

Non-accidental head and neck injuries in children and adolescents

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The authors declare that they have no conflict of interest.

KEYWORDS

Child abuse,
Child malpractice,
Forensic odontology,
Head and neck,
Non-accidental injuries

J Forensic Odontostomatol
2022. Apr;(40): 1-42:52
ISSN :2219-6749

ABSTRACT

Child abuse or maltreatment has been a global problem and research shows that more than half of the cases present with head and neck injuries. This study aimed to propose an online referencing platform for dental professionals to know more about signs of child abuse and neglect (CAN) and how suspicious head and neck injuries might look like in real-life scenarios by proposing a 3D design.

The study was divided into two parts: i) Integrative literature review, ii) Survey. The first part included an integrative literature review to check if there are enough publications by dentists containing real-life images of injuries related to CAN. Using appropriate keywords and searching across four well-known databases 264 publications relevant to CAN were found, of which, only 3 contained real-life images.

Part II of the study included a JISC online survey, consisting of two sections, amongst general dentists, pediatric and forensic dentists. The first section of the survey was about the basic knowledge related to CAN management. A total of 61 dentists from 10 different countries filled the survey, of which 83.1% had seen common head and neck injuries involved in CAN, 61% knew about the dentist's role in reporting such cases, and 66.1% were familiar with local law enforcements to contact. The second section of the survey involved going through real-life scenarios to check the participants understanding of how to tackle a real-life case concluding that only 4/10 participants managed to figure the aspects vital to check before reporting such cases which include a proper detailed history, any previous injuries and their stage of progression, clinical examination of injuries and finally whether the injuries are consistent with the history given.

To conclude, there is insufficient representation of the real-life head and neck injuries for dentists to see related to child abuse. Also, all specialists agreed that they require further training regarding CAN management with real-life examples. To address this, a 3d model of commonly seen head and neck injuries in CAN along with some other tools, was created for training and educational purposes and was embedded in a website <https://3datlasofchildabuse.webflow.io/>.

INTRODUCTION

Child abuse or maltreatment has been a global problem. In the past, it was noticed that the suspects in most child abuse cases are either parents or other caregivers.¹ There are various reasons which increase the risk of child abuse in a household, these include early age parenting, parents who themselves have been victims of abuse in the past, family problems (which might include divorce, remarriage, single parent), mental disorders, repeated pregnancies, unwanted child, poor education and handicapped children.²

According to a record-based analysis done in a children's hospital in Cape Town, South Africa over a span of five years (1992-1996), it was concluded that toddlers were at most risk, and also that intraoral injuries were not quite reported due to examination by medical examiners having insufficient knowledge about intraoral conditions. Based on that, the authors believe that dentists should be consulted for advice on suspicious cases of child abuse and neglect.³ In 2002, many child deaths happened as a result of this issue and a majority of children were targets of bullying and harassment.⁴ Such acts can happen at any place including schools, offices, streets, orphanages, care facilities, etc.¹ The majority of these CAN cases involve injuries in the head and neck region.^{1, 5} A research carried out in 2005 by the dental faculty of the University of Glasgow concluded that out of the total 309 cases of child abuse, 59% of the cases reported injuries in the head and neck region.⁶ According to another research study, 50% of child abuse cases involved injuries in the head and neck region.^{7, 8} Further research stated that out of 4623 cases of trauma admission, 60% had head injuries with a greater risk of leading to death, and 14% were less threatening facial injuries.⁹ Often, children who undergo such type of abuse are more prone to denial of dental treatment due to fear of any further leads.¹⁰ According to a study in Japan, since a great percentage of abuse cases involved facial injuries, it was suggested that dentists should be added to the team of child abuse protection in various hospitals.¹¹ Dentists have a responsibility to report them if recognized.¹²

In the current scenario, keeping in mind the global pandemic (Covid-19), the experts believe that the decrease in the number of reported cases of child abuse may have been due to a decrease in

the number of consultations, whereas the actual count could be much more. This can be said for the families which were more abusive before the pandemic. Therefore, during the pandemic, a rise was seen in the suspected cases of child abuse and neglect.¹³ Another study found that the number of child abuse cases with major head and neck injuries in the UK during the first month of lockdown, i.e, 23rd March 2020 to 23rd April 2020, has increased quite a lot. Whereas, those with less pronounced injuries might be more.¹⁴

