Pain Management in Infants, Children, Adolescents and Individuals with Special Health Care Needs

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Purpose

The American Academy of Pediatric Dentistry (**AAPD**) recognizes that infants, children, adolescents, and individuals with special health care needs can and do experience pain due to dental/orofacial injury, infection, and dental procedures, and that inadequate pain management may have significant physical and psychological consequences for the patient. Appreciation of pediatric pain can help practitioners develop clinical approaches to prevent or substantially relieve dental pain. When pharmacological intervention is necessary to manage pain, the practitioner must understand the consequences, morbidities, and toxicities associated with the use of specific therapeutic agents. These recommendations are intended to provide dental professionals and other stakeholders with current best practices for pain management in pediatric dentistry.

Methods

This document is based on a review of current dental and medical literature pertaining to pain management in pediatric dental patients. Review of existing federal and professional pain management guidelines and consensus statements were used to assist with this document. An electronic search was conducted in the PubMed®/MEDLINE database using the terms: dental pain management, pediatric pain assessment, preemptive analgesia, pediatric and acetaminophen, adolescent and acetaminophen, pediatric and nonsteroidal anti-inflammatory drugs (**NSAIDs**), adolescent and NSAIDs, pediatric and opioids, adolescent and opioids, opioid risk, adolescent orofacial pain, pediatric and adolescent chronic pain, non-pharmacologic pain management; fields: all; limits: within the last 10 years, humans, English, and clinical trials. There were 1395 articles met these criteria. Papers for review were chosen from this list and from references within selected articles. When data did not appear sufficient or were inconclusive, recommendations were based upon expert and/or consensus opinion by experienced researchers and clinicians.

Background

Pain is defined by the International Association of the Study of Pain as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage."[1] Pain management includes pharmacologic and nonpharmacologic strategies to treat both acute and chronic pain. Due to the increased appreciation for pediatric pain and because of the national opioid crisis, recommendations for professional education and approaches for therapeutic management are being reviewed at the national, state, and local levels.[2-5] This document discusses pain processing, pain assessment, pain categories, pre-emptive analgesia, non-pharmacologic pain management, pharmacologic pain management, and best practices for prescribing opioids.

Pain processing

Understanding pain processing is essential for the management of pain. Pain experience in childhood may shape future pain experiences in adulthood.[6] Dental pain is an inflammatory condition resulting from tissue damage, infection, or invasive treatment.[7] Swelling, hyperthermia, and activation of biochemical cascades are hallmarks of inflammatory pain.[7,8] Thermal, mechanical, and chemical stimuli activate free nerve endings.[9,10] Sensory signals travel along afferent trigeminal nerve fibers and relay information to the brainstem and higher structures involved with the perception of pain.[11] Under normal conditions the perception of pain persists until the stimulus is removed.

Peripheral sensitization

Terminal nerve endings at the site of tissue injury exhibit an enhanced neuronal response.[9] This local increase in nerve membrane excitability is referred to as peripheral sensitization.[12] The exaggerated response to stimuli in the region of tissue damage is called primary hyperalgesia.[11]

Central sensitization

Central sensitization refers to enhanced functional status of pain circuits and pain processing at the level of the central nervous system (**CNS**).[8,12,13] Both secondary hyperalgesia, which is an increase in pain intensity to noxious stimuli outside of

ABBREVIATIONS

AAP: American Academy of Pediatrics. **AAPD:** American Academy of Pediatric Dentistry. **APS:** American Pain Society **CDC:** Centers for Disease Control and Prevention. **CNS:** Central nervous system. **FDA:** Food and Drug Administration. **IV:** Intravenous. **NSAIDs:** Nonsteroidal anti-inflammatory drugs. **VAS:** Visual analogue scale.

the area of tissue damage, and allodynia, which refers to pain perception following innocuous stimuli such as light touch, are characteristics of central sensitization.[13]

Pain modulation

Modulation of pain pathways occurs through CNS excitatory and inhibitory processes. Ascending facilitating and descending inhibitory processes enhance or suppress the pain experience, respectively.[12] Both pharmacologic and nonpharmacologic methods target these processes to alter pain processing.[14,15]

