Abstract

Objective: The purpose of this study is to compare postoperative pain scores between children undergoing tonsillectomy and adenoidectomy (T&A) surgery and their parents, identify potential predictors for this disagreement, and determine possible impact on analgesic administration.

Methods: This is a prospective longitudinal study conducted with children undergoing outpatient T&A in 4 major tertiary hospitals and their parents. Children and their parents were enrolled prior to surgery and completed baseline psychological instruments assessing parental anxiety (STAI), parental coping style (MBSS), child temperament (EAS) and parental medication administration attitude questionnaire (MAQ). Postoperatively, parents and children completed at-home pain severity ratings (Faces Pain Scale-Revised, children; Numeric Rating Scale, parents) on postoperative recovery days 1, 2, and 3, reflecting an overall pain level for the past 24 hours. Parents also completed a log of analgesic administration. Based on postoperative pain scores, parent-child dyads were classified as overestimators (i.e., parents rated their child's pain higher than children rated their own pain), in agreement (i.e., rating in agreement), or underestimators (i.e., parents rated their child's pain lower than children rated their own pain).

Results: A significant proportion of parent-child pairs disagreed on pain ratings on postoperative days 1-3 (30.05%-35.95%). Of those pairs in disagreement, the majority of parents overestimated their child's pain on all three postoperative days, specifically such that a total of 24-26% parents overestimated their child's pain on postoperative days 1, 2, and 3. Repeated measures ANOVA demonstrated that parents in the overestimator group administered higher, though still within safe limits, amounts of ibuprofen and oxycodone (mg/day) than did the underestimator or agreement groups. Multiple regression models showed hospital site as the only independent predictor for postoperative pain rating disagreement between children and parents.

Conclusions: Since parents overestimate their child's postoperative pain and may administer more analgesics to their child, it is essential to develop a standardized method of child pain assessment and a tailored recommended postoperative analgesic regimen amongst medical providers for children undergoing T&A.

1. Introduction

Research indicates that up to 75% of all children undergoing surgery in the United States experience significant postoperative pain.[1] A large proportion of these children suffer from pain following discharge from the hospital in the home recovery phase.[2–8] In addition to the hardship associated with this clinical phenomenon, children who suffer from significant postoperative pain are more likely to experience delayed behavioral and clinical recovery.[2,9–11]

It is well established that successful management of postoperative pain requires both reliable assessment of pain levels, as well as administration of the right analgesics in the right dosage and at the right time.[12–16] Within home settings, parents are most often responsible for managing their child's pain following surgery [9,10] and as such, parental assessment of child pain along with child assessment is of high significance. Previous research revealed conflicting results regarding agreement of pain ratings between parent-child dyads. [11,14,17–19] These previous studies suffer from a number of methodological flaws and have focused on describing pain rating disagreement and *not* predictors or clinical impact of such disagreement. We submit that assessing the impact of disagreement on actual clinical practice is of paramount importance and, if it is discovered that such a disagreement does not have any impact on clinical care or outcomes, then pain rating discrepancies between parents and children are less significant. In contrast, if such disagreement has clinical impact, it is highly important to identify predictors for such disagreement.

The primary aim of this study was to compare postoperative pain assessment between children and their parents in a population of children undergoing tonsillectomy and adenoidectomy (T&A), given this procedure is one of the most common pediatric surgeries and has been found to be associated with high levels of postoperative pain.[12,20,21] The study's secondary aims were to determine if any disagreement found had clinical impact in terms of analgesic administration by parents and to identify potential predictors for any disagreement found between children and parents.

2. Materials and Methods

2.1 Participants

This prospective longitudinal 5-year study was funded by the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD) and was conducted from 2012 to 2017. The study included children undergoing outpatient T&A surgery and their parents and was aimed at evaluating a newly developed behavioral intervention that targeted reduction of preoperative anxiety in children. This 5-year study consisted of: 1) a baseline phase which lasted 2.5 years and consisted of only data collection (no intervention), and 2) an intervention phase which lasted 2.5 years and included implementation of the intervention which was detailed previously. [22]

For the purpose of the current manuscript, we analyzed data *only* from the baseline phase of the study and *not* any data following the intervention. Also, none of the analyses and data presented in this manuscript have been published previously. [23]

