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A Comprehensive Examination of the Immediate Recovery of Children Following Tonsillectomy and Adenoidectomy

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Abstract

Objectives: Using multiple well-validated measures and a large sample size, the goal of this paper was to describe the immediate clinical and behavioral recovery of children following tonsillectomy with or without an adenoidectomy (T&A) during the first two weeks following surgery.

Study Design: Observational, longitudinal study.

Setting: Four major pediatric hospitals in the U.S. consisting of Children's Hospital of Orange County, Children's Hospital of Los Angeles, Lucile Packard Children's Hospital, and Children's Hospital Colorado.

Subjects and Methods: Participants included 827 patients between 2 and 15 years of age who underwent tonsillectomy with or without adenoidectomy surgery. Baseline and demographic information were gathered prior to surgery, and measures of clinical, behavioral, and physical recovery were recorded immediately following and up through two weeks after surgery.

Results: Pain following T&A was clinically significant through the first post-operative week and nearly resolved by the end of the second week. Negative behavioral changes were highly prevalent after surgery (75.6% of children at Day 0) through the first week (63.9% at Week 1), and over 20% of children continued to evidence new onset negative behavioral changes at two weeks post-operatively. Children were rated as experiencing significant functional impairment in the immediate three days following surgery and most children returned to baseline functioning by the end of the second week.

Conclusions: Results of this study suggest that children show immediate impairment in functioning and experience clinically significant pain throughout the first week following T&A, and new onset maladaptive behavioral changes persisting even up to the two-week assessment period.

Keywords

tonsillectomy; adenoidectomy; pediatric; recovery; ambulatory surgery; pain

Introduction

Tonsillectomy and adenoidectomy (T&A) is the second most common ambulatory surgery conducted on children under the age of 15[1,2]. Yet, T&A is associated with an above-average pain profile, with over 80% of children experiencing pain at home following discharge[3–5] and up to 25% of children continuing to experience moderate to severe pain by the end of the second post-operative week[6]. Given its prevalence and high pain profile, children's recovery from T&A has received significant attention in the surgical literature.

Typically, children demonstrate long-term improvement in behavior following T&A in categories such as attention, anxiety, aggression, hyperactivity, and somatization, as well as overall quality of life and reduced sleep disturbances beyond six months post-operatively[7–12]. However, in the immediate postoperative period, children experience significant new onset negative behavioral changes following T&A. For example, over 75% of children undergoing tonsillectomy exhibit problematic behaviors at two days after surgery[6], and well over half of parents reported children to be severely limited in performing their regular daily activities up to five days post-operatively[13,14]. With data showing an association between pain following general surgery and the incidence of negative behavioral changes[15,16], this is unsurprising given T&A's above-average pain profile.

Despite the body of literature on recovery following T&A in children to date, there is still a strong need to describe the immediate behavioral recovery profile in children following T&A, particularly considering the incidence of atypical recovery that may be indicative of emotional trauma, which can develop following T&A[17]. Furthermore, current literature on recovery following T&A is limited as many studies are not specific to T&A, but include a variety of pediatric surgeries and may be outdated given the changes that have occurred in healthcare delivery in the recent decade[16,18,19]. In addition, many studies lack validated assessment tools of behavioral changes [4,6,13,20,21], may not cover the immediate two-week postoperative period[3,22], may only examine long-term behavioral recovery as noted above[7–12], and/or may include small heterogeneous sample sizes[3,4,6,13,20]. Accordingly, the aim of this current paper is to comprehensively examine the immediate clinical, behavioral, and physical recovery in children during the first two weeks following T&A using multiple validated tools and a large multi-center cohort of children.

Materials and Methods

2.1 Participants

These data were drawn from a multi-site randomized controlled trial of the efficacy of a healthcare provider behavioral intervention on pre-operative anxiety and post-operative recovery funded by the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD) (R01HD048935). In the larger study, patients were recruited between 2012 and 2017 from one of four major pediatric hospitals in the U.S. Each site was randomly assigned to the intervention or control condition. Data reported here were obtained from baseline phase patients only, at all four sites who were recruited prior to the implementation of the intervention. The institutional review board at each site approved this study and written informed assent/consent was obtained from children and parents as appropriate. None of the data reported in this paper have been previously reported.

Children between 2 and 15 years of age who were scheduled to undergo outpatient T&A were eligible to participate in this study. Further inclusion criteria included families who were either English- or Spanish-speaking and children categorized between I and III by the American Society of Anesthesiologists (ASA) physical health classification. Exclusion criteria included pediatric patients with either chronic illness, history of developmental delay, severe obstructive sleep apnea, and/or premature birth (<32 weeks gestational age). The rationale behind these exclusion criteria is that such children may react differently to stressors of surgery, and it is likely that their responses to baseline and outcome measures may differ from children of normal developmental measures or children without “incapacitating systemic disease” (ASA status IV). In addition, because children with severe OSA are more likely to be admitted after surgery, we excluded children with this diagnosis (based upon medical record review and consultation with participating HCP) due to the outpatient nature of this study.

