

Child Protection Evidence

Systematic review on

Oral Injuries

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While the format of each review has been revised to fit the style of the College and amalgamated into a comprehensive document, the content remains unchanged until reviewed and new evidence is identified and added to the evidence-base. Updated content will be indicated on individual review pages.

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Summary

Facial and intra-oral trauma has been described in up to 49% of infants and 38% of toddlers who have been physically abused^{1,2}. A torn labial frenum (often referred to as frenulum or phrenum) is widely believed by paediatricians to be pathognomonic of abuse³, and has been described as the most common abusive injury to the mouth^{4,5}.

This systematic review evaluates the scientific literature on abusive and non-abusive oral injuries in children published up until **June 2014** and reflects the findings of eligible studies. The review aims to answer two clinical questions:

- Is a torn labial frenum diagnostic of physical child abuse?
- What other intra-oral injuries are caused by physical abuse to children?

Key findings:

- Evidence to date indicates a child with a torn frenum should undergo a full child protection evaluation⁶ but if no other injuries nor any social concerns are identified, the presence of a torn frenum alone is not diagnostic of physical abuse
- The update in 2014 identified an important study comparing injuries during intubation to abusive injuries. Further literature recently picked up in our searches highlighted the significance of oral injuries as sentinel injuries for severe abuse, present in 11% of cases⁷, and tribal practices, including removal of the “killer” canine⁸

Background

This systematic review evaluates the scientific literature on abusive and non-abusive neurological injuries in children published between 1950 and 2014 and reflects the findings of eligible studies. The review aims to answer two clinical questions:

- Is a torn labial frenum diagnostic of physical child abuse?
- What other intra-oral injuries are caused by physical abuse to children?

Methodology

A literature search was performed using a number of databases for all original articles and conference abstracts published since 1950. Supplementary search techniques were used to identify further relevant references. See [Appendix 1](#) for full methodology including search strategy and inclusion criteria.

Potentially relevant studies underwent full text screening and critical appraisal. To ensure consistency, ranking was used to indicate the level of confidence that abuse had taken place and also for study types.

Findings of clinical question 1

Is a torn labial frenum diagnostic of physical child abuse?

The head is the commonest target organ in physical abuse², with 43% of abusive injuries occurring to the face and neck⁹ Of these injuries, a torn labial frenum (often inappropriately referred to as frenulum) is frequently described as pathognomonic of child abuse¹⁰, yet since it is a trivial oral injury in dental terms we wish to determine the probability that a torn labial frenum is due to physical abuse. Many mechanisms are proposed, including force feeding, twisting and direct blow^{10,11} We wish to establish the evidence base for this assertion.

- Of 171 studies reviewed (four foreign language articles), 20 studies addressed this question^{6,12-30}
- Age:
 - The majority of children were aged less than five years, where age was given
- No study addressed disabled children
- Accidental frenal injury was explored in a case²²
- One study included comparative data²³

Influence of ethnicity and socio-economic group

- Only one study specifically noted that ‘coloured children’ were disproportionately represented¹²
- No population figures were given by this study¹²
- A further study noted that the ethnicity was representative of the local population²³

1.1. Abusive torn frenum

Comparative studies of torn frenum

- A prospective study of all children less than 3 years examined within 24 hours of intubation noted that only 1/105 children sustained an oral injury as a consequence of intubation (broken tooth), and torn frena were only observed in 3/14 abused children²³
- One child had a lower frenum tear with associated lip abrasion

- Another child had an upper frenum tear with associated swelling to the lips, bruising to the tongue, blood on the teeth, multiple human bites and eyelid bruising
- The third child had a healed frenum scar with associated bruising to the lip, cigarette burns and subconjunctival haemorrhage
- 2/3 children had associated fractures
- These children were aged, 5, 17 and 21 months

Non-comparative studies of abusive torn frenum

- 15 studies addressed abusive torn frenum^{6,12-14,16-21,24,26-29}
- Included data on 35 children with an abusive torn frenum
- Approximately 90% were fatally abused (where details given)
- Age: 30 aged 5 years old or less where details are given
- 0-10 years for 5 children²⁷
- 13 children had associated head injury^{13,14,16-21,24,26}
- Nine children had fatal head injury^{13,17,19,20,26,28,29}
- Five children had fatal abdominal injuries²⁷
- One fatality had coexistent ano-genital sexual abuse with multiple fractures²¹
- Torn frenum was first recorded as an abusive injury in 1966¹²
- Two infants (aged six weeks and three months respectively) presented with an unexplained torn frenum and no thorough investigation; they re-presented within three weeks with multiple severe injuries⁶

