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Childhood Dental Injuries: A Resiliency Model of Adaptation

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Summary

Background: There is a paucity of research examining how children and their families adapt to traumatic dental injuries. **Aim**: This study examined how clinical and psychosocial factors influence adaptation to this oral stressor using a theoretical framework of resiliency and adaptation. **Design:** Children with traumatised permanent teeth, who were attending a UK dental hospital, completed questionnaires at baseline and at a six month follow-up. Child questionnaires assessed coping styles, social support and quality of life outcomes. Parents were also asked to complete questionnaires, which assessed previous stressors/strains on the family, social support, healthcare satisfaction and family impacts. Data related to the child's dental injury was collected from clinical notes. Structural equation modeling and regression analyses were employed to analyse data. **Results:** 108 children and 113 parents participated at baseline. Children's gender, coping style, social support and family functioning significantly predicted children's oral health related quality of life. Parents' satisfaction with their children's dental care significantly predicted parental quality of life outcomes. Children's close friend support and healthcare satisfaction remained significant predictors of positive outcomes at follow-up. **Conclusions:** The findings revealed important psychosocial factors that influence child and family adaptation to childhood dental trauma.

Introduction

Dento-alveolar trauma involves injury to the mouth, lips, teeth, jaws or gums. Just under half of the population will sustain a dental injury before they reach adulthood, with the majority of these injuries occurring due to falls, traffic injuries and sporting accidents (1, 2). Trauma to the permanent dentition can result in irreversible damage to the tooth structures and therefore whilst treatment for dental injuries aims to restore the aesthetics and function of the mouth, research has revealed that a variety of functional, emotional and social impacts associated with these injuries can persist following dental treatment (3). Within family systems theory it is widely recognised that childhood injuries can place significant amounts of stress on the wider family unit (4). Indeed, parents of children who have experienced dental injuries are often required to have to take time away from their usual commitments to support their child undertake lengthy and complex treatments programmes (5).

Berger et al. (6) investigated the impacts of severe dental injuries (i.e. luxation or avulsion injuries) on children attending a dental hospital for treatment and found that 64% of children aged between eight and 10-years reported feeling concerned about what others thought about their mouth, 55% felt upset and 45% felt shy or embarrassed as a result of their dental injury. Berger et al. also found that over two thirds of the parents of these children reported feeling upset immediately after their child's dental injury. Whilst impacts were found to reduce over a 12-month period lasting impacts were reported at follow-up for both children and parents suggesting that there are considerable persistent impacts on families as a result of childhood dental trauma. However, not all parents and children report negative impacts associated with childhood dental injuries (3, 6) and no research to date has investigated the clinical, demographic or psychosocial factors that may be important in the child or family's adaptation to this injury stressor.

It is possible that clinical variables such as the severity and visibility of the injury may be an influential factor on how children and families are affected by the dental injury. Indeed, children who have noticeable visible facial differences are thought to be especially vulnerable to stigmatisation (7) and research has shown that the severity of a condition is often linked to adjustment outcomes in children (8). However, it has also been proposed that contextual factors within the family unit can play an important role in influencing how an individual and their family adapts to the stressors which they are faced with (9). The Family Resiliency Model of Stress, Adjustment and Adaptation has been used extensively to investigate the recovery factors involved in chronic childhood conditions. The model proposes key psychosocial variables influence outcomes following injury/illness which include the existing pressures on the family unit (e.g. 'pile-up' of demands), family typology (e.g. hardiness and coherence), the social support/resources available to the family (e.g. friends/family and healthcare) and the problem solving and coping strategies that family members employ.

Family demands may be directly related to the severity of the patient's injury (10), however, they will also include any previous stressors the family has recently had to manage (e.g. bereavement, change of job). Family hardiness has been found to be a protective factor which can help families adjust to the demands placed on them by the health stressor and refers to the internal strengths and durability of a family unit and is characterised by its sense of control over the outcomes of life events and active orientation towards adjustment (11). Higher levels of perceived social support have also been associated with more positive outcomes in children adjusting to chronic health problems (12) and the support and satisfaction families receive from healthcare providers can be a practical resource which the family can use to help them deal with their situation (4). Additionally, there is support for the role coping plays in the adjustment to oral health stressors, with avoidance coping generally being predictive of

poor outcomes (13).Therefore, it is important to examine the role family typology, social support, healthcare satisfaction and coping all play in adaptation to dental injuries.

Understanding the factors that influence positive outcomes following childhood dental injuries is essential if dental practitioners are to support their child patients and families effectively manage the stressors of their dental injury. Therefore, the overall aim of this study was to identify the factors that are important in childhood and family adaptation to dental injuries using the Resiliency Model of Stress, Adjustment and Adaptation (14).

