Primary Care Dentists’ management of permanent dentition traumatic dental injuries in 7- to 16-year-olds: A sequential mixed-methods study

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Abstract
Background/Aims: Primary care dentists play a pivotal role in the management of traumatic dental injuries in children, despite little evidence on the barriers they face in providing care. The aim of this study was to explore and contextualize the knowledge and attitudes of general dental practitioners regarding their management of permanent dentition traumatic dental injuries in children aged 7–16 years old.

Material and Methods: A two-phase sequential mixed-methods study included a questionnaire that was disseminated to all 619 primary care dentists, identified via a triangulated sampling strategy, based across the north-east of England (Phase I). Statistical analyses were performed using Mann–Whitney U- and Kruskal–Wallis tests, Spearman’s correlation and chi-square test. Multivariate factor analysis, with principal components extraction, was used to test between multiple ordinal variables. Respondents were invited to a face-to-face or telephone semi-structured interview (Phase II). Interviews were transcribed verbatim and analysed using inductive thematic analysis.

Results: Primary care dentists were less confident in managing complex dental trauma. Inadequate financial remuneration was the main reason for not providing care, often prompting a referral to the local dental hospital. This was more apparent for those who qualified before 2000. More recently qualified dentists felt the long-term costs, related to traumatic dental injuries, were insufficiently remunerated. Most still provided emergency management, irrespective of remuneration, as long as they had the requisite knowledge and skills. Four major themes arose: impact of traumatic dental injuries on patients, parents and primary care dentists; barriers to providing treatment; educational opportunities for primary care dentists; and interactions between primary and secondary care services.

Conclusions: There is high confidence in managing simple traumatic dental injuries but less for complex injuries. A lack of sufficient financial remuneration associated with the long-term management of dental trauma was the main barrier for dentists to manage these cases.
1 | INTRODUCTION

Primary care dentists, also known as general dental practitioners (GDPs), play a pivotal role in the care pathways for children who sustain traumatic dental injuries (TDIs). The 2013 Children's Dental Health Survey (England, Wales and Northern Ireland) found that 10% of children had clinical evidence of a TDI,1 with similar figures being reported internationally.2,3

Appropriate diagnosis, timely immediate management and follow-up are essential to achieve favourable outcomes.4–6 Several immediate management strategies exist in an attempt to maintain the pulp and reduce the risk of undesirable sequelae such as external resorption.

In the UK, GDPs provide routine dental care for children either under the National Health Service (NHS), privately, or through a combination of both. If provided under the NHS, treatment for all children under the age of 18 years is free with GDPs in England and Wales being paid using a system based on units of dental activity (UDA). UDAs are a measure of the amount of work performed during a course of dental treatment. More complex dental treatments generate more UDAs. An urgent appointment, which the immediate management of dental trauma would be classified as, would merit 1.2 UDAs. The monetary value of each UDA varies across the UK; however, an average value has been estimated at around £20 Great British Pounds per UDA.7

Sub-groups of children may present or be referred to either a dentist with additional skills and experience, a specialist in paediatric dentistry, or a consultant-led service based in secondary dental care facilities. Alternatively, some patients with TDIs may present to a hospital Accident and Emergency department. A recent north-east England study reported that the most common dental reason for attendance in 6- to 11-year-olds was dental trauma.8 Thus, the provision and delivery of care for patients with TDIs can be disjointed. This could be overcome by developing and implementing a managed clinical network (MCN) to ensure patients receive appropriate care from suitably trained professionals.9

It has been reported that 60% of children across the UK initially presented to their GDP following a TDI. However, only half of these had a course of emergency treatment carried out in this setting.10 Similar findings have been reported in both the UK and internationally.11,12 Despite this predominance of management being carried out in general dental practices, both in the UK and internationally, there is little evidence pertaining to the barriers and/or challenges that face GDPs when managing a TDI. Insufficient knowledge and financial payments have been previously reported as barriers to providing care for children.13 These were elicited using a structured interview (interview guided questionnaire) and were not contextualized by exploring and addressing the underpinning beliefs which led to these responses.15 A recent study, using a sequential mixed-methods approach, reported and explored barriers to managing TDIs in adults. However, to the authors’ knowledge, there has been no such study in children.16

The aim of this study was to explore and contextualize the knowledge and attitudes of general dental practitioners regarding their management of traumatic dental injuries in the permanent dentition in 7- to 16-year-olds.

