Posttonsillectomy Pain in Children

Evidence-based recommendations for prevention and management.

OVERVIEW: Tonsillectomy, used to treat a variety of pediatric disorders, including obstructive sleep apnea, peritonsillar cellulitis or abscesses, and very frequent throat infection, is known to produce nausea, vomiting, and prolonged, moderate-to-severe pain. The authors review the causes of posttonsillectomy pain, current findings on the efficacy of various pharmacologic and nonpharmacologic interventions in pain management, recommendations for patient and family teaching regarding pain management, and best practices for improving medication adherence.

Keywords: adenoidectomy, nonsteroidal antiinflammatory drugs, opioid complication, pain management, posttonsillectomy pain, tonsillectomy, wound healing

Tonsillectomy, with or without adenoidectomy, is effective in relieving pediatric sleep-disordered breathing—a term that describes a spectrum of obstructive disorders, ranging from snoring to obstructive sleep apnea. It can reduce the incidence of sore throat in children who have frequent throat infections and may be effective in treating children with peritonsillar cellulitis or abscesses. In addition, tonsillectomy plays a role in preventing the recurrence of rheumatic fever and in controlling chronic pharyngeal carriage of group A β-hemolytic streptococci. Nevertheless, despite a century of use and refinement, tonsillectomy remains a traumatic experience for children and their families.

In the best of hands, tonsillectomy has a 2% to 4% risk of immediate or delayed hemorrhage[1] and a death rate of one in 35,000.[2] Many children who have this surgery experience separation anxiety and night terrors; postoperative edema, dysphagia, and weight loss are common sequelae. Despite pharmacologic advances in treating postoperative nausea and vomiting, both are common after tonsillectomy. Although the pain following tonsillectomy varies from child to child, it is typically prolonged, relatively constant, and rated by most children as moderate to severe in intensity even when it is treated with nonopioid and opioid analgesics.[3,4]

This article explores the causes of posttonsillectomy pain. It reviews evidence-based best practices for mitigating this pain through both pharmacologic and nonpharmacologic interventions used in the hospital and in outpatient settings. In addition, it provides information about patient and family education and ways to improve medication adherence.

THE MECHANISM OF POSTTONSILLECTOMY PAIN

There has been remarkably little research into the mechanism of posttonsillectomy pain. Much information in this area comes to practitioners by way of analogy, referencing burn literature on wound healing at the cellular level and the role of inflammatory mediators.[5]

Tonsillectomy may damage tissue in a number of ways. The retractor, which is used to expose the oropharynx, compresses the tongue, produces venous congestion, and may injure sensory nerves (see Figure 1). The electrosurgical devices commonly used to excise the tonsils cause thermal damage to surrounding tissues, leading to acute inflammation and edema. After tonsillectomy, because the pharyngeal wound is left open, nerve pain fibers are exposed to hypotonic solutions and mechanical trauma from swallowed food. Related pain is most severe immediately after surgery and gradually diminishes over the ensuing days.

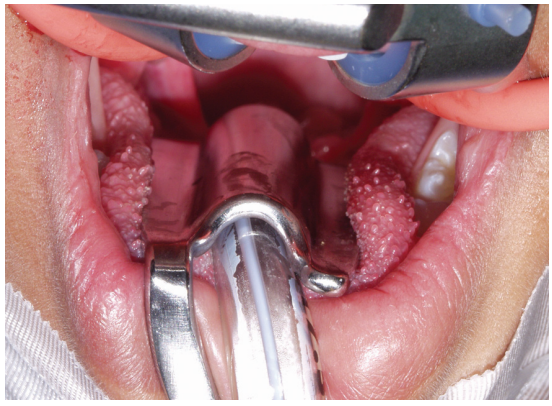

Figure 1. The tonsillectomy retractor, used to expose the oropharynx.

Figure 2. The oropharynx as it appears 24 hours after surgery, with a thick white coating of fibrin and inflammatory cells in the tonsillar fossae and an edematous uvula and pharyngeal wall.