Materials and Methods

Design

Following ethical approval from the South Sheffield Research Ethics Committee, families were recruited from a UK dental hospital. Informed consent was gained from parents and assent was gained from children. Self-report questionnaires were posted out to those families who had expressed an interest in taking part in the longitudinal study six months after they completed the first set of questionnaires. Participants were made aware that participation was entirely voluntary and that their dental care would not be affected by participation in the study.

Participants

The target population included children, aged 7-17 years, who were receiving treatment for a dental injury to one or more of their permanent teeth. A family member (e.g. parent or legal guardian) of each child was also invited to take part in the study.

Measures

Child measures

The Coping Scale for Children and Youth (CSCY) (15) was used to measure children's coping strategies. This scale is composed of 29 items comprising four domains (assistance seeking; cognitive-behavioural problem solving; cognitive avoidance; and behavioural avoidance). When responding to the questionnaire children were asked: *'Think about something that has upset you or worried you to do with the injury to your teeth or mouth in the past few months'*. Cluster analysis using k-means analysis was conducted to identify coping profiles within the current sample. The Social Support scale for Children and Adolescents (SSSC) (16) was used to measure social support. The SSSC comprises 24 items and assesses four sources of social support

(parents, teachers, peer/classmate and peer/close friend). For the baseline analysis the four sub-scales fed into the latent variable 'social support' (see Figure 1).

Children's' generic Health-related Quality of Life (HRQoL) was assessed as a child outcome and also included as a predictor variable within the family adaptation model (see Figure 3). Child HRQoL was measured using the Pediatric Quality of Life Inventory™ (PedsQL™ Version 4.0 – UK English). The Module is composed of 23 items comprising four domains (physical functioning, emotional functioning, social functioning and school functioning). Children were asked *'In the past few weeks how much of a problem has this been for you?'*

The child's oral health-related quality of life (OHRQoL) was measured using the ISF-16 short form of the Child Perceptions Questionnaire (CPQ_{11-14}) (17). The ISF-16 CPQ_{11-14} is composed of 16 items comprising four oral health domains (oral symptoms, functional limitations, emotional well-being and social well-being). The participant is asked *'In the past few weeks how often have you.. (had/been)..because of your teeth or mouth?'*. For the baseline analysis three additional global items from the questionnaire (relating to the child's satisfaction with the health of their mouth, the condition of their mouth and the appearance of their teeth) fed into the latent variable 'satisfaction with oral health' (see Figure 1).

Clinical data collection

A clinical collection data sheet was used by the research team to record information from patients' clinical notes (e.g. types of dental injury, number of appointments attended). Severity and visibility of the dental injury were categorised using clinical criteria. Low visibility injuries included injuries which did not lead to the loss of the tooth and high visibility injuries were categorised as injuries that had resulted in the provision of a bridge or denture for the child. The categorisation of the severity of the child's dental injury was based on three categories: 1=low severity (e.g.

crown fractures not involving the pulp); 2=moderate severity (e.g. crown fractures involving the pulp, root fractures, luxation injuries and root fractures); and 3=high severity injuries (avulsion i.e total loss of the tooth from the socket). For the baseline analysis severity, visibility and treatment variables fed into a latent variable of 'injury burden' for both the child and family models (see Figures 1 and 2).

Family measures

The Family Index of Regenerativity and Adaptation – General (FIRA-G) has been developed to assess a variety of family factors relevant to the Resiliency model (18). The following measures from this index were used in the study: Family Stressors Index; Family Strains Index; Social Support Index; Relative and Friend Support Index; Family Hardiness Index and Family Coping Coherence Index. In order to assess 'family type', a family regenerativity grouping category was derived from k-means cluster analysis using 'Family hardiness' and 'Family Coping Coherence' scores. For the baseline analysis family stressors and strains fed into the 'family pile-up' latent variable and social support and relative and friend support fed into the latent variable 'family support' (see Figure 2).

Healthcare satisfaction was measured using the PedsQL™ Family Healthcare Satisfaction Generic Module (19). The Module is composed of 24 items and the participant is asked *'Were/are you happy with?'.* An example item is *'How much information was provided to you about your child's diagnosis'.* Permission was granted from Dr James Varni to modify the language of certain items so that they were appropriate to the context of the study.

Family functioning (which was included as a *predictor* of child adaptation) and parental worry and parental HRQoL (which were included as family adaptation *outcomes*) were measured using the PedsQL™ 2.0 Family Impact Module (20). Parent/carers were asked '*In the past few weeks, as a result of your child's dental*

health, how much of a problem have you had with…'. Family functioning was composed of 36 items comprising eight domains (physical functioning, emotional functioning, social functioning, cognitive functioning, communication, worry, daily activities and family relationships). As a result of the pilot study, two additional items were added to the questionnaire resulting in a 38-item measure. These included *'Employers have been unsupportive when I (or my partner) have had to take time off of work to attend our child's dental appointment'* and *'Taking time off work to attend our child's dental appointment has caused difficulties for our family'.* Parental HRQoL score was calculated by combining the parent's cognitive, emotional, physical and social functioning (total 20 items).