2 | MATERIALS AND METHODS

This study adopted a two-phase sequential mixed-methods design, where quantitative approaches (Phase I) were followed by qualitative (Phase II) approaches with GDPs. The project was approved by the Newcastle University Ethics Committee (Ref: 15173/2016).

In Phase I, a self-completed questionnaire was disseminated to all NHS and private GDPs working in six local health authorities (LHA) – Sunderland; Gateshead; Newcastle; North Shields; South Shields; and Northumberland – in the north-east of England.17 LHA's exist to review current and future health and social care needs of local people and to recommend health and care priorities for action on this basis. These LHAs presented an opportunity to purposively sample GDPs from the same LHAs rather than a random sample of UK GDPs. This presented a unique opportunity to observe whether any differences in confidence, knowledge or attitudes amongst GDPs have changed over a 17-year period.

Identification of individual GDPs within their respective LHAs is relatively complex, as a national database of both NHS and private practitioners and the LHAs in which they work does not exist. A sampling framework was developed in 2018 by triangulating three independent sources of information relating to NHS and private GDPs: NHS-BSA (NHS Business Services Authority); CQC (Care Quality Commission) individual practice reports; and the NHS Choices website. Individual NHS practices and the number of dentists in each practice in the six LHAs concerned were identified using an NHS BSA Freedom of Information request. A CQC report was used to confirm individual NHS practices and to highlight private practices in these locations. Individual NHS practitioners were identified using the NHS Choices website. If a practice was not on the NHS Choices website (eg private practice) or the information on NHS Choices had not been updated within the last 12 months, then the practice was contacted via telephone for this information. Any GDP that worked in multiple sites was only included once. This meant all NHS and private dentists, working across the six local health authorities, were included and subsequently invited to participate in the study. This gave a sample size of 619.
The questionnaire was developed and adapted, with permission, from a previous postal-questionnaire study undertaken in 2003. Demographics were collected. Open and closed questions on a 5-point Likert scale were used to ascertain how important it was to manage a TDI, suspected barriers to managing TDIs in primary care as well as exploring the relationships between primary and secondary care. The questionnaire was piloted for content and face validity with seven GDPs who worked with the chosen LHAs. Amendments were made based on the feedback from the piloting process. Each questionnaire was assigned a unique code that corresponded to each GDP. Questionnaires were posted to each GDP with a stamp-addressed return envelope in May 2019. GDPs were given eight weeks to respond, after which non-responders were identified and re-sent the questionnaire. To reduce response bias, further communication with non-responders was not undertaken.

A power calculation was calculated using an online sample size calculator (http://www.raosoft.com/samplesize.html). Using a total population size of 619 and accepting a confidence level of 95%, response distribution of 50% and margin of error 8%, a sample of 121 would be sufficient to establish significance. Data were coded and entered into SPSS Statistics for Windows, Version 25.0 (IBM Corp). Due to the non-normal distribution of ordinal data obtained, Mann–Whitney U- and Kruskal–Wallis tests and Spearman’s correlation were used. Chi-square test was used for categorical variables. Statistical significance was set at $p < 0.05$.

Multivariate factor analysis (with principal components extraction) was carried out to examine relationships between all GDPs responses to questions 2–19, which are multiple ordinal variables. Each factor represented a different aspect (dimension) of the data. A factor was comprised of a weighted combination of the questions, and questions having a high weight were used to label a factor. A factor score for each factor can be calculated for each respondent allowing construction of a multi-dimensional map where nearby points depict respondents with similar views. The Kaiser–Meyer–Olkin measure of sampling adequacy and Bartlett’s test were generated to ensure that the criteria for a satisfactory factor analysis were met. Factors with eigenvalues >1 were retained. For interpretation purposes, Varimax rotation was employed which, when compared to the unrotated solution, better differentiated the factors. Factor loadings were interpreted with an absolute value >0.4. The parametric two-sample t-test was utilized to test for significant differences between sub-groups. For the purposes of the factor analysis, the year of qualification was dichotomized into two groups, those who qualified before and after the year 2000.