All perioperative management of the patients was conducted as per standard of care at the participating sites and preferences of the individual clinical providers. That is, use of preoperative sedative medications, parental presence at anesthesia induction, and the surgical, anesthetic, and analgesic practices were all conducted according to the preferences of the providers. Discharge instructions for management of post-operative pain varied across the four hospitals in this study and are detailed in a separate publication.[23]

2.2 Data Collection

The day before surgery, surgery schedules were used to identify potential participants and determine study eligibility. All eligible families of participating healthcare providers were approached for the study. On the day of surgery, families were approached by researchers in the preoperative holding area and consented for participation. Following surgery, children and their parents completed measures on the day of surgery (D0), the following 3 post-operative days (D1, D2, D3), 1 week following surgery (W1), and finally, 2 weeks after surgery (W2).

2.3 Measures

2.3.1 Pain at Home

Faces Pain Scale-Revised (FPS-R): The FPS-R is a self-report pain scale consisting of a series of six faces ranging from a neutral expression (“no pain”) to an expression representing the “most pain possible”[24]. Scores on this measure are rated from 0 to 10, and this well-validated scale has been recommended for use with children aged 4 to 18 years old[25]. The original FPS has shown good to excellent reliability[26,27], and the FPS-R has demonstrated good convergent validity with established measures of pain[24]. For this study, parents asked children aged 4 to 15 years old to point to the face, which corresponded to how much pain they had experienced that day. For children aged 2-4 years, pain severity was only assessed via parent-report.

Numeric Rating Scale (NRS): The NRS is an observational numeric rating of pain measured on a scale from 0 to 10 with 0 referencing ‘no pain’ and 10 referencing ‘severe pain’, and has been shown to be valid and reliable with good sensitivity[28]. For each postoperative day, parents completed the NRS at home based on how much pain they thought their child had for that day.

2.3.2 Behavioral Recovery at Home

Post-Hospitalization-Behavior-Questionnaire for Ambulatory-Surgery (PHBQ-AS): The adapted PHBQ for ambulatory surgery (PHBQ-AS) consists of 11 questions, and has been shown to have good internal consistency reliability and concurrent validity with another measure of children's psychosocial and physical functioning[29]. For each item (e.g., Does your child have a poor appetite?, Does your child have temper tantrums?), parents were asked to rate the extent to which each behavior changed as compared to before surgery. To score the PHBQ-AS, averages were calculated by summing the items for each respondent and then dividing by the total number of items. The total PHBQ-AS score provides a continuous variable with values equal to 3 indicating no behavioral change (3 being the midpoint), values greater than 3 indicating maladaptive behavioral changes, and values lower than 3 indicating improvements in behavioral change.

2.3.3 Clinical and Physical Recovery at Home

Recovery Inventory Index (RI): The recovery inventory index assesses postoperative recovery and includes sleep, appetite, strength and energy, self-assistance, and movement[30]. On each postoperative day, parents were asked to rate each item on a six-point Likert-type scale ranging from 1 (Very poor) to 6 (Excellent). Each item was summed for a total score, with higher scores indicating better recovery.

Functional Disability Inventory (FDI): The FDI was constructed after multiple adult measures of activity of daily living were reviewed and items appropriate for children were generated[31]. The FDI is a widely used scale and has been shown to be internally consistent (0.90 to 0.94) and has significant test-retest reliability over a three-month period. This scale also demonstrates good concurrent and construct validity[32]. The FDI assesses children's difficulty in performing 15 daily functions (e.g. Walking to the bathroom, Getting to sleep at night and staying asleep) due to physical health utilizing a 5-unit Likert-type scale ranging from 0 (No Trouble) to 4 (Impossible) and is scored on a scale from 0 to 60 with higher scores indicating higher levels of functional disability. Both children (aged 8 to 15 years old) and parents completed the FDI for the relevant days.

2.4 Statistical Analysis

Descriptive statistics were used to examine recovery trends in this cohort. Child- (FPS-R) and parent-report pain severity (NRS) scores are presented as medians with their respective interquartile ranges. Clinical recovery (RI and FDI) scores are presented as means and standard deviations. Behavioral recovery is presented as mean total PHBQ-AS scores, as well as frequencies of responses to individual items. Pearson product-moment correlations were conducted between child- (FPS-R) and parent-reported (NRS) pain severity and clinical and behavioral recovery variables (PHBQ-AS, RI, FDI) on post-operative day one. All analyses were calculated utilizing IBM SPSS Statistics for Windows, Version 24.0 (Armonk, NY: IBM Corp).

Results

3.1 Demographic Data

Of the 1315 patients recruited at baseline, 402 declined to participate, and 87 were lost to follow-up; thus, 826 patients were included used for analysis in this paper (see Figure 1 for a participant flow chart). Demographic data for all 826 participants are provided in Table 1. On average, children were 6.05 ± 2.92 years old, with a relatively equal number of boys and girls (53% and 47%, respectively). Primarily mothers completed the follow-up surveys (88.3%) with the majority of families being either Hispanic/Latino (55.7%) or White (28.4%).

3.2 Pain at Home

Median pain scores with their respective interquartile ranges (IQR) for each postoperative day are reported for children (Figure 2) and parents (Figure 3). Pain on the day of surgery and the following three days post-operatively was in the moderate range (4-5 out of ten) and at one week after surgery was in the mild range. Post-operative pain was resolved by week 2. Analysis of differences in immediate post-operative pain by site showed that on average, children recruited from

3.3 Behavioral Recovery

Post-Hospitalization-Behavior-Questionnaire for Ambulatory-Surgery (PHBQ-AS): The PHBQ-AS results are shown in Figure 4. The majority of children (nearly 80%) exhibited new onset negative behavioral changes immediately in the first three days post-operatively which persisted through the first week. At the end of the second week, approximately 1 out of 5 children continued to display negative behavioral changes. The most common negative behavioral changes being cited were ‘child spends time just sitting or lying and doing nothing’, ‘child makes a fuss about eating,’ and ‘child needs a lot of help doing things.’ Furthermore, by the end of the second week, the vast majority of children with 73.7% ($n = 252$) displayed no change/returned to baseline, with only 4.1% ($n = 15$) of children displaying positive behavioral changes.