Data analysis

Baseline analysis

The statistical modelling procedure of Structural Equation Modeling (SEM) using AMOS 16.0, was used to test how well the child and family models (based on McCubbin and MCubbin's (14) model of family stress, adjustment and adaptation) fit the data set. For the measurement model, confirmatory factor analysis was used to test whether the data relating to the indicators of each of the latent variables were consistent with the model. All latent and single indicator factors within each of the models were allowed to correlate freely with one another within the measurement model. Maximum likelihood estimation was used and the adequacy of model fit was assessed using five fit indices recommended within the literature (Chi-square test statistic, Chi-square divided by degrees of freedom, Root-Mean-Squared-Error of Approximation, Comparative Fit Index and Standardised Root Mean Square Residual) and a two-step modelling approach was used (21). For the structural model, boot-strapping was employed to provide a robust analysis deriving less biased standard errors and 95% confidence interval (CI) bootstrap percentiles were used to interpret the results.

Child model of adaptation

Three latent variables included: injury burden; social support; and satisfaction with oral health (Figure 1). Injury burden was a latent variable and was measured using three indicator variables which included: injury severity; injury visibility; and number of appointments attended (1-4; 5-10; >10 appointments). These variables were chosen to represent the burden of both the injury and dental treatment. Social support was measured using the four scales of perceived social support. Satisfaction with oral health was measured using the three global questions from the CPQ; with high scores reflecting high levels of dissatisfaction. In addition to these latent variables, five observed variables were included within the model including: gender; coping style; family functioning (impacts); OHRQoL; and HRQoL (see Figure 3).

A total of 20 pathways were hypothesised within the child model. It was predicted that injury burden would directly influence family functioning, child coping, child social support, OHRQoL, HRQoL and satisfaction with oral health. Pathways between gender and the following variables; coping; social support; OHRQoL; and HRQoL were specified. It was predicted that direct relationships between family functioning and coping, social support, child OHRQoL and HRQoL would exist. It was also hypothesised that social support and coping would influence OHRQoL and HRQoL. Finally, pathways between OHRQoL and satisfaction with oral health and HRQoL were proposed.

Family model of adaptation

Three latent variables were included within the family model which included; family pile-up; injury burden; and family support (Figure 2). Family pile-up had three indicators including family stressors, family strains and the child's HRQoL. Family

support was a latent variable with two indicators including: support from family and friends and social support. In addition to these latent variables four observed variables were included within the structural model which included; healthcare satisfaction; family regenerativity; parental worry; and parental HRQoL (see Figure 4).

The family model hypothesised 16 pathways and predicted that injury burden would directly influence family pile-up, healthcare satisfaction, parental worry and parental HRQoL. Direct pathways from family pile-up to family regenerativity, support, parental worry and parental HRQoL and family support to family regenerativity were also specified. Pathways between process variables family support, regenerativity and healthcare satisfaction and outcomes variables parental worry and HRQoL were also hypothesised. Finally, a direct pathway between worry and HRQoL was hypothesised.

Longitudinal analysis

Given the smaller sample size in the follow-up study the longitudinal analysis employed four linear multiple regressions; two for the child (HRQoL and OHRQoL) and two for the family (parental worry and parental HRQoL), to analyse which baseline child and family variables predicted outcomes at follow-up.

Data management

Due to skewed distributions square root transformations were undertaken on the non-categorical psychosocial variables which were included in the analysis. Following these transformations higher scores represented lower levels of child social support, family functioning, social support and healthcare satisfaction; higher levels of family strains and stresses; and worse quality of life outcomes for children and families. Missing values were replaced with the mean scores for that item (mode scores were used for items which had ‘weighted scores’) which is consistent with strategies used in previous HRQoL research.

Results

Participants

The sample consisted of 108 children and 113 parents (44% & 46% response rates, respectively). The mean age of children at the time of the baseline study was 12-years (range=7.4 to 16.8-years, SD=2.4) and 67 (62%) of the children were males. A total of 95 (84.8%) of the participants who completed the 'family questionnaire' were children's mothers. The greatest proportion of children had sustained an injury to only one of their teeth (N=44, 40.7%) but just under a quarter of children had injured three or more permanent teeth (23.1%). Detailed findings of the impacts reported by children and families following the dental injury have been published elsewhere (22, 23).