All tonsillectomy wounds become inflamed and infected.[6] Within 24 hours of surgery, a thick white coating of fibrin and inflammatory cells appears in the tonsillar fossae, and the uvula and pharyngeal wall become edematous (see Figure 2). Inflammation intensifies between the third and fifth postsurgical days and may be associated with a transient increase in pain (see Figure 3[7, 8]). Eventually, a fibrin clot fills the tonsillar fossae. It peels away at the start of the second postsurgical week, as surrounding mucosa grows in to cover raw muscle and granulation tissue. Usually, the newly formed epithelium completely lines the tonsillar fossae within two weeks of surgery, at which point severe pain dissipates, though some stiffness and referred ear pain may persist for weeks thereafter. The tonsillectomy and adenoidectomy operation can cause pain at sites other than the throat, including the head, stomach, tongue, ears, and lips.[9]

Some evidence suggests that intracapsular tonsillectomy (tonsil reduction), which produces a smaller wound than the classic extracapsular tonsillectomy (total tonsil excision), causes less postsurgical pain and heals faster.[10, 11] A growing body of evidence supports intracapsular over extracapsular tonsillectomy in children whose indication for surgery is upper airway obstruction, and surgical outcomes for both procedures are comparable in reducing symptoms of obstructive sleep apnea and sleep-disordered breathing.[12] The need to follow up intracapsular tonsillectomy with complete tonsil excision because of regrowth was experienced by fewer than 1% of patients in a recent study.[13] In our clinical experience, children whose indication for tonsillectomy is recurrent sore throat seem to have more postsurgical pain than those whose indication is tonsillar hypertrophy, regardless of the type of tonsillectomy surgery they undergo.

Beyond physiologic considerations, the pain associated with tonsillectomy has an important emotional component. Perioperative anxiety may intensify the posttonsillectomy pain, and parental anxiety can be transferred to children.[14, 15] Racial and ethnic differences have also been found to affect the experience of posttonsillectomy pain, with one prospective, observational study finding that black children experienced significantly more posttonsillectomy pain than white children and that white children experienced significantly more opioid-related adverse effects.[16]

PHARMACOLOGIC PAIN MANAGEMENT

Intraoperative medications. Short-acting IV opioids are prophylactically administered during surgery to reduce pain in the immediate postoperative period. Evidence regarding the use of a local anesthetic, such as lidocaine spray applied to the tonsillar fossae, is conflicting and at best suggests a modest reduction in immediate posttonsillectomy pain.[17, 18] The pharyngeal anesthesia associated with these agents is frightening to some children and nerve blocks can cause severe upper airway obstruction.[19] Typically, a single dose of an intraoperative steroid (usually IV dexamethasone 0.5 mg/kg) is used to decrease postoperative nausea and vomiting, and may have a favorable effect on swelling and pain as well. By contrast, routine perioperative antibiotics have shown no benefit in reducing pain or other posttonsillectomy morbidity.[20, 21] Similarly, chemical or biologic coatings (such as sucralfate or a hemostatic matrix sealant) have not proven effective in protecting the tonsillar fossae following surgery.[22]

Opioid analgesics. Oral analgesics form the cornerstone of posttonsillectomy pain control. Although widely prescribed, acetaminophen with codeine has not demonstrated superior pain control over acetaminophen alone.[7] In a clinical trial of 80 children who had undergone tonsillectomy and received the

standard weight-based doses of acetaminophen with codeine for the first three days at home, the medication failed to provide effective analgesia.[4]

Another consideration is the metabolism of codeine to morphine in children, which occurs in the liver through the actions of the cytochrome P-450 (CYP) 2D6 isozyme. Although most children have normal CYP2D6 activity and their response to codeine is as expected, a substantial minority have CYP2D6 activity that is higher or lower than normal, potentially resulting in an excessive or inadequate response to codeine.[23] While codeine provides little or no benefit to slow metabolizers, its use in ultrarapid metabolizers is potentially dangerous, as it may produce suddenly high serum levels of morphine, resulting in excessive sedation, respiratory depression, and other adverse effects.

In August 2012, the U.S. Food and Drug Administration issued a strongly worded safety announcement regarding the use of codeine after tonsillectomy or adenoidectomy, citing concerns about the unpredictable metabolism of this agent and related incidence of morphine toxicity in children who are ultrarapid metabolizers (a group estimated to represent between 1% and 7% of the general pediatric population, and up to 29% of certain African pediatric populations).[24] This warning was followed in 2013 by a boxed warning declaring that the use of codeine after tonsillectomy or adenoidectomy is contraindicated.[25]

