

Coping Skills in Children: An Introduction to the Biopsychosocial Model of Pain Control as a Tool to Improve Postoperative Outcomes

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Abstract: Pain management is a significant challenge for both families and physicians following major orthopaedic surgery in children. Psychosocial factors such as anxiety, catastrophizing, and self-efficacy have all been documented to affect postoperative pain. Unfortunately, interventions attempting to address these different variables have been limited across pediatric orthopaedics. In this article, we review the psychosocial constructs that impact a child's ability to manage pain while recovering from pediatric orthopaedic surgery. Additionally, we will highlight some promising coping skills and resilience interventions to date as well as what the 'ideal' psychosocial intervention might encompass. By familiarizing our colleagues with the evidence behind each of these concepts, we hope to improve surgeon confidence in managing psychosocial issues and catalyze efforts aimed at addressing this important knowledge gap.

Key Concepts:

- The *biopsychosocial model of pain* suggests that there is a complex interplay of biological, psychological, social, and cultural factors that influence the intensity of pain that someone experiences in response to a given stimulus.
- The psychosocial contributors to postoperative pain may be divided into three categories: 1) the thoughts and feelings of individual patients; 2) the influence of parents and family; and 3) broader societal and cultural factors.
- In addition to traditional analgesics, the ideal perioperative pain management pathway would employ psychosocial strategies as a primary treatment option *prior to surgery* in order to reduce acute postoperative pain, improve patient and family satisfaction, and *prevent* the conversion of acute-to-chronic pain.
- The ultimate analgesic after musculoskeletal surgery likely includes a combination of resiliency, greater self-efficacy, and appropriate parental support.
- There is a significant opportunity for pediatric orthopaedists to collaborate across disciplines in order to build improved perioperative care pathways that integrate early use of psychosocial strategies as part of a comprehensive, multimodal approach to pain management.

Introduction

Pain management is a significant challenge for both families and physicians following major orthopaedic surgery in children. Although pain improves reliably over time

after surgery,^{1,2} it frequently persists beyond baseline for months to years and can have a major deleterious impact on functional, psychological, and social well-being.³⁻⁸

