Dental Traumatology

Dental Traumatology 2011; **27**: 2–9; doi: 10.1111/j.1600-9657.2010.00943.x

Quality of life impacts following childhood dento-alveolar trauma

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Accepted 4 September, 2010

Abstract – *Background*: Dental injuries occur commonly in childhood and may necessitate demanding courses of treatment. The aim of this study was to investigate a variety of clinical and demographic factors that may influence the quality of life impacts experienced by children after a dental injury. *Method*: A total of 244 children who attended a UK dental hospital, for management of traumatised permanent incisors, were invited to participate in the study. Clinical, demographic and psychosocial variables were collected at baseline, and outcome variables were assessed again at a 6-month follow up. Clinical variables included number of teeth injured; severity of the dental injury; visibility of the injury; time since injury; and number of dental appointments attended within the hospital. Psychosocial outcomes assessed included children's oral health-related quality of life (OHRQoL) and health-related quality of life (HRQoL). *Results*: One hundred and eight children participated in the baseline study (44% response rate), and of this group of children, a total of 70 children completed follow-up questionnaires (65% response rate). The results indicated that the most affected areas of children's OHRQoL and HRQoL were functional limitations and school-related activities, respectively. Of all the demographic and clinical variables, which were investigated within the current study, the only variable that significantly predicted OHRQoL and HRQoL for children was gender. Boys were found to report fewer impacts on their OHRQoL and HRQoL than girls. Interestingly, over two-thirds of children reported fewer impacts at the 6-month follow up. *Conclusions*: The results revealed that girls were more likely to report higher level of impacts on their OHRQoL and HRQoL than boys following traumatic injury to their permanent incisors. Clinical variables were not significant predictors of child quality of life outcomes following dento-alveolar trauma at baseline or at the 6-month follow up.

Dental injuries are a common occurrence in childhood, constituting a dental public health concern (1). The UK children's dental health survey of 2003 (2) found that 5% of 8-year-olds and 13% of 15-year-olds had sustained accidental damage to their permanent incisors. However, it is thought that the prevalence of dental injuries could actually be much higher than is reported in cross-sectional research (3, 4). Indeed, some findings suggest that as many as one in two children sustain a dental injury before reaching adulthood (5). The most common traumatic dental injury seen in children is a crown fracture with maxillary central incisors being the most frequently affected teeth (5, 6). Collisions, falling during play and sports, have been identified as the predominant causes of paediatric traumatic dental injury (7–9).

Current research has indicated that a wide variety of biological, physical, social, environmental and behavioural factors may play a role in the occurrence of dento-alveolar trauma. Gender is a well-known risk factor for traumatic dental injuries; with boys experiencing dental injuries at least twice as often as girls (4). The main physical characteristics that have been outlined as significant risk factors for dento-alveolar trauma are poor lip coverage and an increased overjet (3, 10). Several social and environmental factors have also been found to be associated with dento-alveolar trauma in developed countries such as living in an overcrowded house and deprivation (3, 11). Furthermore, a positive history of trauma has also been found to be a predisposing factor for further dento-alveolar trauma (11, 12).

Traditionally, treatment outcomes within dentistry have been largely based on clinical indictors of health status (13). However, it is now increasingly recognised that, whilst clinical indicators of oral health are important, they alone provide little insight into the psychosocial impact of oral conditions on the patient's life (14, 15). Thus, investigators are increasingly using specific oral health-related quality of life (OHRQoL) and generic health-related quality of life (HRQoL) measures to assess the impact of oral conditions and related interventions (16).

There is emerging evidence that dento-alveolar trauma may negatively impact the individual. Children who have sustained a traumatic dental injury can experience

emotional stress, pain and discomfort relating to their dental injury, and such injuries can have a negative impact on children's OHRQoL (17–20). Previous enquiry has shown that two-thirds of children with untreated fractured teeth report an impact on their OHRQoL and that these children are 20 times more likely to report an impact on their OHRQoL than children with no traumatic dental injury (17). Furthermore, children and adolescents who have received treatment for dental injuries are still more likely to report negative impacts on their OHRQoL than children who have never sustained a dental injury (18, 19).