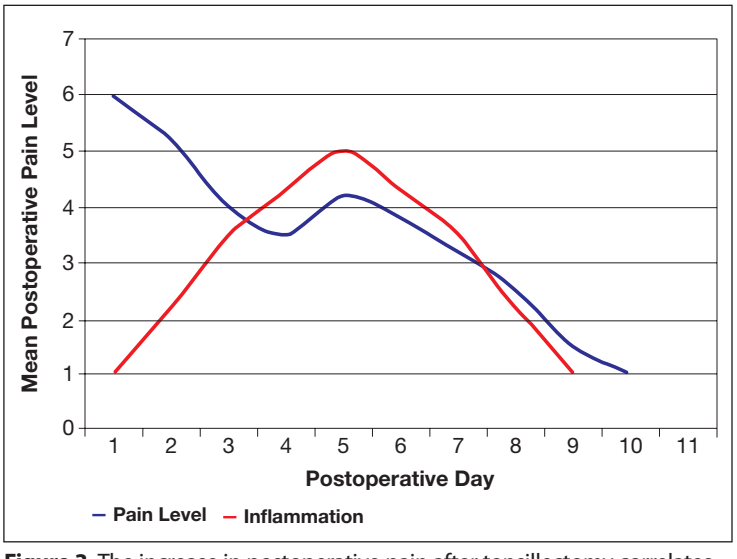

Figure 3. The increase in postoperative pain after tonsillectomy correlates with a peak in inflammation. In our clinical experience, the trajectory of posttonsillectomy pain closely mirrors the findings of Moir and colleagues,[7] while inflammation follows the pattern generally seen in wound healing as described by Witte and Barbul.[8] Here, the blue line represents mean daily pain levels reported by parents of children whose posttonsillectomy pain was treated with acetaminophen over the first 10 days following surgery.[7] The red line represents the typical course of inflammation over the same period, based on neutrophil proliferation observed during wound healing.[8]

It is theoretically possible to avoid the CYP2D6 dilemma by substituting oral morphine, either alone or in combination with acetaminophen or a nonsteroidal antiinflammatory drug (NSAID). Unfortunately, very little is known about the pharmacokinetics of oral morphine in children,[26] and fixed combinations of these drugs are not readily available. The practicality of this approach is further limited by the fact that morphine is more tightly regulated by the U.S. Drug Enforcement Administration than codeine.

The other commonly used alternative oral opioids, oxycodone (OxyContin and others) and hydrocodone, like codeine, are metabolized by CYP2D6. The clinical study of these drugs has been less extensive than that of codeine, but the use of hydrocodone in combination with acetaminophen (Vicodin and others) has been advocated as an effective alternative opioid for managing pediatric posttonsillectomy pain.[27,28] Unlike codeine, a relatively weak μ agonist whose analgesic action depends significantly on metabolic conversion to morphine, hydrocodone is believed to be primarily responsible for its observed analgesic effects (that is, active metabolites play a minor role in its analgesic action).[29] We do not know whether slow metabolizers will have reduced analgesia when treated with hydrocodone or if ultrarapid metabolizers may risk toxicity with normal doses.[30] Although both hydrocodone and oxycodone are used to manage pain in adult patients following tonsillectomy and adenoidectomy, there is no evidence to support the use of oxycodone to manage posttonsillectomy pain in children. If oral opioids are prescribed for posttonsillectomy pain, provider awareness and parental education are critical to ensure that early signs of overdose are immediately reported to the prescribing practitioner.

Nonopioid analgesics. A renewed focus on nonopioid oral analgesics for posttonsillectomy pain management, including acetaminophen and NSAIDs, has been prompted by concerns that opioids contribute to postoperative nausea, vomiting, and constipation and may worsen respiratory depression in children with obstructive sleep apnea.[31]

Acetaminophen is widely used and considered safe at normal doses.[32] When used alone, however, it may provide inadequate analgesia for posttonsillectomy pain.[3,33] Acetaminophen's therapeutic index is narrow, and at higher doses the drug may cause hepatic toxicity.[34] Since a number of over-the-counter remedies contain acetaminophen, it is important to remind parents to check the labels on all medications they give their child to avoid exceeding the maximum safe dosage of acetaminophen—for children under 12, 10 to 15 mg/kg every four to six hours, not to exceed five doses (50 to 75 mg/kg) in 24 hours; for children 12 and older, 650 to 1,000 mg every four to six hours as needed, not to exceed 4,000 mg in 24 hours.