Pain assessment

Ethnic, cultural, and language factors may influence expression and assessment of pain.[16] Pain is assessed using self-report, behavioral (vocalization, facial expression, body movement), and biological (heart rate, transcutaneous oxygen, sweating, stress response) measures.[17] Direct questioning or a structured, comprehensive pain assessment can be clinically beneficial for pediatric and adolescent patients.[17,18] Conducting a structured interview begins with asking specific questions regarding pain onset, provoking factors, palliative factors, quality or character, region or location, severity or intensity, timing or duration, and impact on daily activities. Obtaining information through self-report can be aided by asking the child to make comparisons, using temporal anchors and facilitating communication through objects or gestures.[17] Assessing behavioral reactions and physiological reactions to pain are required in non-verbal and young patients.[17] Four- to 12-years-old patients can likely quantify pain based on a series of faces.[19] Patients older than seven should be able to mark pain using a visual analogue scale (**VAS**) or numeric scale.[19,20] Validated instruments available for assessing pain in verbal or nonverbal patients include: Faces Pain Scale (Revised), VAS, numeric rating scale, Faces, Legs, Activity, Cry, and Consolability score (FLACC), Revised Faces, Legs, Activity, Cry and Consolability (r-FLACC), and the McGill Pain Questionnaire.[19,21,22]

Pain categories

Pain may be divided into diagnostic categories such as somatic, visceral, and neuropathic.[23-26] Pain encountered in dentistry is typically inflammatory and categorized as somatic (i.e., periodontal, alveolar, mucosal) or visceral (i.e., pulpal) pain.[27]

Pain also may be categorized as acute or chronic. Acute pain that fails to respond to treatment may become chronic over time.[28] Chronic pain refers to pain that is dysfunctional and persists beyond the time for typical tissue healing.[29-32] Temporomandibular disorder (TMD) is an example of a chronic pain condition encountered in dentistry.[33]

Pain management

Pre-emptive pain management

Pre-emptive pain management refers to administration of an anesthetic agent, medication, or technique prior to a surgical event with the goal of decreasing pain. Goals of pre-emptive pain management include attenuating central sensitization, decreasing postoperative pain, improving recovery, and reducing postoperative analgesic consumption.[11,15] Postoperative pain management in pediatric patients has been suboptimal in large part because of the misconception that children do not feel pain as severely as adults do[34] and the fear of adverse events.[35] It has been shown that nearly 50 percent of patients undergoing dental rehabilitation describe moderate to severe pain[36], and there is data to support pre-emptive measures to optimize pain control for a variety of dental and surgical procedures.[37] However, level of evidence is low due to sparse well-controlled trials.[38-40]

Achieving profound anesthesia prior to initiating treatment decreases central sensitization.[37] Topical anesthetics are used in a dentistry to minimize pain; however, these medicaments alone may not be sufficient for dental procedures.[41,42] Other factors that may contribute to a patient's pain experience are the anesthetic properties and the needle used during the injection.[43] Distraction techniques made at the time of the injection such as jiggling the patient's cheek take advantage of Aß-fiber signal dominance and can significantly reduce the intensity of pain-related C-fiber signaling.[43] Buffering or decreasing acidity of local anesthetic using sodium bicarbonate can decrease injection site pain and postoperative discomfort by increasing the pH of the anesthetic. This is a well-accepted technique in medicine but has not been commonly used in dentistry.[43,44] Finally, decreasing anesthetic delivery rate also has demonstrated pain reduction during injection.[45]

In one study, the use of pre-emptive analgesics in conjunction with local anesthetics increased the ability to achieve pulpal anesthesia in patients with irreversible pulpitis when compared with placebo.[46] The pre-emptive analgesics most commonly used in dentistry are NSAIDs and acetaminophen, either alone or in combination.[47] Analgesics with sedative properties are often administered during the pre-, peri-, and post-operative periods when moderate to severe pain is anticipated.[48-51]

Use of local anesthesia during general anesthesia

Although pain is not experienced during general anesthesia, central sensitization occurs when peripheral nerves are stimulated.[37,52,53] Operating without local anesthesia may result in priming of CNS neurons and increased future pain sensitivity.[6] Central sensitization is minimized with pre-emptive analgesia or anesthesia. For this reason, regional block or infiltration anesthesia is commonly performed prior to surgical procedures to decrease postoperative pain.[11,54,55] However, pharmacologic and cardiac considerations along with avoiding the numb sensation and potential for self-inflicted oral trauma are reasons providers may choose not to provide local anesthesia during general anesthesia.[55,56]