Interestingly, it has been shown that, whilst dental injuries have the potential to impact negatively on children, not all children who sustain a dental injury report negative impacts on their daily lives (17, 18). However, to date, no research has investigated how clinical or demographic factors may influence the impact that dental injuries may have on children. Whilst there is some evidence that children report improved OHRQoL throughout treatment (20), there is also a paucity of research investigating how impacts of dento-alveolar trauma change over time, throughout the treatment process. Therefore, the overall aim of the project was to determine the impact of childhood dento-alveolar trauma on children's OHRQoL and HRQoL over time. This study also aimed at identifying clinical or demographic factors that may influence the impact of dento-alveolar trauma on children's quality of life outcomes.

Method

Participants

Following ethical approval from the National Research Ethics Service, UK, participants were recruited from a UK Dental Hospital. The target population included children between the ages of 7–17 years who were receiving treatment for a dental injury sustained to one or more of their permanent incisors. Children were approached in the waiting room of the clinic whilst they were awaiting their dental treatment. The participants who agreed to take part in the follow-up study were then posted out repeat self-report questionnaires approximately 6 months after they completed the first set of questionnaires. This study formed part of a larger investigation that also sought to determine family impacts associated with paediatric dento-alveolar injury (publication in preparation).

Materials

Clinical and demographic information was collected from patients' dental records and included gender; age; ethnic origin, postcode; date of dental injury; cause of dental injury; tooth/teeth injured; type (classification) of dental injury; and treatment received. Information regarding the family's level of deprivation was calculated from participants' postcodes using the Geo-convert tool (Crown Copyright 2006). This system uses the National Statistics/Ordinance Survey (2007) to convert postcode indicators into deprivation scores (http://geoconvert.mimas.ac.uk). For analysis purposes, deprivation ranks were recoded into deprivation fifths based on population norms.

The severity and visibility of the child's dental injury were categorised using clinical criteria. Two categories of visibility were employed: low-visibility injuries comprised cases where the tooth had been re-implanted, root canal treatment had been conducted and/or a tooth fragment or composite had been employed to restore a crown fracture. High-visibility injuries were categorised as injuries that had necessitated provision of a removable prosthesis. The categorisation of the severity of the child's dental injury was based on Andreasen and Andreasen's (21) classification system that distinguishes between uncomplicated and complicated injuries in regard to the involvement of the tooth's pulp and periodontal ligament. Three categories for injury severity were used: 1 = low-severity; 2 = moderate-severity, and 3 = high-severity injuries. Children who had sustained uncomplicated injuries (e.g. uncomplicated crown fractures) were categorised as having a low-severity injury. Children who had complicated injuries (e.g. complicated crown fractures, root fractures, luxation injuries and root fractures) were categorised as having a moderately severe injury, and children who had avulsion injuries were categorised as having high-severity injuries. For analysis purposes, child age and age at which the child had sustained the dental injury were categorised into two subgroups representing younger children and adolescents: 1 = 7–12.9 years and 2 = 13+ years.

Self-report questionnaires were used to collect information on quality of life outcomes. Children's HRQoL was measured using the Paediatric Quality of Life Inventory™ (PedsQL™ Version 4.0 – UK English). The Module is composed of 23 items encompassing 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?' Example items included 'I have aches and pains' and 'I feel sad'. The module uses a 5-point Likert scale ranging from 0 to 4 (0 = never to 4 = always). Items were reverse-scored and linearly transformed to a 0–100 scale (never = 100; almost never = 75; sometimes = 50; often = 25; almost always = 0). Within the current study, the internal reliability for the measure was found to be excellent, with a Cronbach's alpha score of 0.93. Children's OHRQoL was measured using the ISF-16 short form of the Child Perceptions Questionnaire ($CPQ_{11–14}$) (22). This shortened measure has the purported advantages of being easier to administer, placing less burden on respondents and reducing the risk of total and item non-response (22). The ISF-16 $CPQ_{11–14}$ is composed of 16 items encompassing 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?' Example items include 'Pain in your teeth or mouth' and 'Felt shy'. The response options are never = 0; once/twice = 1; sometimes = 2; often = 3; everyday/almost everyday = 4. Within the current study, the internal reliability for the measure was excellent, with a Cronbach's alpha score of 0.90.