Children enrolled in the 5-year study underwent surgery at Children's Hospital of Los Angeles; Lucile Packard Children's Hospital at Stanford; Children's Hospital, Denver; and Children's Hospital of Orange County. The average annual number of outpatient T&A surgeries performed at each of these institutions was 523, 480, 1151, and 774, respectively. Children adhered to the following criteria: 2-15 years old, an American Society of Anesthesiologists (ASA) physical health status of I-III, and English- and/or Spanish-speaking. Exclusion criteria included children with chronic illness that puts them in ASA IV (extreme systemic disorders which have already become an eminent threat to life regardless of the type of treatment), developmental delays as diagnosed by primary pediatrician, or born prematurely (<32 weeks gestational age). Children admitted overnight were excluded from the study. These exclusion criteria were implemented because children with cognitive impairments may present different responses and emotions to stressors of surgery. The institutional review board at each of the four sites approved the study, and informed consent and age appropriate assent were acquired from parent and child at each site.

Of the 1,315 eligible patients for the 5-year study, 402 declined to participate and 86 consented but later withdrew their consent to participate. A total of 827 parent-child dyads completed the 2.5-year baseline phase. As some of the patients in the baseline phase did not report their postoperative pain, only a total of 311 parent-child dyads are included in the analysis of this manuscript. Because of variability in responses across postoperative days, our final sample size is 306, 287, and 203 dyads for postoperative ratings on days 1, 2, and 3, respectively.

2.2 Measures

2.21 Pain Assessment Measures:

2.211 Child:

Child self-reported pain was measured using the Faces Pain Scale-Revised (FPS-R), which consists of a series of six faces ranging from a neutral expression ("no pain") to an expression of "most pain possible".[24] The FPS-R has demonstrated good convergent validity to a linear interval scale of observational ratings of pain,[24] excellent reliability, and is recommended for use with children 4 to 18 years old.[25,26]

2.212 Parents:

Parents used the Numeric Rating Scale (NRS) to rate children's postoperative pain on a 0 to 10 point scale. The NRS has been found to be valid, reliable, and favored by patients for its high sensitivity.[27] Furthermore, prior research has found the NRS and FPS-R as functionally equivalent.[16,28]

2.22 Psychological Measures

2.221 Emotionality Activity Sociality Temperament Survey (EAS-TS)[29]

The EAS-TS is a parent-reported measure of children's temperament from early childhood to adolescence in emotionality, activity, sociality, and shyness. Parents use a Likert-type scale to rate their child on 20 statements reflecting temperament. We selected the EAS-TS given that child temperament predicts child's response to pain,[30] and this survey has demonstrated both strong validity across temperament measures and high test-retest reliability.[29]

2.222 Medication Attitudes Questionnaire (MAQ)

Parents completed the self-report MAQ, which characterizes attitudes on the use of analgesics to treat children's pain. The MAQ is comprised of 27 items rated on a Likert-type scale, which characterize parent beliefs on three subscales: *Appropriate Use* (e.g., "Children learn how to use pain medication responsibly when it is given for pain"), *Side Effects* (e.g., "There is little need to worry about side effects from pain medication"), and *Avoidance* (e.g., "Pain medication works best when it is given as little as possible").[10] Previous findings have reported the MAQ to have an overall internal consistency between 0.68 and 0.73, as determined by Cronbach's Alpha.[31]

2.223 State-Trait Anxiety Inventory (STAI)[32]

Parent anxiety was measured using the STAI, a self-report assessment which assesses the state (situational) and trait (baseline) anxiety using 20 items on a 4-point scale. The STAI-state anxiety assesses respondents on how they feel at the present time, while the STAI-trait anxiety assesses respondent on how they "generally" feel. Higher scores on both state- and trait-STAI tests correspond to higher levels of anxiety. This measure has shown high test-retest correlations, which range from 0.73 to 0.86.[32]

2.224 Miller Behavioral Style Scale (MBSS)[33]

Parental coping style was measured using the MBSS, a parent self-report form with strong validity and reliability,[33] that presents respondents with four stressful scenarios and eight possible reactions to each scenario, instructing the respondent to indicate which reaction(s) they would most likely display. Respondents are characterized on two behavioral styles: monitoring (high monitoring--information seeking, low monitoring—information avoiding), and blunting (high blunter—distractors, low blunter—non-distractors).

2.23 Demographic Measures

Baseline demographics were collected for each parent-child dyad, including child gender, ethnicity and race of child and parent, and primary language spoken at home.

