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Pain, Anxiety, and Cooperativeness in Children with Cerebral Palsy After Rhizotomy: Changes Throughout Rehabilitation[1]

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Assessed pain, anxiety, physical functioning, and cooperativeness in 32 children with spastic cerebral palsy. This is the first study to assess children throughout rehabilitation following selective posterior rhizotomy. Results of the Observational Scale of Behavioral Distress and observer Likert ratings confirmed the hypothesis that children's pain and anxiety decrease over time. Children's physical functioning and cooperativeness improve over time. No significant correlation was found between pain and changes in physical functioning. Cognitive impairment, parental involvement, and children's pain behaviors explained 77% and 56% of the variance in two forms of cooperativeness. Research and clinical implications are discussed, and special considerations regarding pain assessment and management in this population are addressed.

KEY WORDS: pain; distress; cooperativeness; rehabilitation; children; cerebral palsy; rhizotomy.

Experiences of acute and chronic pain are not uncommon for many children with disabilities. Unfortunately, the pain experiences of children have received much less clinical and research attention than those in adults (Schechter, Berde, & Yaster, 1993). In a call for action in the pediatric health care community, Walco,

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Cassidy, and Schechter (1994) recommended that pain assessment be a critical focus. The assessment of pain in children postsurgery, and in children with cancer, juvenile rheumatoid arthritis, or sickle cell disease have been among the first efforts to empirically address the issues of pediatric pain. There have been initial attempts to document the pain experiences of children with cerebral palsy (e.g., Geiduschek et al., 1994). However, these have focused on the acute postoperative period only. To date, there are no investigations of the ongoing pain experiences of these children, such as the frequency or intensity of pain during muscle stretching.

Approximately 2 per 1,000 children (live births) in Western countries are eventually diagnosed with cerebral palsy (Mackenzie & Lignor, 1994). Cerebral palsy may be classified by the area of the brain that is impaired with the resulting tonal abnormality (i.e., spastic, dyskinetic, and ataxic types) (Olney & Wright, 1995). This paper deals with children diagnosed with spastic cerebral palsy. One of the hallmarks of spasticity is its velocity-dependent nature. As the child's limb is moved with increasing speed, the child's muscle responds with increased resistance to movement. One of the consequences of this spastic response is loss of muscle range or contracture. In the late 1970s a surgical intervention was introduced in Europe as a viable treatment option for many children with spastic cerebral palsy. The procedure, called selective posterior rhizotomy (SPR) or functional rhizotomy, was first performed in the United States in 1986. SPR is a neurosurgical intervention that decreases spasticity by severing dorsal nerve rootlets (Abbott, Forem, & Johann, 1989). After a child has undergone SPR, muscle tone is significantly reduced throughout the child's extremities, necessitating a course of physical rehabilitation. This therapy usually includes muscle stretching to increase range of motion (ROM), muscle strengthening to increase endurance, and reeducation to impart a better pattern of muscle use (Abbott et al., 1989; Abbott, Johann-Murphy, & Gold, 1991). Increasing ROM is imperative to the achievement of the other two goals. If a child does not attain full ROM, functional gains will be limited.

Significant functional gains resulting from aggressive, consistent stretching have been well documented (Abbott et al., 1989). The optimal method of stretching is functional stretching where the therapist places the child in a position and then encourages the child to initiate active movement. However, this method is ineffective if the child cannot cooperate. The experience of pain often makes this form of stretching impossible or impractical for many children with cerebral palsy. One alternative is an aggressive passive stretching program where the therapist moves the limb to the point of resistance, pushes the limb beyond that point, and holds the stretch for a count of 10. Each motion is repeated three times. There are other methods of stretching such as slow massage techniques and serial casting. These often prove impractical due to time constraints and the need to stretch multiple muscle groups. Regardless of the method used, stretching is understood to be the most painful aspect of the physical therapy (PT) regimen. Both pain and anticipatory anxiety are common in the initial stages of treatment, and are often a cause of disruption during PT sessions. Nevertheless, Johann-Murphy (1994) reported that in her 10 years of experience treating this population, children express less distress during stretching as their therapy progresses. However, with no empirical studies available to substantiate these clinical observations, concerns remain regarding the child's ability to cope with the painful aspects of this stretching treatment.