Mechanism of abusive torn frenum:

- The only mechanism of injury recorded in the literature was a direct blow to the mouth, although no precise mechanism was recorded for the majority of the cases^{6,29}

1.2. Accidental torn frenum

Comparative studies of torn frenum

- One comparative study of 105 children aged less than 3 years examined within 24 hours of intubation did not demonstrate any non-abusive torn frenum²²

Non-comparative accidental torn frenum studies

- Four single case studies were conducted, representing four children^{15,25,27,30}
- Two cases occurred as a consequence of intubation; one child aged six months, the other 0-10 years^{15,27}

- 3.5 year old child fatally injured by an air bag; injuries included torn labial frenum, multiple fractures and intracranial haemorrhages²⁵
- year old fell from his bike with intrusion of central upper incisor and torn upper labial frenum; lip injury completely healed within 1 week³⁰
- A study of 324 children aged 0-10 years undergoing resuscitation and dying of natural causes found a single case of torn labial frenum occurred as a consequence of CPR (noted as absent at onset of CPR, confirmed at autopsy²⁷

1.3. Implications for practice

An injury must never be interpreted in isolation and must always be assessed in the context of medical and social history, developmental stage, explanation given, full clinical examination and relevant investigations. Any unexplained injury that causes concern in a child should be investigated as appropriate:

- Any unexplained torn labial frenum should be fully investigated to exclude the presence of other occult injuries
- There is inadequate evidence to support the view that torn labial frenum is pathognomonic of child abuse, if after a full investigation no occult injuries or social concerns are present in addition to the torn frenum
- Where age is given, the majority of children are less than five years old
- The limited comparative data means that a probability of abuse for torn labial frenum cannot be estimated
- An accidental torn frenum should be a memorable injury for parents, as there is likely to be considerable bloody saliva from the child's mouth following the injury
- Accidental causes of torn frenum include falls or an accidental blow to the mouth

1.4. Research implications

Further research is needed:

- Prospective comparative studies of torn labial frenum in children, due to abuse or other causes
- Epidemiologic studies of torn frenum in children aged less than five years, including mechanism of injury and co-existent injuries

1.5. Limitations of review findings

- Extremely limited numbers of children represented, and only a single comparative study
- Uncertainty as to frequency of oral examinations performed in child abuse cases

- Possible under-recording of non-abusive torn frenum due to its trivial nature in dental terms
- Lack of epidemiological data on non-abusive torn frenum
- No evidence to support any abusive mechanism of injury other than a direct blow

Findings of clinical question 2

What other intra-oral injuries are caused by physical abuse to children?

We aim to document other intra-oral injuries found in physical abuse, as well as their relative frequency. For the purposes of this review, ‘intra-oral’ was defined as between the vermilion borders of the mouth. We did not deal with injuries due to sexual abuse, burns or dental neglect since these will be addressed in separate reviews.

- Of 171 studies reviewed (four foreign language articles), 17 studies addressed this question^{1,18,23,24,26,28,29,31-40}
- Confirmation of abuse was high; in 12/17 studies the ranking of abuse was 1 or 2
- Age (where provided):
 - Less than two years^{18,24,29,31,33,34,36,39,40}
 - Less than five years^{23,28,29,35,38,40}
 - Less than 15 years^{24,26,28,32,37}
- No study addressed disabled children

Influence of ethnicity and socio-economic group

- One study addressing this observed no difference in ethnicity to that of the reference population²³

Intra-oral injuries recorded in physically abused children

Comparative studies

- One study examining 105 children aged less than 3 years within 24 hours of intubation demonstrated one broken tooth secondary to intubation, one hard palate injury secondary to foreign body insertion, and 8/14 abused children with oral injuries²³
- 6 children sustained lip injuries including swelling, petechiae, bruising or lacerations
- 3 included injury to the tongue, with erythema, laceration and a bite mark
- 3 had torn frena
- All of the above children had coexistent injuries including fractures, intracranial injury, burns, bruises, bites or eye injuries