2.3 Procedures

The day before surgery, potential participants were identified using surgery schedules and determined for eligibility based on electronic medical record pre-screening. During the patient's pre-surgical appointment, or on the day of surgery, researchers approached potential participants in clinic or within the preoperative holding area, respectfully. After gaining consent and confirming eligibility, parents and children were provided with study information documents. On the day of surgery, parents completed a demographics questionnaire including gender, age, race and ethnicity, education, income, etc., and several psychological surveys (MAQ, EAS-TS, STAI, MBSS). These measures were completed while parents were in the preoperative holding area before surgery or waiting area as their children underwent surgery. At the end of each day on postoperative days 1, 2, and 3, parents completed the NRS and administered the FPS-R to their child to reflect the child's overall pain level for the past 24 hours. In addition, parents documented all analgesics administered to children on each of these assessment days using a questionnaire later submitted to the research team. Documentation included date and time of administration, type of analgesic given (ultimately decided upon by the parent), and dosage in whichever method the analgesic was given (tablet, teaspoon, cc/mL, droppers, etc). If more than one analgesic was administered, parents provided these same data parameters for each analgesic.

All clinical personnel were instructed not to change any of their standard management of the patients as this was the observational longitudinal phase of the 5-year study. As such, preoperative sedative premedication, parental presence during induction of anesthesia, as well as the surgical, anesthetic, and analgesic course were all managed based on preferences of individual anesthesiologists and surgeons. Following surgery, children were moved to the post-anesthesia care unit (PACU) and subsequently met by their parents. The PACU nurse then explained discharge instructions and provided directions for at-home postoperative pain management to the parent and child. Instructions for pain management varied by the four hospital sites and are described in Table 1. The case surgeon then returned to meet the families and provided a surgical summary, answered questions, and authorized the child's discharge. Pain throughout the entire perioperative period was managed per standard of care of each of the four hospitals and the anesthesiologist and surgeon managing the case.

2.4 Statistical Analyses

Normally distributed continuous data are presented in this manuscript as means ± standard deviation; skewed continuous data are presented as medians (interquartile range); and categorical data are presented as proportions. Data were analyzed with SPSS software (version 22.0; IBM, Armonk, NY, USA), and $P < 0.05$ was used to determine statistical significance.

To determine parent-child agreement in pain ratings, we first calculated the differences in pain rating between parents and children using the child FPS-R (consisting of six faces which were scored 0—no pain to 10—maximum pain, with intervals of 2 points between each face) and the parent NRS (recorded on a 0-10 scale). Since pain reporting data was not normally distributed, a Wilcoxon Signed Ranks Test was used to determine disagreement between median parent and child postoperative pain ratings on each of the follow up assessment days.[34]

Next, we calculated the percentage of dyads who demonstrated significant disagreement between postoperative pain ratings. Previous research has identified that a difference of 20% - 35% in pain rating corresponds to a meaningful decrease in pain intensity.[35,36] As such, we determined *a priori* that disagreement in this study between the score of the child and the score of the parent will be defined as a difference of 2 or more points on the standardized 0-10 pain rating scale. Once we identified which parent-child dyads were in disagreement on each of the three postoperative days, all parent-child dyads included in the study were categorized into one of 3 groups: parents who overestimated their child's pain (OE), parents whose pain ratings were in agreement with child ratings (A), and parents who underestimated their child's pain (UE).

Due to instances in which a parent-child dyad was inconsistent in their ratings across the three postoperative days (that is, the parent may have overestimated their child's pain on one of the postoperative days, and been in agreement or underestimated on another one of the days), we decided that parents had to overestimate, be in agreement, or underestimate their child's pain on at least two of the three postoperative days to be classified in one of the three groups. This methodology eliminated 56 dyads who were inconsistent in their pain rating classifications across postoperative days. These dyads were not included in the subsequent bivariate analysis to identify predictors of disagreement, or in comparisons of analgesic administration between groups.

Analgesic administration, which accounted for both type and dosage administered by parent to their child (in milligram per kilogram), was examined within each of the three groups. Statistical differences of various analgesics administered over time were calculated using repeated measures analysis of variance (ANOVA), where T1= postoperative day 1, T2= postoperative day 2, and T3= postoperative day 3, and the three groups in question were overestimators (OE), agreement (A), and underestimators (UE).