Child psychosocial variables

Mean scores for predictor and outcome variables included within the child model can be seen in table 1. Cluster group analysis conducted on children's coping styles revealed three dominant coping profile utilised by participants, which were similar to those reported in previous research (24). An examination of the cluster means from the three profiles revealed a high proportion of *mixed copers* (N=28) who scored relatively highly on cognitive-behavioural problem solving (mean=1.19), cognitive avoidance (mean=1.43), behavioural avoidance (mean=0.91) and assistance seeking (mean=1.26); *low copers* (N= 42) who achieved relatively low scores on cognitive-behavioural problem solving (mean=0.30), cognitive avoidance (mean=0.83), behavioural avoidance (mean=0.21) and assistance seeking (mean=0.93); and *active copers* (N=32) who obtained relatively high scores on assistance seeking (mean=2.19) and cognitive-behavioural problem solving (mean=1.08). The HRQoL and OHRQoL means of these three groups were examined in order to generate an appropriate coding system for entry into the SEM analysis (1=low copers; 2=active copers; and

3=high mixed copers). Children generally reported high levels of social support, the highest levels of perceived support reportedly coming from their parents (mean=3.7).

The mean scores for children's HRQoL was 83.0 which falls within the range of available norms reported by Upton et al. (25) for children within the UK who included a mixture of healthy children and children with chronic conditions (mean=82.3, SD=13.1). Within the current study, only three (2.8%) children reported no impacts (e.g. score of 100) on their HRQoL within the previous few weeks. The mean score for children's OHRQoL was 15.5 which is higher (worse OHRQoL) than the mean score reported for children with malocclusions (mean=11.9, SD=9.2) but lower (better OHRQoL) than those children with oro-facial conditions (mean=16.5, SD=8.3) (17).

Child models

The child measurement and structural models did not significantly differ from the observed data (x^2=82.88, df=67, *p*=0.09 and x^2=91.10, df=75, *p*= 0.10, respectively) and the fit indices indicated the models were an acceptable fit (Table 2). The bootstrapped standardised estimates and standardised errors for the measurement model can be seen in Figure 1. All indicators were significant predictors of their latent construct. The variables included within the structural model (Figure 3) accounted for 45.6% of OHRQoL, 53.8% of satisfaction with oral health and 66.5% of HRQoL.

Direct pathways

There were seven direct pathways within the model (Table 3). Females reported more oral health impacts than males. Lower family functioning predicted worse OHRQoL. Mixed copers reported the most oral health impacts and females were significantly more likely to use high levels of mixed coping styles than males. Those with lower social support reported worse HRQoL. Poor OHRQoL predicted worse HRQoL and worse OHRQoL predicted increased dissatisfaction with oral health.

Indirect pathways

There were six significant indirect paths within the model (Table 3). Females reported higher levels of dissatisfaction and this was mediated through worse OHRQoL. Children who used high/mixed coping styles reported worse HRQoL, mediated through worse OHRQoL HRQoL. Children who used mixed coping strategies reported high levels of dissatisfaction, mediated through worse OHRQoL. Lower levels of family functioning was also indirectly related to worse OHRQoL, less satisfaction with oral health and worse HRQoL.

Family psychosocial variables

Table 1 outlines the means of the psychosocial variables of interest. Over one third of parents reported that their family had not experienced any stressors (N=45, 40.2%) and strains (N=37, 32.7%) within the previous 12 months. The most common stressor reported by parents was a family member changing job or being given more responsibilities at work (N=34, 30.1%) and the most common strain was increased strain on family money for medical expenses, clothes, food, education etc. Examination of the cluster means for family typology suggested that one group had high levels of family regenerativity (N=55) scoring highest on both coping-coherence (mean=15.2) and family hardiness (mean=52.2), one group had moderate levels of family regenerativity (N=48) scoring moderately on both coping coherence (mean=13.6) and family hardiness (mean=41.5) and the final group had low levels of family regenerativity (N=6) scoring lower on both coping coherence (mean=12.0) and family hardiness (mean=21.8). These groups were allocated scores corresponding to the group's level of family regenerativity (1=low, 2=moderate, 3=high) for the purpose of the family analysis. The majority of parents were very satisfied with the dental care their child received (mean=87.8, SD=20.4).

Family models

The family measurement and structural models did not significantly differ from the observed data (x^2=40.63, df=37, *p*=0.31 and x^2=53.19, df=44, *p*=0.16, respectively) and the fit indices indicated the models were an acceptable fit (Table 2). The three factor measurement model can be seen in Figure 2 and the bootstrapped standardised estimates and standardised errors are shown within this figure. All indictors were significant predictors of their latent construct. The variables included within the structural model (Figure 4) accounted for 12% of the variance of parental worry and 41.1% of the variance of parental HRQoL.