In Phase II, telephone and face-to-face (in person and remote video) semi-structured interviews were carried out with GDPs who returned the questionnaire and expressed an interest in taking part in Phase II. Purposeful sampling was undertaken to ensure adequate representation of GDPs from each LHA, gender, year of qualification and both NHS and private care providers. Written consent was obtained. Each interview was conducted by one researcher (GT), a clinical academic/specialist trainee in paediatric dentistry using a semi-structured topic guide. As this was a sequential exploratory mixed-methods study, the questions that formed the topic guide were developed using the key findings from the quantitative phase. Interviews were recorded and transcribed verbatim using a professional transcription company. Transcripts were uploaded to NVivo 12 Pro (QSR) for management. Coding was applied to two transcripts by GT and OS independently, using a thematic analysis approach, and compared, before discussing initial themes with the wider team (RH & PJW) to develop a coding framework and triangulate the data. GT then coded all other manuscripts, using this updated coding framework, with OS reviewing this coding on a further two manuscripts. The whole team discussed and arrived at a consensus of the themes.

### 3 RESULTS

One hundred and twenty-eight GDPs (20.7%) responded to the questionnaire, of which 123 (94.1%) qualified in the UK. The median year since undergraduate qualification was 2001 (range: 1981–2018), and when the year of qualification was clustered into year groups, 16 (12.5%), 42 (32.8%), 43 (33.6%) and 27 (21.1%) qualified between 1980 and 1989, 1990 and 1999, 2000 and 2009 and 2010 and 2018, respectively. Thirty-seven (28.9%) were principal practitioners (owners of a dental practice), 89 (69.5%) were associates (non-owner independent employees of a dental practice) and two (1.6%) were foundation trainees (a newly qualified dentist). One hundred and twenty-one (94.5%) worked in a mixed NHS/private practice, with enough representation from each LHA, suggesting that a broadly geographic representative sample of GDPs in the north-east responded. Thirty-four (26.6%) GDPs had some form of postgraduate training in dental trauma; however, only two had obtained formal postgraduate qualifications (1 Masters in Endodontics; 1 Masters in Paediatric Dentistry). All 128 (100%) had access to the internet. Ninety-three (72.2%) GDPs were aware of the online evidence-based management aid ‘Dental Trauma Guide’ (www.dentaltramage.org); however, only 39 (30.5%) reported to have used this to help manage a patient.

The total number of traumatic dental injuries separated by diagnosis that presented for initial management to GDPs within the last year is shown in Table 1. Questionnaire responses are presented in Tables 2 and 3.

Significant associations were seen between GDPs’ confidence in managing TDIs and the number of cases seen within the last year for enamel/dentin/pulp fractures ($p = 0.022$), root fractures ($p = 0.041$) and intrusions ($p = 0.032$). However, the confidence overall did not correlate with the year of qualification ($p = 0.064$) or position in the practice ($p = 0.071$).

Positive correlations were observed between the year of qualification and the responses to the questions: ‘insufficient payment would be a reason for me to refer my cases of dental trauma to a dental hospital’ ($p = 0.042$); ‘I would not treat trauma cases in my practice because the fee is insufficient’ ($p = 0.037$); and ‘I refer to online guidelines to aid my management of dental trauma’ ($p = 0.047$).
Associations for the overall responses between different questions were observed for:

- ‘The NHS payment for treating dental trauma is sufficient’ and ‘GDPs in practice have a responsibility to treat dental trauma’ ($p = 0.028$).
- ‘All patients with dental trauma should be referred to the local dental hospital for management’ and ‘The NHS payment for treating dental trauma is sufficient’ ($p = 0.031$).
- ‘Managing dental trauma would take up too much of my time’ and ‘Before referring a patient with dental trauma, GDPs have a responsibility to provide emergency management’ ($p = 0.023$).

After application of factor analysis for the overall responses, five factors cumulatively accounted for 57.4% of the total information in the data. Only the first (most important) factor is discussed here, as the dimensions are the most interpretable. Scores for factor 1 will tend to be high if the respondent:

- Agrees that they would not treat dental trauma in their practice because the fee is insufficient.
- Agrees that all management of all cases of dental trauma is only the responsibility of the local hospital.
- Agrees that insufficient payment would be a reason for them to refer cases of dental trauma to a dental hospital.
- Agrees that all patients with dental trauma should be referred to the local dental hospital for management.
- Disagrees that GDPs in practice have a responsibility to treat dental trauma.
- Disagrees that before referring a patient with dental trauma, GDPs have a responsibility to provide emergency management.
- Disagrees that referring to online guidelines is needed to aid management of dental trauma.

For the sub-group analyses, scores for principals and associate practitioners, for factor 1, were not significant ($p = 0.152$). Scores for those who qualified before 2000 were significantly higher than those who qualified after 2000 ($p = 0.001$).