The next phase of statistical analyses determined whether any of the collected demographic and psychological variables predicted parent-child postoperative pain disagreement. Demographic variables in question included: child gender, race-ethnicity, and age; parent education and race-ethnicity; family marital status, household income, whether the child had undergone previous surgery, child anxiety at previous medical visits, and pain level that parents expected their child to endure during the current procedure. Psychological variables included the EAS-TS, MAQ, STAI, and MBSS. Using the three subgroups of dyads (OE, A, UE), a chi-square calculation was performed for categorical variables and a one-way ANOVA was performed for continuous variables to identify potential correlations between predictor variables and postoperative pain rating agreement. Results of these analyses were used to compute logistic regression models to examine the relation between dyad groups and possible predictive variables, as well as to control for potential confounding variables.

3. Results

A total of 311 parent-child dyads were included in this study. The reader is referred to Table 2 for a full description of the various demographic characteristics of the population reported in this manuscript. Participants primarily consisted of male children (50.2%) with a mean age of 6 ± 3 years, parent respondents were primarily mothers (85.2%), and English was the primarily language (74.0%).

3.1 Do parents and child disagree when assessing postoperative pain?

Across all postoperative days, parental median NRS scores were significantly higher than child FPS-R median scores (p's < 0.05, Table 3). Using the previously defined criterion (2-points) for clinically significant disagreement between parent and child pain ratings, we found that a large proportion of parent-child dyads were in disagreement on postoperative day 1, 110/306 (35.95%), day 2, 102/287 (35.54%), and day 3, 61/203 (30.05%) (Fig. 1). When looking only at dyads who were in disagreement, in 79/110 (71.82%) of the dyads, parents overestimated on day 1; in 75/102 (73.52%) of the dyads, parents overestimated on day 2; and in 49/61 (80.33%) of the dyads, parents overestimated on day 3.

3.2 What is the clinical impact of the disagreement between parents and children?

A two-way repeated measures ANOVA was conducted to examine differences in the postoperative administration of ibuprofen both across time (T1, T2, T3) and group (OE, A, UE). This analysis did not reveal a significant difference within groups across time (T1-3, $p = 0.575$), however it did reveal borderline statistical differences across groups ($p = 0.074$). A between group post-hoc analysis indicated that parents in the OE group administered more ibuprofen than did parents in the A group on day 2 ($p = 0.013$) and day 3 ($p = 0.047$).

A second two-way repeated measures ANOVA was conducted for oxycodone and included only postoperative days 1 and 2 given the sample size of children who used this medication on day 3 was in the single digits. We found statistically significant differences both over time ($p = 0.001$) and between groups ($p = 0.000$). Post-hoc between groups analysis revealed that administration of oxycodone was higher in the OE group than the A group on day 1 ($p = 0.037$) and day 2 ($p = 0.004$).

Next, we ran three individual repeated measures ANOVA tests for acetaminophen, hydrocodone, and codeine consumption over days 1, 2, and 3. We found that for all these three medications there was a decrease of total amount given per day as a function of the postoperative day ($p = 0.001$), but that there were no group (OE, A, UE) differences for these medications.

3.3 Is it possible to predict which parent-child dyad will be in disagreement?

In order to answer this question, we first conducted a chi-square analysis for categorical variables and a one-way ANOVA for continuous variables to identify potential predictors of disagreement. As can be seen in Table 4, anxiety of the child at previous medical visits ($p = 0.012$) and hospital site of the study ($p = 0.005$) emerged as clinically different between the three study groups. There were no other differences identified between the 3 groups for all other variables tested (p = ns).

In order to control for potentially confounding variables, we next conducted logistic regression models utilizing the previously identified potential predictors. Two sets of logistic regression models were performed to evaluate hospital site as a predictor of group assignments. The first model used hospital site to predict whether parents were more likely to underestimate or agree with their child (overall significance, p = 0.210), and the second used hospital site to predict whether parents were more likely to overestimate or agree with their child (overall significance, p

= 0.002). Table 5 depicts the distribution of group assignments across all hospital sites on each of the three postoperative days in question. Table 6 indicates, hospital site was found to be the only independent predictor for group assignment of the dyads. Specifically, overall parents were more likely 5.7 times more likely to overestimate than agree with their child's pain at Lucile Packard Children's Hospital as compared to Children's Hospital, Denver ($\beta = 1.749$, $p = 0.001$, $OR = 5.750$, $95\%\ CI = 2.108\text{-}15.687$). An additional logistic regression model determined that anxiety of the child at previous medical visits was not a significant predictor of group assignment ($p = 0.164$). Table 7 conveys the breakdown of socioeconomic data at each of the hospital sites used to compute the logistic regression model.