Dentists should be obliged to identify and report cases that show signs of child abuse and neglect.^{2, 15} The dentists carry an important role as they are concerned with the head and neck region.¹⁵ According to a report published by the American academy of pediatrics, it is mandatory for healthcare providers across America to report child abuse and neglect cases to the concerned authorities.¹⁶ A more recent review of 51 jurisdictions across the United State of America concluded that all of them had laws related to dental neglect in children, and dentists who report such cases were protected by law, those who failed to report were sanctioned according to the respective jurisdiction.¹⁷ A literature review of articles related to domestic violence against children concluded that more training is required in this area of dentistry, i.e, forensics, which includes reporting of such cases.¹⁸ Since forensic odontology deals with more legal and criminal aspects of dentistry,¹⁹ the specialists should be sufficiently trained in managing cases of child abuse. Previous research confirms that there is a scarcity of both literature and training on the concerned topic,^{1, 4} therefore, more specific training including more realistic approaches along with the addition of child abuse and its management in the curriculum of undergraduate dental courses is required.

To address the above-stated issues, this study aimed to investigate the knowledge of various dentists and forensic dentists about child abuse case management, and based on the findings, provided a solution to the problem.

MATERIAL AND METHODS

This study has been approved by the University of Dundee Schools of Health Sciences and

Dentistry Research Ethics Committee under reference number UOD-SHS-SDEN-TPG-2020-026.

In order to address the aims of this study, the methodology was divided into two sections: an integrative literature review (part I) to investigate the availability of publications containing good-quality images of head and neck injuries in cases of child abuse and neglect and a survey (part II) to understand the knowledge and perspective of various dentists concerning child abuse and neglect, respectively:

Part I: Integrative Literature Review

A Boolean search technique was used with the following search criterion; (*Dentistry OR Odontology OR dental OR dentist*) AND (*Child abuse OR child neglect OR Child maltreatment OR non-accidental injuries*) AND (*Head OR Neck*). The databases used included Scopus, Latin American and Caribbean Health Sciences Literature (LILACS), Web of Science, and PubMed. Inclusion criteria for this review included: a) open-source scientific articles published by dentists; b) papers containing good quality images of head and neck injuries related to child abuse; c) scientific papers published from January 1990 till March 2021. Whereas the exclusion criteria included: a) open-source scientific articles not published by dentists; b) papers with no images of head and neck injuries related to child abuse. The Preferred Reporting Items for Systematic reviews and Meta-analyses (PRISMA) guidelines were used for this review (20). The publications selected were then critically analyzed for various parameters for image analysis which included the following: a) the type of image used for publication, whether it was colored or black and white? b) is the image used digital or analog? c) does the publication include a close-up image of the injury or a full-body image of the victim? d) does the publication contain images of intra-oral or extra-oral injury?

Part II: Survey

A survey was designed using Joint Information Systems Committee (JISC) Online Surveys, version 2021, consisting of two sections: first consisting of 1 open-ended and 4 mixed type questions, whereas the second section consisting of 7 open-ended questions.

The first section consisted of questions about the qualification, demographics, and experience with child abuse and neglect cases of the participant. Furthermore, there were questions about law enforcement in their respective locality to refer such cases to and aimed to understand the background knowledge of the participant and his/her experience (if any) regarding cases of child abuse and/or neglect.

The second section consisted of six different clinical scenario-based open-ended questions where the participants were asked whether such scenarios would raise suspicion of a possible child abuse/neglect case. Case scenario 1: a false history given by an accompanying parent/guardian commonly seen in cases of child physical abuse; Case scenario 2: a possible case of child abuse in form of bite marks; Case scenario 3: a possible case of child dental neglect; Case scenario 4: a child sexual abuse where parents/guardian's history is not consistent with the injuries; and case scenario 5 and 6: knowledge on referring a case to law enforcement authorities. An additional open-ended question was added to know whether the participant would like further training on head and neck injuries in child abuse/neglect cases, and if so, what means of training they would prefer.

The above-mentioned survey was launched from 26th March 2021 till 16th April 2021. An online public link for the survey was sent to official emails of Forensic odontologists from the British association of forensic odontology (BAFO) (n = 30), the American Board of forensic odontology (ABFO) (n = 81), International Organization for Forensic Odonto-Stomatology (IOFOS) (n = 59), Brazilian Association of Forensic Odontology (ABOL) (n = 50 of which 40 were Forensic odontologists while the rest were Pediatric Dentists), and the alumni of University of Dundee (n = 34). Furthermore, it also included dentists from Rehman College of Dentistry (RCD), Peshawar, Pakistan (n = 69). The email addresses of all participants were taken from websites of the respective organizations. All participants were given three weeks to fill the survey. Inclusion and exclusion criteria were summarized in table 1 below.