Thirty-six GDPs expressed an interest in Phase II. All were contacted, and ten consented to be interviewed. Subsequently, two withdrew their consent (could not commit the time) which meant eight interviews were completed. The sample included a breadth of gender, type of provider (NHS only, mixed NHS/private, and Private only), year of qualification and LHA (all six were represented). Four major themes arose from the interviews: (i) the impact of TDIs on patients, parents and GDPs; (ii) barriers to providing treatment; (iii) educational opportunities for GDPs; and (iv) the interactions between primary and secondary care services. The evolution of coding, themes and sub-themes is shown in Table 4.

The impact TDIs had on patients, parents and dentists was raised by all GDPs. Patients were concerned about the aesthetic impact of a TDI, but often did not voice this concern: ‘Other than teenage girls, most children often appear not to be worried about how it looks, but deep down, you can tell they are’ (Female, NHS only, qualified 1989). GDPs reported parents were more impacted than their child. Exploring this further explained these concerns related more to the future implications of the TDIs: ‘The parents worry what’s gonna happen in the future...it’s quite hard for them to swallow’ (Female, mixed NHS/private, qualified 2016). The potential for a poor outcome resonated with some GDPs: ‘I had a couple of cases where a child lost a tooth and I had to give the child a denture, I really felt bad’ (Male, mixed NHS/private, qualified 2003). Exploring this in more detail highlighted that there was an internal expectation by some GDPs that they had to ‘get it right’ as the consequences, including potential litigation, of mismanagement were significant stressors for them: ‘If you don’t get it right at the initial stage the consequences are people could lose their front tooth. If you didn’t do it properly, whose fault is that?’ (Male, mixed NHS/private 1999).

Inadequate financial remuneration was a key barrier to managing TDIs, especially for those who qualified before 2000: ‘I’m not going to get paid for this, so I’d refer on immediately...’ (Male, qualified 1991). In contrast, a maternal/paternal instinct of more recently qualified GDPs drove the decision to manage these cases rather than financial remuneration: ‘I treat these cases as if it were my son who had had the trauma

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**TABLE 1** Number of cases according to the type of injury which initially presented to GDPs within the last year

| Type of injury                        | 0 cases | 1–3 cases | 4–6 cases | 6–9 cases | 10+ cases |
|--------------------------------------|---------|-----------|-----------|-----------|-----------|
| Enamel or enamel/dentin fracture     | 3.1%    | 25%       | 31.3%     | 14.8%     | 25.8%     |
| (n = 4)                               | (n = 32)| (n = 40)  | (n = 19)  | (n = 33)  |
| Enamel/dentin/pulp fracture           | 23.4%   | 53.9%     | 14.8%     | 3.9%      | 3.9%      |
| (n = 30)                              | (n = 63)| (n = 19)  | (n = 5)   | (n = 5)   |
| Root fracture                         | 41.4%   | 46.9%     | 10.2%     | 1.6%      | 0%        |
| (n = 53)                              | (n = 60)| (n = 13)  | (n = 2)   | (n = 0)   |
| Lateral luxation                      | 44.5%   | 53.1%     | 0.8%      | 1.6%      | 0%        |
| (n = 57)                              | (n = 68)| (n = 1)   | (n = 2)   | (n = 0)   |
| Intrusion                             | 68.0%   | 30.4%     | 1.6%      | 0%        | 0%        |
| (n = 87)                              | (n = 39)| (n = 2)   | (n = 0)   | (n = 0)   |
| Extrusion                             | 76.6%   | 21.1%     | 2.3%      | 0%        | 0%        |
| (n = 98)                              | (n = 27)| (n = 3)   | (n = 0)   | (n = 0)   |
| Avulsion                              | 77.3%   | 21.1%     | 1.6%      | 0%        | 0%        |
| (n = 99)                              | (n = 27)| (n = 2)   | (n = 0)   | (n = 0)   |
rather than worrying about how much I will make.’ (Male, mixed NHS/private, qualified 2003). Insufficient remuneration was mentioned by all when it came to the long-term costs of managing TDIs: ‘It is more to do with the long-term costs as if I’m not getting paid for reviewing them, then I won’t do it...’ (Male, mixed NHS/private, qualified 2003).

Some GDPs suggested that secondary care dental services should help when needed: ‘I am happy to manage things myself if I was given advice when I didn’t know what to do...’ (Male, private only, qualified 2007). Others felt they should accept sole responsibility: ‘They will all end up going to a specialist centre anyway. I think that’s much better than having it done in practice personally’ (Male, mixed NHS/private, qualified 1991).