4. Discussion

The goals of the study were to identify if there is disagreement on pain rating between children undergoing surgery and their parents, as well to examine if we can predict those parents and children who disagreed and to examine the potential impact of this disagreement on the administration of analgesics. Under the conditions of this study, we found that a significant proportion of parents and children were in disagreement in determining the children's postoperative pain severity in the first 3 days after surgery. Of parent-child dyads in disagreement, most parents overestimated their child's pain, and those parents were more likely to administer more ibuprofen and oxycodone during the postoperative course. Multiple regression models showed hospital site as the sole independent predictor for postoperative pain rating disagreement.

Postoperative pain management is a critical factor in recovery after surgery. After discharge from the hospital, parents are mostly responsible for managing their child's postoperative pain. As evident in the postoperative medication instructions (Table 1), each of the four sites included in this manuscript provided parents with individualized instructions for at-home analgesic administration. This could be one explanation for the finding that parents at Stanford were significantly more likely to overestimate their child's pain as compared to parents at other sites. That is, if parents at Stanford were instructed to administer pain medication around the clock, they may have interpreted this as an indication that their child should be experiencing pain and would require more medication. This could potentially lead to parent-child pain rating disagreement, which is supported by previous findings which have shown that parents often experience difficulty in accurately identifying their child's pain level and determining the proper amount of analgesics to relieve the pain.[19,37,38] It is interesting to note that the present study did not identify socioeconomic status (neither in family income, nor in parental education) as predictors of disagreement. This finding may even further emphasize the need for providing parents highly specific instructions on postoperative pain management, for parents do not necessarily rely on their own education or knowledge-base in identifying and treating their child's pain. Table 7 highlights the distribution of education levels and incomes of parent-child dyads amongst the four hospital sites.

If parents are provided a way of interpreting their child's postoperative pain, with analgesic instructions that correspond to appropriate pain levels, it could mean that a more specific means of identifying postoperative at-home pain levels may be imperative in reducing parent-child pain rating disagreement. Previous research on parent management of child's postoperative pain at home has found that 79 percent of parents found a supportive phone call to clarify instructions on postoperative pain management was useful.[15] Further, current practice in most institutions typically devotes more time on directions of how to assess pain and how to manage pain in the PACU, rather than in the pre-surgical visit. Since parents are highly stressed on the day of surgery, it is no wonder that many parents simply don't comprehend or remember these instructions from the PACU. A better solution would be to provide more information preoperatively or use mobile Health (mHealth) as a supportive tool.[39,40]

Analyses of pain medication administration found that overestimator parents provided significantly more ibuprofen and oxycodone on some postoperative days than those dyads in agreement. This is the first study in this area that has documented that parental overestimation of pain can result, in some cases, in higher administration of analgesics by parents. Although the average quantity of analgesics administered by overestimator parents was still within safe limits, it is important to recognize that since the child's pain is less than assumed by the parent, it can likely be treated by a lower dosage of analgesics. By recognizing appropriate pain levels and administering the appropriate amount of analgesics, there is greater likelihood of avoiding higher-administration, which, if severe, may result in acetaminophen-induced liver toxicity,[41] codeine-associated nausea, dizziness, vomiting, and fatalities,[42] and ibuprofen-related gastric discomfort or vomiting.[43] The results of this report should also be viewed within the context of the ongoing debate on the opioid epidemic and the role of pain management in that epidemic. The finding that hospital site was a predictor of disagreement, and that postoperative analgesic instructions varied by site highlights the critical importance of providing a clear methodology of assessing and treating a child's postoperative pain, as well as clear expectations on the amount of pain that should be expected. We believe, that these elements of clear instructions as well as clear expectations could be used to combat the opioid epidemic within the context of postoperative pain

Future studies should seek to provide refined postoperative pain management instructions. most postoperative pain management instructions required parents to provide analgesics "as needed" based on their child's pain (Table 1), and our findings demonstrate significant disagreement in parent-child postoperative pain ratings, there is great risk of parents misinterpreting their child's pain, and therefore, providing inaccurate analgesic dosages.

The present study did not include highly sensitive measures to identify the impact of ethnicity, but it is important to note that previous literature has shown that parental perioperative anxiety and stress can be impacted by variables such as ethnicity, language, and acculturation.[23] Such, it would be helpful to explore the role of these variables in affecting parental vigilance when evaluating postoperative pain.