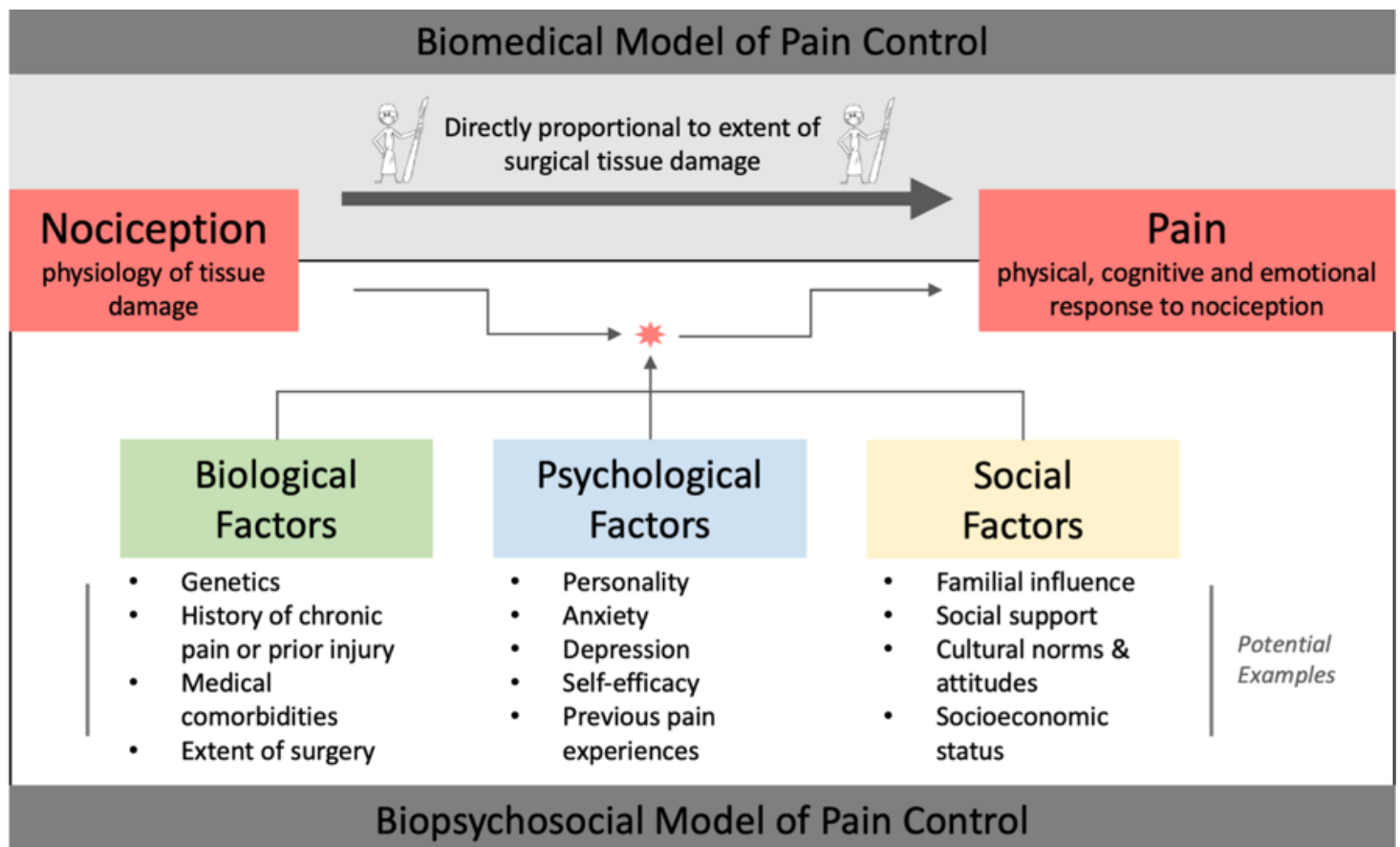


Figure 1. Both the biomedical and biopsychosocial models of pain describe the relationship between nociception or the physiology of tissue damage, and pain, which comprises the physical, cognitive, and emotional response to nociception. The biomedical model of pain control assumes a direct and linear relationship between nociception and pain. In contrast, the biopsychosocial model posits that pain is influenced by a combination of biological, social, cultural, and psychological factors inherent to that individual. In this figure, representative examples are presented for each potential contributor to the biopsychosocial model.

Multimodal medication pathways have been successfully developed to enhance the management of perioperative pain,^{9–12} but less attention has been directed towards the psychosocial aspects of long-term pain management and functional recovery at home. As such, establishing evidenced-based protocols that move beyond the biomedical model of pain to include non-pharmacological interventions targeting the psychosocial contributors to pain represent a significant opportunity for improving orthopaedic outcomes.

There are numerous barriers to the development of these protocols. Surgeons are not trained to evaluate and manage psychosocial aspects of patient care, and their

willingness to address these issues is related to both their level of confidence in engaging effectively as well as their perception that the necessary resources are available to help.^{13,14} Additionally, incentives are not aligned to encourage treatment of psychosocial issues within the confines of a busy surgical practice.

In this article, we review the psychosocial constructs and interventions that impact a child's ability to manage pain while recovering from pediatric orthopaedic surgery. Notably, this is a focused literature review by *orthopaedists* for *orthopaedists*, as there is extensive literature on these factors outside of our field.^{15–20} Our goals are to educate and equip surgeons to add the biopsychosocial

model to the more familiar biomedical model in order to optimize the management of surgical pain.

The Biopsychosocial Model of Pain Control

Postoperative pain may be broken down into two theoretical models (Figure 1). Each model considers the relationship between nociception or the physiology of tissue damage, and pain, which comprises the physical, cognitive, and emotional responses to nociception.^{21,22} The traditional *biomedical model of pain control* assumes a direct relationship between nociception and pain,²¹ which implies that pain is proportional to the extent of tissue damage and can be treated primarily by titrating the amount of analgesics administered.

In contrast, the *biopsychosocial model of pain* posits that, for any given nociception, there is a complex interplay of biological, psychological, social, and cultural factors that together influence the pain that a patient experiences.^{21,23–25} In other words, pain is more than a physical sensory experience. Evidence in support of this model exists across orthopaedics, as depression,^{26–28} anxiety,²⁹ catastrophic thinking,^{30,31} pain self-efficacy,^{32–34} and overall mental health^{35–38} have all been found to influence symptom intensity and functional disability following orthopaedic surgery.