The use of NSAIDs alone or in combination with acetaminophen is increasing. There is evidence that

Table 1. Recommendations for Preventing and Treating Tonsillectomy Pain in Children

Issue	Recommendation
Preoperative anxiety	Educate family about surgery, anesthesia, and postoperative pain management. Provide teaching booklet and preoperative instruction prior to surgery date.
Avoid excessive nausea	Consider a perioperative antiemetic, especially a serotonin receptor antagonist. Consider substituting acetaminophen or ibuprofen for oral opioids.
Dehydration	Ensure adequate control of pain and nausea. Encourage, but do not force, fluids.
Postoperative pain	Establish a pain treatment plan in collaboration with the family. Address anxieties and common misconceptions about analgesics and pain control. Consider time-contingent (around-the-clock) analgesics. *Pharmacologic measures:* Remember that ibuprofen is safe to use for postoperative pain. Do not administer acetaminophen with codeine after tonsillectomy or adenoidectomy. Observe patient for signs of atypical metabolism (inadequate analgesia or adverse effects) if prescribed an alternative oral opioid. Consider contacting the family after discharge to reinforce teaching. *Nonpharmacologic measures:* Suggest using cool drinks to provide comfort after surgery. Do not advise parents to restrict the child's diet or exercise. Remind parents that holding younger children on the lap is an effective adjunct for postoperative pain alleviation in the home.

NSAIDs, such as ibuprofen, diclofenac, ketoprofen, and ketorolac, are effective analgesics in children.[35] Although for many years, otolaryngologists were reluctant to use NSAIDs after tonsillectomy for fear of platelet inhibition and postsurgical hemorrhage, a 2010 update of a 2005 review from the Cochrane Collaboration found that NSAIDs (other than aspirin and cyclooxygenase-2 inhibitors, which are not recommended for children and were not studied in the reviewed trials) did not significantly alter postoperative bleeding compared with placebo or other analgesics.[36] The updated review analyzed data from 15 randomized controlled trials that included more than 1,000 children. Based on this evidence, the 2011 American Academy of Otolaryngology—Head and Neck Surgery Clinical Practice Guideline on Tonsillectomy in Children states that ibuprofen can be used safely for pain control after adenotonsillar surgery.[37]

Inadequate administration of prescribed medication by caregivers has been cited as a cause of poor postoperative pain control.[38] To address this issue, the use of around-the-clock regimens for postoperative analgesic administration has been advocated. Of the four clinical trials evaluating this approach in children who have undergone tonsillectomy,[3, 4, 27, 28] only one study of around-the-clock acetaminophen with hydrocodone resulted in lower pain scores than as-needed dosing.[28] Whether incomplete pain relief in these studies was owing to the dosing schedule or the choice of drug (acetaminophen, acetaminophen with codeine, rofecoxib, or hydrocodone) is unclear.

PATIENT AND FAMILY EDUCATION

In addition to effective analgesia, the prevention and management of tonsillectomy pain requires perioperative education to manage expectations, increase understanding, and promote attentive family care (see Table 1).

In the past, patient education about tonsillectomy pain was often withheld for fear of causing anticipatory anxiety. Today, there is evidence that education may help in controlling postoperative pain.[39] In a prospective study involving 60 children undergoing tonsillectomy (30 assigned to receive an age-appropriate patient education booklet and 30 assigned to standard care), 96% of children in the intervention group reported that preoperative pain education, which included learning about the 0-to-10 numeric pain intensity scale, helped with their postoperative pain. In addition, 91% of children in the standard care (control) group reported that it would have been helpful to learn about the numeric pain intensity scale before surgery.

Establishing a pain treatment plan requires advance planning on the part of the physician, nurse, parents, and if developmentally appropriate, the patient.[40, 41] Discharge instructions should be provided prior to the day of surgery to allow time to prepare for home

care.[42, 43] Important information may need to be repeated because parents may not remember everything they are told during the preoperative period.[40]

Several pain assessment tools, such as the Wong-Baker FACES Pain Rating Scale, have been validated for use in a pediatric population, and both children and parents may benefit from learning to use these tools. Depending on the child's age and ability to communicate, pain may be assessed using self-report or behavioral observation, with self-report being the preferred assessment, if feasible.

Instructional methods. Children and parents alike express a desire for information on pain management.[39, 44] Limited studies have examined the relative effectiveness of different instruction methods for children undergoing outpatient tonsillectomy.[43, 45]

An illustrated children's book about a cartoon character undergoing tonsillectomy was reported by mothers, but not by nurses, to reduce distress in children ages two to 10 who were preparing for tonsillectomy or adenoidectomy.[46] A pain education booklet for children ages seven to 13 was reported by children to have helped them deal with pain after tonsillectomy or adenoidectomy, although their pain scores were not lower than those in a control group who did not receive the booklet.[39] A recent study of adolescents undergoing tonsillectomy found that an Internet presurgery preparation, presented in a "peers teaching peers" conversational format, increased patient satisfaction and knowledge acquisition but did not reduce anxiety or postoperative pain outcomes.[43] While many children may benefit from online access to information, significant variability exists in the reliability and usability of Web-based resources available to parents and children undergoing tonsillectomy, and clinicians should assess available information and direct families to credible Web sites.