3.4 Physical Recovery

Recovery Inventory Index (RI): The recovery profile of children as measured by the parent-report Recovery Inventory (RI) is displayed in Figure 5, and is reported as means with their respective standard deviations. As noted above in section 2.3.3, higher RI scores indicate higher levels of recovery. By end of the second week, 27% ($n = 109$) of children had a complete recovery inventory score of 30.

Functional Disability Inventory (FDI): The FDI means and standard deviations are presented as reported by children and parents (Figure 6). Child- and parent-report FDI scores were relatively consistent (greatest difference of 3.18 at the end of Week 1) with child scores being lower than parental score from the second post-operative day onwards. By the end of the second week, mean values of less than 1 were reported in both child and parent scores.

3.5 Associations Between Pain and Recovery

In order to examine the relationship between pain severity and recovery, correlation analysis was conducted (Table 2). As can be seen, children who experienced high pain severity by both child- and parent- report had significantly greater new onset postoperative behavioral changes (PHBQ-AS), and poorer clinical and behavioral recovery (RI and FDI).

Discussion

Given the prevalence and high postoperative pain severity of pediatric T&A, recovery has received a significant focus in surgical literature. Utilizing our large, diverse cohort, we sought to add to the understanding of recovery from T&A by examining trends in the immediate two weeks following surgery using a comprehensive battery of validated assessments of behavioral, clinical, and physical recovery at home. In terms of pain, average severity in the first 3 days post-operatively was clinically significant and in the moderate range. Post-operative pain largely resolved at one week and was non-existent by week two. The overwhelming majority of children experienced new onset negative behavioral changes post-operatively that persisted through the first week and largely resolved by week two, although over 20% of children continued to show new onset negative behaviors two weeks post-operatively. Children's functional disability during the first three post-operative days was greater than that of children with chronic pain[33,34], but, by the end of the first week, children had less difficulty with daily activities than that of their chronic pain counter-parts. Most children returned to baseline by the end of the second post-operative week.

In terms of pain, our data show that children experienced moderate pain in the first several days at home after T&A, which was associated with poorer recovery. These data are consistent with previous studies of children's pain at home following outpatient surgery[5] and suggest that pain at home is an important area for knowledge translation. Our center, as well as others, have consistently shown that children's post-operative pain is under treated in the home setting[5,35,36]. This is important because under treated pain is associated with numerous negative sequelae, including later difficulty with adequate pain control, development of behavioral problems after surgery and delayed clinical and physical recovery[14,37]. In addition, poorly controlled acute pain is a major predictor for the development of chronic post-operative pain, which is a significant patient and economic burden[38]. We propose that with proper pain management, there is no need for children to be experiencing moderate pain after surgery. It is important to note that we are not advocating for increased use of opioids following T&A. In fact, it is becoming increasingly routine to use single agent analgesic therapy following T&A with over-the-counter medications such as acetaminophen or ibuprofen, with evidence suggesting no differences in pain severity after T&A with use of acetaminophen or ibuprofen compared to narcotic medication and improved recovery, including eating and return to normal activity, with over-the-counter medication[39,40]. Multiple published guidelines for management of acute pain in children exist[41]; however, there are significant gaps in translation of evidence into practice. In addition, there are parental factors associated with the suboptimal treatment of children's pain in the home setting, including misconceptions about pain expression and analgesic use in children[42,43] and lack of systematic use of non-pharmacological strategies. Thus, efforts to improve pain management in children in the home setting are needed.

Regarding behavioral changes following T&A, our data suggest that there is a greater incidence of negative behavioral change in children undergoing T&A when compared to children undergoing dental procedures under general anesthesia[19] or general pediatric day-case surgeries[15]. One potential avenue for intervention would be improving management of preoperative anxiety, which has been linked to increased post-operative pain and post-operative behavioral challenges[14]. Given the nature of the items most commonly endorsed on the PHBQ-AS, improving post-operative pain should also improve behavioral recovery. More specifically, reductions in pain will allow for improved ability to eat and be active.

Although most children were reported to return to baseline functioning by the end of the second week, over one-fifth of the sample (22.2%) continued to exhibit negative behavioral changes at this time. This group of children will be important to assess further out from surgery as long-lasting negative behavioral changes may reflect a more traumatic surgical experience that warrants intervention. This appears to be a new finding as similar studies also conclude that most children return to baseline at one week, but do not examine the remaining incidence of negative behavioral changes specifically[3,18]. Conversely, our data show that a very small percentage (4.1%) of children experience positive behavioral changes at two weeks following surgery, which may not be consistent with extant literature showing long-term positive changes associated with T&A surgery in children (as early as 6 months).[7–12] Given that these positive behavioral changes have only been reported as early as 6 months, it is possible that these "new" positive changes are not the result of the surgery itself, but perhaps another distinct event between the surgery and 6 months later. Alternatively, it may be that improved behavior occurs more slowly post-operatively and understanding factors associated with positive behavior change will be important to explore. It may also be important to consider the indication for T&A in children when examining pain and recovery. Specifically, whereas earlier data suggest that the most common indication for T&A in children was recurrent infection, more recent data indicate that this trend has shifted and that obstruction is now the top reason T&A is performed.[44] Because obstruction can cause sleep disruption and subsequent emotional and behavioral issues, it may be that assessment of children's behavior both pre- and post-surgery is important contextual data to understand the reasons that some children show behavioral improvements whereas some experience persistent negative behaviors.