Potential Impact on Children and Adolescents

Pain is not a purely biomedical problem.³⁹ In turn, failing to account for the psychosocial aspects of pain control may lead to poor perioperative pain management, which can have a number of negative long-term consequences in children and adolescents. The transition from acute postoperative pain to chronic postsurgical pain occurs within the first few weeks to months after major surgery,^{6,40–42} and may persist into adulthood.⁴³ Chronic pain in children following surgery is also common:¹⁷ 10–64% of children experience chronic pain lasting more than 1 year following spinal fusion for idiopathic scoliosis surgery,^{2–4,42,44} with 30% still using analgesics 2 years postoperatively.³ Finally, chronic pain has a significantly deleterious impact on children's lives, including

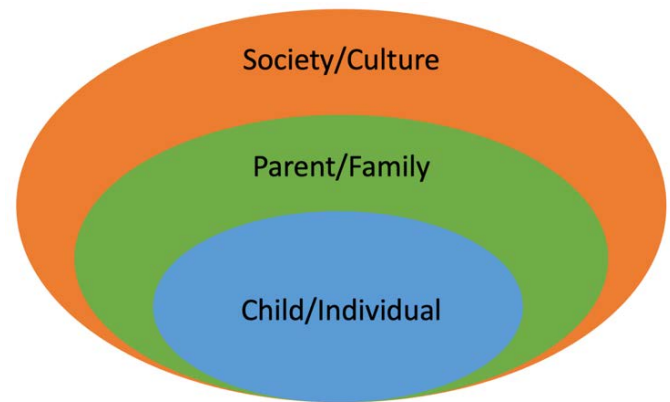


Figure 2. The different psychosocial contributions to postoperative pain.

decreased quality of life, increased functional disability and impaired attention, cognition, and affect.^{5,6,43,45}

Adolescents are at a higher risk for chronic pain and addictive behaviors following surgery, given the combination of neurobiological, psychological, and social changes occurring during this age.^{45–47} As a result, failure to establish healthy pain skills in the acute perioperative period may set the stage for poor pain management and addictive behaviors later in life.⁴⁸ This has been brought into focus by the opioid epidemic.^{19,21,49} For example, 5% of opioid-naïve youth undergoing surgery develop new persistent opioid use as compared with 0.1% of nonsurgical counterparts.⁵⁰

In summary, the ideal perioperative goal is comprehensive treatment of acute postoperative pain in order to improve patient satisfaction and *prevent* conversion to chronic pain. However, instead of being utilized as primary treatment options employed *prior to surgery*, psychosocial strategies are typically only trialed *after* the biomedical model has first failed.³⁹

The Psychosocial Contributors to Pain

The psychosocial contributors to postoperative pain may be divided into three categories: 1) the thoughts and feelings of individual patients (intrinsic), 2) the influence of parents and family (locally extrinsic), and 3) broader societal and cultural factors (globally extrinsic) (Figure 2).

Individual Contributions

The primary individual-level contributions include *anxiety*, *pain catastrophizing*, and *pain self-efficacy*. *Anxiety* is defined as a feeling of worry, nervousness, or unease about an imminent event of unfamiliar or uncertain outcome. In children undergoing spine surgery, greater baseline anxiety is associated with greater acute and chronic postsurgical pain.^{2,40,42,51,52} The higher the anxiety, the higher the pain.² Specifically, anxiety contributes to increased hypervigilance to pain, poor pain coping, and increased pain disability.^{2,40,53} Furthermore, greater baseline anxiety predicts slower improvement in pain in the postoperative setting.²

A similar psychological construct is *pain catastrophizing*, which is a persistently negative thinking style, or pattern of cognition, that leads to exaggerated and consuming concern about actual or anticipated pain. For example, a patient may believe that pain will be intolerable, or last indefinitely, which amplifies the experience presently as well as in the future.⁵⁴ Catastrophizing may be interrelated with anxiety as a form of pain-specific apprehension (as opposed to anxiety about a scar or returning to school). Although catastrophizing may be a normal human response to pain intended to protect us against extreme danger, when triggered by surgery, it becomes a form of misdirected problem solving or maladaptive thinking.^{21,55} In the context of pediatric surgery, catastrophizing is associated with lower pain tolerance, higher pain intensity, and greater pain-related disability.^{6,55–58} Similarly, studies in adults have identified catastrophic thinking as a major predictor of pain intensity and disability after both orthopaedic and general surgery.^{23,59,60} In sum, those who worry or feel helpless in the face of pain are at increased risk of poor outcomes.