Patient education may help in controlling postoperative pain.

Results of two randomized clinical trials have suggested that a booklet may be an effective means of standardizing discharge teaching for parents of children undergoing adenotonsillectomy, particularly if it instructs parents to provide around-the-clock medication.[4, 28] These investigations found that children whose parents were provided with printed instructions that recommended around-the-clock medication administration—and also described the expected course of postoperative pain, the rationale for aggressive pain management, and methods for facilitating analgesic administration at home—received more of the prescribed opioid than those whose parents received printed instructions recommending that they administer the drug "every four hours, as needed." On the other hand, a study evaluating the use of illustrated informational handouts in helping parents distinguish between expected postoperative symptoms and complications requiring medical evaluation found that the handouts had no significant effect in reducing the volume of after-hour phone calls to the surgeon.[47]

Studies evaluating the efficacy of various counseling modalities in helping the parents of children undergoing adenotonsillectomy to retain knowledge of surgical risks have reported conflicting results.[48, 49] One study found that parents who received a detailed handout during counseling demonstrated significantly improved retention compared with parents who received only standard informed consent counseling but no handout.[49] Another study found no difference in retention scores achieved by parents who received standard oral counseling, standard counseling plus a printed handout, or standard counseling plus video instruction.[48] More research is needed to determine which educational interventions are most successful in improving the postoperative course of children undergoing tonsillectomy.

IMPROVING MEDICATION ADHERENCE

Failure to provide sufficient analgesia for children's posttonsillectomy pain after discharge remains a significant problem.[50-54] Optimal use of pain medication after tonsillectomy is essential in reducing such associated complications as dysphagia, decreased oral intake, and dehydration.[9, 37, 55]

Barriers to prescribed medication adherence are complex and varied, so a multifaceted approach is needed to improve adherence. Nurses and physicians can promote medication adherence by

- engaging families in the process of treatment decision making.
- assessing parental knowledge and understanding of the medication regimen.
- addressing and modifying inaccurate beliefs concerning the safety and effectiveness of pain medications.
- simplifying the drug regimen to the degree possible.

Parents should be advised to fill prescriptions in advance of the scheduled surgery to ensure the availability of pain medication after discharge. In addition, many parents have identified the following tools as practical aids in implementing a successful pain management plan in the home:

- a digital timer to assist with the prescribed analgesic regimen[56, 57]
- a pain management diary to track analgesic dosing, the child's pain intensity scores, and other symptoms[56]
- use of an algorithm to assist in making decisions about analgesic administration[58]

Other strategies include using alcohol-free versions of prescribed analgesics to avoid irritating the injured throat, adding flavoring to medications, and refrigerating medications to make them easier to swallow; however, the effectiveness of these strategies has not been studied.

At many outpatient surgery centers, nurses follow up with patients by calling their home the day after surgery to ask about their progress and the effectiveness of pain medication, reinforce discharge instructions, and respond to parental concerns. Parents of children undergoing tonsillectomy consider these calls useful in providing emotional support and reassurance.[56, 59, 60] In one investigation, nurse telephone follow-up improved home analgesic administration and fluid intake,[60] in contrast to a previous study in which it had no effect on medication administration, although parents found it validated their decision making and promoted their use of a pain management diary.[56]

NONPHARMACOLOGIC PAIN MANAGEMENT STRATEGIES

Both parents and school-age children report eating cold foods (like ice cream) and drinking fluids as the nonpharmacologic strategies they most commonly use to manage pain following tonsillectomy.[61-63] Other studies of postsurgical pain management have included such nonpharmacologic strategies as sleep or rest, distraction, and parents spending time with or holding their child.[9, 62, 64, 65] A cold pack to relieve pain around the neck and jaw, a heating pad for ear pain, chewing gum to lessen pterygoid muscle spasm, and use of a humidifier to prevent the discomfort of desiccation have also been suggested but are not well supported by research.

