Putting the Pieces Together: Preliminary Efficacy of a Web-Based Family Intervention for Children with Traumatic Brain Injury

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Objective To report preliminary efficacy data from a Web-based family problem-solving intervention to improve parent and child adaptation. Method Eight parents and six children with moderate to severe traumatic brain injury (TBI) who were injured more than 15 months earlier (M =16 months) participated in the intervention. Families were given computers, Web cameras, and high-speed Internet access. Weekly videoconferences with the therapist were conducted after they completed self-guided Web exercises on problem-solving, communication, and antecedent behavior management strategies. Results Paired t tests comparing pre- and post-intervention scores revealed significant improvements in injury-related burden, parental psychiatric symptoms, depression, and parenting stress. There were also significant reductions in antisocial behaviors in the injured child, but not in self-reported depressive symptoms. Conclusions These findings suggest that a computer-based intervention may successfully be used to improve both parent and child outcomes following TBI in children.

Key words telehealth; acquired brain injury; intervention; problem-solving; online.

Child and Family Sequelae of Traumatic Brain Injury

Pediatric traumatic brain injury (TBI) poses significant challenges for both the injured child and his or her family (Brown, Chadwick, Schaffer, Rutter, & Traub, 1981; Wade et al., 2002). Parents are confronted with physical and cognitive impairments as well as changes in the child's behavior and personality (Fletcher, Ewing-Cobbs, Miner, Levin, & Eisenberg, 1990). Long-term follow-up studies suggest that emerging behavior problems represent the most persistent and stressful sequelae of TBI in children (Fletcher et al., 1990; Max, Koele, et al., 1998; Schwartz et al., 2003).

Not surprisingly, parents of children with severe injuries report elevated levels of parental burden and psychological distress that persist for many years following the injury (Rivara et al., 1996; Wade et al., 2002). Children who sustain TBIs also have psychosocial needs that are often inadequately addressed. Deficits in social-problem-solving skills are a particular problem for many children following TBI (Jacobs & Anderson, 2002; Janusz, Kirkwood, Yeates, & Taylor, 2002). Such deficits require learning or relearning strategies for understanding and responding to social situations and managing their impulsivity and anger (Ylvisaker & Feeney, 1998). Existing studies suggest that child recovery and family adaptation exert reciprocal influences on one another over time (Kinsella, Ong, Murtaugh, Prior, & Sawyer, 1999; Max, Castillo, et al., 1998; Yates et al. 1997). Thus, family-centered interventions may provide a viable means for improving both child and family outcomes.
Family Interventions Following Pediatric TBI

The findings outlined above suggest a need for family interventions following pediatric TBI. Yet, only two investigations have evaluated interventions for families following pediatric TBI (Singer et al., 1994; Wade, Michaud, & Brown, 2004). The lack of established family treatment for pediatric TBI may be, in part, attributable to the unique barriers to care facing many families. Most children with TBI receive treatment at centralized rehabilitation centers serving large geographic areas. Thus, returning for outpatient counseling may be impossible or unduly time-consuming. However, local providers may lack requisite knowledge and expertise regarding TBI. Thus, families must choose between traveling long distances and forgoing services altogether.

Given these considerations, families of children with TBI may be particularly able to benefit from interventions delivered via computer or the World Wide Web (WWW or Web) that eliminate barriers to treatment such as time, distance, and the unavailability of knowledgeable providers. Although a number of Web sites currently provide information and referrals regarding brain injury, most information is geared toward adult TBI. Additionally, no existing website provides one-to-one, synchronous assistance in coping with the challenges of TBI sequelae.

Innovation

This report describes preliminary efficacy data for online Family Problem Solving (FPS) for families of children with TBI. This project represents one of the first Web-based interventions designed to be used by members of a family together, requiring responses from both individual family members and the family as a group. Moreover, this intervention may be the first to integrate self-guided Web materials with synchronized videoconferencing between a family and therapist. We tested two hypotheses corresponding to the major outcomes targeted by the intervention: (a) Can FPS reduce parental burden, depression, anxiety, and distress? (b) Can FPS reduce child behavior problems and improve social outcomes and metacognitive or executive skills following TBI?