In contrast, *pain self-efficacy* refers to the belief that one can manage pain. This is one of the strongest protectors against chronic postsurgical pain in children.¹⁷ Children's confidence in their ability to control pain after spinal

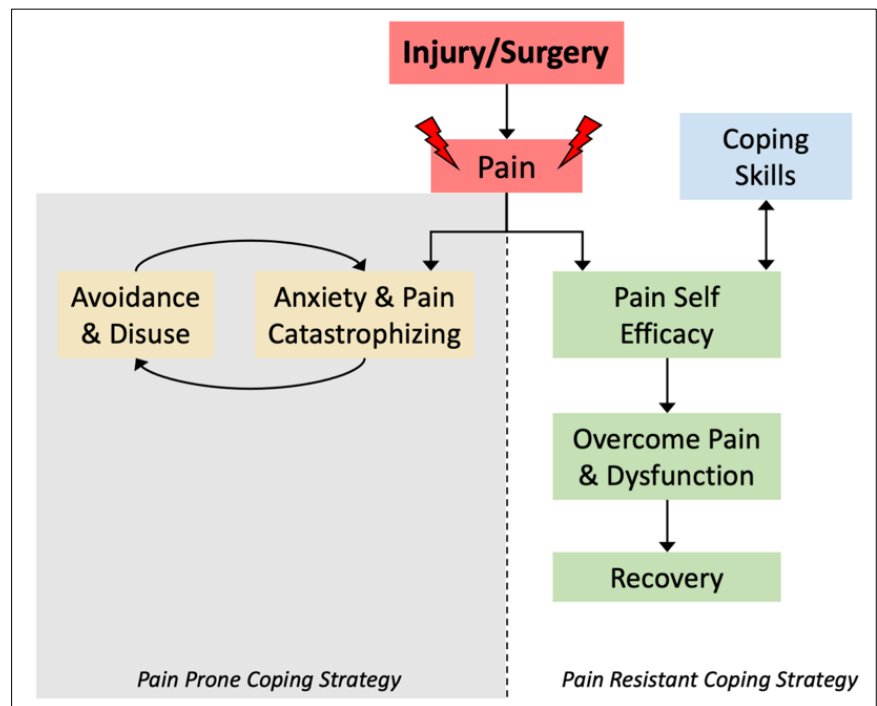


Figure 3. Two (of many) potential pain-coping pathways in response to postsurgical pain. Ideally, patients would follow the pathway on the right, which minimizes long-term morbidity and maximizes functional recovery by incorporating coping skills that enhance a patient's sense of self-efficacy. Conversely, a response that includes excessive anxiety and/or pain catastrophizing might lead to a cycle of avoidance, disuse, and chronic pain.

fusion for idiopathic scoliosis predicts a more rapid improvement in both postoperative pain and highest pain trajectories.² Additionally, children who focus their attention on dealing with the concrete aspects of recovery, such as activity modifications, returned to normal function sooner than children who focus on emotional features, such as complications or disfigurement.⁶¹ An essential component of self-efficacy is pain anticipation, which is proportional to reported postoperative pain.⁶²

Compiling the evidence, pain self-efficacy is a *pain-resistant* coping strategy, whereas pain-catastrophizing and anxiety are *pain-prone* strategies (Figure 3).^{58,61,63–65} Essential to coping with pain is the self-confidence to manage anxiety and avoid catastrophizing. At the same time, *individual differences*, or stable and enduring person-to-person variations (e.g., personality), play an important

role in how people respond to painful stimuli.⁶⁵ As a result, different children may respond very differently to the same psychosocial intervention.

Family Contributions

There is a bidirectional relationship between a parent's and a child's pain experience, as children learn to cope with pain within the context of family. Specifically, the ways in which parents react to a child's pain influences the child's behaviors and psychological response to that pain.⁶⁶ Beyond just their initial reaction to pain, children's thoughts and beliefs related to their ongoing pain experience are also shaped directly through interactions with and observations of their parents.⁶⁶ In turn, the parents' own experience and history with pain will influence how they interpret their child's experience. Parents are also poor interpreters of their child's pain,⁶⁷ which can lead to inaccurate and inconsistent analgesic administration.

In the context of surgery, parents' and children's pre-operative and postoperative anxiety scores are significantly correlated.^{2,51,66} High parental anxiety is also associated with increased narcotic use following spinal fusion.⁶⁸ Additionally, parental catastrophizing is associated with increased risk of chronic postsurgical pain, higher functional disability, and lower school attendance.^{6,66,69,70} In fact, parental pain catastrophizing following major surgery may be one of the strongest predictors of child pain intensity in the postoperative setting.^{17,66,71} Social support, which can come from both friends and family, also has an impact on postoperative recovery. Looking at household status in children undergoing limb reconstructions, kids in two-parent households had reduced inpatient opioid use, shorter length-of-stays, and fewer unplanned readmissions and outpatient visits as compared to their one-parent peers. In adults, social support has been found to predict both functional disability and return to work following major extremity trauma.⁶⁵

Cultural Contributions

It is important to recognize that children are embedded in multiple systems that collectively influence their response