Investigations into the effects of diet and activity restrictions on posttonsillectomy recovery have been inconsistent. Although a 1995 study showed that such restrictions had no effect on posttonsillectomy pain, vomiting, number of doses of acetaminophen administered, and postoperative bleeding,[66] a 2010 study found that they had noticeable effects on postoperative pain (pain was lowest in the least-restricted group), as well as on bleeding and antibiotic use (both were most frequent in the least-restricted group).[67] The extent to which nonpharmacologic comfort measures reduce the intensity of children's postoperative pain has not been evaluated, but the perceived benefit reported by children and parents suggests that they are helpful and should be incorporated into patient and family teaching. ▼

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REFERENCES

1. Stevenson AN, et al. Complications and legal outcomes of tonsillectomy malpractice claims. *Laryngoscope* 2012;122(1):71-4.
2. Pratt LW, Gallagher RA. Tonsillectomy and adenoidectomy: incidence and mortality, 1968–1972. *Otolaryngol Head Neck Surg* 1979;87(2):159-66.
3. Romsing J, et al. Examination of acetaminophen for outpatient management of postoperative pain in children. *Paediatr Anaesth* 1998;8(3):235-9.
4. Sutters KA, et al. A randomized clinical trial of the effectiveness of a scheduled oral analgesic dosing regimen for the management of postoperative pain in children following tonsillectomy. *Pain* 2004;110(1-2):49-55.
5. Broughton G, 2nd, et al. The basic science of wound healing. *Plast Reconstr Surg* 2006;117(7 Suppl):12S-34S.
6. Isaacson G. Tonsillectomy healing. *Ann Otol Rhinol Laryngol* 2012;121(10):645-9.
7. Moir MS, et al. Acetaminophen versus acetaminophen with codeine after pediatric tonsillectomy. *Laryngoscope* 2000; 110(11):1824-7.
8. Witte MB, Barbul A. General principles of wound healing. *Surg Clin North Am* 1997;77(3):509-28.
9. Wiggins SA, Foster RL. Pain after tonsillectomy and adenoidectomy: "ouch it did hurt bad." *Pain Manag Nurs* 2007;8(4):156-65.
10. Cohen MS, et al. Intracapsular vs. extracapsular tonsillectomy: a comparison of pain. *Laryngoscope* 2007;117(10):1855-8.
11. Walton J, et al. Systematic review of randomized controlled trials comparing intracapsular tonsillectomy with total tonsillectomy in a pediatric population. *Arch Otolaryngol Head Neck Surg* 2012;138(3):243-9.
12. Mangiardi J, et al. Polysomnography outcomes for partial intracapsular versus total tonsillectomy. *Int J Pediatr Otorhinolaryngol* 2010;74(12):1361-6.
13. Doshi HK, et al. Age-related tonsillar regrowth in children undergoing powered intracapsular tonsillectomy. I*nt J Pediatr Otorhinolaryngol* 2011;75(11):1395-8.
14. Chieng YJ, et al. Perioperative anxiety and postoperative pain in children and adolescents undergoing elective surgical procedures: a quantitative systematic review. *J Adv Nurs* 2013 Jul 19 [Epub ahead of print].
15. Crandall M, et al. Children's tonsillectomy experiences: influencing factors. *J Child Health Care* 2009;13(4):308-21.
16. Sadhasivam S, et al. Race and unequal burden of perioperative pain and opioid related adverse effects in children. *Pediatrics* 2012;129(5):832-8.
17. Grainger J, Saravanappa N. Local anaesthetic for post-tonsillectomy pain: a systematic review and meta-analysis. *Clin Otolaryngol* 2008;33(5):411-9.
18. Hollis LJ, et al. Perioperative local anaesthesia for reducing pain following tonsillectomy. *Cochrane Database Syst Rev* 2000(2):CD001874.
19. Bean-Lijewski JD. Glossopharyngeal nerve block for pain relief after pediatric tonsillectomy: retrospective analysis and two cases of life-threatening upper airway obstruction from an interrupted trial. *Anesth Analg* 1997;84(6):1232-8.
20. Al-Layla A, Mahafza TM. Antibiotics do not reduce post-tonsillectomy morbidity in children. *Eur Arch Otorhinolaryngol* 2013;270(1):367-70.
21. Dhiwakar M, et al. Antibiotics to reduce post-tonsillectomy morbidity. *Cochrane Database Syst Rev* 2012;12: CD005607.