Though the present study did not find age to be a predictor of dyad disagreement, the data showed that children of UE parents were older, on average, than children of A or OE parents (Table 4). This corresponds to previous literature which has shown that older children may experience more pain, as well as increased analgesic use and delayed return to day-to-day functioning than younger children following T&A surgery.[44,45] Since UE dyads were of higher age, on average, it is worthwhile to provide specific instructions to parents of older children on potentially higher pain rates. Ultimately, is of most critical importance to provide concrete directions to all parents on identifying and treating child postoperative pain.

The results of this study should be interpreted with caution because of a number of methodological limitations. We did not consider the operative surgeon, surgical technique, anesthesiologist, and anesthetic techniques that all have a bearing on postoperative pain, but should not affect the proportion of OE, A, and UE dyads. In the analysis of analgesics administered, we did not consider the combination of codeine and acetaminophen as a separate group or those patients who alternated acetaminophen with ibuprofen. Indeed, we analyzed the data for each drug for the entire group, and this was done because of the small sample size of both the alternating group and the combination group. The results analyzed also depend on the reliability of parents in correctly recording analgesic administration, as this was not witnessed/verified by any additional parties. In addition, there was substantial loss to follow-up over time, such that 306 dyads reported data for postoperative day 1, as compared to 203 dyads on day 3. This drop off can be expected, as parents may not be as inclined to continue recording data if the child is recovering and returning to baseline function. These methodological limitations aside, we should note that this is the first publication of its kind that not only describes the phenomena of disagreement in pain scores between children and their parents, but also looks at the impact of these scores on analgesic consumption as well as trying to identify predictors for this phenomena.

Conclusively, the present manuscript provides evidence that a significant portion of parent-child dyads are in disagreement on children's postoperative pain ratings. Of dyads in disagreement, the majority of parents overestimated their child’s pain and provided substantially more analgesics to their child during postoperative recovery at home. Given the substantial number of children suffering from postoperative pain during home recovery, as well as the negative implications of postoperative pain and overmedication, it is crucial to improve postoperative pain management at home. This could be done by establishing a universal protocol used throughout hospitals on how to use a pain scale in assessing child pain and tailoring pain medications based on the pain score.

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Table 1. Pain medication instructions provided by each hospital site for parents to manage their child’s postoperative pain

Site	Instructions
CHOC - Children’s Hospital Orange County	Administer acetaminophen and ibuprofen as recommended on label packaging and alternate between acetaminophen and ibuprofen for pain relief.
CHLA – Children’s Hospital Los Angeles	All parents were advised to administer acetaminophen every 4 hours as needed for pain. Parents of older children were allowed to administer Tylenol with codeine, per prescription from the surgeon (this practice was stopped in 2012). Children were not allowed aspirin or aspirin-containing medications within two weeks of surgery.
LPCH – Lucile Packard Children’s Hospital at Stanford	Younger Children: For at least the first two postoperative days and nights, administer alternating acetaminophen and ibuprofen every 4-6 hours. Specifically, administer acetaminophen, then, in 4-6 hours, administer ibuprofen, and in another 4-6 hours, administer acetaminophen. Parents should wake their children at night to continue medication, at least for the first few nights. In a few days postoperatively, parents may increase time between doses depending on child pain level. Older Children: Parents may administer Oxycodone to older children every 6 hours postoperatively, in addition to alternating acetaminophen and ibuprofen regimen noted above. All Children: Parents should offer children 1-2 ounces of liquid to drink during all waking hours to prevent dehydration.
The Children’s Hospital, Denver	Most frequently, parents were advised to administer acetaminophen every 4 hours as needed and ibuprofen every 6 hours as needed. At the discretion of the particular surgeon performing the operation, some parents were also instructed to administer Oxycodone every 6 hours as needed in addition to the acetaminophen and ibuprofen.

Note: Instructions represents the practice during the years data in this manuscript was collected.

Important Note: In 2013, the FDA released a black box warning for the use of codeine in children <12 years of age, as it may cause serious complications such as respiratory depression and death. In 2018, the FDA issued a

"Contraindication" to codeine in children <12 years old, and a "Warning" against its use in adolescents ages 12-18 who are obese or may have respiratory problems such as obstructive sleep apnea or severe lung disease.

Table 2. Demographic Characteristics of Respondents (n= 311). Categorical variables reported as counts and proportions. Continuous variables reported as mean ± standard deviation.

