Diagnosing abuse: a systematic review of torn frenum and other intra-oral injuries

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INTRODUCTION: A torn labial frenum is widely regarded as pathognomonic of abuse.

METHODS: We systematically reviewed the evidence for this, and to define other intra-oral injuries found in physical abuse. Nine studies documented abusive torn labial frenum in 30 children and 27 were fatally abused: 22 were less than 5 years old. Only a direct blow to the face was substantiated as a mechanism of injury.

RESULTS: Two studies noted accidentally torn labial frenum, both from intubation. Abusive intra-oral injuries were widely distributed to the lips, gums, tongue and palate and included fractures, intrusion and extraction of the dentition, bites and contusions.

CONCLUSIONS: Current literature does not support the diagnosis of abuse based on a torn labial frenum in isolation. The intra-oral hard and soft tissue should be examined in all suspected abuse cases, and a dental opinion sought where abnormalities are found.

METHODS

Data sources and participants

We carried out an all-language literature search of research articles, conference abstracts, websites and references in all articles identified, including review articles and relevant textbooks from 1950 to June 2006. The key words and details of databases searched can be found in tables 1 and 2, respectively. Articles were scanned for duplication and relevance. Authors were contacted where necessary. The resulting studies were reviewed by members of the Welsh Child Protection Systematic Review Group, a panel of 31 people who were paediatricians, child health professionals with child protection expertise, or paediatric or forensic dentists. Each study was subjected to two independent reviews and a third if disputed. Standardised criteria for study definition, data extraction and critical appraisal were used. Full critical appraisal and data extraction forms are available at http://www.core-info.cf.ac.uk.

Data extraction

We included all studies of children aged 0–18 years with intra-oral injuries due to physical child abuse, and torn labial frenum of any aetiology, in live and fatal cases. We defined intra-oral as the area between the vermilion border of the lips and the hypopharynx.

We excluded review articles, expert opinion or guidelines that did not include primary evidence, studies with mixed adult and child data where the children’s data could not be extracted, studies that addressed complications or management of abusive injuries, intra-oral injuries due to sexual abuse, or thermal injuries (as these will be encompassed in separate reviews) or dental neglect.

Studies were ranked by study design and by the likelihood that abuse had taken place in the “abused” population. We used our own ranking of abuse, as previously described, where a ranking of 1 gave the highest security of diagnosis that abuse had taken place, and a ranking of 5 the least confidence (table 3). We included studies with a ranking of 1–4. In the case of non-abusive injuries, we only included studies where authors had described methods to ensure that abuse had been excluded.

RESULTS

Of 154 studies reviewed, 19 met the inclusion criteria. These represented data on 591 children. There were no comparative cross-sectional or case-control studies of torn labial frenum to enable a probability of abuse to be determined for this injury. The only mechanism described for an abusive torn frenum was a direct blow to the face, recorded in two children. No details of mechanisms were given in other cases. Likewise, there were no comparative studies to compare the characteristics of other abusive and non-abusive intra-oral injuries.

Abusive torn labial frenum

Nine studies documented torn labial frenum in abused children (table 4); seven were case series or case studies, and one was a case-control study. None of these studies were designed to address torn frenum specifically; the case-control evaluated blunt abdominal trauma in association with cardiopulmonary resuscitation.

These studies represented data on 30 children, of whom 27 (90%) were fatally abused. Twenty two were 5 years of age or
younger. The age range given was 0–10 years for five children in one study. Four of these studies ranked 1 for abuse, three ranked 3 and two ranked 4.

Cameron was the first to report a torn labial frenum as a consequence of physical abuse in 1966. In a retrospective study of 29 fatally abused children between birth and 4.5 years, he noted “the presence in nearly half of the cases of laceration of the mucosa of the inner aspect of the upper lip near the phrenum [sic], sometimes with tearing of the lip from the alveolar margin of the gum was a striking feature of possible significance”. Later the same year, Tate reported six cases of fatal abuse among children under 3 years old. He noted “the presence in nearly half of the cases of laceration or laceration of the alveolar margin of the gum was a striking feature of possible significance”. Later the same year, Tate reported six cases of fatal abuse among children under 3 years old. He noted “the presence in nearly half of the cases of laceration or laceration of the alveolar margin of the gum was a striking feature of possible significance”.