Analysis

Item impact analysis was conducted on items from the ISF-16 Child Perceptions Questionnaire$_{11–14}$ and the Paediatric Quality of Life Inventory^{TM} to investigate which items had the highest impact scores. This procedure involved multiplying the percentage of participants who reported a negative impact on each of the individual items with the items' means. Two MANOVAS were performed to investigate whether clinical or demographic variables influenced the number of impacts children experienced following dento-alveolar trauma. To investigate whether clinical variables were associated with baseline OHRQoL and HRQoL outcomes, a 2 (visibility) × 3 (severity) × 3 (number of teeth) × 3 (number of appointments) × 4 (time since injury) × 2 (OHRQoL and HRQoL) MANOVA was conducted. To investigate whether children's demographic variables were associated with baseline OHRQoL and HRQoL, a 2 (gender) × 2 (age) × 2 (age when sustained dental injury) × 5 (deprivation) × 2 (OHRQoL and HRQoL) MANOVA was conducted. Based on an effect size of $f^2 = 0.15$, statistical power aimed at $1–\beta = 0.80$, significance level of 0.05 and a maximum of five potential variables (15 subgroups), and the total number of participants needed was $N = 93$. Wilcoxon signed-rank tests were conducted and change scores calculated to investigate changes in children's QoL outcomes over time. Spearman correlation coefficients were examined to identify possible predictors of follow-up outcomes. A criterion of $P < 0.20$ was used to preselect the variables that were entered into the two linear multiple regressions for follow-up OHRQoL and HRQoL (23).

Results

Baseline study

In total, 244 children were invited to participate in the research and 108 children completed self-report questionnaires for the baseline study (44.3% response rate). The mean age of children at baseline was 12 years (range = 7.4–16.8 years, SD = 2.4), and 67 (62.0%) children were boys and 41 (38.0%) girls. From the patient notes, 85 (78.7%) children were identified as white British, five (4.6%) children as Pakistani, one (0.9%) child as African, one child as Indian (0.9%), one child (0.9%) as multiple heritage, and the ethnic background of 15 (13.9%) children was unknown.

Of the 108 children who took part in the study, children first sustained the dental injury to their permanent tooth/teeth between the age of 6.3 and 15.5 years. The mean age when children sustained the injury to their permanent incisors was 10.1 years (SD = 2.3). The main cause of injuries was accidents including falls and collisions in 52 (48.2%) cases. This was followed by bicycle and road traffic accidents ($N = 22$, 20.4%), sport-related incidents ($N = 10$, 9.3%) and assaults ($N = 5$, 4.6%). The cause of the dental injury was unknown for 19 (17.6%) children, as the specific details were not recorded in their dental records.

On average, children had attended the hospital dental clinic for just over 2 years (mean = 25.4 months, SD = 26.3, range = 1–117 months). The average number of appointments attended by children was 6.7 (SD = 5.7, range = 1–32). The greatest proportion of children had sustained an injury to only one of their teeth ($N = 44$, 40.7%) but almost a quarter ($N = 25$, 23.1%) had damaged three or more incisors.

The mean scores for children's HRQoL (PedsQL^{TM}) and OHRQoL (ISF-16 CPQ$_{11–14}$), and the domains included within these scales, are reported in Table 1. The data for children's OHRQoL and HRQoL scores were significantly skewed (skewness values of 1.01 and −1.77, respectively), indicating that children experienced a relatively low number of impacts on their quality of life following a dental injury. However, only a very small percentage of children reported no impacts on their OHRQoL (1.9%) and HRQoL (2.8%) in the previous few weeks. For HRQoL, the domain that received the highest number of reported impacts was the child's school-related activities. For OHRQoL, children reported the highest level of impacts on performing functional activities. There was a significant positive association between children's OHRQoL and HRQoL scores at baseline ($r = −0.67$, $P < 0.001$). That is, children who reported worse OHRQoL also reported worse general HRQoL outcomes.

