44(3):275-7, 1993.
237. Schwolow, R.; Wilckens, E., and Roth, N. Effect of transcutaneous nerve stimulation (TENS) on dental pain: comparison of psychophysical and neurophysiological data and application in dentistry. *Activitas Nervosa Superior*. 30(2):129-30, 1988 Jun.
238. Scott, D. Jr. The arousal and suppression of pain in the tooth. *International Dental Journal*. 22(1):20-32, 1972 Mar.
239. Seltzer, S. and Boston, D. Hypersensitivity and pain induced by operative procedures and the "cracked tooth" syndrome. *General Dentistry*. 45(2):148-59, 1997 Mar-Apr.
240. Seward, G. R. Emergency dentistry for the general practitioner. I. Pain from dental disease. *British Medical Journal*. 2(5512):509-10 contd, 1966 Aug 27.
241. Seward, G. R. Emergency dentistry for the general practitioner. II. Treatment of the primary conditions causing pain. *British Medical Journal*. 2(5513):567-71, 1966 Sep 3.
242. Sharav, Y.; McGrath, P. A., and Dubner, R. Masseter inhibitory periods and sensations evoked by electrical tooth pulp stimulation in patients with oral-facial pain and mandibular dysfunction. *Archives of Oral Biology*. 27(4):305-10, 1982.
243. Sharav, Y. and Tal, M. Masseter inhibitory periods and sensations evoked by electrical tooth-pulp stimulation in subjects under hypnotic anesthesia. *Brain Research*. 479(2):247-54, 1989 Feb 13.

244. Shevel, E.; Koepf, W. G., and Butow, K. W. A subjective assessment of pain and swelling following the surgical removal of impacted third molar teeth using different surgical techniques. *SADJ*. 56(5):238-41, 2001 May.
245. Shira, R. B. A rational approach to drug therapy in modern dentistry. *Bulletin of the Contra Costa Dental Society*. 12(6):7-14, 1967 Sep.
246. Sicuteri, F.; Nicolodi, M.; Fusco, B. M., and Orlando, S. Idiopathic headache as a possible risk factor for phantom tooth pain. *Headache*. 31(9):577-81, 1991 Oct.
247. Singer, E. Pain control in dentistry: management of chronic orofacial pain. *Compendium*. 8(2):114, 116-8, 120-2, 1987 Feb.
248. Skidmore, A. E. Pain of dental origin. *Clinical Journal of Pain*. 7(3):192-204, 1991 Sep.
249. Slavkin, H. C. Clinical dentistry in the 21st century. *Compendium of Continuing Education in Dentistry*. 18(3):212-6, 218, 1997 Mar.
250. Steiner, M. Managing pain and anxiety in dentistry: an overview. *Kentucky Dental Journal*. 39(2):18-9, 1987 Mar-Apr.
251. Stoller, E. P.; Gilbert, G. H.; Pyle, M. A., and Duncan, R. P. Coping with tooth pain: a qualitative study of lay management strategies and professional consultation. *Special Care in Dentistry*. 21(6):208-15, 2001 Nov-Dec.
252. Subhash, G.; Kapoor, K. K.; Mehrotra, K. K., and Jaya, D. Periodontal treatment systems--a clinical assessment and gingival tissue index, gingival pain index and tooth hypersensitivity index. *Journal of the Indian Dental Association*. 58(12):513-26, 1986 Dec.
253. Surveyor, A. B. Interpret your x-ray. Pain and mobility in the lower anterior teeth. *Journal of the Indian Dental Association*. 55(9):347, 1983 Sep.
254. Taintor, J. F.; Langeland, K.; Valle, G. F., and Krasny, R. M. Pain: a poor parameter of evaluation in dentistry. *Oral Surgery, Oral Medicine, Oral Pathology*. 52(3):299-303, 1981 Sep.
255. Tare, V. M. Pain control in dentistry. *Newsletter International College of Dentists, India Section*. 11(3-4):28-9, 1974 Sep-Dec.
256. Tassinari, G.; Migliorini, A.; Girardini, F., and Luzzani, A. Reference fields in phantom tooth pain as a marker for remapping in the facial territory. *Functional Neurology*. 17(3):121-7, 2002 Jul-Sep.
257. Taube, S.; Piironen, J., and Ylipaavalniemi, P. Helium-neon laser therapy in the prevention of postoperative swelling and pain after wisdom tooth extraction. *Proceedings of the Finnish Dental Society*. 86(1):23-7, 1990.
258. Thurauf, N.; Ditterich, W., and Kobal, G. Different sensitivity of pain-related