Similarly, our data suggest that immediate functional disability following T&A is greater than that experienced by children with chronic pain, but that children who underwent T&A have much improved physical recovery by the first post-operative week.[33,34] Furthermore, the vast majority of children returned to baseline with regard to physical functioning by the end of the second week. Thus, children with continuing disability may represent a subpopulation experiencing a more traumatic surgical experience.

Existing literature on recovery following T&A is currently limited in that many studies include a congregate of pediatric surgeries[16,18,19], lack validated assessment tools of behavioral changes[4,6,13,20,21], may not cover the immediate two-week postoperative period[3,22], may only examine long-term behavioral recovery[7–12], and/or may include small heterogeneous sample sizes. Although our paper addresses these issues, it is not without limitations. Namely, as we did not assess outcomes beyond two weeks, we cannot describe the recovery course to baseline for all children or determine when positive behavioral outcomes may occur in this sample. In addition, our patient population in this study may not be representative of the larger population of children who undergo T&A. More specifically, we had a higher percentage of Hispanic/Latino children than in most studies in this area and given the potential for ethnic differences in responses to pain and stress, our findings may not be generalizable to a broader population of children undergoing surgery. We also did not collect data regarding indications for surgery and because this study did not standardize surgical, anesthetic, and analgesic approaches, it is not possible to place our findings in the context of perioperative procedures that may have impacted pain outcomes. Because a sleep study was not conducted as part of this study, it is possible that we did not exclude every child with OSA. Finally, because we did not control for perioperative management of the child by anesthesiologists and surgeons, we could not examine potential perioperative influences on postoperative pain and recovery in children, such as use of pre-, intra-, and immediate post-operative medications and surgical technique. This is particularly important to note because there were differences in child- and parent-reported pain and behavioral recovery (as measured by the PHBQ-AS) as a function of hospital, suggesting that hospital and healthcare provider practice may have impacted outcomes. It may be important to examine the specific impact of perioperative management of children undergoing T&A on recovery parameters in order to further develop guidelines for care that optimize quality of life and functioning of children in the post-operative period.

In summary, our data suggest that the majority of children who undergo outpatient T&A experience significant pain through the first post-operative week and new onset negative behavioral changes through the first two post-operative weeks. Despite connections between pain and behavior changes, it is noteworthy that children's negative behaviors persisted beyond the resolution of pain. In terms of physical recovery, children's functional abilities were significantly impacted for the first week post-operatively but largely returned to baseline by week two. These findings suggest that focusing on immediate recovery in the home setting following T&A is important to improve quality of life and identify those children most at risk for long-term difficulties in recovery. Improving children's pain management in the home setting can be challenging, given parental misconceptions regarding children's pain expression and potential hazards of analgesic use for children, particularly in the context of the opioid crisis[45]. Future research will need to identify effective strategies to address this important clinical problem to minimize suffering and facilitate optimal recovery following T&A.

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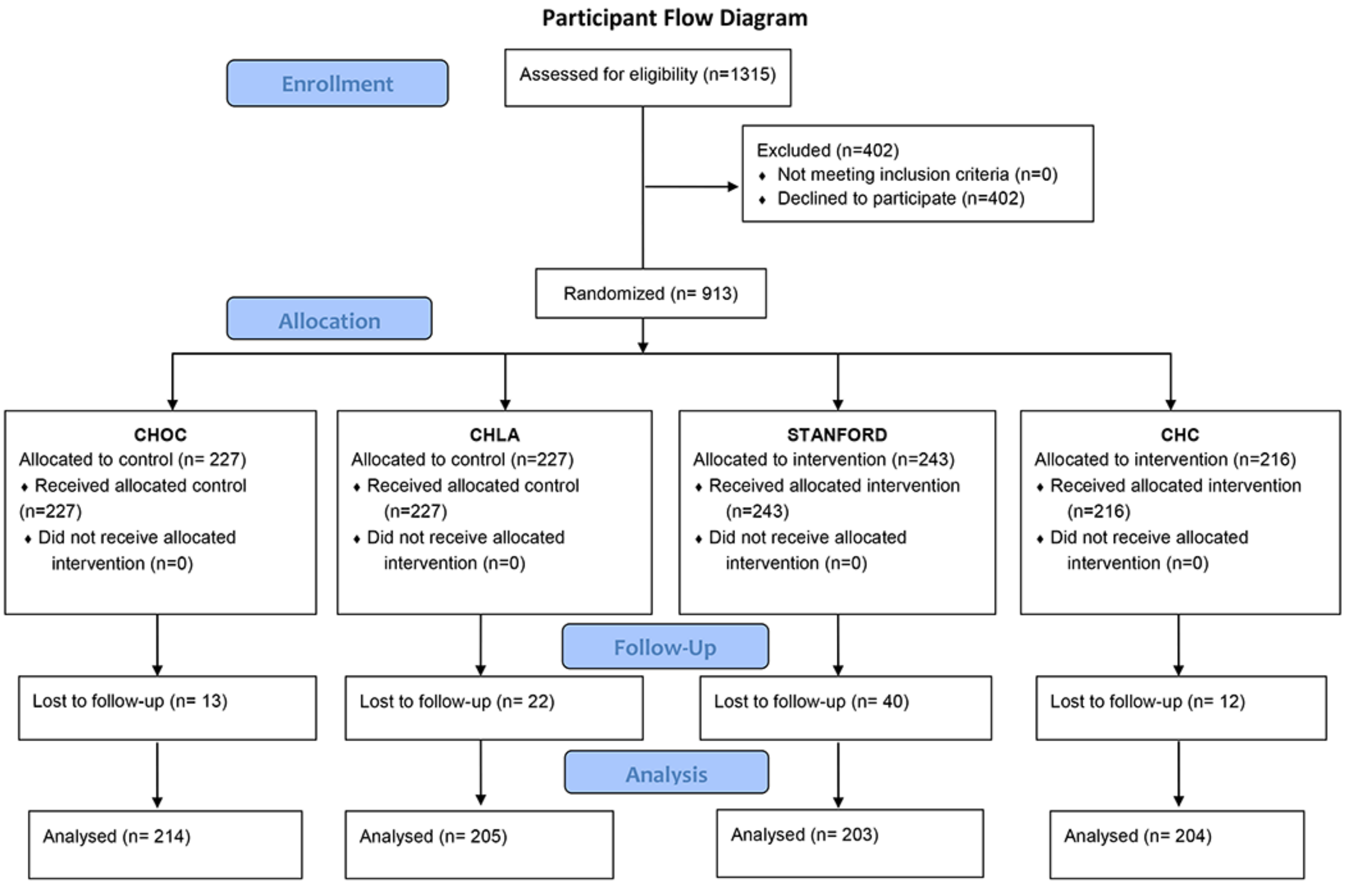