Non-comparative studies

Details of injuries found (where enumerated) include:

- The commonest recorded injury was laceration or bruising to the lip^{1,18,24,26,28,29,32-40}
- The remaining injuries included^{1,18,24,26,28,29,32-40}:
 - Mucosal lacerations
 - Dental trauma (including fractures, intrusion and forced extraction)
 - Tongue injuries including an adult bite
 - Gingival lesions
- No characteristics of these lesions were specific to an abusive aetiology

Lingual frenum laceration:

- 3 month old twins with oral bleeding and lacerated lingual frena as a consequence of forceful insertion of fingers into mouth³³
- Co-existent fractures and faltering growth in both twins³³
- First recording of abusive oral injuries in multiple births³³

Two bizarre case reports of unusual injuries to the mouth include:

- An adult biting the tongue of a 10 month old infant, associated injuries included multiple fractures, bruises, lacerations and an intracranial injury³⁴
- The parents extracting their own children's teeth, including their permanent dentition, as a form of punishment³²

A further case report of an unusual injury to the mouth:

- Dummy obstructing airway, forced removal by parents causing laceration of soft palate and pneumothorax³¹

Presentation with oral bleeding:

- In four studies oral bleeding was a presenting symptom^{24,33,39,40}

2.1. Implications for practice

- Oral cavity must be examined in all cases of suspected physical abuse
- Paediatricians should be aware of features of primary and secondary dentition, and the likely ages at which they are present
- If any abnormalities are found, seek dental opinion
- Anywhere in the oral cavity can be injured abusively
- The lips are the commonest recorded site of abusive injury (not torn frenum) although it is not always clear how often the oral cavity was examined

2.2. Research implications

Further research is needed:

- Further prospective comparative studies of intra-oral injuries in abused / non-abused children with researchers trained to recognise oral and dental injuries and detailing co-existent injuries and mechanism of injury

2.3. Limitations of review findings

- Possible underestimate of intra-oral injuries due to uncertainty as to how many oral examinations were conducted
- Subtle signs of dental injury may be missed by paediatricians

Other useful resources

Clinical question 1

- Be aware of congenital abnormalities of the labial frenum which may be mistaken for a tear⁴¹⁻⁴³
- One study recorded the distribution of various types of maxillary labial frenum attachment⁴⁴
- Twisting and pulling the child's lip to cause torn frenum was noted in a single case. This study did not meet our inclusion criteria¹¹
- Comprehensive guidance for dentists and dental hygienists relating to safeguarding children is available online

Clinical question 2

- Are dentists referring suspected physical abuse cases? Surveys suggest only 8-18% of suspected abuse cases are referred by dentists^{1,45}
- Dental neglect frequently co-exists with oral abuse⁴⁶
- Injury to alveolar margin and mucosa with later oesophageal atresia⁴⁷
- UK guidance on child protection referrals for dental practitioners⁴⁸
- Dental trauma included dental fractures leading to discolouration of teeth and / or inappropriately missing teeth⁴⁹
- Discolouration may occur with dentinogenesis imperfecta⁴⁹ Hypopharyngeal and proximal esophageal rupture with abscess formation⁵⁰
- Although following the original review we are no longer including single case reports, a recent case study has demonstrated supratonsillar lacerations and scattered facial petechiae in an 11 month old infant⁵¹

Traditional treatment

- Ebinyo – Infant oral mutilation involving extirpation of primary canine tooth follicles for perceived medical benefits in certain African tribes^{8,52}

Accidental oral injuries

- 30% of children aged one to six years sustain dental trauma, the peak age being three years⁵³⁻⁵⁶
- Dental trauma is more frequent in boys than girls⁵³⁻⁵⁶
- The commonest accidental injury is laceration to lips and mucosa⁵³⁻⁵⁶
- Dental injuries are more common in⁵⁶:
 - the lower socio-economic group
 - obese children
 - areas of poor dental care provision (Brazil)
- The infants of mothers with more than eight years' education sustained more dental injuries during the first year of life⁵³

Sentinel injuries

- A large scale case-control study identified that 11% of children later found to be abused had a previous intra-oral injury which was not acted upon⁷