Pain has been defined by the International Association for the Study of Pain as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage" (Merskey, 1979). The factors influencing a child's perceptions of pain can be broadly categorized as child, family, and environmental which include such variables as age, cognitive-developmental level, previous experience with painful events, socioeconomic status, parental involvement, and coping behaviors of adults present during the procedures (Blount, Davis, Powers, & Roberts, 1991; McGrath, 1990). Although behavioral, physiological, and psychological methods are available for measuring pain (McGrath, 1990), the accurate assessment of children's distress after rhizotomy is particularly challenging. In a population that often experiences secondary disabilities such as impaired cognitive functioning, the children's ability to accurately communicate the extent of their discomfort is often limited.

The impact of distress on a child's ability to cooperate with treatment is an ongoing concern for physical therapists. Clinical experience has shown that decreases in cooperation result in prolonged therapy sessions. Lack of cooperation also makes it difficult for the therapist to place the child's limb in proper biomechanical alignment for effective stretching (Johann-Murphy, 1994). The child's cooperativeness also impacts the parent's willingness and/or ability to implement carry-over stretching during hospitalization and after discharge. The majority of available research has discussed "cooperation" in terms of the child's adherence or compliance to a medical regimen (e.g., Bearison, 1994). The long-term consequences of adherence are often insufficient motivators and less salient to the child than the more immediate aversive consequences. Thus, for the rhizotomy patient, immediate results of stretching (pain and anxiety) may be more predictive of cooperativeness than long-term consequences (improved function).

The research to date has revealed no reliable pattern of demographic characteristics or of patients' knowledge of their illness/treatment that predicts compliance or cooperation (Bearison, 1994). However, parent and staff behavior have been shown to impact several aspects of the child's experience in treatment such as distress level and coping ability (Blount et al., 1989; Frank, Blount, Smith, Manimala, & Martin, 1995). No studies have investigated the impact of demographic characteristics, parental involvement, and child distress on the child's ability to cooperate with painful stretching procedures.

The purpose of this study was to conduct a multimethod evaluation of children's pain and anxiety (i.e., behavioral distress) throughout the rehabilitation process. There were three specific objectives: (a) to assess distress in children during rehabilitation following rhizotomy and to compare those assessments over time; (b) to compare ratings of ROM, tone, and function over time; (c) to investigate the impact of demographic characteristics, parental involvement, and children's distress on the children's cooperativeness during PT. It was hypothesized that, consistent with clinical experience, children's behavioral distress would decrease over time.

METHOD

Participants

A consecutive sample of 32 children admitted for inpatient rehabilitation immediately following SPR were enrolled in this study. No children or caretakers refused participation. All children were diagnosed with spastic cerebral palsy. Discharge data were not collected for 2 subjects who were discharged prematurely from the facility due to unanticipated family circumstances, thereby reducing the subject pool to 30. There were no significant differences between these 2 children and the remaining 30 on demographic characteristics, or pain and cooperativeness scores. The children's ages ranged from 2.6 to 9.1 years ($M = 4.5$, $SD = 1.51$). The length of admission for rehabilitation ranged from 7.0 to 36.0 weeks ($M = 15.1$, $SD = 6.73$). Table I includes frequency distributions for additional demographic and clinical characteristics. Seven percent of the children received acetaminophen with codeine and 10% received acetaminophen before PT at Time 1 (T1). No children received analgesia at Time 2 (T2) or Time 3 (T3). The pain caused by stretching was not ongoing, nor was it experienced outside of PT. None of the children was reported to experience dysesthesias or sensory loss. The primary caregivers were 24 mothers (80%), 3 foster mothers (10%), 2 grandmothers (7%), and 1 father (3%). For the purpose of this paper, "parent" is used to refer to the child's primary caretaker. The median number of *parent-initiated* contacts with the physical therapist per week was 1 (range = 0–5). The median number of carry-over sessions per week was 2 (range = 0–7). A "carry-over session" refers to the execution of one or more PT tasks by the parent and child. These tasks include stretching, mobility (tricycle riding), and ambulation (walking with assistive devices). These sessions were not part of the child's scheduled appointments with the physical therapist. Parent–therapist contact and parent carry-over are referred to as parental involvement variables.