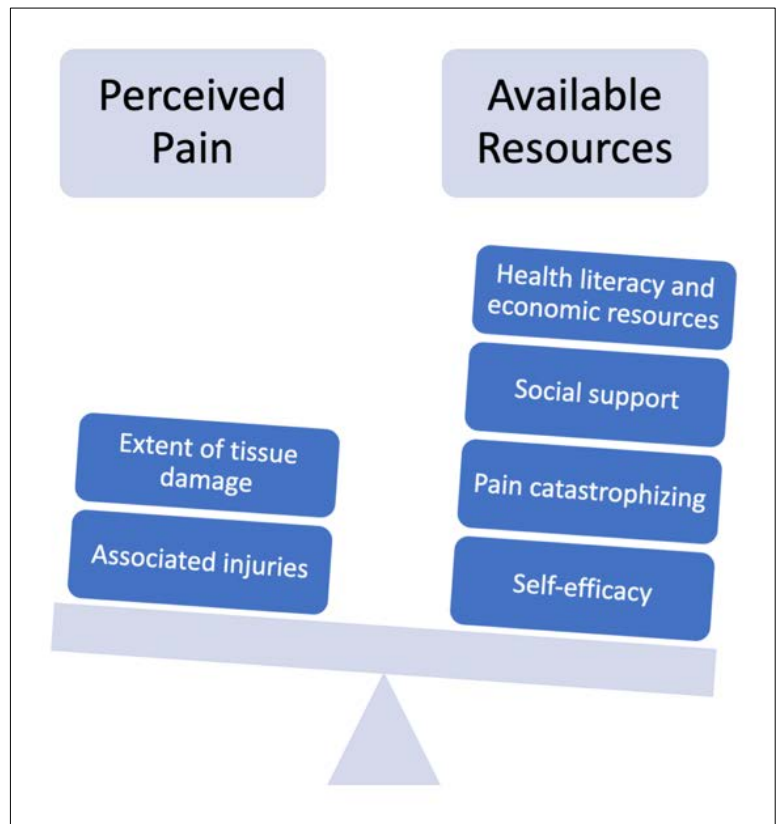


Figure 4. The perception of pain following an injury or surgery is influenced by an individual's available resources, including both intrinsic (e.g., self-efficacy, pain catastrophizing, temperament, comorbidities) and extrinsic factors (e.g., social support, health literacy, available economic resources). An abundance of resources can help someone balance out (or overcome) their perceived level of pain.

to pain. From a cultural perspective, a combination of norms, attitudes, and expectations play a role in how a patient responds to pain. For example, prescription opioid consumption in adults is four times lower in Western Europe compared with the United States and Canada.²¹ In one study comparing Dutch and U.S. adults, nationality was the best predictor of both pain intensity and opioid consumption following ankle fracture fixation.^{22,72} Furthermore, opioids are not routinely prescribed following common orthopaedic procedures in many developing countries. These cultural contributions likely influence children, who model their behavior and thought processes after parents and other adult role models. Unfortunately, there are few studies exploring this topic in orthopaedics.