Non-pharmacologic approaches to pain management

Studies suggest that nonpharmacologic interventions may be effective alone or as adjuncts to pharmacological interventions in managing procedure related pain, anxiety, and distress with minimal risk of adverse effects.[9,57-59] Fear and anxiety activate circuits within the CNS that facilitate pain.[29] Creating a safe, friendly environment may help a child feel more comfortable

and less stressed.[58,60] The American Academy of Pediatrics (**AAP**) and the American Pain Society (**APS**) recommend that providers reduce distress-producing stimulation and provide a calm environment for procedures to improve pain management.[3] Emotional support is a key component in creating a comfortable environment.[61] Although there is no evidence that the presence of parents decreases pain, there is data to support that it may decrease the child's anxiety and distress.[60] Conversely, parental catastrophizing has been associated with poor outcomes for pediatric pain management.[62] The AAP and APS jointly advise expectation management for parents along with preparation for comforting their children when pain is anticipated.[3] Individual studies have shown the efficacy of psychologic techniques, including preparation and information, parent coaching or training, suggestion, memory alteration or change, and coping self-statements.[63-65] However, a 2013 Cochrane review concluded that there is no strong evidence available to support the efficacy of preparation and information, combined cognitive or behavioral strategies, parent coaching plus distraction, or suggestion for reducing needle-related pain and distress.[66]

Distraction and imagery

Distraction is an effective method of pain management in the pediatric population.[16,67] It can be cognitive (e.g., counting, non-procedural talk) or behavioral (e.g., videos, games), both of which aim to shift attention away from pain. Distraction techniques such as bubbles, counting, conversation, music, television, toys and video games may be used by health care providers or the child's caregiver.[58,60] There is strong evidence supporting the efficacy of distraction techniques for needle-related pain and distress in children and adolescents.[66] Distraction has been shown to be significantly effective when measuring pulse rates, respiratory rates, and self-reported pain.[3,60] Additionally, distraction intervention has been shown to lower the perception of pain distress in younger children as reported by parents.[61] Distraction techniques may be of great use with patients with special needs that have shortened attention spans and are unable to understand verbal reasoning or reassurance.[63]

Imagery guides the child's attention away from the procedure by harnessing imagination and story-telling. Imagery in combination with distraction have been shown to be helpful in decreasing postoperative pain in children.[67,68] This technique requires the active cooperation of the patient and is most effective when used for children over eight years old.[57]

Hypnosis

Hypnotherapy aims to alter sensory experiences and dissociate from pain experiences, and hypnosis is best for school-aged or older children.[26] There is strong evidence that hypnosis is effective in reducing needle-related pain and distress in children and adolescents.[66,69] There is no evidence that hypnosis alone is capable of producing an anesthetic effect for dental procedures; therefore, it should always be combined with profound local anesthesia.[69]

Other techniques

Studies have shown efficacies for pediatric pain management with other techniques such as relaxation and breathing exercises, transcutaneous electrical nerve stimulation, acupuncture, counterstimulation, virtual reality, and music therapies.[65,67,70-75] Additional research is need on these interventions to measure their effectiveness.

Pharmacologic Agents

Management of pain in children is changing rapidly as a result of improvements in the appreciation of pediatric pain and pharmacologic knowledge. However, randomized controlled trials are lacking in children so the use of many pain medications are still considered off label.[76,77] Acetaminophen, ibuprofen, and opioids are common medication choices for the treatment of acute pain in children.[16,76]

Non-opioid analgesics

Nonsteroidal anti-inflammatory drugs (NSAIDs). NSAIDs are among the most commonly used class of drugs and have anti-inflammatory, analgesic, antipyretic, and antiplatelet properties.[78] They inhibit prostaglandin synthesis, with specific action on cyclooxygenase (COX).[50] Representatives of the major categories of NSAIDs are salicylic acids (aspirin), acetic acids (ketorolac), proprionic acids (ibuprofen, naproxen), and cyclooxygenase-2 selective (celecoxib). Ibuprofen in oral or intravenous (**IV**) form is a commonly used analgesic and antipyretic agent in pediatrics.[78] Ketorolac, an IV or intranasal NSAID, is useful in treating moderate to severe acute pain in patients unable or unwilling to swallow oral NSAIDs.[26,54,79] Some of the adverse effects associated with NSAIDs include: inhibition of bone growth and healing, gastritis with pain and bleeding, decreased renal blood flow, inhibition of platelet function, and increased incidence of cardiovascular events.[26] A specific concern with NSAIDs is the potential to exacerbate asthma due to a shift in leukotrienes.[76] Due to shared pathways, NSAIDs and steroidal anti-inflammatory medications should not routinely be co-administered.[81]