Table I. Frequency and Percentage Distributions for Demographic Characteristics ($N = 30$)

Variable	Frequency	%[a]
Gender		
Male	19	63
Female	11	37
Ethnicity		
Caucasian	14	47
Hispanic	9	30
African American	7	23
Disability		
Spastic diplegia	19	69
Spastic quadriplegia	11	31
Mobility (presurgery)		
I: Independent	1	3
II: Independent with devices	2	7
III: Quadraped crawler	16	53
IV: Commando crawler	10	33
V: No independent locomotion	1	3
Cognitive impairment[b]		
None (IQ ≥ 90)	9	30
Mild (80–89)	6	20
Moderate (70–79)	4	13
Severe (≤ 69; mental retardation)	11	37

[a]Percentages may not total 100 due to rounding.
[b]IQ was assessed using the Stanford-Binet Intelligence Scale (3rd edition).

The package of comprehensive care received by the children totaled 6 to 7 hours per day, 5 days per week. All children received physiatry services, physical therapy, occupational therapy, psychology, recreational therapy, and social work. Children also received speech therapy as needed. An aggressive passive stretching protocol was used during PT. The psychology services included an initial psychological evaluation followed by play therapy. All parents had a brief consultation with the staff psychologist and the parents of 5 children requested additional meetings to discuss behavior management and separation issues. Parents were not able to stay with their children overnight, and attendance at PT sessions was limited. However, the physical therapists became very familiar with most parents. The therapist assisted the child in demonstrating newly acquired skills in the presence of the parents (e.g., transferring, ambulation, dressing, and adapted tricycle riding). The frequency of such demonstrations ranged from one to five times weekly, depending on family availability and rapidity of the child's therapeutic gains. Parents were encouraged to practice these skills with their children during evening and weekend visits. Parents also attended a one-on-one training meeting with their child's physical therapist during the week of discharge. They were taught how to implement a stretching protocol at home. The physical therapists had no formal training in pain management, and children were not typically provided with pain coping strategies beyond the occasional provision of verbal comfort or encouragement.

Measures

Observation Scale of Behavioral Distress (OSBD; Elliott, Jay, & Woody, 1987; Jay, Ozolins, Elliott, & Caldwell, 1983). Since anxiety and pain are difficult to distinguish in acute clinical situations, the term "behavioral distress" is often used to encompass both constructs (Katz, Kellerman, & Siegel, 1980). The OSBD consists of 11 operationally defined behaviors indicative of pain and/or anxiety in children ages 2 to 20 (see Table II). Behaviors are recorded in continuous 15-second intervals. Subscale scores are computed by totaling the occurrence ratings for each behavior. The behaviors are then weighted according to intensity (1.0–4.0) and totaled to create an overall distress score. Reliability and validity are well established. Elliott et al. (1987) reported an alpha internal consistency coefficient of .68 (.72 for a shortened version). High interrater reliability is reported by the authors for two observers' ratings of the occurrence of behaviors (Pearson $r = .98$; mean agreement = 84%). For this study it was necessary to add a 12th behavior, "Reaching to Pain." This behavior was defined as "any extension of the hand toward the area of the body which is being treated/manipulated." This behavior occurred in an average of 39% of the sample over time. It appeared to be an important expression of children's distress that was not otherwise captured by this instrument. Cronbach's alpha test of internal consistency was conducted before and after the addition of Reaching to Pain for the three administrations. An alpha coefficient of .41 was obtained for this sample using the original scale, and a coefficient of .46 was obtained using the scale with the additional category. Discriminant validity for this category was assessed by using a t test. The median was used to divide the children into high and low distress groups. Groups showed no difference in scores at T1 or T3. However, children in the high distress group showed significantly more Reaching to Pain behaviors ($M = 4.1$, $SD = 5.52$) than children in the low distress group at T2 ($M = 0.9$, $SD = 2.15$), $t(21) = 2.25$, $p < .05$. The weight assigned to this behavior was generated using the same procedures described by the authors of the OSBD. Five rehabilitation professionals (three doctoral level psychologists, one master's level psychologist, and one master's level physical therapist) who were familiar with both the PT rhizotomy program and the OSBD assigned an intensity rating to this behavior. The ratings differed no more than 1 point. These five scores were averaged to yield the final intensity rating of 2.5. Three raters recorded the child's distress behaviors while viewing a videotape of the child's PT session. The raters were psychology research assistants who were trained in the use of the OSBD. They were familiar neither with the children nor the physical therapists. Interrater reliability coefficients for the 12 subscales and the total index ranged from .97–.99.