Table 2 outlines the results from the item impact analysis, which was conducted on the children's responses to the PedsQL^{TM}. This analysis revealed that the item that was most impacted upon, within the child's HRQoL, was missing school to go to the dentist (item impact score = 186.6). This was followed by worry over

Table 1. Data for child quality of life outcome measures and subscales at baseline

Child's quality of life	Possible range	Mean (SD)	Min–Max	*N*
Health-related quality of life	0 (high impacts) to 100 (no impacts)	83.0 (15.2)	7.6–100.0	106
School	0–100.0	74.0 (18.5)	5.0–100.0	107
Social	0–100.0	89.5 (17.5)	5.0–100.0	106
Emotional	0–100.0	77.3 (20.3)	10.0–100.0	107
Physical	0–100.0	88.1 (15.8)	9.4–100.0	108
Oral health-related quality of life	0 (no impacts) to 64.0 (high impacts)	15.5 (11.6)	0–51.0	106
Functional limitations	0–16.0	4.3 (3.8)	0–15.0	106
Oral symptoms	0–16.0	4.2 (3.0)	0–13.0	106
Emotional impacts	0–16.0	3.8 (3.9)	0–16.0	106
Social impacts	0–16.0	3.3 (3.3)	0–15.0	108

Table 2. Item impact scores for items included in the Paediatric Quality of Life Inventory™

Questionnaire item	Item impact score	Rank
I miss school to go to the doctors or dentists	186.6	1
I worry about what will happen to me	60.7	2
I feel angry	58.0	3
I have aches or pains	54.0	4
I forget things	52.3	5
I feel tired	52.0	6
I feel sad	47.7	7
I miss school because of not feeling well	37.4	8
I feel afraid or scared	35.5	9
It is hard to pay attention in class	28.1	10
I have trouble sleeping	27.2	11
I have trouble keeping up with school work	24.9	12
Other children tease me	17.1	13
I have trouble getting on with other children	9.9	14
It is hard for me to do sports activities or exercise	9.8	15
It is hard to keep up with other children of my age	9.6	16
I cannot do things other children of my age can do	9.0	17
Other children do not want to be my friend	7.8	18
It is hard for me to do chores around the house	7.3	19
It is hard for me to lift heavy things	6.7	20
It is hard for me to run	4.6	21
It is hard for me to walk more than a couple of streets	4.3	22
It is hard for me to have a bath or shower by myself	0.8	23

what will happen to them (item impact score = 60.7) and feelings of anger (item impact score = 58.0). The items that children reported the least impacts on, unsurprisingly, were bathing by themselves (item impact score = 0.8) and difficulty walking more than a couple of streets (item impact score = 4.3).

Table 3 outlines the results from the item impact analysis, which was conducted on the children's responses to the ISF-16 $CPQ_{11–14}$. The analysis revealed that the item that was the most impacted upon, within the child's OHRQoL, was food stuck in between their teeth (item impact score = 125.7), followed by difficulty chewing or biting firm foods (item impact score = 104.8). The least impacted upon areas included difficulty saying words (item impact score = 11.5), followed by other children teasing or calling them names (item impact score = 13.2). Four of the top five items related to children having functional problems and oral symptoms, indicating that specific oral problems cause the most impacts for children's oral health-related quality of life for children who were receiving treatment for a dental injury.