Direct pathways

Five direct pathways were found to exist (Table 4). Higher level of family pile-up was associated with lower levels of support and lower family regenerativity. Lower levels of healthcare satisfaction predicted higher levels of parental worry and low levels of family support were associated with low levels of regenerativity. Finally, higher levels of parental worry were associated with worse HRQoL.

Indirect pathways

There were three significant indirect paths within the model (Table 4). Higher level of family pile-up was associated with lower levels of family regenerativity, mediated through decreased family support. Low levels of healthcare satisfaction was associated with worse HRQoL and this effect was mediated through increased worry. Higher levels of family pile-up was indirectly related to worse HRQoL and an examination of the coefficients indicates that the main pathway in which this effect was mediated was through higher levels of worry.

Longitudinal analysis

Child variables and follow-up outcomes

In order to investigate the relationships between children's baseline variables and follow-up quality of life all the variables were correlated against other (Table 5). On the basis of these results, two multiple linear regressions were conducted for follow-up OHRQoL and HRQoL, which included all significant predictors of the follow-up outcome variables (Table 7). Baseline OHRQoL predicted 53% of the variance of follow-up OHRQoL and that variance explained increased to 57.3% when the remaining significant variables were entered into the model. An examination of the final coefficients model revealed that baseline OHRQoL ($t(56)=5.7$, $p< 0.001$) and close friend support ($t(56)=2.2$, $p<0.05$) were the only significant predictors of follow-up OHRQoL when all the variables were included within the model. Baseline OHRQoL was found to make the largest contribution within the model ($\beta=0.6$) followed by close friend support ($\beta=0.3$). Children with poor OHRQoL at baseline and those with low levels of close friend support were more likely to report poor OHRQoL at follow-up.

For follow-up HRQoL, baseline HRQoL predicted 43.1% of the variance of follow-up HRQoL and that this increased to 49.6% when the remaining significant variables were entered into the model. However, examination of the final coefficients model revealed that baseline HRQoL ($t(56)=3.5$, $p< 0.01$) and gender ($t\ 56)=2.8$, $p<0.01$) were the only significant predictors of follow-up HRQoL when all variables were included within the model. Baseline HRQoL was found to make the largest contribution within the model ($\beta=0.5$) followed by gender ($\beta=0.3$). Children with poor HRQoL at baseline and females were more likely to poor HRQoL at follow-up.

Family variables and follow-up outcomes

In order to investigate the relationships between family baseline variables and follow-up parental worry and HRQoL variables were correlated against other (Table 6). On the basis of these results, two multiple linear regressions for follow-up worry and follow-up HRQoL were conducted, which included significant predictors of the outcome variables at follow-up (Table 7). Baseline worry predicted 37.6% of the variance of follow-up worry and that this decreased to 36.5% when the remaining significant variables were entered into the model. An examination of the final coefficients model showed that baseline worry ($t(67)= 5.4$, $p<0.001$) was the only significant predictor of follow-up worry when all the variables were included in the model ($\beta=0.6$). Parents with high levels of worry at baseline were likely to report high levels of worry at follow-up.

Baseline HRQoL predicted 24.2% of the variance of follow-up HRQoL and this increased to 42.7% when the remaining significant variables were entered into the model. However, an examination of the final coefficients model revealed that baseline HRQoL ($t(64)=2.8$, $p<0.01$), child HRQoL ($t(64)=2.4$, $p<0.05$) and healthcare satisfaction ($t(64)=2.9$, $p<0.01$) were the only significant predictors of follow-up HRQoL when all the variables were included within the model. Baseline HRQoL was found to make the largest contribution within the model ($\beta=0.4$), followed by child HRQoL ($\beta=0.3$) and healthcare satisfaction ($\beta=0.3$). Parents who reported poor HRQoL and low levels of healthcare satisfaction at baseline and parents who had children who reported poor HRQoL at baseline were all more likely to report poor HRQoL at follow-up.

Discussion

To date, there has been a paucity of research investigating how children and families cope with traumatic dental injuries. This research found that injury characteristics and treatment variables did not significantly predict the coping or

adaptation of children or parents. Females, children with low levels of social support and those that used a variety of different coping strategies were found to be at greatest risk of reporting impacts on their oral health related or health related quality of life following a dental injury. Families who reported high levels of satisfaction with their children's dental care were least likely to worry or impacts on their HRQoL, highlighting the importance of healthcare satisfaction in family adaptation to childhood injury. The findings from the study highlight the role that psychosocial factors play in how children and their families manage and adapt to oral stressors experienced in childhood.

The finding that females reported more negative outcomes following dental trauma is consistent with previous research that has found females with facial differences are more likely to report negative effects and tend to be more dissatisfied with the appearance of their dentition than their male counterparts (7, 26). Future research could use qualitative methods to examine the possible causal pathways between gender and adaptation following dental trauma.