Observer Ratings of Pain and Anxiety. The child's pain and anxiety were also assessed using Observer Ratings (LeBaron & Zeltzer, 1984). A 5-point Likert scale is used to rate each construct, ranging from 1 (*no pain or anxiety*) to 5 (*extreme pain or anxiety*). In this study Pearson correlations between observers' reports of pain and anxiety were .45 ($p < .05$), .66 ($p < .001$), and .53 ($p < .01$) for T1, T2, and T3, respectively. To allow for comparison with the OSBD, these two ratings were averaged to create a composite score. Pain and anxiety are considered to be elements of behavioral distress (Katz et al., 1980), and the correlations between the two ratings suggest a moderate to strong relationship between the variables in this population. While viewing a videotape of the child's PT session, one physical therapist and one master's level psychologist rated the child's levels of pain and anxiety. Interrater reliability coefficients were .60, .86, and .84 at T1, T2, and T3, respectively.

Graphic Ratings Scales of Anxiety and Pain. A child self-report FACES scale was adopted for this study (LeBaron & Zeltzer, 1984). Five faces indicating increasing levels of distress are presented together with the numbers 1 through 5. To ensure that each child had a basic understanding of the affect expressed in the faces, a validity check was performed. At the beginning of the stretching session the therapist asked the child to point to the happiest face and then to the saddest face. A significant number of children (60%) failed the validity check at T1. Eleven of these children have severe cognitive impairments, 4 have moderate impairments, and 2 have mild impairments. The children's cognitive limitations appear to have impeded valid completion. Thus, the scale was not administered at T2 or T3.

Tone/Range/Function. Muscle tone was assessed by the physical therapist using the New York University Rhizotomy Evaluation Form (NYU-REF; Johann-Murphy, Bier, Shakin, Brady, & Klein, 1993). A 5-point scale is used ranging from -1 (*hypotonic*) to 3 (*severely increased tone*). The authors reported interrater reliability (percentage agreement) of 78% with a kappa of .65, and test–retest reliability of 76% with a kappa of .54. Scores for the following muscle groups are averaged to create a composite score: hip flexors, hip adductors, hip internal rotators, quadriceps, plantar flexors, and hamstrings. Passive range of motion (ROM) was assessed by the physical therapist using standardized goniometric measurements of hip extension (normal, 15° past neutral), hip abduction (normal, 0–45°), popliteal angle (hip flexed to 90° and knee brought into extension, normal 180°), and dorsi flexion (normal, 20° past neutral) (Norkin & White, 1985). Each of the four scores is analyzed separately. Function was assessed by the physical therapist using the NYU-REF. Sitting and standing positions are rated using two scales, yielding four scores for analysis. The transition scale describes the method by which the children assumed positions. Children are assigned a rating of 1 to 5 according to the degree of independence in transitions. The assistance scale describes the method by which the children maintained positions. A rating of 1 to 5 is assigned based on the type of support required. Reliability coefficients have been reported for the function scales (Johann-Murphy et al., 1993). Interrater reliability range from 68–100% agreement with a kappa ranging from .54–1.00. Intraobserver reliabilities range from 81–100% agreement with a kappa ranging from .74–1.00.

Infant Behavior Record of the Bayley Scales of Infant Development (Bayley, 1969). The Infant Behavior Record was designed to assess infants' behavior during developmental testing. In this study the Behavior Record was utilized as an indicator of the quality of the child's cooperativeness with PT. Five 5-point Likert scales were used in this study: general emotional tone, goal directedness, attention span, participation, and endurance. Behavioral anchors are provided for each point on the rating scales. Alpha internal consistency coefficients of .89, .82, and .87, were obtained for this sample at T1, T2, and T3, respectively. Scores for cooperativeness were assigned by a physical therapist and a master's level psychologist via videotape playback. Interrater reliability coefficients in this sample were .79, .78, and .81 at T1, T2, and T3, respectively. For ease of analysis, a total score was computed for each of the five behaviors by averaging the child's T1, T2, and T3 scores. The Pearson correlation coefficients between the five behavior ratings ranged from .42–.92. A principal components analysis with varimax rotation was performed. Two eigenvalues reached the minimum value of 1, and two factors were extracted. Both factors were internally consistent and well defined by the variables. High communality values suggested that the variables were well-defined by this factor solution. The first factor, task-focused cooperativeness (TFC), comprises attention span (factor loading = .94; communality = .96) and goal directedness (factor loading = .94; communality = .95). The second factor, emotion-focused cooperativeness (EFC), comprises the child's emotional tone (factor loading = .88; communality = .81), participation (factor loading = .78; communality = .81), and endurance (factor loading = .92; communality = .89). Subscale scores were computed by averaging the appropriate items, and a total cooperativeness score was computed by averaging all five items.