Figure 1.
Chart depicting flow of participants through the study.

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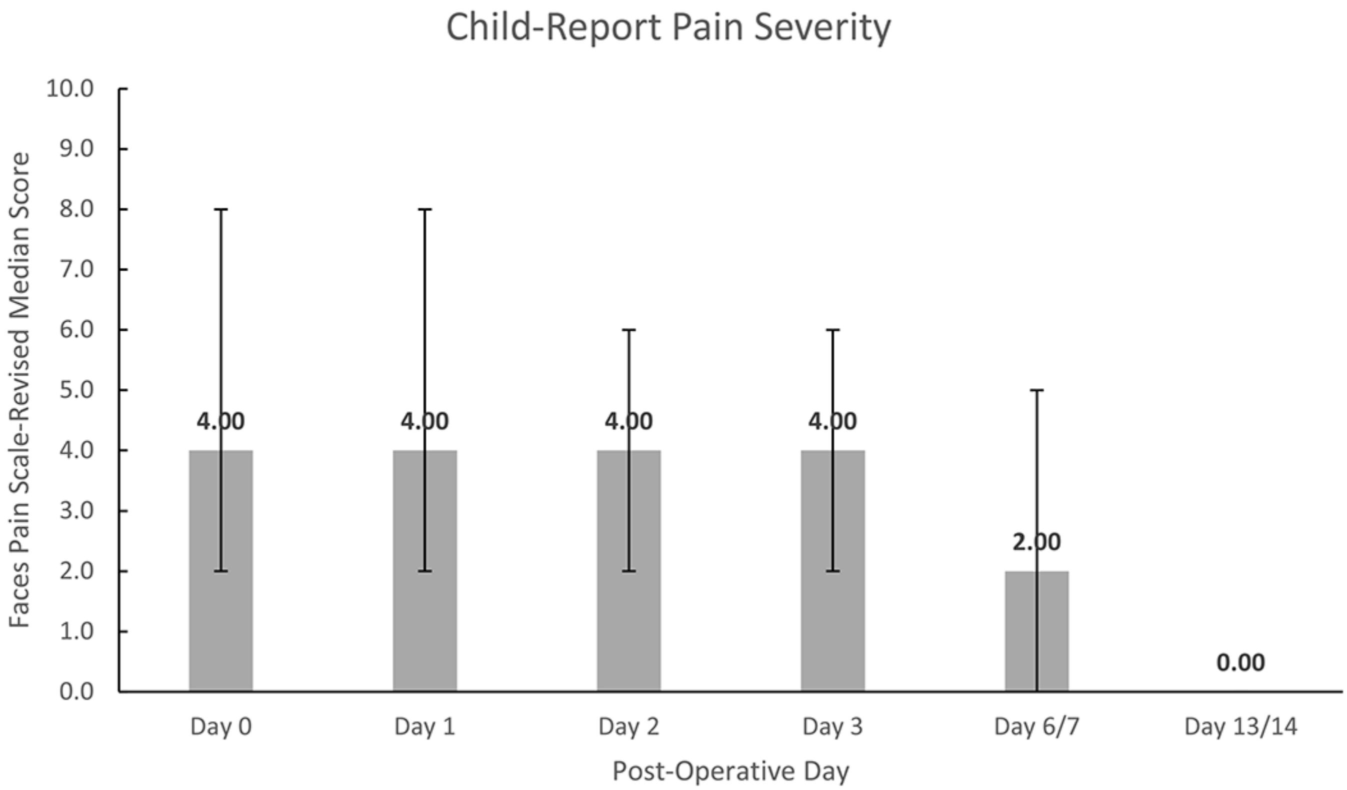

Figure 2:
Median child-report Faces Pain Scale-Revised (FPS-R) scores of pain severity in the first two post-operative weeks.