Table 3. Item impact scores for items within the ISF-16 Child Perceptions $Questionnaire_{11–14}$

Questionnaire item	Item impact score	Ranking
Food stuck in between your teeth	125.7	1
Difficult to chew or bite firm foods	104.8	2
Other children asked you questions about your teeth, lips mouth, jaws or mouth	98.4	3
Pain in your teeth, lips, jaws or mouth	72.7	4
Taken longer than others to eat a meal	61.3	5
Been concerned what other people think about your mouth, teeth, lips or jaw	60.2	6
Difficult to eat or drink hot or cold foods	57.1	7
Felt shy or embarrassed	51.4	8
Been upset	43.8	9
Bad breath	42.8	10
Felt irritable or frustrated	37.4	11
Avoided smiling or laughing when around other children	37.1	12
Sores in your mouth	28.2	13
Argued with other children in your family	22.8	14
Other children teased you or called you names	13.2	15
Difficult to say any words	11.5	16

To investigate whether clinical variables and demographic factors were important in the level of impact dental injuries caused for children, multivariate tests were conducted. Table 4 shows the mean HRQoL and OHRQoL for the different subgroups and the results from the two MANOVAS. No main effects existed for time since injury, number of appointments attended, number of teeth injured, severity of the injury and visibility of the injury. No significant interaction effects existed for any of the clinical variables under investigation. The only demographic variable which was found to be a significant predictor of children's OHRQoL and HRQoL was gender. The results revealed that girls were more likely to report impacts on their OHRQoL ($F(1) = 6.58$, $P < 0.05$) and HRQoL ($F(1) = 4.63$, $P < 0.05$) than boys. There were no significant interaction effects between gender and age or age when sustained injury or deprivation.

Follow-up study

Seventy children completed follow-up questionnaires (64.8% response rate). The mean age of children was 12 years (range = 7.9 to 17.3 years, SD = 2.4), and 40 (57.1%) children were boys and 30 (42.9%) girls. Only 15.9% of children had not attended any additional treatment appointments at the dental hospital in the 6-month period between the baseline study and the follow-up study. The majority of children had attended an additional two (18.8%) or three (17.4%) dental appointments; however, one child had attended as many as 11 appointments within this 6-month follow-up period.

At the 6-month follow up, school functioning and functional limitations remained the areas of children's HRQoL and OHRQoL which children reported most impacts on (see Table 5). The longitudinal data analysis revealed that there were significant improvements for all domains with the exception of social impacts related to children's OHRQoL. However, social impacts remained the least affected area, within the child's OHRQoL, at the 6-month follow up. The number of children who reported improvements or deterioration in their OHRQoL and HRQoL over time was calculated using change scores, as shown in Table 6. In this table, negative change scores indicated quality of life had worsened over time and positive scores indicate improvements in quality of life over time. The results show that the majority of children reported improvements to their HRQoL (65.3%) and their OHRQoL (62.9%) at the 6-month follow up.

Table 4. Main effects of clinical and demographic variables on baseline child quality of life outcomes