Variable	Study Population
Child's Gender	
Male	156 (50.2%)
Female	154 (49.5%)
Missing	1 (0.3%)
Child's Age (years)	6 ± 3
Parent Respondent	
Mother	265 (85.2%)
Father	40 (12.9%)
Other/Missing	6 (1.9%)
Parent Language	
English	230 (74.0%)
Spanish	81 (26.0%)
Parent Marital Status	
Single	36 (11.6%)
Married	218 (70.1%)
Other/Missing	74 (23.8%)
Parent Education	
<12 Years	45 (15.0%)
Graduated High School	68 (21.9%)
Some College	43 (13.8%)
College/Professional	133 (44.3%)
Missing/Prefer not to answer	22 (7.3%)
Income Bracket (Dollars)	
20,000 and under	61 (19.6%)

21,000-50,000	73 (23.5%)
51,000-100,000	51 (23.5%)
101,000 and greater	76 (24.5%)
Missing/Prefer not to answer	50 (16.7%)
Child Race/Ethnicity	
White	113 (36.3%)
Hispanic	149 (47.9%)
Asian	22 (7.1%)
Other/Prefer not to answer	27 (9.0%)
Has child had previous surgery?	
Yes	63 (20.3%)
No	239 (76.8%)
Missing	9 (2.9%)

Table 3. Parent-child pain rating agreement using Wilcoxon Signed Rank Test. Parent NRS (pNRS) and Child FPS (cFPS) scores are reported by median (range, 25%-75%).

				Difference Between Median Parent and Child Pain Rating	
	n	**Parent pNRS**	**Child cFPS**	**Parent-Child (pNRS – cFPS)**	***p***
Day 1	306	6 (3-8)	4 (2-8)	+2	<.0001
Day 2	287	5 (3-7)	4 (2-6)	+1	<.0001
Day 3	203	4 (2-6)	2 (0-2)	+2	<.0001

Table 4. Analyses by chi-square (for categorical variables) and one-way ANOVA (for continuous variables) to identify any potential predictors of group differences between Underestimator Dyads (UE), Agreement Dyads (A), and Overestimator Dyads (OE). Categorical variables are reported as percentages of total and continuous variables are reported as median (interquartile range).

Predictor Variable	**UE (n=16)**	**A (n=182)**	**OE (n=57)**	**p**
Child				
Child Gender (Male)	50.0%	50.0%	49.1%	0.993
Child Race-Ethnicity	43.8% (Hispanic)	51.1% (Hispanic)	49.1% (White)	0.556
Child Age	8 (6)	6 (3)	5 (3)	0.108
Previous Surgery (No)	68.8%	80.8%	77.8%	0.496
Anxiety at Previous Med Visits	11.0 (36)	25.5 (43)	14 (23)	0.012*
Site				0.005*
Children's Hospital Orange County	1 (2.4%)	34 (80.9%)	7 (16.7%)	
Children's Hospital Los Angeles	5 (8.5%)	48 (81.3%)	6 (10.2%)	
Lucille Packard Children's Hospital	6 (9.8%)	32 (52.5%)	23 (37.7%)	
Children's Hospital, Denver	4 (4.3%)	68 (73.1%)	21 (22.6%)	
EAS - Emotionality	2.5 (1)	2.8 (1)	2.8 (1)	0.596
EAS - Shyness	2.2 (1)	2.4 (1)	2.6 (1)	0.491
EAS - Activity	4.6 (1)	4.2 (1)	4.2 (1)	0.802
EAS - Sociability	4.0 (1)	3.8 (1)	3.8 (1)	0.932
Parent				
Education (College or Professional Degree)	56.3%	42.4%	54.7%	0.917
Race-Ethnicity	56.3% (White)	48.9% (Hispanic)	54.5% (White)	0.421
Language (English)	62.5%	64.6%	80.7%	0.592
Marital Status (Married)	68.8%	75.3%	75.4%	0.236

Country Parent Grew Up In (USA)	81.3%	58.8%	57.9%	0.166
Pain level that parent expects child to experience during surgery (0-100)	60.0 (23)	61.0 (28)	55.0 (20)	0.542
MAQ – Avoidance	24.0 (13)	26.0 (15)	22.0 (12)	0.713
MAQ – Side Effects	21.0 (7)	22.0 (5)	21.0 (6)	0.104
MAQ – Appropriate Usage	22.0 (7)	20.0 (7)	20.0 (4)	0.536
STAI – State	36.2 (10)	40.0 (13)	38.0 (10)	0.924
STAI – Trait	37.0 (10)	35.5 (10)	34.0 (13)	0.897
Miller Behavioral Style – Monitoring	7.0 (4)	7.0 (5)	8.0 (4)	0.866
Miller Behavioral Style - Blunting	2.0 (2)	3.0 (2)	3.0 (3)	0.389

*Note: * indicates significance at $p < 0.05$.*

Table 5. Number of dyads in each (Underestimators, Agreement, and Overestimators) by hospital site on each of the three postoperative days.