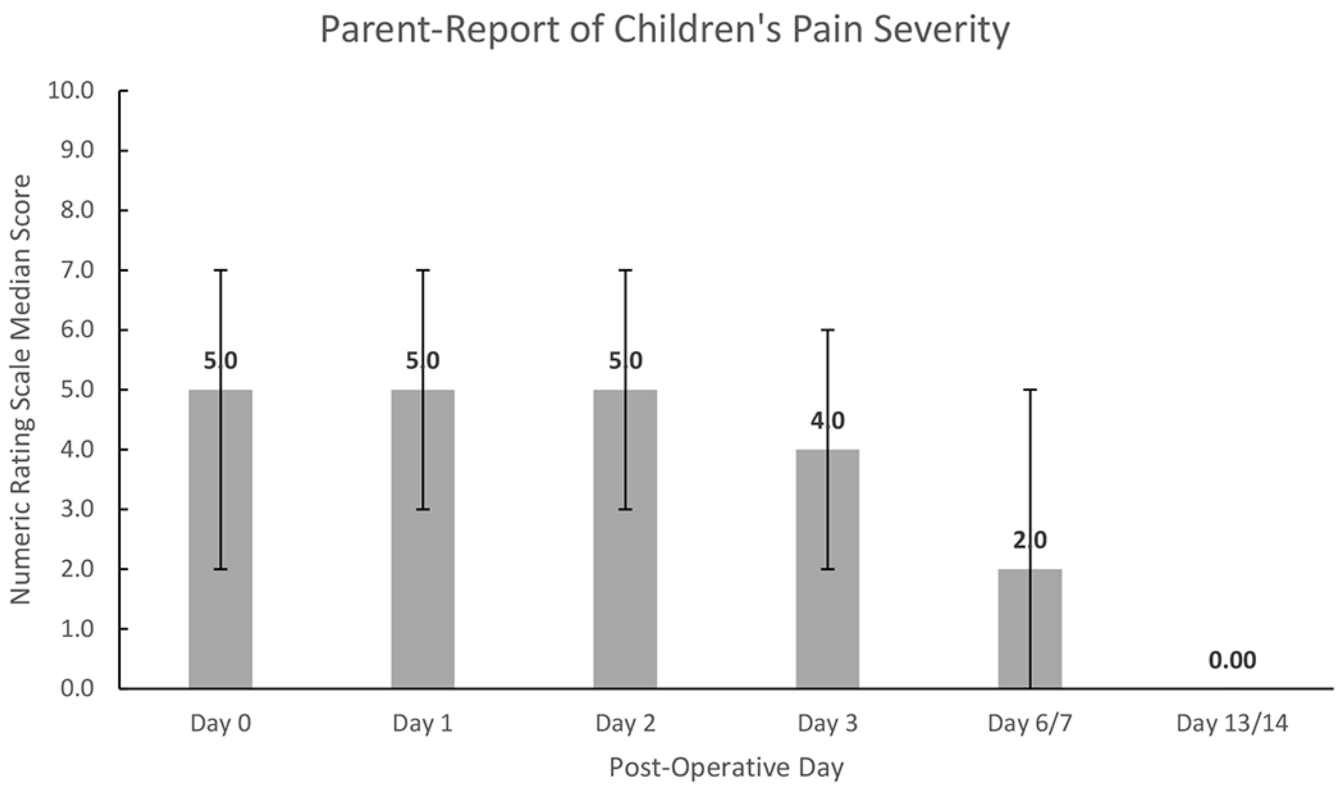

Figure 3.
Median parent-report Numeric Rating Scale (NRS) scores of children's pain severity in the first two post-operative weeks.