Abusive intra-oral injuries

Fourteen studies documented other types of abusive intra-oral injuries. They were all case series or studies, and 11/14 had a higher abuse ranking of 1 or 2. They represented data on 579 children (table 5). The most commonly recorded abusive injuries to the mouth were lacerations or bruising to the lips. The remaining injuries included mucosal lacerations, dental trauma (including fractures, intrusion and forced extraction), tongue injuries and gingival lesions. No characteristics of these lesions were specific to an abusive aetiology, apart from an adult bite to a child’s tongue.

Becker recorded oro-facial trauma in 49% of 260 abused children, 14 (6%) of whom had intra-oral injuries. The largest series, by Naidoo, showed that 59% of 300 physically abused
children had facial injuries, 11% of whom had intra-oral injuries. The most common injuries recorded were to the lips (22 children). There were also seven fractured mandibles, and six injuries to oral mucosa, five to teeth, five to gingiva and three to the tongue. Torn frena were not recorded specifically. The children were selected from those with known physical abuse and orofacial injury. No child was examined by a dentist in any of these studies, and the data were collected retrospectively from chart reviews, raising the question of how often the mouth was actually examined.

Injuries to the tongue included an adult bite to an infant’s tongue in a 10-month-old child, with the arc of the bite pointing towards the lips, confirming it could not have been self inflicted, with multiple fractures, bruises and subdural haemorrhages and abrasions and bruising.

In three studies oral bleeding was a presenting symptom. In one case the infant re-presented five times from the age of 4 months, and was found to have a laceration of the uvula with several abrasions and lacerations of the upper gum, hard palate, floor of mouth and lingual frenum; the child developed a retropharyngeal abscess.

Injuries to teeth included displacement, chips, avulsions, intrusion and fractures. One bizarre case series included three siblings who had endured forced dental extraction of permanent incisors as a form of punishment.

DISCUSSION

This study confirms that intra-oral injury occurs in a significant number of children who have been physically abused. Injuries are widely distributed to the lips, gums, tongue and palate and include fractures, intrusion and extraction of the dentition, bruising, lacerations and bites. There is a paucity of published scientific literature about the torn labial frenum. There are no studies defining the incidence of torn labial frenum in abuse and none that compare the injury in abused and non-abused children. It is impossible, therefore, to ascribe a probability of abuse for a torn labial frenum. Published studies are limited to 30 highly selected cases where a torn labial frenum is described in predominantly pre-school children who had suffered serious abuse, and where the majority of cases were fatal with extensive associated injuries. The only substantiated cause of an abusive torn labial frenum was a direct blow. There were no recorded cases of forced feeding, twisting or rubbing causing this injury. The literature includes mention of torn labial frenum that were not abusive, and therefore a torn frenum in isolation cannot be described as pathognomonic of physical abuse. Clearly the finding of an unexplained torn labial frenum in a young child warrants full investigation, but the paucity of data in the literature and the highly selected nature of cases reported precludes defining an age band where concern would be highest. A diagnosis of physical abuse should not be based on a single injury in isolation, but arrived at in the context of the child’s medical, social and developmental history and the explanation offered for the injury.

Some of the largest series in the literature were not eligible for inclusion as they were only ranked 5 for abuse. They included cases of suspected abuse, with no separation of data on those cases where abuse was actually confirmed. It is important when assessing a possible torn labial frenum to consider rarer congenital abnormalities of the labial frenum such as midline diastema, hypertrophic frenum in association with hypoplastic left heart syndrome, and multiple frenula in other congenital heart syndromes such as Ellis-van Creveld or Pallister-Hall as possible explanations of the abnormality. The most frequently reported abusive injury to the mouth is not a torn labial frenum, as has been suggested, but injury to the lips. This assumes that the mouths of all abused children in the various series were fully examined. As these were retrospective studies of case notes, this is far from clear. None of the described abusive intra-oral injuries had any diagnostic characteristics, except for a bitten tongue.

Many of the intra-oral injuries described in abused children are likely to be seen by general dental practitioners, yet dentists make very few child protection referrals. This is highlighted by Cotton, who noted that of 20 000 child abuse investigations only 12 were initiated by dentists. A survey by Becker et al of 1332 dentists in the USA, where there was mandatory reporting with a response rate of 40%, noted that 22 cases of child abuse were seen but only four (18%) were referred to social services.