Procedure

A repeated measures design with three assessments of behavioral distress and cooperativeness and two assessments of physical parameters was used for this study. Each child attended 1 hour of PT, five times weekly. The structured stretching protocol required an average of 3.5 minutes to complete. Each child maintained the same physical therapist throughout the inpatient stay. There were a total of 17 physical therapists. Each therapist had a minimum of 3 years of experience as a physical therapist, at least 6 months of experience in treating children postrhizotomy, and was trained in the structured stretching protocol. Standard stretch positions for various muscle groups were held for a count of 10. Goals for stretching were adjusted upwards as ROM increased. Thus the children were always being stretched beyond the point at which resistance was felt, that is, within their restricted range.

Measures of behavioral distress and cooperativeness were taken at three points in time. The first measurement (T1) occurred during the first week of admission (i.e., 1 week postsurgery). T2 occurred at 5 weeks postsurgery. Three muscles groups (hip flexors, hip adductors, and ankle plantar flexors) were stretched at T1 and T2. T3 occurred during the week of discharge or 4 months postsurgery, whichever came first (M = 13.2 weeks postsurgery; SD = 3.36). At 6 weeks postsurgery precautions were lifted, and hamstring muscles could be stretched. Therefore, four muscles groups were stretched at T3. The three PT stretching sessions were videotaped. Measures of tone/range/function were taken prior to surgery and 3 to 6 months postsurgery.

RESULTS

The length of the stretching sessions was not held constant; therefore its relationship to behavioral distress was investigated. Significant correlations were found between OSBD scores and length of the stretching session at T1 (r = .63, $p < .001$), T2 (r = .53, $p < .01$), and T3 (r = .60, $p < .001$). It is assumed that pain is distributed relatively equally across the duration of the session. To control for the impact of session time on distress behaviors, the children's OSBD scores were divided by the length of their sessions. The revised distress scores were no longer correlated with the session length and were used in further analyses. Neither the Observer Ratings nor the Cooperativeness ratings were significantly related to session length. The two parental involvement variables showed a positive skew and were transformed using the square root. The transformed scores were used in further analyses.

Behavioral Distress

The descriptive statistics for the OSBD scores and Observer Ratings are presented in Table II. Correlation coefficients between the OSBD scores and Observer Ratings were .64 ($p < .001$), .63 ($p < .001$), and .68, ($p < .001$), at T1, T2, and T3, respectively.

The hypothesis that behavioral distress decreases as rehabilitation pro-

Table II. Descriptive Statistics for the Pain Scores Over Time as Measured by the OSBD and Observer Ratings (N = 30)[a]

		T1		T2		T3	
Pain behaviors	Weight	*M*	*SD*	*M*	*SD*	*M*	*SD*
OSBD							
Seek information	1.5	0.0	0.05	0.0	0.20	0.1	0.14
Cry	1.5	3.3	2.03	1.8	1.93	1.3	1.37
Scream	4.0	1.0	2.39	0.6	1.77	0.4	1.83
Physical restraint	4.0	1.2	1.84	1.8	2.58	1.8	2.43
Verbal resistance	2.5	0.5	0.99	0.2	0.49	0.3	0.67
Seek emotional support	2.0	0.3	0.80	0.0	0.00	0.1	0.19
Verbal pain	2.5	1.0	2.03	1.5	2.56	1.2	1.50
Flail	4.0	0.5	1.14	0.4	0.86	0.2	1.11
Verbal fear	2.5	0.0	0.00	0.1	0.26	0.0	0.17
Muscular rigidity	2.5	4.2	2.03	3.4	2.59	3.8	1.92
Nervous behavior	1.0	0.0	0.06	0.0	0.00	0.0	0.09
Reach to pain	2.5	0.6	0.92	0.7	0.95	0.7	1.15
Total		12.7	5.87	10.7	6.81	10.2	5.81
Observer ratings		3.2	0.79	2.4	0.72	2.3	0.54

[a]The OSBD scores are presented as weighted raw scores divided by length of session (measured in minutes). To compute the frequency of behaviors per minute, divide the OSBD score by the weight. For example, by dividing the children's cry score (3.3) by the weight for that behavior (1.5), we find that children cried an average of 2.2 times per minute at T1.

gresses was confirmed. Both the OSBD scores $F(1, 29) = 3.45, p < .05$, as well as the Observer Ratings decreased over time, $F(1, 29) = 26.46, p < .001$. The greatest decrease in scores occurred between T1 and T2. Changes in the individual distress behaviors (OSBD) were tested using analysis of variance. Bonferroni tests of significance were used to establish more conservative probability levels. Crying showed a significant decrease over time, $F(1, 29) = 18.82, p < .001$.