Variable	Baseline HRQoL		Baseline OHRQoL	
	Mean (SD)	*F* value (*P*)	Mean (SD)	*F* value (*P*)
Clinical variables				
Number of appointments				
1–4 (*N* = 41)	85.5 (12.8)	*F*(2) = 0.20, *P* = 0.82	16.4 (10.7)	*F*(2) = 3.11, *P* = 0.06
5–10 (*N* = 44)	80.0 (17.2)		16.0 (12.4)	
>10 (*N* = 20)	84.5 (15.0)		13.2 (11.8)	
Severity of injury				
Low (*N* = 23)	84.5 (12.0)	*F*(2) = 1.50, *P* = 0.24	15.0 (11.0)	*F*(2) = 1.16, *P* = 0.33
Moderate (*N* = 55)	84.9 (12.7)		13.9 (10.0)	
High (*N* = 27)	77.9 (20.9)		19.5 (14.4)	
Visibility of injury				
Low (*N* = 86)	83.4 (14.9)	*F*(1) = 1.6, *P* = 0.21	15.4 (11.6)	*F*(1) = 2.88, *P* = 0.09
High (*N* = 19)	81.1 (17.2)		16.6 (11.8)	
Number of teeth injured				
1 (*N* = 44)	82.4 (13.0)	*F*(2) = 0.80, *P* = 0.46	15.4 (11.8)	*F*(2) = 0.27, *P* = 0.76
2 (*N* = 38)	85.2 (16.4)		13.8 (9.8)	
3 or more (*N* = 23)	80.6 (17.3)		19.0 (13.6)	
Time since injury				
0–2 months (*N* = 11)	79.4 (16.1)	*F*(3) = 1.12, *P* = 0.35	20.7 (11.0)	*F*(3) = 0.99, *P* = 0.41
3–12 months (*N* = 28)	82.2 (18.6)		17.3 (12.8)	
13–24 months (*N* = 30)	82.7 (14.5)		15.8 (12.0)	
> 24 months (*N* = 35)	84.7 (12.8)		12.5 (10.0)	
Demographic variables				
Child's age at baseline				
7–12.9 years (*N* = 69)	82.9 (16.8)	*F*(1) = 0.20, *P* = 0.65	16.0 (11.5)	*F*(1) = 0.85, *P* = 0.36
13–17 years (*N* = 36)	83.2 (12.0)		14.8 (11.8)	
Child's age when sustained injury				
7–12.9 years (*N* = 90)	82.6 (15.6)	*F*(1) = 0.97, *P* = 1.65	15.4 (11.4)	*F*(1) = 1.65, *P* = 0.20
13–17 years (*N* = 11)	82.8 (13.8)		17.7 (14.6)	
Child gender				
Male (*N* = 64)	85.3 (13.6)	*F*(1) = 4.63*	12.6 (9.7)	*F*(1) = 6.56*
Female (*N* = 41)	79.4 (17.2)		15.6 (11.6)	
Deprivation level (1 = low, 5 = high)				
1 (*N* = 14)	84.4 (13.3)	*F*(4) = 0.01, *P* = 1.00	14.3 (10.6)	*F*(4) = 0.77, *P* = 0.79
2 (*N* = 19)	85.2 (15.6)		13.4 (8.2)	
3 (*N* = 26)	81.8 (12.3)		18.6 (11.7)	
4 (*N* = 18)	84.2 (13.4)		11.9 (6.2)	
5 (*N* = 28)	81.2 (19.5)		17.2 (15.4)	

*$P < 0.05$.
HRQoL, health-related quality of life; OHRQoL, oral health-related quality of life.

Table 5. Child outcome variables at baseline and follow up

Child outcome variables	*N*	Baseline mean (SD)	Follow-up mean (SD)	Wilcoxon test $Z^{\pm}$	Sig Change
Health-related quality of life	69	82.6 (15.5)	87.8 (13.3)	Z = −3.71***	↑
School	68	73.9 (18.2)	81.1 (17.0)	Z = −3.70***	↑
Social	68	88.5 (19.3)	91.7 (17.2)	Z = −1.76*	↑
Emotional	70	75.8 (20.5)	83.7 (16.9)	Z = −3.32**	↑
Physical	70	88.6 (16.3)	92.1 (12.1)	Z = −2.70**	↑
Oral health-related quality of life	70	15.5 (11.5)	12.1 (9.5)	Z = −3.52***	↑
Functional limitations	70	4.3 (3.6)	3.2 (3.1)	Z = −3.18**	↑
Oral symptoms	70	4.2 (3.0)	3.0 (2.5)	Z = −3.13**	↑
Emotional impacts	70	3.8 (3.9)	2.9 (3.2)	Z = −2.22*	↑
Social impacts	70	3.2 (3.4)	2.9 (2.8)	Z = −1.03	↔

$^{\pm}$Baseline and follow-up score are significantly different at the *$P < 0.05$; **$P < 0.01$; and ***$P < 0.001$ level.
↑ = significant improvement at follow up; ↔ = no significant change.

Table 6. Percentage of children with a change in quality of life outcome scores at follow up

Outcome variable	Number	Negative change score (%)	No change (%)	Positive change score (%)
Child health-related quality of life	69	33.3	1.3	65.3
Child oral health-related quality of life	70	30	7.1	62.9

Table 7 outlines the results of the multiple linear regressions for children's follow-up HRQoL and OHRQoL. The results revealed that baseline HRQoL and OHRQoL predicted 44.3% of the variance of follow-up HRQoL and that the variance explained did not increase when injury severity and age when sustained dental injury were entered into the model. An examination of the final coefficients model revealed that baseline

Table 7. Children's variables as predictors of quality of life outcomes at follow up