Method

Participants

Participants were recruited from the trauma registry of an urban children’s hospital. To be eligible, children had to be between the ages of 5 and 16, and to have sustained a moderate to severe traumatic brain injury (TBI) more than 15 months previously. As described previously, severe brain injury was defined as a lowest Glasgow Coma Scale (GCS) score of eight or less. Moderate TBI was defined as a GCS score of 9–12, or a higher GCS score with accompanying evidence of brain abnormalities on imaging studies (Fletcher et al., 1990). Because of the preliminary nature of the project, a convenience sample of six families was recruited to participate. The two girls and four boys with TBI were an average of 9.4 years of age (range: 6 years 8 months to 15 years 9 months) and were injured 16 months prior to recruitment on average (range: 15–29 months). Four of the children had GCS scores of eight or less, indicating a severe TBI. Four children also had significant cognitive or learning impairments. In two cases, these deficits preceded the injury. None of the children was receiving medication or treatment for attention or behavioral problems at the time of the study. One child was African American and one was biracial. In four families, the parents were married and residing together. Socioeconomic status (SES) and education level varied substantially, with parental education ranging from high school dropout to advanced degree. Four families had existing home computers whereas two had limited previous computer experience.

Procedure

After informed consent was obtained, the research assistant went to the family’s house and installed a Dell computer with 19 in. monitor and Web camera. Families were allowed to keep the computers at treatment completion. High-speed Internet access was provided for all but one of the families. During the initial visit, the research assistant completed the baseline assessment and provided family members with training in how to turn on the computer, log onto the Web site via Internet Explorer, and navigate within the Web site.

At the beginning of treatment, the therapist met once with each family in the family’s home. Parents, the injured child, and school-aged siblings were invited to participate in this and subsequent meetings. During the initial meeting, the therapist conducted a structured interview regarding how the injury had affected the child and family, and current concerns and goals. The therapist also reviewed the content and structure of the intervention and entered goals identified by individual family members into the website. Future meetings with the therapist were scheduled for every 1–2 weeks and conducted via videoconferencing. Prior to each videoconference, the family completed self-guided materials on the website.
Description of the FPS Intervention

The FPS homepage featured links to announcements, contact information, resources (other brain injury websites), and the session materials. By clicking the Start Sessions button, participants could access the content from current and previous sessions. The therapist assigned new sessions to each family upon completion of the previous session. Materials were password protected, encrypted, and available at all times.

We designed the Web site to be used by multiple family members at the same time, analogous to a family therapy session. Hence, family members, including children, logged in together by clicking under their picture (see Wade, Wolfe, & Pestian, in press, for a complete description). The family member's picture would appear when an individual response was required. Given the varied age and cognitive abilities of participating children, it was anticipated that parents and children would complete the sessions together, with parents or older siblings providing assistance as needed. The Web site was programmed so that the family could not proceed to the next screen until a response was entered for each question.

The FPS Web site had 12 separate sessions. Eight “core” sessions provided problem-solving, communication and TBI-specific behavior management skills to all enrolled families, whereas the remaining four sessions addressed content related to the stressors and burdens of individual families, including stress management, working with the school, sibling concerns, and marital communication. Each self-guided online Web session included didactic content regarding the skill (i.e., problem-solving), video clips showing families modeling the skill, and exercises giving the family an opportunity to practice the skill. Exercises were designed to be “interactive” and enjoyable by incorporating animation and graphics. The second part of each session involved a synchronous videoconference with the therapist via videoconference. During these sessions, the therapist reviewed the exercises completed by the family and implemented the problem-solving process with a problem or goal identified by the family.

Measures

Injury-related Stress and Burden. The Family Burden of Injury Interview (FBII) was administered to provide a context-specific assessment of injury-related stress (Burgess et al., 1999). Correlations with other measures of family burden and stress and predictive relationships with child outcomes provide evidence of validity. Responses to the FBII were used to identify families requiring more intensive individual intervention in specific areas.