Physical Functioning

The Wilcoxon signed-ranks statistic was used to detect changes in the children's muscle tone, ROM, and functional status after surgery and rehabilitation. It was necessary to control for the inflated probability of a Type I error associated with multiple correlations, thus family-wise Bonferroni tests of significance were used. Children showed significant improvement on all nine physical parameters postsurgery/rehabilitation (Table III). The correlations between function change scores and pain were not significant, that is, change in function was not related to the degree of pain demonstrated by the child. Similarly, there was no relationship between function change and cooperativeness scores.

Cooperativeness During Therapy

The means of the children's total cooperativeness scores were 3.3 ($SD = 0.91$) at T1, 3.8 ($SD = 0.77$) at T2, and 4.0 ($SD = 0.78$) at T3. There was a significant increase in the children's ability to cooperate with the PT protocol, $F(1, 29) = 8.01$, $p < .001$. The two subscales of this measure were also examined. The mean scores for the EFC subscale were 2.7 ($SD = 0.77$), 3.3 ($SD = 0.59$), and 3.4 ($SD = 0.63$) at T1, T2, and T3, respectively. The mean scores for the TFC subscale were 2.6 ($SD = 0.84$), 2.8 ($SD = 0.94$), and 2.8 ($SD = 0.78$) for T1, T2, and T3, respectively. Results of the analyses of variance confirm significant increases for EFC, $F(1, 29)$ 12.54, $p < .001$, but not for TFC, $F(1, 29)$ 1.70, ns.

Demographic Characteristics

Pearson and Spearman correlation coefficients were used to investigate the role of demographic characteristics including age, gender, ethnicity, cognitive impairment, mobility level, and frequency of parent–therapist contact and of parent carry-over sessions. No significant relationship was found between any of

Table III. Descriptive Statistics and Wilcoxon Signed-Ranks Z Values for the Physical Variables ($N = 30$)

	Presurgery		Postsurgery		
Variable[a]	Mdn	Range	Mdn	Range	Z^b
Muscle tone	1.8	0.5–2.7	0.0	0.0–1.7	−5.14[e]
Range of motion					
Hip extension	5.0	−22.5–15.0	15.0	−2.5–15.0	−3.86[e]
Hip abduction	28.8	5.0–45.0	45.0	10.0–45.0	−4.79[e]
Popliteal angle	142.5	110.0–172.5	177.5	145.0–180.0	−5.08[e]
Dorsi flexion	3.8	−12.5–20.0	20.0	−5.0–20.0	−4.19[e]
Function					
Transition scale					
Sitting	2.4	2.0–4.8	3.1	2.0–4.8	−2.39[c]
Standing	2.0	2.0–3.7	3.0	1.3–4.0	−3.14[d]
Assistance scale					
Sitting	3.5	2.0–5.0	4.5	2.0–5.0	−3.12[d]
Standing	2.0	2.0–3.7	3.0	0.7–4.3	−2.49[c]

[a]Decreases in muscle tone scores signify improvement. Increases in function and range of motion scores signify improvement.
[b]To control for the inflated probability levels of multiple comparisons, one-tailed Bonferroni tests were used for investigating pre- and postsurgery differences.
[c]$p < .05$.
[d]$p < .01$.
[e]$p < .001$.

these variables and OSBD scores. Only one variable was related to the physical parameter scores. Cognitive impairment was correlated with the transition scores (Spearman $r = -.52, p < .05$ for sit transition; Spearman $r = -.58, p < .01$ for stand transition) and assistance scores (Spearman $r = -.52$, $p < .05$ for sit assistance; Spearman $r = -.54, p < .05$ for stand assistance), but not with range of motion or tone scores. Transition and assistance ratings require more active involvement from the child, whereas range of motion and tone ratings are based strictly on passive movements.