Postgraduate training in dental trauma management was supported by all GDPs: ‘I think you need to be up to date on things that you’re not doing a lot of because when you come in it’s always a shock’ (Male, private only, qualified 2001). The lack of value in terms of

| Question                                                                 | Question number | Strongly disagree (1) | Disagree (2) | Neither agree or disagree (3) | Agree (4) | Strongly agree (5) | Median response |
|-------------------------------------------------------------------------|----------------|-----------------------|--------------|-------------------------------|-----------|--------------------|----------------|
| All management of all cases of dental trauma is only the responsibility | 1              | 61.7% (n = 79)        | 28.9% (n = 37)| 5.5% (n = 7)                  | 3.9% (n = 5) | 0% (n = 0)         | 1              |
| of the local hospital                                                   |                |                       |              |                               |           |                    |                |
| My undergraduate training was sufficient for me to feel confident in the | 2              | 4.7% (n = 6)          | 26.6% (n = 34)| 24.2% (n = 31)                | 37.5% (n = 48) | 7.0% (n = 9)        | 3              |
| management of dental trauma                                            |                |                       |              |                               |           |                    |                |
| The NHS payment for treating dental trauma is sufficient                | 3              | 37.5% (n = 48)        | 28.9% (n = 37)| 20.3% (n = 26)                | 11.7% (n = 15) | 1.6% (n = 2)        | 2              |
| GDPs in practice have a responsibility to treat dental trauma           | 4              | 0.8% (n = 1)          | 3.1% (n = 4) | 3.1% (n = 4)                  | 41.4% (n = 53) | 51.6% (n = 66)      | 5              |
| Most GDPs see too few cases of dental trauma to be competent in its'    | 5              | 2.3% (n = 3)          | 18.0% (n = 23)| 36.7% (n = 47)                | 35.2% (n = 45) | 7.8% (n = 10)       | 3              |
| management                                                             |                |                       |              |                               |           |                    |                |
| I would not treat trauma cases in my practice because the fee is        | 6              | 3.9% (n = 5)          | 8.6% (n = 11)| 53.1% (n = 68)                | 32.8% (n = 42) | 1.6% (n = 2)        | 3              |
| insufficient                                                             |                |                       |              |                               |           |                    |                |
| Trauma is most effectively managed in specialist centres                | 7              | 4.7% (n = 6)          | 25.0% (n = 32)| 31.3% (n = 40)                | 28.9% (n = 37) | 10.2% (n = 13)      | 3              |
| Most dental trauma cases can be managed effectively in general dental   | 8              | 4.7% (n = 6)          | 8.6% (n = 11)| 16.4% (n = 21)                | 56.3% (n = 72) | 14.1% (n = 18)      | 4              |
| practice                                                                |                |                       |              |                               |           |                    |                |
| All patients with dental trauma should be referred to the local dental  | 9              | 25.0% (n = 32)        | 9.4% (n = 12)| 4.7% (n = 6)                  | 57.8% (n = 74) | 3.1% (n = 4)        | 4              |
| hospital for management                                                 |                |                       |              |                               |           |                    |                |
| Managing dental trauma would take up too much of my time                | 10             | 19.5% (n = 25)        | 43.8% (n = 56)| 21.9% (n = 28)                | 13.3% (n = 17) | 1.6% (n = 2)        | 2              |
| My practice is close enough to a dental hospital to refer               | 11             | 2.3% (n = 3)          | 13.3% (n = 17)| 10.9% (n = 14)                | 49.2% (n = 63) | 24.2% (n = 31)      | 4              |
| Evidence-based management tools are an effective way for GDPs to aid    | 12             | 1.6% (n = 2)          | 3.1% (n = 4) | 10.2% (n = 13)                | 57.0% (n = 73) | 28.1% (n = 36)      | 4              |
| management of dental trauma                                             |                |                       |              |                               |           |                    |                |
| Insufficient payment would be a reason for me to refer my cases of      | 13             | 5.5% (n = 7)          | 37.5% (n = 48)| 16.4% (n = 21)                | 39.1% (n = 50) | 1.6% (n = 2)        | 3              |
| dental trauma to a dental hospital                                      |                |                       |              |                               |           |                    |                |
| The long-term management of dental trauma needs the skills of a          | 14             | 4.7% (n = 6)          | 41.4% (n = 53)| 27.3% (n = 35)                | 18.8% (n = 24) | 7.8% (n = 10)       | 3              |
| specialist                                                              |                |                       |              |                               |           |                    |                |
| Before referring a patient with dental trauma, GDPs have a responsibility| 15             | 1.6% (n = 2)          | 3.9% (n = 5) | 5.5% (n = 7)                  | 32.0% (n = 41) | 57.0% (n = 73)      | 5              |
| to provide emergency management                                         |                |                       |              |                               |           |                    |                |
| I refer to online guidelines to aid my management of dental trauma      | 16             | 1.6% (n = 2)          | 13.3% (n = 17)| 16.4% (n = 21)                | 41.4% (n = 53) | 27.3% (n = 35)      | 4              |
| Dental trauma could be treated more effectively in practice if the NHS  | 17             | 4.7% (n = 6)          | 15.6% (n = 20)| 30.5% (n = 39)                | 35.9% (n = 46) | 13.3% (n = 17)      | 3              |
| payment was greater                                                     |                |                       |              |                               |           |                    |                |
| Postgraduate training in dental trauma management is required for all   | 18             | 0.8% (n = 1)          | 10.9% (n = 14)| 18.0% (n = 23)                | 51.6% (n = 66) | 18.8% (n = 24)      | 4              |
| GDPs to be able to continually manage dental trauma cases appropriately  |                |                       |              |                               |           |                    |                |