Table 1. inclusion/exclusion criteria

Inclusion criteria	Exclusion criteria
Forensic odontologists – Diploma, Workshop, Masters, Post Doctorate	Current postgraduate students enrolled in forensic odontology courses
General Dentists – Any other specialty except forensic odontologist and pediatric dentists	Undergraduate students
Pediatric dentists – Diploma, Workshop, Masters or Post Doctorate	

RESULTS

Part I: Integrative literature review

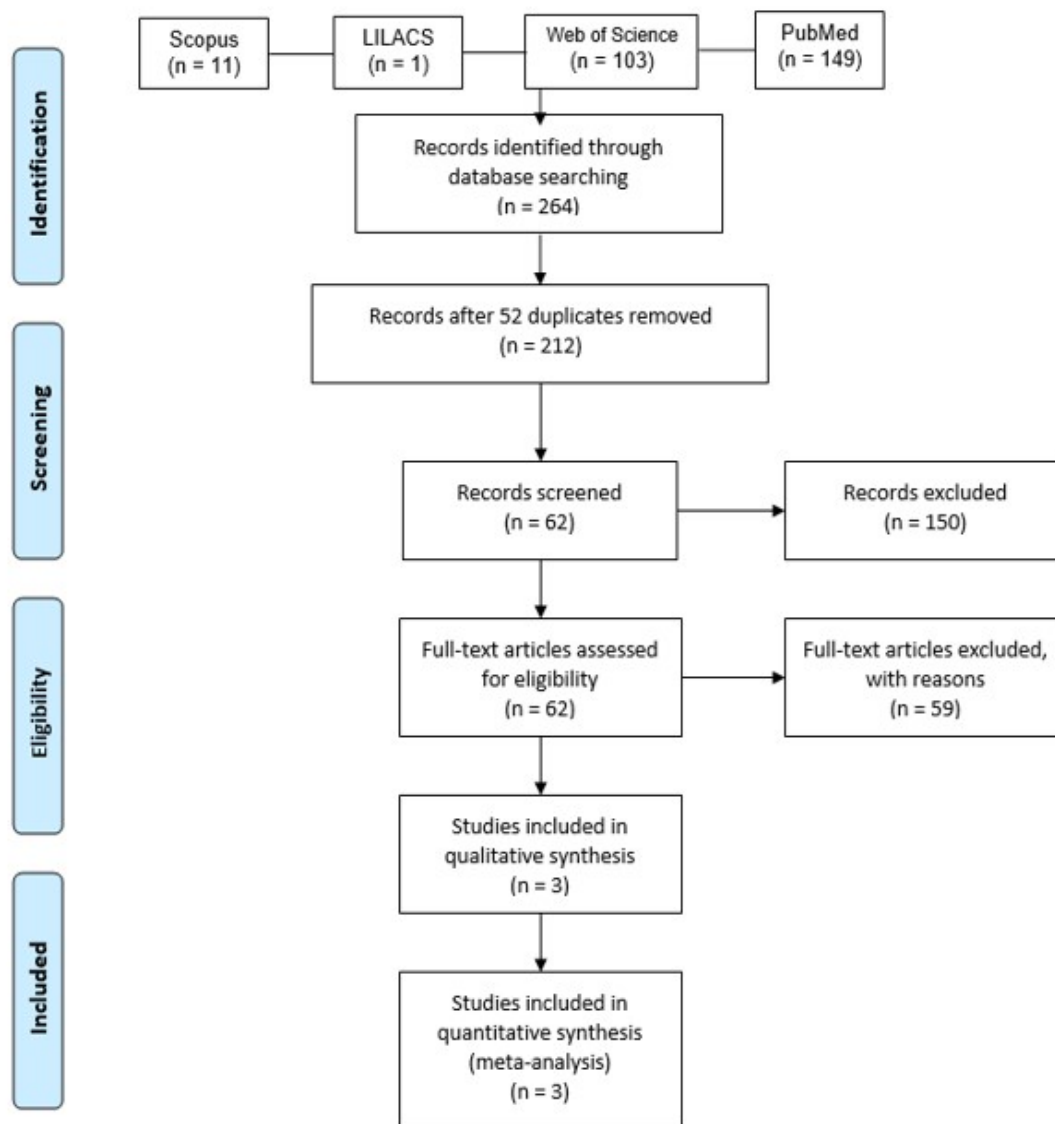
A total of 264 publications were found: LILACS (n=11); Scopus (n=11); Web of Science (n=103); PubMed (n=149); EndNote software was used to search for duplications, only 52 were detected, hence, reducing the total number to 212

publications. The results were further scrutinized based on the inclusion and exclusion criteria and as a result, only 3 publications were found, as shown in table 2 below, published by dental professionals containing real-life images of head and neck injuries in child abuse cases. All the findings are summarized using a PRISMA flow diagram in figure 1.