There are a number of explanations which may account for the relationship between the use of mixed coping styles and worse outcomes in children following their dental injury. Children who had mixed coping styles used high levels of avoidant coping and the maladaptive role of avoidant coping strategies has been widely reported within previous research (13). In relation to the management of dental trauma it could be that these children are more likely to delay or avoid dental appointments/treatment or be reluctant to seek support from others regarding their dental injury. It also plausible, however, that children experiencing a high number of impacts as a result of their dental injury may have resorted to the use of additional coping strategies in an attempt to manage the impacts they were experiencing. Indeed previous research has found that level of dental distress can influence the types and number of coping strategies used by children (27).

The importance of children's support systems was also highlighted within this study. Children who had a close friend who they could seek support from was identified as a protective factor. The relationship between family functioning and children's OHRQoL supports previous research that has found family functioning influences how adolescents adjust to potential stressors (28) and highlights the role that the family unit plays in child adaptation to injury. Indeed, previous research has found that family factors can be more important in predicting children's response to stress than the children's own coping resources (9).

Previous research has found healthcare satisfaction to be associated with positive health outcomes in individuals (29), however, the current study also provides persuasive evidence that a parent's satisfaction with their child's care is also an important variable in the adaptation to their child's injury. This highlights the importance of the dental team identifying and addressing the concerns of parents within treatment consultations.

The lack of direct or indirect relationships between the child's injury variables and child and family outcomes highlights that it is important that the dental team recognise that children who have experienced less severe dental injuries may not experience fewer quality of life impacts than children who have sustained more severe injuries. The relationship between specific impacts associated with dental injuries (e.g. child OHRQoL and parental worry) and the HRQoL of children and their parents suggests that dental injuries can have wide reaching implications for child and family well-being.

It has previously been argued that adjustment research needs to be driven by theoretical frameworks (30). Whilst not all of the pathways within the theoretical model were supported within the current study both models were found to be a good overall fit

to the data and therefore the findings provide some support for the framework in relation to family adaptation to dento-alveolar trauma. The longitudinal research design also strengthened the credibility of the research findings. However, it is important to acknowledge that it is not possible to determine causality between coping and outcome variables through non-experimental research designs and it is plausible that bi-directional relationships exist between coping variables and quality of life outcomes reported within the current study.

The current study had reasonable response rates (44% for children and 46% for parents) considering the magnitude of information that was included within the parent and child questionnaires. However, whilst there were no significant clinical or demographic differences between non-responders and participants, non-responders were more likely to have missed and cancelled treatment appointments than participants. Therefore, it is plausible that there could have been psychosocial differences between these two groups which could have impacted on the generalisability of the findings. Another limitation with the study was that the child and family models tested included relatively small samples for SEM analysis. In order to manage this issue the recommended analysis techniques and fit indices which have been found to provide more reliable analyses of data for small sample sizes were employed (21).

This is the first study that has examined the relationship between a variety of clinical and psychosocial factors and quality of life outcomes following a dental injury using a theoretical framework of adaptation. The findings of the current study revealed that dental injuries have the potential to cause a wide range of negative impacts for the child and their family unit and that key psychosocial variables can influence the outcomes reported by families following this injury stressor.

Why this paper is important to paediatric dentists

- Parental worry about children's dental injuries and their satisfaction with their child's treatment can impact on parents' health-related quality of life. Therefore, the specific worries of parents should be addressed within treatment consultations.
- Social and family factors play a key role in how oral injuries impact on children's quality of life. Children who have a close friend that they can rely on for support report more positive outcomes following their dental injury and therefore the importance of this protective factor could be shared with families.
- The findings from the study highlight the importance of studying childhood adaptation to oral injury or illness within the context of the wider family unit.

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Figure legends

Figure 1. Relationships between the latent variables and their indicator variables within the child measurement model

Figure 2. Relationships between the latent variables and their indicator variables within the family measurement model

Figure 3. Significant recovery factors involved in child adaptation to dento-alveolar trauma

Figure 4. Significant recovery factors involved in family adaptation to dento-alveolar trauma

Tables

Table 1. Means and standard deviations for the child and family psychosocial variables at baseline