Table 2: Questionnaire responses
TABLE 3 How confident GDPs felt being able to provide appropriate initial treatment and long-term care for each type of dental traumatic injury

| Type of injury                      | Strongly disagree (1) | Disagree (2) | Neither agree or disagree (3) | Agree (4) | Strongly agree (5) | Median response |
|------------------------------------|-----------------------|--------------|-------------------------------|-----------|-------------------|----------------|
| Enamel or enamel/dentin fractures   | 0.8% (n = 1)          | 0% (n = 0)   | 0.8% (n = 1)                  | 24.2% (n = 31) | 74.2% (n = 95)   | 5              |
| Enamel/dentin/pulp fractures        | 1.6% (n = 2)          | 4.7% (n = 6) | 3.1% (n = 4)                  | 43.0% (n = 55) | 47.7% (n = 61)   | 4              |
| Root fractures                      | 0.8% (n = 1)          | 31.3% (n = 40) | 22.7% (n = 29)                | 28.9% (n = 37) | 16.4% (n = 21)    | 3              |
| Lateral luxation                    | 3.1% (n = 4)          | 20.3% (n = 26) | 28.9% (n = 37)                | 35.2% (n = 45) | 12.5% (n = 16)   | 3              |
| Intrusion                           | 7.8% (n = 10)         | 28.9% (n = 37) | 26.6% (n = 34)                | 26.6% (n = 34) | 10.2% (n = 13)   | 3              |
| Extrusion                           | 7.8% (n = 10)         | 21.9% (n = 28) | 28.1% (n = 36)                | 31.3% (n = 40) | 10.9% (n = 14)   | 3              |
| Avulsion injuries                   | 6.3% (n = 8)          | 30.5% (n = 39) | 22.7% (n = 29)                | 30.5% (n = 39) | 10.2% (n = 13)   | 3              |

Financial return was voiced by some GDPs: ‘I would pay thousands to do a course on implant-retained dentures because it’ll make [me] a lot of money, but why would I pay to do a trauma course when I’m unlikely to make any money from it?’ (Male, mixed NHS/private, qualified 2003).

4 | DISCUSSION

GDPs level of confidence in managing TDIs correlates with the complexity of the injury sustained - that is the simpler the trauma, the more confident the GDP was. One explanation could be that fewer children present to their GDP with complex injuries. Alternatively, there could be a lack of knowledge relating to managing more complex injuries. Although this was not apparent in this cohort, it has been reported in studies from Lithuania, Germany, and Brazil. A more hypothetical explanation could be that complex injuries increase the demand on the GDP’s decision-making skills. Having to assimilate several pieces of information in an emergency situation can be challenging and could negatively impact a GDP’s confidence in managing more complex injuries.

Inadequate financial remuneration has previously been reported as a barrier to GDPs managing TDIs. In this cohort, GDPs qualifying before 2000 were more inclined to refer patients to secondary care services based on inadequate financial remuneration alone. A change from fee per item (pre-2006) to UDAs means the payments for the short- and long-term management equate to a lower amount now than previously. More recently qualified GDPs were willing to absorb the financial losses associated with short-term management only. It appears that these financial losses could be recouped by providing alternative, better paid treatments (eg implants) for non-TDI patients. Despite this, immediate emergency management was provided when required, suggesting a sense of altruism, or a maternal/paternal instinct by GDPs to do the ‘right thing’ for the child.