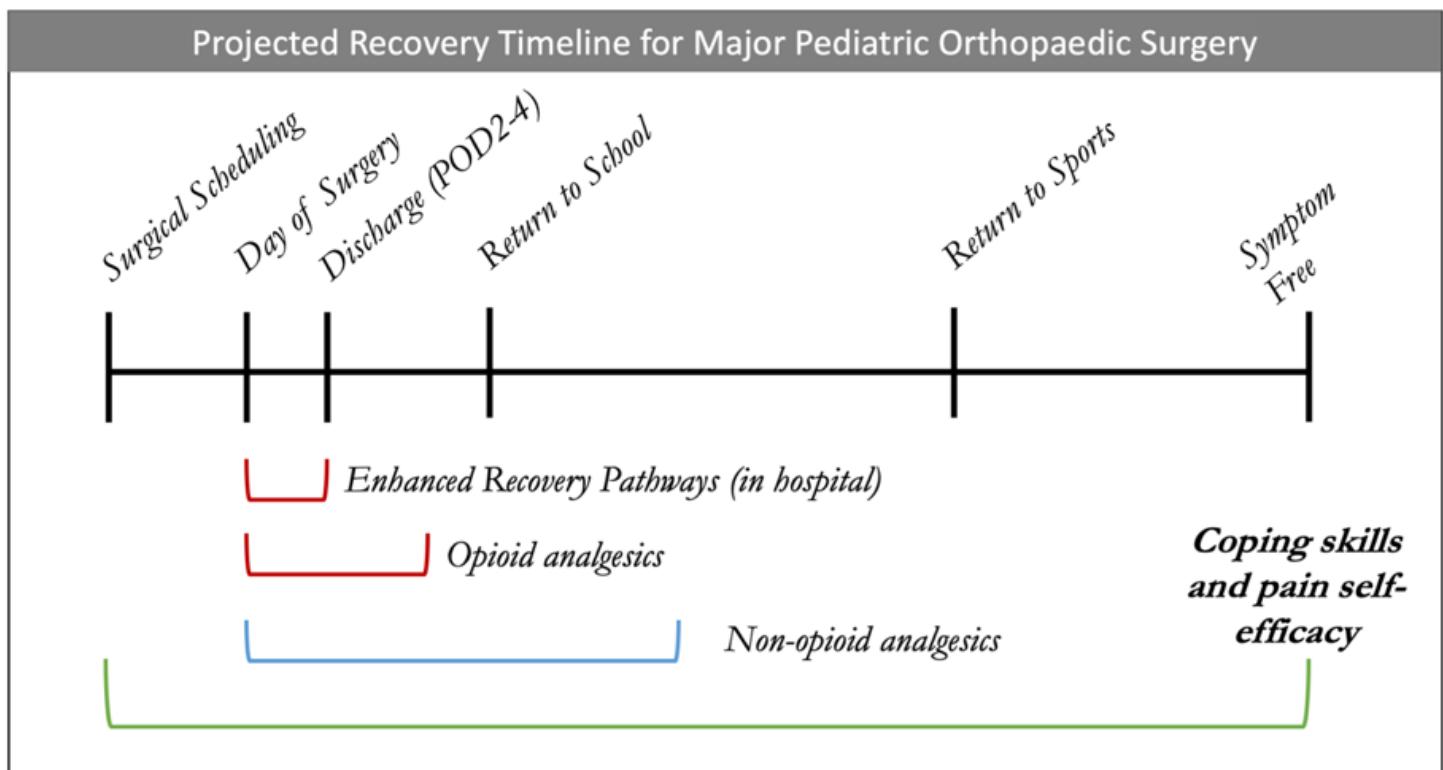


Figure 5. Current postoperative pain management strategies are built on the biomedical model of pain control and emphasize perioperative enhanced recovery pathways, including opioid and non-opioid analgesics. These are short-term solutions. Conversely, pathways built on the biopsychosocial model of pain control may better equip patients with the tools to adequately address the reality of a long recovery process at home through a focus on coping skills and pain self-efficacy.

Additionally, such a broad social construct is rarely amenable to individual-level intervention.

Putting all of these factors together, an individual's postoperative recovery is dependent upon their available resources (Figure 4). This includes a balance of intrinsic resources (e.g., self-efficacy, anxiety, catastrophizing) and extrinsic resources (e.g., family, culture). The more support and available resources an individual has, the more likely they are to successfully overcome the challenges of surgery. While many of these factors are immutable (i.e., outside a surgeon's control), others are modifiable. A surgeon's goal should be to collaborate with other experts, both researchers and clinicians, in order to impact these factors and improve the management of pain.

Coping Skills Interventions

In their review of the opioid epidemic, Helmerhorst and colleagues suggest that "the ultimate analgesic after musculoskeletal surgery is resilience, greater self-efficacy in response to pain; the sense that everything is on course and will turn out well."²¹ In other words, what psychological tools (e.g., coping skills) can we equip patients with so that they avoid the maladaptive coping strategies of anxiety and pain catastrophizing (Figure 3)? Ideally, the solution would include skills that patients can utilize beyond the acute peri-operative period to better address the long recovery process at home (Figure 5).

Coping skills include "an individual's effort to regulate emotion, cognition, physiology, behavior or situations in reaction to stressful events or challenging situations."⁷³ In the context of pediatric surgery, they comprise a toolbox of skills that help a child 'turn down the volume'

of an intense emotion or painful experience. Skills include self-soothing (e.g., deep breathing, progressive muscle relaxation, guided imagery), distraction (e.g., music or playing a game), “opposite action” activities (e.g., exercise), emotional awareness (e.g., journaling, positive self-affirmations), and mindfulness (e.g., focusing on the present) (Table 1).⁷³

Table 1: Different Types of Coping Skills⁷⁰

| Type | Example |
|---------------------|--|
| Self-Soothing | Deep breathing, progressive muscle relaxation, relaxation-guided imagery |
| Distraction | Music, playing video games |
| Opposite Action | Exercise, walking |
| Emotional Awareness | Journaling, positive self-affirmations |
| Mindfulness | Mindfulness-based meditation |