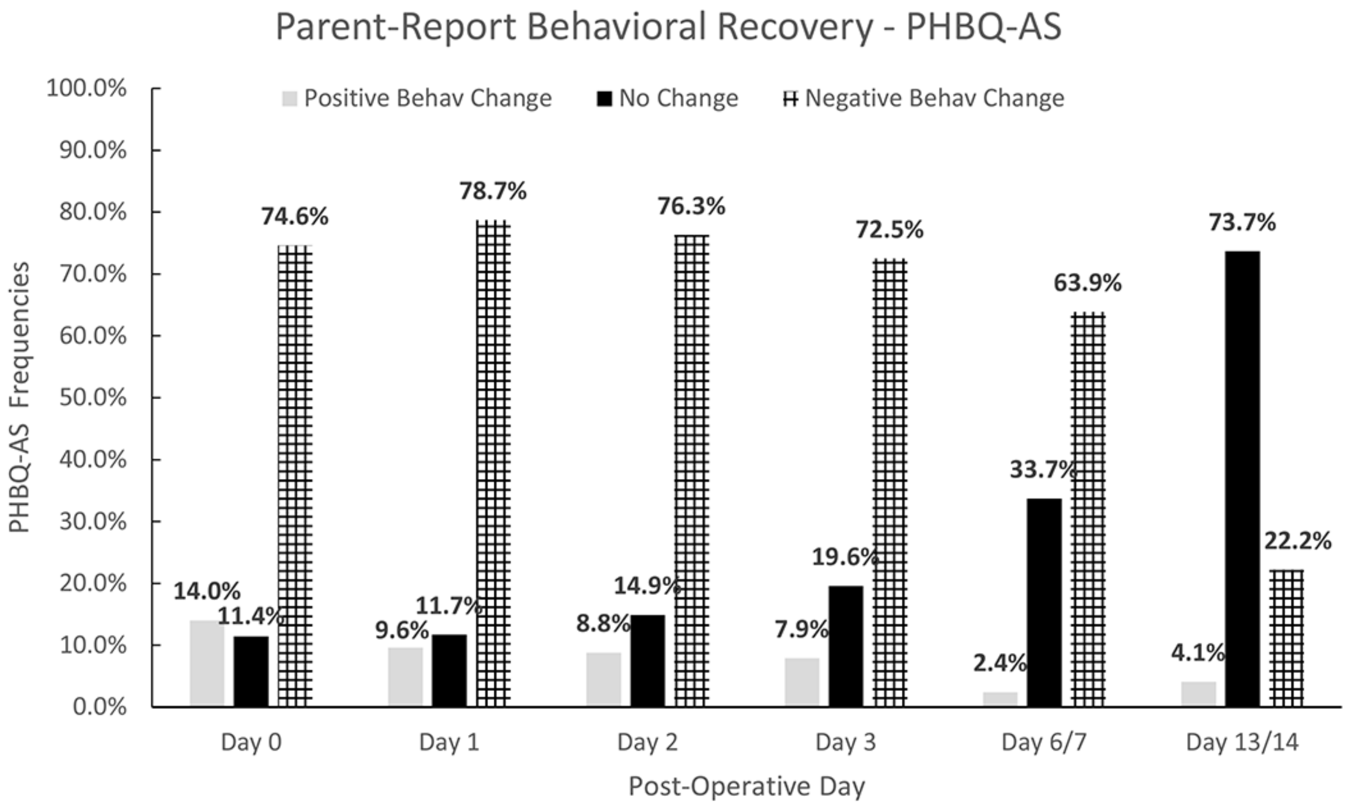

Figure 4.

Frequency of total new onset, negative behavioral changes in children in the first two post-operative weeks.

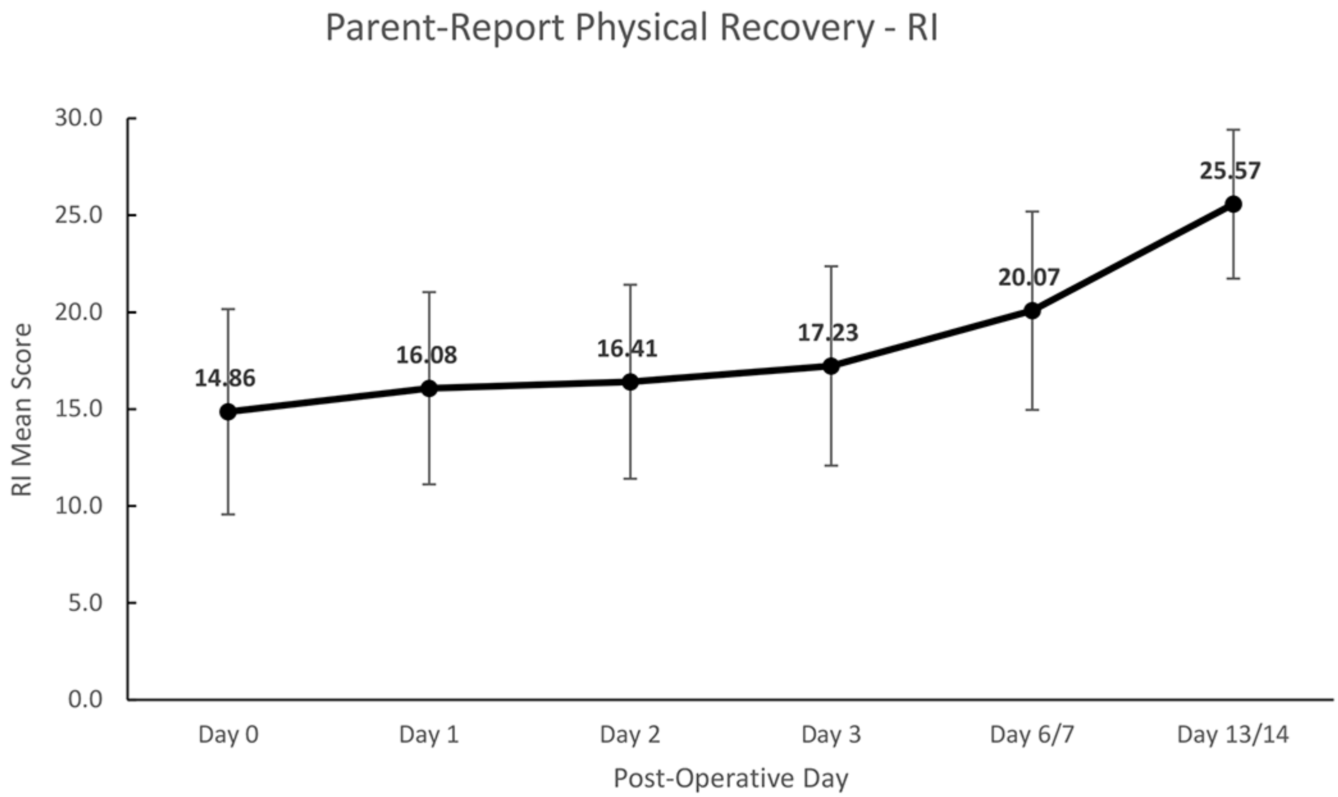

Figure 5.