Hospital Site		UE	A	OE
Children's Hospital Orange County	**Day 1**	2 (4.8%)	33 (82.5%)	7 (16.7%)
	Day 2	3 (7.3%)	32 (78.0%)	6 (14.7%)
	Day 3	1 (3.3%)	26 (86.7%)	3 (10.0%)
Children's Hospital Los Angeles	**Day 1**	9 (15.5%)	40 (69.0%)	9 (15.5%)
	Day 2	6 (10.1%)	46 (78.0%)	7 (11.9%)
	Day 3	3 (6.7%)	34 (75.5%)	8 (17.8%)
Lucille Packard Children's Hospital	**Day 1**	7 (11.5%)	35 (57.4%)	19 (31.1%)
	Day 2	6 (9.8%)	30 (49.2%)	25 (41.0%)
	Day 3	4 (11.4%)	21 (60.0%)	10 (28.6%)
Children's Hospital, Denver	**Day 1**	4 (4.4%)	65 (71.4%)	22 (24.2%)
	Day 2	7 (7.7%)	61 (67.0%)	23 (25.3%)
	Day 3	3 (3.4%)	58 (65.9%)	27 (30.7%)

Table 6. Summary of Logistic Regression Analysis to examine the effect of demographic and clinical variables on likelihood of parents over and under-estimating their child's postoperative pain as compared to parent-child dyads in agreement.

Predictor	**β**	**p**	**Odds Ratio (95% Confidence Interval)**
Underestimators			
Site (Lucille Packard Children's Hospital)		0.210	
Children's Hospital, Denver	-1.159	0.088	0.314 (0.083-1.190)
Children's Hospital Orange County	-1.852	0.095	0.157 (0.018-1.376)
Children's Hospital Los Angeles	-0.588	0.364	0.556 (0.156-1.975)
Overestimators			
Site (Lucille Packard Children's Hospital)		0.002*	
Children's Hospital, Denver	-1.749	0.001*	5.750 (2.108-15.687)
Children's Hospital Orange County	0.904	0.070	2.471 (0.928-6.580)
Children's Hospital Los Angeles	0.499	0.405	1.647 (0.508-5.337)

*Note: * indicates significance at $p < 0.05$.*

Table 7. Socioeconomic status of dyads grouped into either the Underestimator, Agreement, or Overestimator at each hospital site, as represented by parent respondent level of education and total family income.

Socioeconomic Measures	**Children's Hospital Orange County**	**Children's Hospital Los Angeles**	**Lucille Packard Children's Hospital**	**Children's Hospital, Denver**
Income				
20,000 and under	12 (30.9%)	19 (32.2%)	9 (14.8%)	9 (9.7%)
21,000 to 50,000	12 (28.6%)	6 (6.2%)	20 (32.8%)	14 (15.1%)
51,000 to 100,000	7 (16.7%)	7 (11.9%)	11 (18.0%)	25 (26.9%)
101,000 and greater	3 (7.1%)	15 (25.5%)	12 (19.7%)	37 (39.8%)
Missing/No answer	7 (16.6%)	12 (20.3%)	17 (27.9%)	8 (8.6%)
Parent Education				
<12 Years	6 (14.2%)	8 (13.6%)	14 (45.0%)	5 (5.4%)
Graduated High School	14 (33.3%)	9 (15.3%)	13 (21.3%)	20 (21.5%)
Some College	11 (26.2%)	7 (11.9%)	6 (9.8%)	12 (12.9%)
College/Professional	8 (19.1%)	28 (47.4%)	23 (37.7%)	52 (55.9%)
Missing/No answer	3 (7.2%)	7 (11.9%)	5 (8.2%)	6 (6.5%)

Fig. I: Parent-Child Dyads in Agreement vs. Disagreement by pNRS and cFPS