Among these different techniques, relaxation-guided imagery has the best support across the pediatric orthopaedic literature. In one study, a combined informational and coping skills intervention delivered via videotape prior to spinal fusion was most effective for reducing acute postoperative anxiety and pain in younger adolescents.^{74–76} Similarly, a combined video intervention consisting of information and guided imagery/relaxation improved pain control and reduced interference of pain with daily activities in a Canadian spinal fusion cohort.⁷⁷ Looking across all pediatric surgery, a systematic review and meta-analysis assessing the efficacy of psychological interventions for postoperative pain intensity in over 1,000 youth found that distraction/imagery exercises were the most effective with respect to reducing short-term, self-reported pain.⁷⁸

In adults, a recent meta-analysis of more than 60 randomized controlled trials concluded that psychosocial interventions could decrease postoperative pain and

improve the quality of care in orthopaedic surgery.⁷⁹

The authors showed that patient education and relaxation techniques had the most consistently positive effects on pain and anxiety, while cognitive and behavioral techniques could also help improve recovery.

Cognitive-behavioral therapy includes techniques directly targeting pain catastrophizing and kinesiophobia, which has shown promise following lumbar spine surgery,^{80,81} and is also an evidenced-based clinical practice recommendation for adults with chronic low back pain.^{82,83}

Optimizing postsurgical psychosocial recovery requires more than just skills to manage pain. In a qualitative study of children undergoing major surgery, Rabbitts et al. noted that patients and families seek normalization and reassurance from someone who could relate to them on a personal level.⁸⁴ Additionally, the authors identified a number of modifiable targets for a potential psychosocial intervention, including worry and anxiety, parental guilt, fear of pain, and fear of re-injury.

One aspect of normalization and reassurance is preoperative education, which can improve satisfaction and partially offset the psychosocial stress associated with surgery.^{79,85} Paradoxically, in children undergoing spinal fusion, a preoperative tour and educational session may increase anxiety in the immediate postoperative period without impacting length of stay or opioid consumption, suggesting that preoperative education alone is insufficient, and must be combined with coping skills to help children appropriately process new information.⁷ Building on this, recent clinical practice guidelines suggest that providers offer families information on postoperative pain management in advance of surgery, as well as teach parents methods and strategies to appropriately assess pain and administer analgesics.⁸⁶ To the author’s knowledge, however, there have been no published studies detailing specific strategies to address the well-established parental contribution to pediatric pain.

Considering patient’s broader mental health, Richard and colleagues found that an integrated treatment

Table 2: Strategies to Address Psychosocial Contributions to Pain in the Ambulatory Setting.

| Target | Goal | Example Question | Specific Strategies |
|---------------|----------------------------|--|---|
| Child | Mental Health | <i>In general, do you tend to worry a lot or feel sad?</i> | <ul style="list-style-type: none"> • Refer for preoperative psychological and/or psychiatric evaluation and intervention • Consider delaying elective surgery if appropriate • Engage Child Life Services <i>preoperatively</i> |
| | Pain Expectations | <i>What do you think your pain will be like after surgery?</i> | <ul style="list-style-type: none"> • Set realistic patient expectations • Emphasize that pain is a normal response to surgery • Explain that pain will be limited in intensity and duration |
| | Pain Management | <i>When you're feeling pain after surgery, what do you think will you do?</i> | <ul style="list-style-type: none"> • Discuss specific modalities that will be used to treat pain, including non-drug therapy • Suggest alternative coping strategies (e.g., Table 1) |
| | Anxiety | <i>What is your biggest fear heading into surgery?</i> | <ul style="list-style-type: none"> • Point out the child's physical ability to withstand and heal from surgery • Provide normalization and reassurance, "You will get through this, just as others have." • Emphasize what the child <i>can</i> do after surgery |
| Parent | Mental Health | <i>Any history of anxiety in either parent (or caregiver)?</i> | <ul style="list-style-type: none"> • Review the relationship between parental anxiety and the child's pain • Advise parents to avoid projecting anxiety onto the child |
| | Pain Management | <i>When your child is in pain, what will you do?</i> | <ul style="list-style-type: none"> • Teach appropriate responses to pain, including limited use of opioids • Encourage that parents project confidence to the child |
| | Social Support | <i>How has the family prepared for surgery?</i> | <ul style="list-style-type: none"> • Discuss the importance of a safe, stable, and comfortable environment on the child's healing • Suggest that the family coordinate resources in advance, including assistance from extended members |
| | Potential Barriers to Care | <i>Any other specific challenges that you are concerned about after surgery?</i> | <ul style="list-style-type: none"> • Fears about risks • Work schedule and family leave • Driver disability permit • Transportation for follow-up |

approach to hip preservation surgery, including preoperative evaluation with a psychologist, led to significantly improved postoperative psychological function, including increased resiliency and decreased anxiety, school problems, and social stress.^{38,87} Notably, the authors recommended two or more visits beginning at least 60 days before surgery.