Table 4 Studies of abusive torn frenum

<table>
<thead>
<tr>
<th>Author/year</th>
<th>Abuse ranking (1–5)</th>
<th>Number of children (ages)</th>
<th>Co-existing injuries</th>
<th>Fatal/life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cameron et al, 1966</td>
<td>3</td>
<td>13 approx (0–4.5 years)</td>
<td>Some tearing of the upper lip, near the frenum</td>
<td>All fatal</td>
</tr>
<tr>
<td>Tate, 1971</td>
<td>1, 4</td>
<td>3 (23 months–4 years)</td>
<td>With/without intracranial injury</td>
<td>1 live, 2 fatal</td>
</tr>
<tr>
<td>Grace and Grace, 1987</td>
<td>3</td>
<td>1 (18 months)</td>
<td>Later readmitted - multiple fractures, intracranial injury, pharyngeal puncture</td>
<td>Live</td>
</tr>
<tr>
<td>Symons et al, 1987</td>
<td>4</td>
<td>1 (3 years)</td>
<td>Contusion of eye/subdural haemorrhage, multiple bruises</td>
<td>Fatal</td>
</tr>
<tr>
<td>Manning et al, 1990</td>
<td>1</td>
<td>1 (4 months)</td>
<td>Lacerations to uvula, upper gum, hard palate, floor of mouth.</td>
<td>Live</td>
</tr>
<tr>
<td>Hobbs and Wynne, 1990</td>
<td>1</td>
<td>1 (0.4 years)</td>
<td>Multiple bruises, sexual abuse, fractures and retinal haemorrhages, developmental delay</td>
<td>Fatal</td>
</tr>
<tr>
<td>Price et al, 2000</td>
<td>1</td>
<td>5 (0–10 years)</td>
<td>Extensive abdominal injuries, other injuries not detailed in these cases</td>
<td>All fatal</td>
</tr>
<tr>
<td>Cordner et al, 2001</td>
<td>1</td>
<td>1 (18 months)</td>
<td>Occipital skull fracture, intracranial haemorrhage, widespread bruising</td>
<td>Fatal</td>
</tr>
<tr>
<td>Phillips and van der Heyde, 2006</td>
<td>3</td>
<td>1 (5 years)</td>
<td>Traumatic bruising to legs, also bruising to eyes, ear and scalp.</td>
<td>Cerebral oedema</td>
</tr>
</tbody>
</table>
Table 5 Abusive intra-oral injury

<table>
<thead>
<tr>
<th>Authors/year</th>
<th>Abuse rank</th>
<th>Number of children (age)</th>
<th>Orofacial injuries found</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tate, 1971†</td>
<td>1</td>
<td>2 (23 months and 4 years)</td>
<td>Case 1, chipped upper incisor, also torn frenum and fractures, killed 3 weeks later</td>
</tr>
<tr>
<td>Becker et al, 1978†</td>
<td>4</td>
<td>260 (not given by authors)</td>
<td>Case 2, severe laceration of upper lip and loose tooth. Multiple other soft tissue injuries</td>
</tr>
<tr>
<td>Swann and Glasgow, 1982‡</td>
<td>2</td>
<td>1 (7 weeks)</td>
<td>49% orofacial trauma, 14 intra-oral, 4 dental trauma, no other detail on location</td>
</tr>
<tr>
<td>Schuman, 1987‡</td>
<td>1</td>
<td>1 (10 years)</td>
<td>Oral bleeding, bruise and ulcer to fauces, abrasions and bruising to gingiva and around tongue</td>
</tr>
<tr>
<td>Sobel, 1983‡</td>
<td>1</td>
<td>1 (4 years)</td>
<td>Midroot fracture of maxillary incisor</td>
</tr>
<tr>
<td>Grace and Grace, 1987‡</td>
<td>1</td>
<td>3 (10–18 months)</td>
<td>Facial abrasions/bruises, bruising of upper and lower lip, laceration of gingival and alveolar mucosa, intrusion of one incisor and avulsion of incisor, fractured mandible</td>
</tr>
<tr>
<td>Symons et al, 1987‡</td>
<td>4</td>
<td>1 (3 years)</td>
<td>Abrasions of hard palate with associated trauma to ear in one case, two cases of laceration to pharyngeal wall, one with associated intra-oral injury and one trauma to ear</td>
</tr>
<tr>
<td>Manning et al, 1990‡</td>
<td>1</td>
<td>1 (4 months)</td>
<td>Fatally abused, abrasion of upper lip, laceration of frenum of upper lip, intraoral hemorage</td>
</tr>
<tr>
<td>Carrolle, 1990†</td>
<td>1</td>
<td>3 (13 years, n/a)</td>
<td>Recurrent oral bleeding, abrasions and lacerations of upper gum, hard palate, floor of mouth and frenum. Retropharyngeal abscess</td>
</tr>
<tr>
<td>Barrett and Debelle, 1995‡</td>
<td>2</td>
<td>1</td>
<td>Dental extraction of permanent teeth by parents as a punishment</td>
</tr>
<tr>
<td>Naidoo, 2000</td>
<td>2</td>
<td>300 (1 month–14.25 years)</td>
<td>Tear on posterior pharyngeal wall, forcible removal of an impacted dummy</td>
</tr>
<tr>
<td>Lee et al, 2002†</td>
<td>1</td>
<td>1 (10 months)</td>
<td>22 lacerations to lips, 6 injuries to oral mucosa, 5 to teeth, 5 to gingiva, 3 to tongue. Also unspecified number of loose or missing teeth. Seven fractures of mandible/ maxilla</td>
</tr>
<tr>
<td>Stricker et al, 2002‡</td>
<td>1</td>
<td>1 (9 days)</td>
<td>Adult bite to the infants tongue, herpetic lesions perioral and intra-oral, also multiple fractures, skin lesions and lacerations to ear and neck</td>
</tr>
<tr>
<td>Phillips and van der Heyde, 2006†</td>
<td>3</td>
<td>4</td>
<td>Bleeding lesion on hard palate, discharged, returned at 4 weeks with multiple fractures and intra-oral hemorage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(20 months, 2.5 years, 3 years, 5 years)</td>
<td>Bruised lips, lacerated lips, bruised alveolar mucosa, avulsed teeth. All fatal cases, co-existent lacerations, bruises, burns, fractures, sexual abuse (one case) and scars to body, with fatal visceral and head injuries</td>
</tr>
</tbody>
</table>