22. Fedorowicz Z, et al. Oral rinses, mouthwashes and sprays for improving recovery following tonsillectomy. *Cochrane Database Syst Rev* 2011(7):CD007806.
23. Williams DG, et al. Pharmacogenetics of codeine metabolism in an urban population of children and its implications for analgesic reliability. *Br J Anaesth* 2002;89(6):839-45.
24. U.S. Food and Drug Administration. FDA drug safety communication: codeine use in certain children after tonsillectomy and/or adenoidectomy may lead to rare, but life-threatening adverse events or dath. 2012. http://www.fda.gov/Drugs/DrugSafety/ucm313631.htm.
25. U.S. Food and Drug Administration. FDA drug safety communication: safety review update of codeine use in children; new boxed warning and contraindication on use after tonsillectomy and/or adenoidectomy. 2013. http://www.fda.gov/Drugs/DrugSafety/ucm339112.htm.
26. Mashayekhi SO, et al. Pharmacokinetic and pharmacodynamic study of morphine and morphine 6-glucuronide after oral and intravenous administration of morphine in children with cancer. *Biopharm Drug Dispos* 2009;30(3):99-106.
27. Bean-Lijewski JD, et al. Post-tonsillectomy pain management in children: can we do better? *Otolaryngol Head Neck Surg* 2007;137(4):545-51.
28. Sutters KA, et al. A randomized clinical trial of the efficacy of scheduled dosing of acetaminophen and hydrocodone for the management of postoperative pain in children after tonsillectomy. *Clin J Pain* 2010;26(2):95-103.
29. Schumacher MA, et al. Opioid analgesics and antagonists. In: Katzung BG, et al., eds. *Basic and clinical pharmacology* 12th ed. New York, NY: McGraw-Hill Medical; 2011. p. 543-64. Lange Basic Science.
30. Crews KR, et al. Clinical Pharmacogenetics Implementation Consortium (CPIC) guidelines for codeine therapy in the context of cytochrome P450 2D6 (CYP2D6) genotype. *Clin Pharmacol Ther* 2012;91(2):321-6.
31. Khetani JD, et al. Apnea and oxygen desaturations in children treated with opioids after adenotonsillectomy for obstructive sleep apnea syndrome: a prospective pilot study. *Paediatr Drugs* 2012;14(6):411-5.
32. Lavonas EJ, et al. Therapeutic acetaminophen is not associated with liver injury in children: a systematic review. *Pediatrics* 2010;126(6):e1430-e1444.
33. Hamers JP, et al. The effect of paracetamol, fentanyl, and systematic assessments on children's pain after tonsillectomy and adenoidectomy. *J Perianesth Nurs* 1999;14(6):357-66.
34. Li C, Martin BC. Trends in emergency department visits attributable to acetaminophen overdoses in the United States: 1993-2007. *Pharmacoepidemiol Drug Saf* 2011;20(8):810-8.
35. Kokki H. Nonsteroidal anti-inflammatory drugs for postoperative pain: a focus on children. *Paediatr Drugs* 2003;5(2):103-23.
36. Cardwell M, et al. Nonsteroidal anti-inflammatory drugs and perioperative bleeding in paediatric tonsillectomy. *Evid Based Child Health* 2011; 7(1):244-87. http://onlinelibrary.wiley.com/doi/10.1002/ebch.1819/pdf.
37. Baugh RF, et al. Clinical practice guideline: tonsillectomy in children. *Otolaryngol Head Neck Surg* 2011;144(1 Suppl):S1-S30.
38. Sutters KA, Miaskowski C. Inadequate pain management and associated morbidity in children at home after tonsillectomy. *J Pediatr Nurs* 1997;12(3):178-85.
39. Crandall M, et al. Children's pre-operative tonsillectomy pain education: clinical outcomes. *Int J Pediatr Otorhinolaryngol* 2008;72(10):1523-33.
40. Amata A. Pain management in ambulatory/day surgery. In: Kopf A, Patel NB, eds. *Guide to pain management in low-resource settings* Seattle: International Association for the Study of Pain; 2010. p. 119-21.
41. American Academy of Pediatrics, Committee on Psychosocial Aspects of Child and Family Health;Task Force on Pain in Infants, Children and Adolescents. The assessment and management of acute pain in infants, children, and adolescents. *Pediatrics* 2001;108(3):793-7.
42. Kankkunen P, et al. Is the sufficiency of discharge instructions related to children's postoperative pain at home after day surgery? *Scand J Caring Sci* 2003;17(4):365-72.