Acetaminophen (acetyl-para-aminophenol [APAP], paracetamol). Acetaminophen is an analgesic with efficacy for mild to moderate pain and is an antipyretic.[81] Unlike NSAIDs, acetaminophen is centrally-acting and does not have effects on gastric mucosal lining or platelets.[81] Its mechanism of action is the blockade of prostaglandin and substance P production. Acetaminophen is administered in tablets, capsules, and liquid but also is available as oral disintegrating tablets, oral disintegrating films, and rectal and IV forms.[50] Studies have shown that rectal administration has somewhat higher bioavailability and faster onset than the oral route since it partially bypasses hepatic metabolism.[80] Pain control can be optimized when acetaminophen and NSAIDs are alternated or staggered, a technique known as multi-modal therapy.[76,81,82]

Opioid analgesics

Opioid analgesics have been used for many years to produce profound pain relief in all age groups. Opioid analgesics are considered for acute moderate to severe pain refractory to other therapies. Common uses in pediatric patients include pain associated with cancer, sickle cell disease, osteogenesis imperfecta, epidermolysis bullosa, and neuromuscular disease.[83,84,85] Limited studies are available regarding postoperative opioid use in pediatric dentistry, but it is also rare that pediatric dental patients should require opioid analgesics following dental treatment.[50] Major concerns of opioid analgesics in the pediatric population are efficacy, safety, misuse, and accidental deaths.[77,86,87]

Opioids interact differentially with μ, κ, and δ receptors in the central nervous system. Opioid agonists act on receptors located in the brain, spinal cord, and digestive tract. Pathways of opioid receptor signaling are multiple and include G-protein receptor coupling, cyclic adenosine monophosphate inhibition, and calcium channel inhibition.[50] Activation of opioid receptors can cause respiratory depression, pupil constriction (miosis), euphoria, sedation, physical dependence, endocrine disruption, and suppression of opiate withdrawal.[26] Pruritus (itching) may also occur due to histamine release that accompanies some opioid analgesics.[48] Naloxone is a mμ opioid receptor competitive antagonist usually administered parenterally to counter opioid overdose.[50] If patients are actively prescribed opioids for cancer or non-cancer pain, providers should choose another agent for analgesia or consult with a specialty provider (e.g., pain medicine practitioner, anesthesiologist) regarding opioid dosing.[77]

Opioids with active metabolites. Codeine, tramadol, and hydrocodone are opioids that are broken down in the liver to active metabolites by highly variable cytochrome enzyme CYP2D6.[22,81,88] These drugs are ineffective in some children due to poor drug metabolism.[9] Yet other patients known as hyper-metabolizers break these prodrugs to their active forms too quickly, potentially resulting in overdose, respiratory depression, and even death.[88] The U.S. Food and Drug Administration (**FDA**) and European Medicines Agency have issued warnings and contraindications statements on codeine and tramadol over the past few years because of this.[88,89] Hydrocodone also relies on cytochrome p450 metabolism and has potential for similar adverse effects. Although systematic reviews have demonstrated that these medications might provide appropriate analgesia when compared to placebo, evidence is not convincing and safety concerns exist.[90,91] In 2017, the FDA issued a warning specifically for codeine and tramadol in all patients less than 12 years of age, stating they are no longer considered safe to use in this age group.[88] Deaths have occurred in children using these medicines for post tonsillectomy and/or adenoidectomy pain management, general pain, sore or strep throat pain, and cold and cough.[88] The FDA warns that in the 12-17-year age group, these medications should not be used in high-risk patients (e.g., those with obesity, obstructive sleep apnea, lung tissue disease).[88] Furthermore, tramadol and codeine should not be used if breastfeeding since active metabolites are present in breastmilk.[88]

Opioids without active metabolites. Inactive metabolites refer to metabolites that do not have a noticeable effect on the CNS. Naturally-occurring morphine and the synthetics oxycodone and fentanyl do not have CYP2D6 considerations since they do not contain active metabolites.[81] Potency of all opioids is compared to morphine. Morphine provides rapid relief of severe pain for 2-3 hours and is associated with histamine release and respiratory depression. Fentanyl is 100 times more potent than morphine, ultra-short acting, and used for invasive procedures and sedations.[26] Chest wall rigidity is a well-known adverse reaction to fentanyl.[26] Rapidly-acting oxycodone has a longer half-life than morphine and is more potent. Oxycodone is available as a single agent or is combined with aspirin, ibuprofen, or acetaminophen. It comes in tablets, capsules, oral solution, and oral concentrate, and use is considered off label in children 12 years of age and younger.[50]