Parental Distress, Depression and Anxiety. The Global Severity Index (GSI) of Symptom Checklist-90-R (SCL-90-R), a 90-item self-report checklist, was administered to provide an estimate of global psychiatric symptoms and parental distress. The SCL-90-R has well-documented reliability and validity (Derogatis, 1994). We chose the Center for Epidemiologic Studies Depression Scale (CES-D) to measure depression because it is brief, has well-established psychometric properties, and is useful for identifying individuals at risk for developing clinical depression (Radloff, 1977). The 10-item Anxiety Inventory (AI) has been widely used in psychological research in which repeated measures are taken, and limited time is available (Speilberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983). The total stress score from the Parenting Stress Inventory (PSI—short form), a 36-item scale with documented reliability and validity, assessed stress associated with parenting (Lloyd & Abidin, 1985).

Child Adjustment. The Home and Community Social Behavior Scale (HCSBS) is a 64-item, parent-report scale assessing social competence and antisocial behavior provided a measure of child behavior problems and social competence (Merrell, Streeter, & Boetter, 2001). The HCSBS has high internal consistency and test-retest reliability and documented validity. The Behavior Rating Inventory of Executive Function (BRIEF) provided a measure of attention, impulse control, and other executive function behaviors that are often affected following TBI (Gioia, Isquith, & Guy, 2000). Finally, the Children’s Depression Inventory (CDI), 10-item short form, provided a brief measure of depressive symptoms in the injured child (Sitarenios & Kovacs, 1999).

Therapeutic Alliance. Parents completed a seven-item version of the Agnew Relationship Measure (Agnew-Davies et al., 1998) to assess the quality of their relationship with the therapist.

Results

Feasibility

Nineteen individuals participated in the study, including six children with TBI, eight parents, and five siblings. Families completed 10.3 Web sessions on average (range 7–12) and 10.1 synchronous videoconferences (range 7–14). The fact that all families were able to successfully complete the intervention provides preliminary evidence regarding the feasibility of this approach.

Improvements in Parent and Child Outcomes

Paired t tests were used to examine changes in parental stress, burden and functioning from pre- to post-treatment.
Parents reported high levels of distress at baseline, with six of eight participating parents exceeded the clinical cutoffs on both the CES-D and SCL-90. Injury-related stress and burden (FBII), parenting stress (PSI), depression (CES-D), and global psychological symptoms (SCL-GSI) all declined significantly from baseline to follow-up (Table I). Parents also reported a significant reduction in antisocial behaviors on the Home and Community Social Behavior Scale-Antisocial Behavior (HCSBS-AB). Although improvements were also noted on the Behavior Rating Inventory of Executive Function Global Executive Composite (BRIEF GEC), the difference did not achieve statistical significance in the small sample.

**Therapeutic Alliance**

Despite the remote nature of the treatment, parents reported a strong therapeutic alliance, as indicated by high levels of confidence in the therapist and his or her skills ($M = 6.75$; $6.88$ on a 7-point scale), comfort in openly expressing oneself ($M = 6.38$), and agreement on how to work together ($M = 6.14$). These findings suggest that the therapeutic alliance was not weakened by the method of treatment delivery.

**Discussion**

These findings suggest that children with TBI and their families may be able to successfully use and benefit from an online intervention program to improve child and family adaptation. Given the range of prior computer experience among participants, the families’ ability to independently complete self-guided sessions supports the feasibility of a Web-based approach in this population. More importantly, our findings suggest that participation in such a program may contribute to reductions in parental burden and distress as well as improve child behavior problems. These findings are noteworthy, given the persistence of parental stress and burden following pediatric TBI (Rivara et al., 1996; Wade et al., 2002). Six out of eight parents in the current sample were clinically distressed (based on established cutoffs) at baseline compared to only two at follow-up suggesting that reductions in distress were clinically meaningful. Additionally, all families reported significant improvement in one or more dimensions of parent burden and distress.

Significant improvements in child behavior problems in this sample provide preliminary evidence that a Web-based, family-centered approach may also facilitate reductions in behavioral sequelae. FPS may contribute to improved child behavior and adjustment through several avenues. First, parents may learn new skills for managing the child’s behavior. Second, parents and children may engage in more collaborative problem-solving and conflict resolution, thereby reducing the frequency of coercive parenting (Patterson, 1988). Finally, children may themselves develop skills for self-monitoring, problem-solving, and communication that contribute to enhanced self-control. FPS provided training in all of these areas. All sessions emphasized effective (non-coercive)

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**Table I. Pre- and Post-Intervention Differences in Parent Distress and Child Adjustment**