Related publications

Publication arising from oral injuries review:

- Maguire SA, Hunter B, Hunter LM, Sibert J, Mann MK, Kemp AM. Diagnosing abuse: A systematic review of torn frenum and intra-oral injuries. *Archives of Disease in Childhood*. 2007;92(12):1113-1117. Erratum in *Archives of Disease in Childhood*. 2008;93(5):453.
- Comment on oral injuries publication: Welbury R. Torn labial frenum in isolation not pathognomonic of physical abuse. *Evidence-based Dentistry*. 2007;8(3):71

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Appendix 1 – Methodology

We performed an all-language literature search of original articles, their references and conference abstracts published since 1950. The initial search strategy was developed across OVID Medline databases using keywords and Medical Subject Headings (MeSH headings) and was modified appropriately to search the remaining bibliographic databases. The search sensitivity was augmented by the use of a range of supplementary ‘snowballing’ techniques including consultation with subject experts and relevant organisations, and hand searching selected websites, non-indexed journals and the references of all full-text articles.

Standardised data extraction and critical appraisal forms were based on criteria defined by the National Health Service’s Centre for Reviews and Dissemination⁵⁷. We also used a selection of systematic review advisory articles to develop our critical appraisal forms⁵⁸⁻⁶². Articles were independently reviewed by two reviewers. A third review was undertaken to resolve disagreement between the initial reviewers when determining either the evidence type of the article or whether the study met the inclusion criteria. Decisions related to inclusion and exclusion criteria were guided by Cardiff Child Protection Systematic Reviews, who laid out the basic parameters for selecting the studies.

Our panel of reviewers included paediatricians, paediatric dentists, designated and named doctors and specialist nurses in child protection. All reviewers underwent standardised critical appraisal training, based on the Centre for Reviews and Dissemination (CRD) critical appraisal standards 3, and this was supported by a dedicated electronic critical appraisal module.

Inclusion criteria

Inclusion	Exclusion
Articles of all evidence types	Personal practice
English and non-English articles	Review articles
Patients between 0-17 years of age	Studies where the population included adults and children but where we could not extract data that applied solely to children
Oral injury defined as the vermilion border of the lips to the hypopharynx	Single case reports of abusive torn frenum or intra-oral injury (from 2008)
Abusive oral injury	Methodologically flawed papers
Torn labial frenum of any aetiology	Rank of abuse 4 (only rank 5 pre-2008)
	Dental neglect
	Oral injury due to sexual abuse or intentional thermal injury

Complications or outcome of abusive oral injury

Ranking of abuse

Distinguishing abuse from non-abuse is central to our review questions. As our reviews span more than 40 years, standards for defining abuse have changed markedly. We have devised the following ranking score where “1” indicates the highest level of confidence that abuse has taken place. These rankings are used throughout our systematic reviews (where appropriate).

Ranking	Criteria used to define abuse
1	Abuse confirmed at case conference or civil or criminal court proceedings or admitted by perpetrator
2	Abuse confirmed by stated criteria including multidisciplinary assessment
3	Abuse defined by stated criteria
4	Abuse stated but no supporting detail given
5	Suspected abuse

Ranking	Criteria used to define accident
A1	Independently witnessed accidental cause <i>or</i> forensic recreation of scene
A2	By confirmation of organic disease (diagnostic test and / or diagnosis from clinical profile)
B1	By multi-disciplinary assessment and child protection clinical investigation
B2	Consistent account of accident by the same individual over time
B3	By checking either the child abuse register or records of previous abuse
C1	Accidental cause / organic diagnosis stated but no detail given
C2	No attempt made to exclude abuse / no detail given

Ranking of evidence by study type	
T ₁	Randomised controlled trial (RCT)
T ₂	Controlled trial (CT)
T ₃	Controlled before-and-after intervention study (CBA)
O ₁	Cohort study / longitudinal study

O ₂	Case-control study
O ₃	Cross-sectional
O ₄	Study using qualitative methods only
O ₅	Case series
O ₆	Case study
X	Formal consensus or other professional (expert) opinion (automatic exclusion)

Definition of levels of evidence and grading practice recommendations (This classification is based on the Bandolier system adapted to include the Centre for Reviews and Dissemination's Criteria).