Opioid concerns and Centers for Disease Control and Prevention (CDC) recommendations. Trends in opioid overdose, opioid misuse, and concerns for opioid addiction prompted the CDC to issue guidelines for prescribing opioids for chronic pain.[30] The guideline aims to improve prescribing practices to ultimately benefit patient health and quality of life.[93] Although the guidance is specific for adults with chronic pain, all prescribers should be mindful of high-risk prescribing practices.[83] The guideline recommends limiting opioids for moderate to severe pain, restricting prescription to three days, and providing concurrent pharmacologic and non-pharmacologic therapy.[30] The guideline also advises against overlapping benzodiazepines and opioids prescriptions because of the increased potential for respiratory depression.[30] Dentists can have a role in decreasing the overall availability of opioids for nonmedical use and abuse in the home and community.[95]

Deaths due to opioid overdoses are at record highs prompting the CDC to declare an opioid epidemic in 2011.[87,95] Poisoning deaths of opioids nearly quadrupled from 1999 to 2011, with the most recent data at 5.4 per 100,000 individuals.[95] A trend towards increased pediatric emergency department visits due to opioid ingestion and a greater than 5-fold increase in overdose death rates in the 15-24-year age group also have been demonstrated.[95] Since commercial opioids often are combined with acetaminophen, the potential for hepatic failure from toxic levels of acetaminophen also must a be considered.[7] As previously stated, providers treating pediatric and adolescent populations should avoid prescribing opioid analgesics when patients are using benzodiazepines.[30]

Risky use of opioids among children and adolescents is a growing trend, and the concern for opioid use disorder in adolescents is significant.[96,97] In 2016, the American Academy of Pediatrics released a policy statement that recommended

timely intervention to curb opioid use disorder with the goal of eliminating long-term medical, psychiatric, and social consequences of ongoing substance abuse.[98]

Risk mitigation begins with understanding how to recognize drug seeking behavior.[2] To address the potential risk of opioid use/abuse, screening patients prior to prescribing opioids should be standard practice.[30] Screening commonly is performed with adult patients using a variety of screening tools.[99] Although screening adolescents for opioid abuse or misuse has been suggested, a standard assessment has not been identified.[77,99] Therefore, the practitioner should, at a minimum, perform a thorough review of medical history including analgesics used in the past before prescribing.[77] Despite the fact that screening of parents is recommended by the AAP, this is not a common practice.[100,101] Nonetheless, screening is essential for identifying children at risk of opioid exposure in the home. It also is known that children of parents who abuse opioids are at an increased risk for neglect and often suffer from parental instability and lack of structure in the home.[101] Therefore, behavioral health support may be required for emotional disturbances such as drug abuse, depression, or post-traumatic stress disorder.[101]

For professionals who suspect patients have use/abuse issues, the FDA, National Institutes of Health, National Institute on Drug Abuse, the American Dental Association, and state prescription drug monitoring programs have resources available to review the history of prescriptions for controlled substances which may decrease their diversion.[104] Transparent discussion of medication use with teens is important.[105] Furthermore, discussion regarding the proper disposal of unused controlled medications is key to reducing availability/diversion of substances with the potential for abuse or for physical and/or psychological dependence.

Recommendations

Infants, children, and adolescents can and do experience pain due to dental/orofacial injury, infection, and dental procedures. Inadequate pain management may have significant physical and psychological consequences for the patient. Adherence to the following recommendations can help practitioners prevent or substantially relieve pediatric dental pain and minimize risk of associated morbidities.

- Pain assessment should be considered for all patients.
- Careful technique should be used to minimize tissue damage when providing dental treatment.
- Profound anesthesia should be achieved prior to invasive treatment.
- Use of pre-emptive analgesia should be considered when postoperative pain is anticipated.
- Nonpharmacologic techniques (e.g., distraction) should carefully be considered as potentially valuable interventions for pain management.
- APAP/NSAIDs should be used as first line pharmacologic therapy for pain management.
- Use of opioids should be rare for pain management for pediatric dental patients.
- To help minimize the risk of opioid abuse, screen pediatric patients and their parents should be screened regarding previous/current opioid use before prescribing opioid analgesics.
- To avoid diversion of controlled substances, practitioners should utilize prescription monitoring databases and encourage patients to properly discard any unused medications.
- Providers should be knowledgeable of risks associated with analgesic medications prescribed and anticipate and manage adverse effects (e.g., asthma and NSAIDs, sedation and opioids.)
- Seeking expert consultation for patients with chronic pain or other complicated pain condition should be considered.
- Providers should be familiar with analgesic properties of agents used during sedation or general anesthesia.
- Prescribing opioid analgesics should be avoided if patient is using benzodiazepines.
- Synergistic effect from multiple medications (multi-modal analgesia) may be considered.

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