<table>
<thead>
<tr>
<th>Measure</th>
<th>Pre-Intervention [mean (SD)]</th>
<th>Post-Intervention [mean (SD)]</th>
<th>Difference of Pre- and Post-Intervention Scores</th>
<th>$t$</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parent adjustment (n = 8)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Parent Stress Inventory—Total Stress Scale</td>
<td>102.38 (22.88)</td>
<td>84.75 (27.02)</td>
<td>7.63</td>
<td>2.40*</td>
<td>0.27–34.98</td>
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<tr>
<td>Family Burden of Injury Interview—Injury-related stress</td>
<td>51.25 (25.04)</td>
<td>16.25 (8.17)</td>
<td>35.00</td>
<td>3.82**</td>
<td>$-56.69$ to $-13.31$</td>
</tr>
<tr>
<td>Symptom Checklist—90 Global Severity Index</td>
<td>63.63 (8.97)</td>
<td>57.00 (12.97)</td>
<td>6.63</td>
<td>2.37*</td>
<td>0.03–13.22</td>
</tr>
<tr>
<td>Anxiety Inventory Total</td>
<td>14.38 (7.09)</td>
<td>11.88 (7.40)</td>
<td>2.50</td>
<td>0.94</td>
<td>$-3.76$–8.76</td>
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<tr>
<td>Center for Epidemiologic Studies Depression Scale</td>
<td>22.75 (10.98)</td>
<td>16.38 (11.16)</td>
<td>6.38</td>
<td>2.51*</td>
<td>0.36–12.39</td>
</tr>
<tr>
<td><strong>Child adjustment (n = 6)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Behavior Rating Inventory of Executive Function Global Executive Composite</td>
<td>62.17 (11.70)</td>
<td>54.83 (3.31)</td>
<td>7.33</td>
<td>1.49</td>
<td>$-5.31$–19.97</td>
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<td>Home and Community Social Behavior Scale—Antisocial Behavior</td>
<td>51.67 (7.50)</td>
<td>45.50 (6.74)</td>
<td>6.17</td>
<td>2.42*</td>
<td>$-0.38$–12.72</td>
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<td>Children’s Depression Inventor</td>
<td>4.40 (4.16)</td>
<td>5.20 (5.36)</td>
<td>$-0.80$</td>
<td>$-0.24$</td>
<td>$-9.86$–8.26</td>
</tr>
</tbody>
</table>

*indicates significance $p < .05$.

**indicates significance $p < .01$. 

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Web-Based Family Intervention

communication and parent–child collaboration in problem-solving. Two sessions focused specifically on antecedent behavior management for parents. Children were encouraged to “Stop and Think” and to apply the problem-solving and communication skills to their own problems. Although we did not directly assess parenting practices, the significant reductions in parenting stress suggest that parents felt more confident about their parenting skills. Likewise, improvements in executive function behaviors support the idea that the children themselves adopted the organizational and planning strategies that were taught in FPS.

The current study is part of a growing literature supporting the utility of online interventions for a variety of conditions (Marks, Susan, & Parkin, 1998). However, our involvement of an entire family in a Web-based intervention is relatively unique (see also Ritterband et al., 2003). We found that participants established a strong relationship with the therapist, despite the fact that face-to-face contact was limited to an initial session. Further research is necessary to determine how important face-to-face contact is for establishing a therapeutic alliance and the value of videoconferencing over telephone contact.

These are preliminary findings and care must be taken in generalizing from these results. The study was conducted with a small convenience sample that is not necessarily representative of the broader population of children with moderate to severe TBI. In fact, the high level of distress among this sample at baseline suggests that they may differ in important ways from the “typical” family more than a year following TBI. Given the lack of a control group, it is impossible to determine how much of the documented improvement was associated with factors other than the treatment (e.g., the passage of time). Because participants were given the computer following participation, their responses may also have been biased by social desirability factors. The small sample size also precluded subsample analyses to better understand the nature of the treatment effects.

This study represents an important first step in developing effective online interventions for families of children with TBI. Large, randomized clinical trials are necessary to examine the efficacy of online FPS versus alternative treatments and standard care and to identify critical components of the intervention. Nonetheless, the results provide important initial evidence of the potential efficacy of family-centered online intervention for improving child and family adaptation following pediatric TBI.

Acknowledgments

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