Outcome and baseline variables	Adjusted R square	R square change	*F* change (sig)	*F* value (sig)
Outcome: Follow-up HRQoL				
Predictor variables				
Baseline HRQoL and OHRQoL	0.44	0.46	26.43***	26.43***
Age when sustained dental injury, injury severity	0.44	0.02	1.02	13.73***
Outcome: Follow-up OHRQoL				
Predictor variables				
Baseline OHRQoL and HRQoL	0.56	0.57	42.80***	42.80***
No. of teeth, injury severity, time since injury, gender	0.57	0.04	1.50	15.71***

***$P < 0.001$.
HRQoL, health-related quality of life; OHRQoL, oral health-related quality of life.

HRQoL ($t(60) = 4.10$, $P < 0.001$) was the only significant predictor of follow-up HRQoL when all the variables were included within the model. Children with high levels of HRQoL at baseline were more likely to report high levels of HRQoL at follow up. The results revealed that baseline HRQoL and OHRQoL predicted 55.5% of the variance of follow-up OHRQoL and that the variance explained increased to 56.8% when injury severity, gender, time since injury and number of teeth injured were entered into the model. An examination of the final coefficients model revealed that baseline OHRQoL ($t(61) = 4.70$, $P < 0.001$) was the only significant predictor of follow-up OHRQoL when all the variables were included within the model. Children with high levels of OHRQoL at baseline were more likely to report high levels of OHRQoL at follow up.

Discussion

A key finding from this study was that children reported more impacts on their OHRQoL than has previously been reported by children with caries (mean = 11.9, SD = 9.2) and malocclusion (mean = 13, SD = 7.6) (22). The mean OHRQoL score reported in this study (mean = 15.5, SD = 11.6) relates more closely to scores obtained from children with oro-facial conditions such as cleft lip and palate (mean = 16.5, SD = 8.3). This is perhaps not surprising as children who are receiving treatment for caries and malocclusion have been found to experience significantly less functional limitations than children with oro-facial conditions (24). The present study also found that, with respect to OHRQoL, children were most likely to report difficulties relating to functional limitations and oral symptoms. Notably, the activities that were reported as most affected included having food stuck in between the teeth and difficulty chewing food. Whilst these findings are inconsistent with previous research that has shown that children who have received treatment for their dental injuries report most impacts on their social well-being (18), our findings do support research which has highlighted that functional limitations continue to be problematic for children even after they have received treatment for their dental injury (19). School functioning was the most affected area of children's HRQoL. This undoubtedly reflects the fact that all of the participants were undergoing active treatment for their dental injury. Therefore, it is likely that the majority of these children would have needed to take time off school to attend their treatment appointment. The strong relationship between OHRQoL and HRQoL at baseline and follow up suggests that the oral impacts, which may be caused as a result of the child's dental injury, can have wide-reaching implications for the child's more general well-being over time.

Interestingly, injury and treatment variables did not predict either baseline or follow-up OHRQoL and HRQoL. Previous research has reported conflicting findings in regard to the relationship between clinical variables and OHRQoL. The findings from the present investigation are in agreement with some studies that have also failed to find consistent relationships between clinical variables and OHRQoL (25–27). However, other investigations have shown that the severity of an oral condition can be associated with increased impacts on children's OHRQoL (22, 28). Indeed, research conducted by Fakhruddin (19) found that children with untreated dental injuries reported more impacts than those who had received treatment for their dental injury, indicating clinical factors did play a role in children's OHRQoL following a dental injury. One possible explanation for why injury variables were not associated with outcomes within this present study may be attributed to the fact that all participants had already received emergency dental treatment for their injured teeth. Thus, interventions to restore the aesthetics and function of the teeth were underway, and differences between the clinical subgroups were more subtle than had they not received any treatment for their dental injury.