Average Recovery Inventory (RI) scores of children in the first two post-operative weeks.

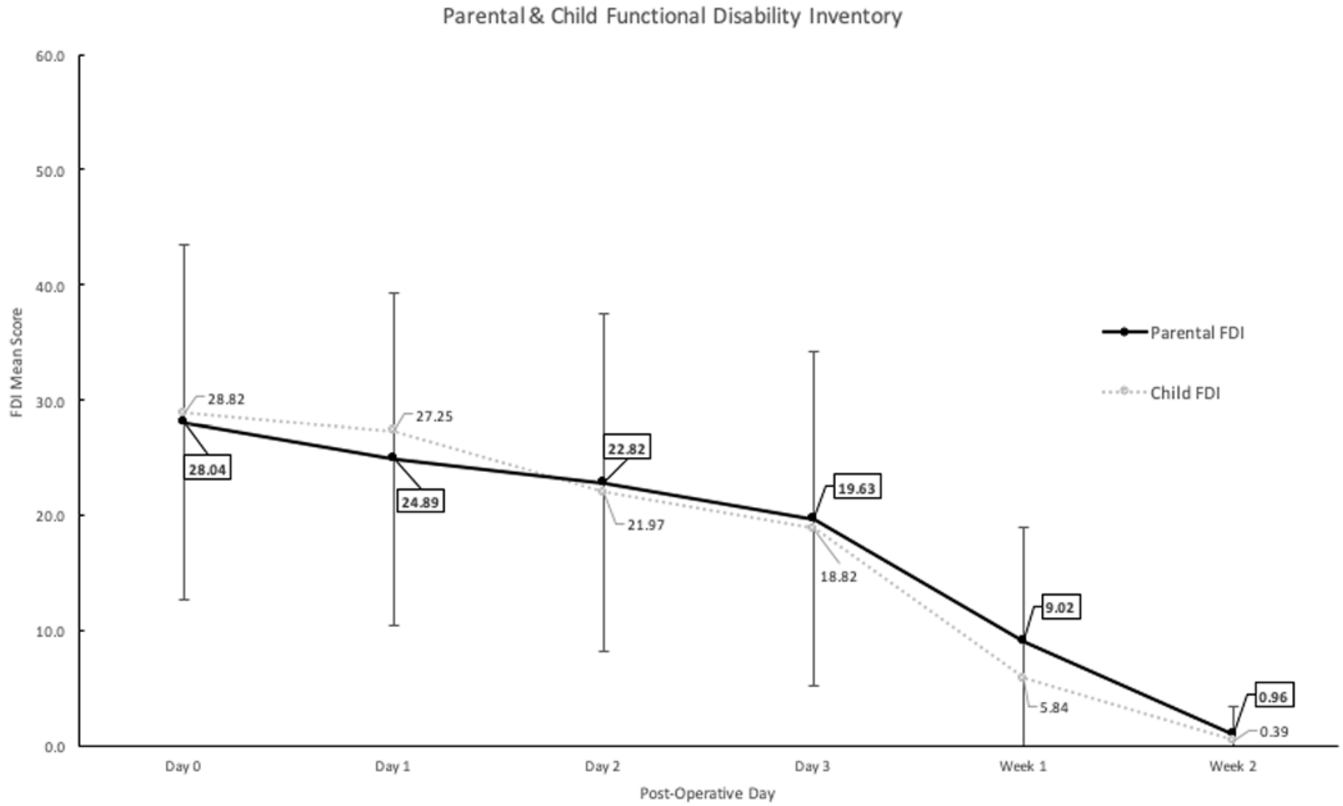

Figure 6.

Average child- and parent-report Functional Disability Inventory (FDI) scores in the first two post-operative weeks.

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Table 1:

Participant Demographic Characteristics

Child Demographics	
Age in Years (M ± SD)	6.05 ± 2.92
Gender *N* (%)	
Male	428 (53.0%)
Female	378 (47.0%)
Race/Ethnicity *N* (%)	
Hispanic/Latino	461 (55.7%)
White	235 (28.4%)
Asian	51 (6.2%)
African-American	24 (2.9%)
Other	56 (6.8%)
Parent Demographics	
Gender *N* (%)	
Mothers	715 (88.3%)
Fathers	95 (11.7%)
Age (M ± SD)	35.24 ± 7.06
Education in years (M ± SD)	13.52 ± 3.64
Median Income (Range)	$21,000 - $30,000

Note: Household income was assessed utilizing categorical ranges; thus, the median income categorical range is reported above.

Table 2.

Associations Between Pain and Recovery

	Behavioral Recovery - PHBQ-AS	**Clinical Recovery - RI**	**Parent-Reported Functioning - FDI**	**Child-Reported Functioning - FDI**
Child-reported pain	0.225**	−0.455**	0.352**	0.243*
Parent-reported pain	0.315**	−0.493**	0.395**	0.181

* $P < 0.05$,

** $P < 0.001$

PHBQ-S = Post Hospitalization Behavioral Questionnaire for Ambulatory Surgery; RI = Recovery Inventory; FDI = Functional Disability Inventory