GDPs felt that children were not overtly concerned about the aesthetic impact of a TDI. This could be due to a child’s resilience or that some children displayed a sense of bravery as part of their coping mechanism to deal with their TDI. Recognizing that some children may have aesthetic concerns, despite not reporting them, is important for GDPs to consider. Good quality aesthetic treatment for children following a TDI has been shown to yield important psychosocial benefits as negative social judgements are often made by similarly aged children. Parents were mainly concerned about the long-term implications of TDIs. Previous evidence suggests that parents report a reduction in their own health-related quality of life after their child has sustained a TDI. However, this improves over time if they are satisfied with the dental treatment provided and the long-term complications are minimized.

Mismanaging children with TDIs resonated with GDPs as this may result in a poor outcome, or in the worst case, tooth loss. Ode et al. demonstrated that dentists worry about patients fearing the loss of their teeth following a TDI. Although this finding was for adults with TDIs, it can also be generalized to paediatric patients. Mismanagement could lead to litigation. Dentists are becoming more concerned about potential litigation, with the number of legal claims regarding the profession increasing. Vocalizing the potential for a negative outcome of a TDI at the outset could alleviate GDPs fears of mismanagement as TDI-associated complications may occur despite optimal management.

A good working relationship between primary and secondary care dental services is necessary for children with TDIs. The extent of how involved (eg provision of advice only, joint care or responsibility for entire care) the local dental hospital should be had divided opinions. This has several policy and commissioning ramifications and may cause confusion, potentially resulting in poor outcomes.
| Evolution of themes and sub-themes | GT coding after two manuscripts | OS coding after two manuscripts | Whole team (initial themes and sub-themes) after two manuscripts | Final Themes (and sub-themes) after eight manuscripts |
|-----------------------------------|--------------------------------|--------------------------------|-------------------------------------------------|--------------------------------------------------|
| Barriers                          | Ability of dentist to treat  | Barriers                       | Barriers to providing treatment                |                                                  |
| Age                               | Aesthetics                   | Cooperation                    | Cooperation                                    |                                                  |
| Cooperation                       | Business and practice factors | Equipment restraints           | Cooperation                                    |                                                  |
| Location                          | CPD and education            | Knowledge                      | Practitioner knowledge                         |                                                  |
| Knowledge                         | Dental factors               | Location                       | Education                                      |                                                  |
| Education                         | Dentist confidence           | Education                      | Impact of TDIs                                 |                                                  |
| Keeping up to date                | Dentist experience           | Training opportunities         | On the child                                   |                                                  |
| Payment                           | Dentist knowledge            | Updating knowledge             | On the dentist                                 |                                                  |
| Training opportunities            | Equipment restraints         | Impact                         | On the parents                                 |                                                  |
| Financial Impact                  | Financial barrier            | On the child                   | Finances has on driving decisions              |                                                  |
| On practice                       | Geography                    | On the dentist                 | Primary and secondary care interactions       |                                                  |
| Impact on the child               | Guidelines                   | On other patients/dental practice|                                              |                                                  |
| Aesthetics                        | Impression of secondary care | Financial                      |                                                |                                                  |
| Function                          | Long-term effects            | Interactions                   |                                                |                                                  |
| Pain                              | Medicolegal                  | Primary vs Secondary Care      |                                                |                                                  |
| Psychological                     | Painful or unpleasant        | Care pathways                  |                                                |                                                  |
| Short- and long-term treatment    | Parental anxiety             | NHS vs Private                 |                                                |                                                  |
| Impact on the parents             | Patient anxiety and cooperation|                                    |                                                |                                                  |
| Impact on dental practitioner     | Personal feelings to patient |                                                |                                                |                                                  |
| Impact of Injuries on management  | Personal impact (dentist)    |                                                |                                                |                                                  |
| Impact the dentist has on         | Psychological impact to      |                                                |                                                |                                                  |
| management                        | patient                      |                                                |                                                |                                                  |
| Impact to other patients or       | Sense of duty                |                                                |                                                |                                                  |
| practice                          |                                |                                                |                                                |                                                  |
| Methods to cope with emergencies  | Societal view                |                                                |                                                |                                                  |
| Paternal/Maternal instincts        | Specialist referral          |                                                |                                                |                                                  |
| Interactions                      |                                |                                                |                                                |                                                  |
| NHS vs Private                    |                                |                                                |                                                |                                                  |
| Patient – parent                  |                                |                                                |                                                |                                                  |
| Patient – dentist                 |                                |                                                |                                                |                                                  |
| Parent – dentist                  |                                |                                                |                                                |                                                  |
| Referral Pathways                 |                                |                                                |                                                |                                                  |
| Benefits of referring             |                                |                                                |                                                |                                                  |
| MCNs                              |                                |                                                |                                                |                                                  |
| Parents opinions of primary vs    |                                |                                                |                                                |                                                  |
| secondary care                    |                                |                                                |                                                |                                                  |
| Primary vs Secondary Care         |                                |                                                |                                                |                                                  |
| Reason for referral               |                                |                                                |                                                |                                                  |
| Role of secondary care            |                                |                                                |                                                |                                                  |
| Role of primary care              |                                |                                                |                                                |                                                  |