Table 2. Analysis on literature review findings

Publications	Year	Journal	Author	Black/White or colored	Digital/Analog?	Close-up or full body	intra or extra-oral
Dental Treatment Abuse	2014	Journal of clinical and diagnostic research	Paul Chalakkal	Colored	Digital	All close-up intra-oral images	Both
Dentist attitudes and responsibilities concerning child sexual abuse. A review and a case report	2015	Journal of clinical and experimental dentistry	Arturo Garrucho-Rangel	Black and White	Digital	All close-up intra-oral images	Intra-oral
Forensic odontology, part 5. Child abuse issues	2011	British dental journal	Judy Hinchliffe	Colored	Digital	All close-up images of injuries	Extra-oral

Figure 1. Prisma flow diagram



Part II: Survey

The survey link was forwarded to a total of 323 participants. The sample size calculated using an online open-source sample size calculator keeping confidence level 90% with a 10% margin of error for the total participants (n = 323) came out to be n = 56. The survey was filled by 61 participants which contribute to a total response rate of 18.89%. Out of the total sample, the distribution was as follows, general dentists (n = 23, 38.33 %), Pediatric dentists (n = 3, 5%) and Forensic odontologists (n = 34, 56.67%). A country-wise distribution revealed that the participants were from countries including United Kingdom (n = 8), Brazil (n = 22), Pakistan (n = 10), United states of America (n = 7), Malaysia (n = 3), Netherlands (n =

2), India (n = 2), Italy (n = 1), Canada (n = 1) and Spain (n = 1).

83.1% of the participants agreed to have sufficient knowledge of the injuries commonly seen in cases of child abuse and neglect, of which, 45.8% had never assessed a case of child abuse before and only had theoretical knowledge. 15.3% of the participants were unaware of various forms of injuries, whereas 1.7% stated that they do not do child abuse cases in their respective countries of practice. 61% of the participants were confident they knew how to manage cases of suspected child abuse and provided their share of knowledge, whereas 10.2% had no knowledge and 28.8% were not sure how to manage such cases. Further on, participants were asked if they knew

of the respective law enforcement in their country to contact in case, they encounter a suspected case of child abuse, and 66.1% said Yes and provided details of the law enforcement agency, whereas 11.9% said No and the remaining 22% were not sure about any law enforcement agencies in their country.

When tested through fictitious scenarios, most of the participants (90%) were confident they could decide on basis of the type of injuries whether a case should be reported or not. The participants' focus was mainly on the type of injuries in

question, and they overlooked the fact that in some scenarios, the subject was either a continuing patient (the practice would have had a previous clinical record available) or the injuries were inconsistent with the history being given. The participants wanted to know more about specific details of the injuries such as images and dimensions ignoring the crucial signs which would have helped in differentiating the nature of the injury and perhaps a better diagnosis. The findings from the scenarios are summarized in table 3.

Table 3. Scenario findings

S.No	Scenario	General Dentists	Pediatric Dentists	Forensic Dentists
1	A 10-year-old male patient presents a facial swelling on the right side (as a new patient) and also exhibits various bruises in progressive stages of healing on the right side of his neck. It was tender to touch, and after radiographic examination, you diagnosed a fracture of the mandibular body. The parents claimed that it was due to a fall with an impact on his chin.	None managed to understand the aspects of reporting cases, majority thought it was caused by someone else and they require more information.	None managed to understand the aspects of reporting cases, wanted more information.	Only 4 gave an insight on why it should be reported. The rest wanted more information.
2	A 1.5-year-old female patient was brought to you, on her third visit, presenting multiple round marks on her cheeks. The mother said it happened while the child played with a pencil, and she went to the kitchen for a while.	Wanted more information about injury, 4 provided more specific information. Failed to recognize child neglect.	Wanted more information about the injury. Failed to recognize child neglect.	Wanted more information about the injury, 6 provided more specific information. Failed to recognize child neglect.
3	A 9-year-old girl came to your dental practice (for the first time) accompanied by her mother presenting multiple carious lesions on her anterior teeth. Her mother gave a history of improper diet.	Well equipped with knowledge	Well equipped with knowledge	Well equipped with knowledge
4	A 15-year-old girl came to your practice presenting multiple round bruises with a central hematoma on her neck and a very distinct set of marks with a similar pattern on her left cheek. A linear abrasion mark was also seen on her neck. Her father said she was involved in a local street crime where the perpetrators hit her with the back of the pistol multiple times before they took her belongings and help arrived. What would be your interpretation of the marks?	Focused mainly on bitemark injury, ignored other markers of child abuse.	Focused mainly on bitemark injury, ignored other markers of child abuse.	Focused mainly on bitemark injury, ignored other markers of child abuse. Only 6 managed to identify the markers.