Table 3. Psychosocial Intervention Checklist for Children & Adolescents

1. Comprehensive and detailed preparatory information (surgery through recovery)
2. Normalization and reassurance (anxiety)
3. Address maladaptive thought processes (pain catastrophizing)
4. Modify harmful patterns of parental responses
5. Encourage patient confidence around self-directing coping strategies (pain self-efficacy)
6. Flexible, remote intervention delivery
7. Start *before* surgery (goal 60 days)

Recommendations for Clinical Practice

Advanced training is not needed to address the psychosocial aspects of pain. Table 2 includes a few suggestions for simple, open-ended questions that can be easily integrated into any surgeon's standard preoperative visit. While by no means comprehensive, such questions may identify potential barriers to recovery and corresponding opportunities to intervene. Equally important, surgeons should assemble a team of colleagues with complementary expertise, including psychologists, social workers, and child life therapists, to employ as needed for a more complete approach to pain management. Ultimately, it is important to remember that psychosocial management should be part of a larger, multidisciplinary perioperative care model that integrates different evidenced-based strategies and spans the entire operative experience to include long-term recovery.¹⁹ A checklist of suggestions for such an intervention is provided in Table 3.^{2,17,21,55,66,84,88}

Case Example

Consider the following patient: Tiffany is a 13-year-old gymnast presenting for evaluation of scoliosis and a 65-degree curve. She is referred by a nonoperative sports medicine colleague who was evaluating her for low back pain. She has a history of anxiety, depression, and borderline anorexia. Family notes that she has had a number of prior injuries from gymnastics, and that she has always been slow to recover. She routinely takes both ibuprofen and acetaminophen for musculoskeletal pain. Her parents are separated and do not have an amicable relationship. There is a family history of addiction, and mom is on disability for chronic pain due to multiple prior spinal surgeries. What should the clinical team do?

Although this scenario may seem like hyperbole, it is unfortunately all too common. The most important step is for the clinical team to recognize that this will not be a straightforward surgery and to take the appropriate time to address each of these complex psychosocial issues in a thoughtful and compassionate manner. As mentioned above, a referral should be made to psychology, and the family can be connected with both social work and child life therapy. With respect to the surgical team itself, a team member should talk with the family outside of designated clinic time in order to walk them through the entire process and answer specific questions on hospitalization and pain management. Time should be invested in educating both parents on how to appropriately assess pain and judiciously administer analgesics. One of the most powerful resources that surgeons can employ is a network of former patients. Connecting prospective patients directly with someone who has been through this exact experience before can provide extremely valuable normalization and reassurance. This applies to parents as well. Realistically, a surgery date at least 60-90 days away should be selected in order to allow sufficient time for the appropriate work-up and follow-through of each of these issues. Finally, surgeons should not forget about the family during this time. While it is understandably challenging to provide extensive counseling within the confines of a busy clinic day, consider monthly appointments (either in person or video visit) with designated

and pre-specified topics for each session (e.g., recovery expectations, pain medications, etc.) in order to answer questions, ease fears, and help build confidence and self-efficacy around the time of surgery.

Summary

Pain is the combined cognitive, emotional, and behavioral response to a given stimulus. The pain that any given patient experiences after surgery is due to a complex interplay of various biological, psychological, social, and cultural factors. Modifiable factors such as anxiety, catastrophizing, and poor pain coping strategies increase pain intensity and duration. By contrast, self-efficacy, parental support, and resiliency may reduce pain and minimize long-term dysfunction. Interventions to address these psychosocial variables have been limited in pediatric orthopaedic surgery. While this burden of expanded care should not fall exclusively to surgeons, it is imperative to be familiar with how these factors play a role in postoperative pain and recovery so that surgeons can be a part of the solution. Collaboration across disciplines to build perioperative care pathways that include psychosocial interventions represent an opportunity to significantly improve pain management in children. Further research is necessary in order to facilitate greater specificity in recommendations with respect to the effectiveness of various tactics (e.g., apps, videos, written materials), how to optimally approach the differences between children and adolescents, and the best way to address parental contributions to children's pain.

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