The only significant demographic factor that influenced baseline OHRQoL and HRQoL was gender. Previous research has found that girls with visible facial differences are more likely to report negative affects on their quality of life than their male counterparts (29–31). Girls, with a range of different dental conditions, have also been found to report more impacts on their emotional well-being than boys (27). Whilst it is possible that, within the current study, girls who had sustained a dental injury may have experienced more negative impacts than the boys who had sustained a dental injury, it is also plausible that girls felt more comfortable reporting their health-related concerns or emotional problems than boys.

The results indicated that school functioning and functional oral limitations continued to be the most affected areas within children's HRQoL and OHRQoL, respectively, at the 6-month follow up. Approximately two-thirds of children reported fewer impacts on their overall OHRQoL and HRQoL over time, and the only area where children did not report fewer outcomes at

follow up was oral specific social impacts. One possible explanation for the improvement in quality of life outcomes at the follow up could be because of the healing factor of time. However, the baseline analysis revealed that initial time since injury was not a significant predictor of children's oral impacts or HRQoL. This indicates that other variables may be more important in predicting the impact of the injury than the amount of time that has passed since the child sustained their dental injury. It is possible, therefore, that because all of the children were actively engaged in treatment at the time they participated in the current investigation, improvements relating to children's OHRQoL and HRQoL could be as a direct result of the treatment they had received.

Whilst the current study took significant steps to understand the psychosocial impact of dental injuries on children, the research was not without some limitations. The response rate was only 44% for the baseline study and 65% for the follow-up study. However, previous studies, which have investigated the psychosocial impacts of dental injuries using postal questionnaires, have reported similar response rates for baseline and longitudinal studies (19, 20). Another potential limitation of the study was that all of the children included within the present investigation were receiving their dental care from one dental hospital within the United Kingdom. Therefore, it is not possible to generalise the results found within this study for children who receive their dental care in other geographical areas or from different service providers (e.g. primary care services). A proportion of the patients who received treatment at the dental hospital may have been referred to the dental clinic because of their concerns about their dental injury or the complexity of the injury. Also because of the fact that all of the children included within this study were receiving treatment for their dental injury, the results from this investigation may not be generalisable for children with untreated dental injuries. Indeed, previous research has revealed that children with untreated dental injuries are likely to report different, and an increased number of, impacts on their OHRQoL than children who have received treatment for their dental injury. This group of children have been found to be more concerned with the emotional and social difficulties which their injury creates (17, 19).

It is acknowledged that without a trauma-free control group, it is impossible to determine whether the impacts children reported were caused as a result of the child's dental injury. However, within the questionnaire, children were advised to report the difficulties they had experienced as a result of the injury to their teeth, lips, jaws or mouth or the dental treatment they had received. Indeed, the number of impacts reported by children following dento-alveolar trauma was similar to the number of impacts reported by children with oro-facial conditions (22). The finding that the majority of children reported improvements to their OHRQoL and HRQoL throughout dental treatment, and the positive relationship between OHRQoL and HRQoL, provides support for the argument that the impacts children reported were related to their dental injuries.

Despite its acknowledged limitations, the study has important implications for future research and clinical practice.

Further research is warranted to investigate the additional factors that may play a role in promoting children's long-term recovery following dento-alveolar trauma. More research is also required to facilitate a greater understanding of the specific causal mechanisms through which the child's variables (e.g. gender, coping) influence their adjustment to traumatic dental injuries. It is proposed that qualitative research, using child-centred methods, is essential to fully understand the child's experience after a dental injury (32).

The findings from this study contribute to an increased understanding of the impacts experienced by children who have sustained a dental injury. It is important that clinicians are aware of the groups which are most likely to be negatively affected by dento-alveolar trauma. It is proposed that greater attention to concerns voiced by girls in the dental setting may help to reduce the negative impacts of dental injuries on this group of children. The lack of relationship between clinical variables and impacts experienced indicates that the dental team should be aware that children with uncomplicated injuries may be just as concerned and negatively affected by their dento-alveolar trauma, as those children who have more serious dental injuries. It is recognised that effective clinical treatment of dento-alveolar trauma is essential in reducing the variety of impacts caused by dental injuries. However, this study provides evidence that the restoration of the damaged tooth may not be sufficient in resolving the wide range of impacts the dental injury may cause the child patient.

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