Predictors of Cooperativeness During Therapy

Hierarchical regression analyses were used to investigate the impact of demographic characteristics, parental involvement, and the children's pain on their cooperativeness with therapy (Table IV). A total pain score was computed for each OSBD behavior by averaging the scores from the three assessments. A total TFC score and a total EFC score were computed in the same manner. Two regression models were to be conducted, one for each form of cooperativeness. The independent variables were examined in order to create the most parsimonious regression equations. Preliminary regression analyses were conducted

Table IV. Hierarchical Multiple Regression Analyses of Cooperativeness During Therapy ($n = 29$)

Predictors	β	*F* for model	Adjusted R^2	R^2 change
	Task-focused cooperativeness			
Step 1: Demographics				
Cognitive impairment	$-.45^{d}$	28.12^{e}	.50	$.50^{e}$
Step 2: Parent involvement				
Parent–therapist contact	.07	17.45^{e}	.55	$.05^{a}$
Step 3: Child pain				
Crying	$-.33^{c}$			
Flailing	$-.28^{c}$			
Verbal pain	$.30^{c}$	18.68^{e}	.77	$.22^{d}$
	Emotion-focused cooperativeness			
Step 1: Parent involvement				
Parent carry-over	.16	5.23^{b}	.17	$.17^{b}$
Step 2: Child pain				
Physical restraint	$-.41^{b}$			
Verbal resistance	$-.21$			
Crying	$-.51^{c}$	7.59^{c}	.56	$.39^{c}$

$^{a}p = .06$.
$^{b}p < .05$.
$^{c}p < .01$.
$^{d}p < .001$.
$^{e}p < .0001$.

for each group of independent variables. The variables which met a PIN (probability of F to enter) of $p < .05$ and a POUT (probability of F to remove) of $p < .10$ in the preliminary regressions were marked for inclusion in the final regressions. The entry order of the independent variables was guided by our interest in assessing the unique contribution of the children's pain. Significantly related demographic characteristics were entered first because they were preexisting, relatively stable variables. Parental involvement variables were entered next, followed by children's pain behaviors. As the first regression shows, cognitive impairment accounted for 50% of the variance in TFC; frequency of parent–therapist contact accounted for an additional 5% of the variance; and child pain behaviors accounted for a final 22% of the variance. Crying and flailing were predictive of lower TFC whereas verbal pain was predictive of better TFC.

The second regression analysis shows that 17% of the variance in EFC was accounted for by frequency of parent carry-over sessions, and an additional 39% is accounted for by child pain behaviors. Physical restraint and crying were associated with lower EFC.

DISCUSSION

This study represents the first attempt to measure pain and anxiety in children undergoing rehabilitation following rhizotomy. As hypothesized, ratings of children's pain and anxiety decreased throughout rehabilitation. This finding supports clinical experience. The greatest decrease in OSBD scores is noted at T2. The children's distress behaviors then remain somewhat stable between T2 and T3. This is particularly encouraging since hamstring stretching is introduced between T2 and T3. These children do not show an increase in pain despite the addition of a new stretch (i.e., they maintain their accommodation to pain).

Psychological processes such as coping may be accounting for the decrease in pain. Coping strategies such as diverting attention and calming self-statements are effective for children with sickle cell disease (Gil et al., 1993). In contrast, catastrophizing thoughts are associated with impaired ability to participate in activities of daily living in children with chronic arthritic pain (Branson, Craig, & Malleson, 1988). The children in this study may be using their accumulated experience with stretching to moderate pain. With repeated exposure to stretching the children may become more confident in their ability to tolerate the pain; and/or familiarity with the procedure may enable them to develop an increased sense of control over the situation. In addition to these more cognitive coping strategies, the children may be using the support of the therapeutic relationship as a means of coping. The developing bond between the children and physical therapists in this study is easily recognized by staff and visitors. The therapists' response to the children's pain as well as the children's ability to draw support and strength from the relationship may contribute to the decrease in pain. The decrease may also be explained in operant terms. For example, the child's behavior may change due to environmental responses (or lack thereof) while there may be no change in the child's level of subjective distress.