Variable	Mean (SD)	Possible range	Min – Max	N
Child social support				
Teacher	3.3 (0.6)	0-4	1.0-4.0	98
Close friend	3.5 (0.6)	0.4	1.7-4.0	98
Class mate	3.5 (0.6)	0.4	1.5-4.0	98
Parent	3.7 (0.4)	0.4	2.2-4.0	98
Child quality of life outcomes				
Health related quality of life	83.0 (15.2)	0-100	7.6-100.0	106
Oral health related quality of life	15.5 (11.6)	0-64.0	0-51.0	106
Family pile-up				
Family stressors	7.6 (7.8)	0-50.1	0-37.7	113
Family strains	7.2 (8.9)	0-41.8	0-34.8	112
Family resources and support				
Social support	44.3 (8.4)	0-68.0	12.0-63.0	112
Relative and friend support	25.9 (5.3)	0-40.0	0-40.0	113
Healthcare satisfaction	87.9 (20.4)	0-100.0	0-100.0	113
*Family functioning and impacts**				
Overall family functioning	77.6 (17.6)	0-100	22.4–100	113
Parental HRQoL	76.0 (19.8)	0-100	15.0–100	113
Parental worry	71.2 (21.2)	0-100	16.7 -100	113

Note: The data presented is prior to square root data transformation and therefore for child variables higher scores represent: higher social support; worse OHRQoL and more positive HRQoL. For family variables higher scores represent: more stressors and strains; higher levels of social support; higher levels of healthcare satisfaction and more positive family functioning (fewer impacts).

Table 2. Goodness of fit indices for the child and family models

Model	X^2 / df (p value)	CMIN/df	RMSEA	CFI	SRMR	Criteria fitted
Child Measurement model	82.88 / 67 **(p=0.09)**	**1.24**	**0.05**	**0.95**	**0.072**	5/5
Child Model	91.13 / 75 **(p=0.10)**	**1.22**	**0.05**	**0.95**	0.082	4/5
Family Measurement model	40.63 / 37 **(p=0.31)**	**1.10**	**0.03**	**0.98**	**0.059**	5/5
Family Model	53.19 / 44 **(p=0.16)**	**1.21**	**0.05**	**0.96**	**0.076**	5/5

Note: Figures in bold are those in line with the model-fitting criteria.

CMIN/df=Chi square divided by degrees of freedom; RMSEA=Root Mean Squared Error of Approximation; CFI=Comparative Fit Index; SRMR=Standardised Root Mean Square Residual

Table 3. Direct pathways within the child structural equation model

	β value	Standard error	BC bootstrapped 95% CI
Direct pathways			
Gender[+] → OHRQoL	0.35**	0.09	0.17 - 0.52
Child's family functioning → OHRQoL	0.40**	0.09	0.23 - 0.56
Coping style → OHRQoL	0.26*	0.09	0.06 - 0.43
Social support → HRQoL	0.44**	0.21	0.18- 0.66
OHRQoL → HRQoL	0.59**	0.16	0.42 - 0.82
Gender → coping style	0.24*	0.10	0.05 - 0.44
OHRQoL → satisfaction with oral health	0.74**	0.16	0.40 - 0.98
Indirect pathways			
Gender → OHRQoL → satisfaction with oral health	0.28**	0.08	0.15 - 0.45
Coping style → OHRQoL → HRQoL	0.15	0.07	0.04 - 0.29
Coping style → OHRQoL→ satisfaction with oral health	0.19*	0.08	0.07 - 0.36
Child's family functioning → OHRQoL	0.08*	0.05	0.01 - 0.22
Pathway 1: via social support Pathway 2: via coping style	0.02 0.06		
Child's family functioning → satisfaction with oral health	0.36**	0.10	0.17 - 0.54
Pathway 1: via social support → OHRQoL Pathway 2: via coping style → OHRQoL Pathway 3: via OHRQoL	0.02 0.04 0.30		
Child's family functioning → HRQoL	0.40**	0.15	0.22- 0.64
Pathway 1: via social support Pathway 2: via coping style Pathway 3: via OHRQoL Pathway 4: via social support → OHRQoL Pathway 5: via coping style → OHRQoL	0.10 0.02 0.24 0.01 0.04		

[+] (1=male, 2=female) * p<.05, **p<.01

Table 4. Direct pathways within the family structural equation model

	β value	Standard error	BC bootstrapped 95% CI
Direct pathways			
Family pile-up → family support	0.44**	0.12	0.20 - 0.68
Family pile-up → family regenerativity	-0.30*	0.13	-0.54 - -0.06
Healthcare satisfaction → parental worry	0.20*	0.11	0.01 - 0.39
Family support → family regenerativity	-0.52**	0.15	-0.82 - -0.23
Parental worry → parental HRQoL	0.49**	0.10	0.26 - 0.64
Indirect pathways			
Family pile-up → support → family regenerativity	0.23**	0.11	-0.51 – -0.10
Healthcare satisfaction → worry → HRQoL	0.10*	0.06	0.00 - 0.22
Family pile-up → HRQoL Pathway 1: via regenerativity Pathway 2: via support Pathway 3: via worry	0.24* 0.04 0.03 0.14	0.14	0.03 - 0.52