Grade	Level	Type of evidence
A	Ia	Evidence obtained from a well designed randomised controlled trial of appropriate size (T1)
B	Ib	Evidence obtained from a well designed controlled trial without randomisation (T2, T3)
B	IIa	Evidence obtained from a well designed controlled observational study e.g. cohort, case-control or cross-sectional studies. (Also include studies using purely qualitative methods) (O1, O2)
C	IIb	Evidence obtained from a well designed uncontrolled observational study (O3, O4)
C	III	Evidence obtained from studies that are case series or case studies (O5, O6)

Search strategy

The below table presents the search terms used in the 2014 Medline database search for all injuries and bites, truncation and wildcard characters were adapted to the different databases where necessary.

Oral injuries search strategy:	Bites search strategy:
1 Child/	1. Child/
2 (child: or toddler: or baby or infant:).mp.	2 (toddler: or baby or infant: child: or babies).mp.
3 1 or 2	3 (paediatric population or pediatric population).mp.
4 non-accidental injur:.mp.	4 or/1-3
5 dental trauma.mp.	5 exp child abuse/

6 nonaccidental injur:.mp.	6 (battered child or shaken baby or battered baby).mp.
7 (non-accidental: and injur:).mp.	7 child maltreatment.mp.
8 nonaccidental trauma.mp.	8 child protection.mp.
9 soft tissue injur:.mp.	9 Child abuse.mp.
10 (abusive trauma or physical abuse).mp.	10 or/5-9
11 (or/4-10) and 3	11 non-accidental injur:.mp.
12 (child abuse or child protection or child maltreatment).mp.	12 physical abuse.mp.
13 exp child abuse/	13 (non-accidental: and injur:).mp.
14 exp Shaken Baby Syndrome/	14 soft tissue injur:.mp.
15 exp Battered Baby Syndrome/	15 dental trauma.mp.
16 (battered child or shaken baby or battered baby).mp.	16 dental injur:.mp.
17 (child adj3 maltreatment).mp.	17 oral trauma.mp.
18 (child adj3 physical abuse).mp.	18 (or/11-17) and 4
19 or/12-18	19 10 or 18
20 11 or 19	20 Tooth Injuries/
21 Accidents/	21 (tooth or teeth).mp.
22 accident:.mp.	22 animal bite:.mp.
23 (21 or 22) and 3	23 human bite:.mp.
24 dental trauma.mp.	24 (adult bite or bitemark).mp.
25 facial injur:.mp.	25 (bite or bites).mp.
26 (oral or dental injur:).mp.	26 Bites, Human/
27 Incisor/in [Injuries]	27 odontology.mp.
28 ((intraoral or oral or dental) adj3 (abrasion: or lesion: or laceration:)).mp.	28 elliptical mark.mp.
29 (frenum or frenum or Frenulum).mp.	29 (Avulsion adj3 injur:).mp.
30 (torn lingual frenu* or torn labial frenu:).mp.	30 avulsion injur:.mp.
31 lingual frenum/	31 ((intraoral or oral or dental) adj3 (abrasion: or lesion: or laceration:)).mp.
32 (lingual frenum or frenum).mp.	32 (bite: adj5 injury).mp.
33 (labial frenum or frenum).mp.	33 (puncture adj5 bite).mp.
34 (torn adj3 frenum).mp.	34 (Forensic Dentistry or pathology).mp.
	35 exp Forensic Dentistry/