The results of the regression analyses confirm the importance of cognitive impairment, parental involvement, and pain behaviors in predicting the child's level of cooperativeness with treatment. Interestingly, cognitive impairment predicts task-focused cooperativeness (i.e., attention span and goal directedness) but not emotion-focused cooperativeness. Of particular clinical value are the results in support of parental involvement. Parent-initiated contacts with the physical therapist and parent carry-over sessions improve the child's TFC and EFC, respectively. While the strong relationships between pain behaviors and cooperativeness are not surprising, the *type* of behavior and the *direction* of the relationships are very important. Children who are able to verbally describe their pain show *increased* TFC. One explanation for this finding is that the manner in which the children express their pain may act as a form of coping. Finally, it should be noted that the regression models were used to capture one part of the pain–cooperation relationship. Clinical experience has shown that the child's pain behaviors predict cooperativeness which may in turn impact the child's further experience of pain. Thus, the relationship between the two sets of variables may be cyclical with the independent variable (cooperativeness) becoming the dependent variable in the next phase of treatment.

Clinical Implications

The clinical implications of this study are many. First, it appears that children do accommodate to pain experienced during treatment. Although debate surrounds this issue (Katz et al., 1980), some researchers have found that familiarity with a noxious stimulus results in an increased tolerance for it (Jay et al., 1983; McGrath, 1990). The mechanism for this accommodation was not investigated in this study, however, psychological factors such as the child's coping are thought to play an important role. Thus, pain management techniques which promote cognitive and behavioral coping strategies may be helpful in reducing pain during PT. For example, therapists may help the child to experience control by providing appropriate and ongoing information about the stretching. Involving the child in decision making and in the treatment may help reduce combative and resistant behaviors (Melamed & Siegel, 1980; Shafir, Weiss, & Herman, 1988). It is important to remember that while decreases in pain were significant, the children in this study still experience some degree of pain associated with treatment at T3. Thus, even when accommodation occurs, the critical need for pain management must not be underestimated.

Earlier findings of increased physical functioning over time (Abbott et al., 1989) are confirmed by the results of this study. These data can be helpful in educating children, parents, and physical therapists regarding their expectations for treatment (e.g., pain during stretching can be expected to significantly decrease by the 5th week of rehabilitation).

The significance of the child's pain and parental involvement in predicting cooperativeness during therapy has important clinical implications as well. Parents can be encouraged to engage in carry-over activities with their child and to initiate contact with the physical therapist. Parents need to be educated regarding the potential impact of such action on the child's ability to cooperate with treatment. Therapists can encourage the exchange of information with parents, and they can teach parents how to incorporate carry-over activities into routine visits with the child. Finally, children can be taught to verbally describe their pain. This behavior was associated with increased cooperation, and may be a more helpful expression of pain than verbal resistance, crying, and/or flailing.

Research Implications

With the addition of one behavioral category, the OSBD appears to be a useful instrument for assessing these children's experience of distress. It not only yields a global index but also provides data on the occurrence and frequency of individual pain behaviors. Observer ratings are particularly useful for their utility in the clinical setting (e.g., less than 1 minute is required for completion). Correlations between the observer ratings and OSBD scores were very strong at T1, T2, and T3. These observer ratings require a minimum of effort, time, and expense, and can be obtained regardless of the age or cognitive level of the child (e.g., Varni, Thompson, & Hanson, 1987). Thus, observer ratings may be of particular value when assessing children who are younger and/or cognitively impaired.

One limitation of this study was the absence of valid self-reports. Since the child's pain behaviors may not be the same as the child's *perception* of pain intensity, conclusions regarding the latter cannot be directly addressed. Second, inferences are limited concerning the efficacy of treatment owing to the single-group descriptive design. Finally, this study does not provide data regarding *how* the child accommodates to the pain of stretching. Additional research is needed to address the process of adaptation. Of special interest is the impact of the child's coping strategies, of therapist and parent characteristics, and of the relationship between the child and therapist. While recent attention has been given to the impact of parent's coping on the child's ability to manage pain (Blount, Landolf-Fritsche, Powers, & Sturges, 1991; Frank et al., 1995), the inclusion of medical staff has received less attention. Beyond uncontrolled descriptive studies, the next steps in treatment-related psychological research include randomized trials to investigate the impact of pain management techniques on children's pain and cooperativeness, and the impact of parent–therapist coping training on children's pain and cooperativeness.

The results of this study provide important information for both the evaluation of treatment efficacy and the training of parents and therapists. The results may allow for a more informed comparison between functional outcome and the costs of achieving that outcome. Furthermore, assessments of children's pain may lead to the implementation of appropriate pain management interventions, and may advance collaboration between members of the rehabilitation team. Finally, in recognizing the impact of parental involvement, interventions with the parents and therapists can be made in an effort to alter the child's experience of and ability to cooperate with painful treatment.

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