Despite a legal requirement to report suspected abuse. A similar study by Malecz showed that not only did few dentists report abuse cases, but 7% of 155 respondents said that under no circumstances would they report child abuse. Reasons cited included uncertainty about diagnosis and fear of litigation, although practitioners making a referral “in good faith” are protected from litigation in the United States. Even 12 years later, a survey of 250 dentists, 157 of whom responded, showed that 50% of dentists had suspected abuse but one third did not refer the case, and similar reluctance has recently been documented in the UK where 21% of dentists did not refer cases they suspected of having been abused. There have been a number of initiatives in the United States to tackle this issue, and Welbury et al have developed a computer-assisted learning programme for general dental practitioners in the United Kingdom, and the British Dental Council have recently published guidance.

There is no legal mandatory reporting of child abuse in the UK, but the British Dental Association has made it clear that dentists do have an ethical responsibility to report child abuse. Clearly, those responsible for child protection training in each region must include dental practitioners and hygienists in such programmes, and offer ongoing support.

As in previous reviews, children with disability were not represented. This is particularly disappointing as disabled children are recorded as being three times more likely to be abused than their able-bodied counterparts.

Whilst this review did not deal with dental neglect, a notable number of cases presented co-existing neglect with resulting dental caries, likely to cause severe pain to the child. Dental neglect while variably defined, should be considered in any child with extensive dental caries or early childhood caries where appropriate dental care has not been sought. This subject merits a review in its own right, in view of the potential implications in relation to pain, morbidity and faltering growth.

Future research should be directed at determining the sensitivity and specificity of intra-oral injuries in abuse by well designed comparative studies. It is clear that we need to define those children who sustain accidental torn frena, in isolation or otherwise, by age, developmental stage and co-existent injury and cause, in order to aid the distinction from abusive torn frena. Attention should be given specifically to documenting the full extent of intra-oral injuries in physically abused children and their co-existent injuries, and this should include disabled children.

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Competing interests: None.

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Intra-oral injuries

33 Chan L, Hodes D. Images in paediatrics. When is an abnormal frenulum a sign of child abuse? Arch Dis Child 2004;89:277.
Therefore, the levels of nNO in the elder brother and parents were evaluated. The nNO levels were normal in both parents. By contrast, in the 7-year-old child the mean nNO was 41 ppb at the first assessment, and it was confirmed as low (30 ppb) after 90 days, when he was in a stable healthy period. The PCD diagnosis in case 2 was also confirmed by nasal brushing, but in this case the imaging investigation failed to show situs viscerum inversus. For both brothers intensive physiotherapy was instituted.