35 (torn adj3 freanum).mp.	36 **Bites"/ and "Stings"/di [Diagnosis]
36 (torn lingual or torn labial).mp.	37 Tooth Fractures/ or Tooth Avulsion/
37 alveol:.mp.	38 or/20-37
38 avulsed teeth.mp.	39 exp Photography, Dental/
39 avulsion injur:.mp.	40 (photography adj5 imag*).mp.
40 (intraoral adj3 burn:).mp.	41 (identi* adj3 forensic).mp.
41 (intraoral adj3 lesion:).mp.	42 (forensic adj3 photo*).mp.
42 lip scars.mp.	43 (forensic adj3 imag*).mp.
43 (lip or lips).mp.	44 forensic imag*.mp.
44 (scars adj3 lip).mp.	45 forensic identification.mp.
45 vermilion border.mp.	46 Image Processing, Computer-Assisted/
46 (jaw or tongue).mp.	47 or/39-46
47 floor of mouth.mp.	48 19 and 38 and 47
48 lateral luxation.mp.	49 limit 48 to yr="2013-Current"
49 subluxated tooth.mp.	
50 (((Crown adj3 fracture) or root) adj3 fracture).mp.	
51 dental traumatology.mp.	
52 oral traumatology.mp.	
53 gingival contusion.mp.	
54 gingival tear.mp.	
55 gingival bruise.mp.	
56 (articulation or disarticulation).mp.	
57 (Occlusion or malocclusion).mp.	
58 (torn fraenum or frenum).mp.	
59 (gingivae or gingival laceration:).mp.	
60 (Periodontal injury or gingival injury).mp.	
61 (Alveolar injury or alveolar fracture).mp.	
62 (Crown fract: or root fract:).mp.	
63 (Luxation or luxated tooth).mp.	
64 (displaced tooth or intruded tooth or extruded tooth or avulsed tooth).mp.	

65	(intrusion injury or extrusion injury).mp.
66	(phrenum or phreanum or phraena).mp.
67	Maxillofacial Injuries/
68	Facial Injuries/
69	(oro-dental injur: or oro-facial injur:).mp.
70	tooth injur:.mp.
71	Tooth Fractures/
72	Tooth Avulsion/
73	Oral Hemorrhage/
74	dental Trauma*.mp.
75	(oral adj3 (bleed* or trauma or contusion or bruise or tear)).mp.
76	(gingiva* adj3 (bleed* or trauma or contusion or bruise or tear)).mp.
77	Labial Frenum/
78	Lingual Frenum/
79	or/24-78
80	20 and 79
81	23 and 79
82	80 or 81
83	Child Abuse, Sexual/
84	sexual abuse.mp.
85	“Review”/
86	(rat:or mouse or mice or hamster: or animal: or dog: or cat: or rabbit: or bovine or sheep).mp.
87	Animals/
88	animal stud\$.mp.
89	or/83-87
90	82 not 89
91	limit 90 to yr="2013 -Current"

Fourteen databases were searched together with hand searching of particular journals and websites. A complete list of the resources searched can be found below.

Databases	Time period searched
ASSIA (Applied Social Sciences Index and Abstracts)	1987 – 2014
Child Data	1958 – 2009 [†]
CINAHL (<i>Cumulative Index to Nursing and Allied Health Literature</i>)	1982 – 2014
Cochrane Central Register of Controlled Trials	1996 – 2014
EMBASE	1980 – 2014
MEDLINE	1950 – 2014
MEDLINE In-Process and Other Non-Indexed Citations	1951 – 2014
Open SIGLE (System for Information on Grey Literature in Europe)	1980 – 2005 [*]
Pubmed E publications (Epub ahead of print)	2014
Scopus	2009 – 2014
Social Care online (previously Caredata)	1970 – 2014
Trip Plus	1997 – 2005 [†]
Web of Knowledge – ISI Proceedings	1990 – 2014
Web of Knowledge – ISI Science Citation Index	1981 – 2014
Web of Knowledge – ISI Social Science Citation Index	1981 – 2014
[*] ceased indexing [†] institutional access terminated [‡] no yield so ceased searching	
Journals 'hand searched'	Time period searched
Child Abuse and Neglect	1977 – 2014
Child Abuse Review	1992 – 2014
Websites searched	Date accessed
Child Welfare Information Gateway (formerly National Clearinghouse on Child Abuse and Neglect)	10 June 2014

Pre-review screening and critical appraisal

Papers found in the database and hand searches underwent three rounds of screening before they were included in this update. The first round was a title screen where papers that obviously did not meet the inclusion criteria were excluded. The second was an abstract screen where papers that did not meet the inclusion criteria based on the information provided in the abstract were excluded. In this round the pre-review screening form was completed for each paper. These first two stages were carried out by clinical experts. Finally a full text screen with a critical appraisal was carried out by members of the clinical expert sub-committee. Critical appraisal forms were completed for each of the papers reviewed at this stage. Examples of the pre-review screening and critical appraisal forms used in previous reviews are available on request (clinical.standards@rcpch.ac.uk).