43. O'Conner-Von S. Preparation of adolescents for outpatient surgery: using an Internet program. *AORN J* 2008;87(2):374-98.
44. Fortier MA, et al. Children's desire for perioperative information. *Anesth Analg* 2009;109(4):1085-90.
45. Koller D. Child Life Council evidence-based practice statement: preparing children and adolescents for medical procedures. Rockville, MD: Child Life Council; 2007. http://www.childlife.org/files/ebppreparationstatement-complete.pdf.
46. Felder-Puig R, et al. Using a children's book to prepare children and parents for elective ENT surgery: results of a randomized clinical trial. *Int J Pediatr Otorhinolaryngol* 2003;67(1):35-41.
47. Ko AB, et al. Introduction of visually oriented information handouts in an academic pediatric otolaryngology practice. *Otolaryngol Head Neck Surg* 2007;136(3):471-6.
48. Adams MT, et al. Multimedia approach to preoperative adenotonsillectomy counseling. *Otolaryngol Head Neck Surg* 2012;146(3):461-6.
49. Nadeau DP, et al. Informed consent in pediatric surgery: Do parents understand the risks? *Arch Otolaryngol Head Neck Surg* 2010;136(3):265-9.
50. Helgadottir HL, Wilson ME. Temperament and pain in 3 to 7-year-old children undergoing tonsillectomy. *J Pediatr Nurs* 2004;19(3):204-13.
51. Huth MM, Broome ME. A snapshot of children's postoperative tonsillectomy outcomes at home. *J Spec Pediatr Nurs* 2007;12(3):186-95.
52. Stewart DW, et al. The severity and duration of postoperative pain and analgesia requirements in children after tonsillectomy, orchidopexy, or inguinal hernia repair. *Paediatr Anaesth* 2012;22(2):136-43.
53. Vallee E, et al. Pain management after tonsillectomy: morphine is not enough. *J Otolaryngol Head Neck Surg* 2008;37(2):279-84.
54. Wilson ME, Helgadottir HL. Patterns of pain and analgesic use in 3- to 7-year-old children after tonsillectomy. *Pain Manag Nurs* 2006;7(4):159-66.
55. Abou-Jaoude PM, et al. Complications of adenotonsillectomy revisited in a large pediatric case series. *J Otolaryngol* 2006;35(3):180-5.
56. Sutters KA, et al. The pediatric PRO-SELF: pain control program: an effective educational program for parents caring for children at home following tonsillectomy. *J Spec Pediatr Nurs* 2011;16(4):280-94.
57. Wiggins SA. Family exemplars during implementation of a home pain management intervention. *Issues Compr Pediatr Nurs* 2009;32(4):160-79.
58. Seid M, Varni JW. Pediatric day surgery outcomes management: the role of preoperative anxiety and a home pain management protocol. *J Clin Outcomes Manag* 1999;6(2):24-30.
59. Le T, et al. Follow-up phone calls after pediatric ambulatory surgery for tonsillectomy: what can we learn from families? *J Perianesth Nurs* 2007;22(4):256-64.
60. Paquette J, et al. A randomized clinical trial of a nurse telephone follow-up on paediatric tonsillectomy pain management and complications. *J Adv Nurs* 2013;69(9):2054-65.
61. Sutters KA, et al. Children's expectations of pain, perceptions of analgesic efficacy, and experiences with nonpharmacologic pain management strategies at home following tonsillectomy. *J Spec Pediatr Nurs* 2007;12(3):139-48.
62. Idvall E, et al. Pain experiences and non-pharmacological strategies for pain management after tonsillectomy: a qualitative interview study of children and parents. *J Child Health Care* 2005;9(3):196-207.
63. Sylvester DC, et al. The use of ice-lollies for pain relief post-paediatric tonsillectomy. A single-blinded, randomised, controlled trial. *Clin Otolaryngol* 2011;36(6):566-70.
64. Kankkunen PM, et al. Children's postoperative pain at home: family interview study. *Int J Nurs Pract* 2002;8(1):32-41.
65. Pölkki T, et al. Hospitalized children's descriptions of their experiences with postsurgical pain relieving methods. *Int J Nurs Stud* 2003;40(1):33-44.
66. Hall MD, Brodsky L. The effect of post-operative diet on recovery in the first twelve hours after tonsillectomy and adenoidectomy. *Int J Pediatr Otorhinolaryngol* 1995;31(2-3):215-20.
67. Zagolski O. Do diet and activity restrictions influence recovery after adenoidectomy and partial tonsillectomy? *Int J Pediatr Otorhinolaryngol* 2010;74(4):407-11.