Note: Evolution of themes (in bold) and sub-themes during the analysis process
for patients. Developing an MCN could clarify the situation and ensure patients receive the care they need, from the correct personnel, in a timely manner. The MCN will act as a referral pathway between GDPs, satellite clinics and secondary care services, allowing patients, where appropriate, with slightly more complex TDIs to be managed in the short and long term more locally with suitably trained staff. Additionally, these satellite clinics are more likely to have all the necessary equipment required to manage a TDI, compared to a primary care practice, which addresses a major concern raised by GDPs.

There are several strengths and limitations of this study. To the best of the authors’ knowledge, this is the first UK-based study to use a sequential mixed-methods approach to explore confidence and barriers in managing children with TDIs. The robust sampling framework reduced selection bias as every GDP working across the six LHA areas was invited to participate. Utilizing the same LHAs as a previous study provided a unique opportunity to observe differences in knowledge and attitudes over a 17-year period. Conversely, limiting the sample to these six LHAs in the north-east of England only, rather than a random sample of the UK, may reduce the general application of the study findings. TDI management by GDPs and access to secondary care services across the UK will be very similar to what is provided by and available to GDPs in these LHAs. Very few areas of the UK do not have a specialist unit in close proximity. In these regions, it is likely that GDPs confidence and management relating to TDIs may be different and is something that could be explored in future studies.

It is important to consider the impact the interviewer (GT) may have had on the respondents. As a paediatric dentist, GT’s preconceptions may have shaped the outcome of the interviews, but having a clinical understanding of TDIs was important to ensure the interviews were meaningful. Another strength was that the coding framework was developed using a robust and rigorous process before a consensus was met. This included analyst triangulation, with a specialist in dental public health (RH), who is less likely to analyse the data with a bias of having a paediatric dental background.

The response rate of 20.7% was lower than anticipated although it is known that professional groups will often not respond to a questionnaire unless the topic is of relevance to them. The questionnaires could not be sent electronically, with evidence supporting that response rates and quality of response will not be improved with electronic distribution. The breadth of participant demographics, including double the number of associates to practice owners, an even spread of qualification year and the majority of whom work in a mixed NHS/private practice, reflects and is representative of the current north-east GDP population. Despite this, a sampling bias is likely to exist as those who responded may be more confident in managing trauma, thus under-estimating the true levels of knowledge and attitudes amongst the population reported in this study.

The sample size for the qualitative phase was eight. This could be a limitation as data saturation may not have been achieved. However, data saturation may be attained by as few as six interviews, with the richness (quality) and thickness (quantity) of data being far more important than the size of the sample. Data saturation was reached on the basis that the richness and thickness of data was apparent by the last interview analysed as no new data, themes or coding were apparent at this point.

The findings suggest that GDPs are generally confident in managing simple traumatic dental injuries, but less so for more complex injuries. Despite barriers existing, managing the acute injuries for children with TDIs remains important to GDPs. Furthermore, there are methods that can be implemented to overcome some of these barriers (ie developing an MCN). Ensuring patients receive optimum care from the most appropriate clinical team in a timely fashion will ultimately help to ensure favourable outcomes.

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CONFLICTS OF INTEREST

None of the authors declare any conflicts of interests.

AUTHOR CONTRIBUTIONS

GDT contributions to the study are overall design of the study including development of sampling framework; literature review; design and piloting of the questionnaire; dissemination of the questionnaire; conducting and analysing the questionnaire and interview data; and compiling the report and manuscript. OS contributions to the study are analysing the interview data and reviewing manuscript. RDH and PJW contributions to the study are overall design of the study; design of the questionnaire; analysing the interview data; and reviewing the manuscript.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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