*p <0.05, **p <0.01

Table 5. Correlations between children's baseline characteristics and follow-up quality of life

Baseline characteristics	Correlation	Follow-up OHRQoL	Follow-up HRQoL
Baseline HRQoL	Coefficient	.46**	.51**
	Sig.	.00	.00
	N	69	69
Baseline OHRQoL	Coefficient	.73**	.52**
	Sig.	.00	.00
	N	70	70
Gender[+]	Coefficient	.26*	.35**
	Sig.	.03	.00
	N	70	70
Age	Coefficient	-.12	-.06
(7-12, 13-17)	Sig.	.31	.61
	N	70	70
No. of appointments	Coefficient	-.11	-.04
(low/medium/high)	Sig.	.38	.76
	N	70	70
Severity of injury	Coefficient	.16	.16
	Sig.	.19	.19
	N	70	70
Visibility of injury	Coefficient	.06	-.05
	Sig.	.65	.67
	N	70	70
Family functioning	Coefficient	.40**	.39*
(impacts)	Sig.	.00	.00
	N	70	70
Coping style	Coefficient	.18	.12
	Sig.	.14	.35
	N	67	67
Teacher support	Coefficient	.35**	.29*
	Sig.	.00	.02
	N	63	63
Parent support	Coefficient	.16	.15
	Sig.	.22	.25
	N	63	63
Classmate support	Coefficient	.27*	.29*
	Sig.	.03	.02
	N	63	63
Close friend support	Coefficient	.33**	.21
	Sig.	.01	.10
	N	63	63

[+] (1=male, 2=female)

* $p < 0.05$, ** $p < 0.01$

Table 6. Correlations between family baseline characteristics and follow-up worry and health-related quality of life

Baseline characteristics	Correlation	Follow-up worry	Follow-up HRQoL
Baseline worry	Coefficient	.62**	.51**
	Sig.	.00	.00
	N	73	73
Baseline HRQoL	Coefficient	.30**	.50**
	Sig.	.01	.00
	N	73	73
Severity of injury	Coefficient	.19	.12
	Sig.	.11	.32
	N	73	73
Visibility of injury	Coefficient	-.00	-.02
	Sig.	.98	.85
	N	73	73
No. of appointments	Coefficient	.05	-.11
(low, medium, high)	Sig.	.67	.35
	N	73	73
Family stressors	Coefficient	.26*	.41**
	Sig.	.03	.00
	N	73	73
Family strains	Coefficient	.32**	.41**
	Sig.	.01	.00
	N	73	73
Child HRQoL	Coefficient	.29*	.40**
	Sig.	.01	.00
	N	72	72
Relative and friend support	Coefficient	.19	.16
	Sig.	.11	.18
	N	73	73
Social support	Coefficient	.22	.25*
	Sig.	.06	.04
	N	73	73
Healthcare satisfaction	Coefficient	.18	.36**
	Sig.	.13	.00
	N	73	73
Regenerativity	Coefficient	-.18	-.18
	Sig.	.13	.14
	N	71	71

* $p < 0.05$, ** $p < 0.01$

Table 7. Baseline characteristics as predictors of quality of life outcomes at follow-up

Outcome and baseline characteristics	Adjusted R square	R square change	F change (sig)	F value (sig)
Child Outcome: Follow-up OHRQoL				
Baseline characteristics:				
1. Child's OHRQoL	.53	.54	70.98***	70.98***
2. Gender[+]	.52	.00	.04	34.95***
3. Family functioning	.52	.00	.57	23.33***
4. Teacher, classmate and close friend support	.57	.07	3.48*	14.88***
Child Outcome: Follow-up HRQoL				
Baseline characteristics:				
1. Child's HRQoL	.43	.44	48.06***	48.06***
2. Gender	.46	.04	4.59*	27.74***
3. Family functioning	.49	.03	4.07*	20.80***
4. Teacher and classmate support	.50	.03	1.90	13.62***
5. child OHRQoL	.50	.00	.01	11.16***
Family Outcome: Follow-up parental worry				
Baseline characteristics:				
1. Parental worry	.38	.39	43.85***	43.85***
2. Family stressors, family strains and child HRQoL	.37	.02	.62	11.25***
Family Outcome: Follow-up parental HRQoL				
Baseline characteristics:				
1. Parental HRQoL	.24	.25	23.68***	23.68***
2. Family stressors, family strains and child HRQoL	.34	.12	4.28**	9.96***
3. Social support and healthcare satisfaction	.42	.10	6.11**	9.69***
4. Worry	.43	.01	1.43	8.57***

[+] (1=male, 2=female)

* p <0.05 ** p <0.01 ***p<0.001

Note: On examination of the final coefficients model, family functioning was not found to be a significant predictor of child HRQoL when all of the variables were included within the model