PCD is an underdiagnosed genetic disease that represents a rare cause of neonatal respiratory distress. In half of the patients it is associated with situs viscerum inversus (Kartagener’s syndrome), and some of these patients have mild minimal transmission electron microscopy defects (ie, atypical PCD), 1 with a wide spectrum of disease variability. Recent studies have demonstrated low nNO levels in patients with PCD compared with healthy age-matched subjects and, therefore, this measurement has been proposed as a diagnostic marker for screening. 2 Our observation that markedly low levels of nNO represent a characteristic feature of PCD even in newborns with situs viscerum inversus and respiratory distress at birth 3 further supports the use of this marker for the early detection of the disease in children.

To the best of our knowledge, the case we are reporting is the first demonstration of the potential application of nNO as a non-invasive, low-cost tool for the family screening of PCD after the identification of a positive case in a newborn.

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Prevalence of anaemia in an inner city primary school population

Iron deficiency, defined as a serum ferritin level of <15 μg/l,1 has been shown to adversely affect many aspects of health and development in childhood and persistence into school age may result in sub-optimal health and academic under-achievement. National research has demonstrated that a high prevalence of anaemia in pre-school children (12%), causally linked to iron deficiency related to dietary factors, is common in areas of socioeconomic deprivation1 and particularly in children of minority ethnic parentage, especially of Pakistani origin.2 There is little information in the literature about the prevalence of anaemia in school aged populations, so trained operators using a HaemoCue (HaemoCue, Angelholm, Sweden) machine3 tested a whole school sample in an inner city area with a high percentage of children of Pakistani parentage.

A total of 319 children aged 4–11 years were tested, representing an uptake rate of 90%; 88% of these children were of Pakistani origin. Anaemia was found in 25% (95% CI 20% to 30%) of the children: 22% (95% CI 18% to 27%) were mildly anaemic and 3% (95% CI 1% to 5%) were severely anaemic. We used the standard WHO reference4 for defining severe anaemia as a haemoglobin level below 9.0 g/dl for those under 5 and between 9.5 and 11.0 g/dl for those aged 5 and over. Mild anaemia was defined as a haemoglobin level between 9.0 and 11.0 g/dl, with a significant trend across school years being found.

Parents or carers of the mildly anaemic children were offered dietary advice and follow-up by the community nursing team. The eight children who were severely anaemic were assessed by a community paediatrician and appropriate treatment and follow-up were arranged. Full blood count, serum electrophoresis and serum ferritin levels were carried out and confirmed iron deficiency in all eight cases. One child was found to have the thalassaemia trait in addition to iron deficiency.

We have demonstrated that anaemia is a significant health problem in this school aged population, most likely caused by iron deficiency. We are now carrying out similar studies in other local areas of different ethnicity and social constitution to ascertain whether this is a more general problem. It may be that the problem is related as much to the modern western diet of a school age child as to the continuing effects of traditional weaning and early childhood diets that have been implicated in this population. It will also be important to ascertain the extent of any problem in the adolescent age group.

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CORRECTION

doi:10.1136/adc.2006.113001corr1

Maguire S, Hunter B, Hunter L, et al. Diagnosing abuse: a systematic review of torn frenum and other intra-oral injuries (Arch Dis Child 2007;92:1113–17). A number of errors were published in this paper as follows:

In the methods section of the Abstract the second sentence should read: “Nine studies documented abusive torn labial frenum in 27 children and 24 were fatally abused…”

The second sentence of the Results section should read: “These represented data on 603 children.” Also in the Results section, under the subheading “Abusive torn labial frenum”, first sentence of the second paragraph should read: “These studies represented data on 27 children, of whom 24 (88%) were fatally abused.”

Under the heading “Abusive intra-oral injuries” on p1114 the third sentence of the first paragraph should read: “They represented data on 580 children (table 5).”

Table 1

<table>
<thead>
<tr>
<th>Patient</th>
<th>T0 ppb</th>
<th>T1 ppb</th>
<th>T2 ppb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case 1</td>
<td>9.2; 6.5; 6.0 mean 7.2</td>
<td>10; 8.0; 6.0 mean 8.0</td>
<td>6.0; 10; 10 mean 8.6</td>
</tr>
<tr>
<td>Case 2</td>
<td>38; 42; 43 mean 41</td>
<td>43; 35; 37 mean 38.3</td>
<td>25; 40; 25 mean 30</td>
</tr>
</tbody>
</table>

Case 1: T0 at 5 days of life, T1 at 30 days without clinical symptoms and finally T2 at 60 days of life.

Case 2: T0 first test, T1 after 60 days and T2 after 90 days.

nNO, nasal nitric oxide; PCD, primary ciliary dyskinesia.
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