- chemosensory potentials evoked by stimulation with CO₂, tooth pulp event-related potentials, and acoustic event-related potentials to the tranquilizer diazepam. *British Journal of Clinical Pharmacology*. 38(6):545-55, 1994 Dec.
259. Tordoff, S. G.; Brossy, M.; Rowbotham, D. J.; James, J. N.; James, R., and Raphael, J. H. The effect of pre-incisional infiltration with lignocaine on postoperative pain after molar teeth extraction under general anaesthesia. *Anaesthesia*. 51(6):585-7, 1996 Jun.
260. Troullos, E. S. and Dionne, R. A. Pain control in dentistry: opioids and analgesic combinations. *Compendium*. 7(10):746, 748-53, 1986 Nov-Dec.
261. Umino, M.; Sano, H.; Ohwatari, T.; Oka, S., and Kubota, Y. Relationship between subjective pain estimation and somatosensory evoked potentials by electrical tooth stimulation. *Bulletin of Tokyo Medical & Dental University*. 35(3):67-74, 1988 Sep.
262. Valachi, B. and Valachi, K. Preventing musculoskeletal disorders in clinical dentistry: strategies to address the mechanisms leading to musculoskeletal disorders. *Journal of the American Dental Association*. 134(12):1604-12, 2003 Dec.
263. van der Bijl, P. Psychogenic pain in dentistry. *Compendium*. 1948 Mar-1948 Mar 31; quiz 54, 1995 Jan.
264. Vargas, C. M.; Macek, M. D., and Marcus, S. E. Sociodemographic correlates of tooth pain among adults: United States, 1989. *Pain*. 85(1-2):87-92, 2000 Mar.
265. Verrill, P. J. Pain control in dentistry. *British Dental Journal*. 149(12):362-3, 1980 Dec 16.
266. Vickers, E. R. and Cousins, M. J. Neuropathic orofacial pain part 1--prevalence and pathophysiology. *Australian Endodontic Journal: the Journal of the Australian Society of Endodontology*. 26(1):19-26, 2000 Apr.
267. Weil, K.; Hooper, L.; Afzal, Z.; Esposito, M.; Worthington, H. V.; van Wijk, A. J., and Coulthard, P. Paracetamol for pain relief after surgical removal of lower wisdom teeth. *Cochrane Database of Systematic Reviews*. (3):CD004487, 2007.
268. Whitehead, P. N. Local anaesthesia for pain relief following wisdom teeth extraction under general anaesthesia. *Anaesthesia*. 51(2):200, 1996 Feb.
269. Widerstrom, E. G.; Aslund, P. G.; Gustafsson, L. E.; Mannheimer, C.; Carlsson, S. G., and Andersson, S. A. Relations between experimentally induced tooth pain threshold changes, psychometrics and clinical pain relief following TENS. A retrospective study in patients with long-lasting pain. *Pain*. 51(3):281-7, 1992 Dec.
270. Wolfe, S. Update on pain management in dentistry: an exclusive interview with Dr. Stanton Wolfe. Interview by Phillip Bonner. *Dentistry Today*. 13(11):36, 38-40, 1994 Dec.
271. Wraith, A. Pain and anxiety control in dentistry. *SAAD Digest*. 16(3):2, 1999 Jul.

272. Yamasaki, K.; Shibata, Y.; Shibasaki, Y., and Fukuhara, T. The nature of the pain reaction associated with orthodontic tooth movement. *Nippon Kyosei Shika Gakkai Zasshi - Journal of Japan Orthodontic Society*. 44(2):332-8, 1985 Jun.
273. Yanagida, H.; Corssen, G.; Ceballos, R., and Strong, E. Alcohol-induced pituitary adenolysis: how does it control intractable cancer pain?--An experimental study using tooth pulp-evoked potentials in rhesus monkeys. *Anesthesia & Analgesia*. 58(4):279-87, 1979 Jul-Aug.
274. Yoser, A. J. and Mito, R. S. Injury prevention for the practice of dentistry. *Journal of the California Dental Association*. 30(2):170-6, 2002 Feb.
275. Youssef, H. A. An evaluation of four desensitizing agents for treatment of the post preparation tooth pain: silver nitrate, potassium nitrate, strontium chloride and ferric oxalate. *Egyptian Dental Journal*. 41(4):1485-94, 1995 Oct.
276. Yukizaki, H.; Nakajima, S.; Nakashima, K.; Yamada, Y., and Sato, T. Electroacupuncture increases ipsilaterally tooth pain threshold in man. *American Journal of Chinese Medicine*. 14(1-2):68-72, 1986.
277. Zambito, R. F. Controlling acute pain in dentistry. Part I. *New York State Dental Journal*. 50(7):420-1, 1984 Aug-Sep.
278. Hill AB. The environment and disease: association or causation? *Proc R Soc Med*. 1965;58:295-300.

Appendix 1

WorkSafeBC Evidence-Based Practice Group levels of evidence ^{adapted from 1,2,3,4}

1	Evidence from at least 1 properly randomized controlled trial (RCT) or systematic review of RCTs.
2	Evidence from well-designed controlled trials without randomization or systematic reviews of observational studies.
3	Evidence from well-designed cohort or case-control analytic studies, preferably from more than 1 centre or research group.
4	Evidence from comparisons between times or places with or without the intervention. Dramatic results in uncontrolled experiments could also be included here.
5	Opinions of respected authorities, based on clinical experience, descriptive studies or reports of expert committees.

References

1. Canadian Task Force on the Periodic Health Examination: The periodic health examination. CMAJ. 1979;121:1193-1254.
2. Houston TP, Elster AB, Davis RM et al. The US Preventive Services Task Force Guide to Clinical Preventive Services, Second Edition. AMA Council on Scientific Affairs. American Journal of Preventive Medicine. May 1998;14(4):374-376.
3. Scottish Intercollegiate Guidelines Network (2001). SIGN 50: a guideline developers' handbook. SIGN. Edinburgh.
4. Canadian Task Force on Preventive Health Care. New grades for recommendations from the Canadian Task Force on Preventive Health Care. CMAJ. Aug 5, 2003;169(3):207-208.