5	An 11-year-old boy came to your department (presenting for the first time) crying continuously and exhibiting severe discomfort. On examination, a hematoma was noted in the left periorbital region and ecchymosis was also noted in the right periorbital region. The parents claimed it originated as a sports injury. What would be your interpretation of the findings?	Wanted to know more about the sport being played, and also thought of a possible physical abuse.	Wanted to know more about the sport being played, and also thought of a possible physical abuse. 2 provided more extensive critique.	Wanted to know more about the sport being played, and also thought of a possible physical abuse. 6 provided more extensive critique.
6	A young female patient aged 11 years old and familiar with the practice presented with multiple crown fractures, an abrasion mark on the left cheek, and a bruise on both upper and lower lips. She is accompanied by her elder sister who claims that she was injured in a road traffic accident. What would be your views and treatment of these features?	Failed to realize patient was familiar to practice. Wanted more information.	Failed to realize patient was familiar to practice. Wanted more information.	Majority failed to realize patient was familiar to practice. Only 4 managed to recognize the age of consent, and the familiarity.

Furthermore, on being asked whether or not the participants would like to attain further training in respect of child abuse case management, 92% of the participants agreed that it is required, whereas only 8% believed they have sufficient knowledge about child abuse case management. The participants who agreed wanted more specific training based on management and reporting of such cases with guidance on the recognition of injuries by using examples and real-life images of injuries that may raise suspicion.

DISCUSSION

Based on the findings of this study, there is a need to spread more awareness and research is required in this field for early detection of child abuse which would be vital in terms of reducing the overall child abuse case count, avoiding death and mental traumas, and perhaps the betterment of our society. As evident from previous research, more knowledge about reporting of such cases is required in almost every country, therefore, research on the importance of dental health professionals in detecting early signs of child abuse and reporting was required.^{4, 16, 21, 22} By examining various studies, it was concluded that a gap exists in this area regarding injuries in the head and neck region in cases of child abuse and neglect, and according to the authors, there was no specific head and neck injury pattern which may contribute to suspicion about child abuse and neglect cases.^{4, 23, 24} This study aims to gather the response of various forensic odontologists,

general dentists, and pediatric dentists to cases of possible child abuse that would help understand whether more awareness and education is required. To help decrease the frequency of child abuse and neglect, establishing more law enforcement and perhaps training professionals on how to identify and report such cases in the future is vital.

The survey in this study was distributed via electronic means, which was mainly due to better reach and ease of access to the participants, also in current times of pandemic, it was difficult to think of a paper-based survey and/or interview-based study. According to the first part of the survey, where the participants were asked about their general knowledge regarding the management of child abuse cases in practice, a significant percentage of participants (n = 49, 83%) mentioned being aware of various forms of injuries commonly seen in cases of child abuse and neglect. The results were in line with previous research conducted regarding similar topics which also concluded that the experts had prior knowledge about child abuse in general, whereas they wanted more specific training on how to proceed when one encounters such a case.^{11, 25-27} Furthermore, it could be seen that although a large majority of the participants (n = 36, 61%) claimed to have had sufficient knowledge about child abuse case management in general, very few managed to identify the markers of child abuse put in the scenario-based questions in the second part of the survey. The

participants wanted to know more about specific details of the injuries such as images and dimensions ignoring the crucial signs which would have helped in differentiating the nature of the injury and perhaps a better diagnosis. These findings were consistent with previous literature which concluded that dental professionals were aware of injuries which may be a caution sign for child abuse or neglect cases.^{25, 28-30}

Apart from that, some signs of child abuse mentioned by W.H.O (World Health Organization) as part of their guidelines for healthcare workers which are related to history taking in suspected cases of child abuse state that the professional should be trained on how to carefully take history keeping in mind the importance of consented history by the victim themselves when they are able to speak and not rely on care-takers history.^{31, 32} Markers used in scenarios were collectively taken from various research publications and textbooks, and included the following commonly seen signs which may arise suspicion; i) false or incomplete history given by the parent or accompanying guardian; ii) injuries at various stages of healing; iii) injuries inconsistent with the history; iv) patients attitude towards dentist/healthcare worker.^{2, 4, 33, 34}

The primary reason for this discrepancy could be the fear of dental professionals to report due to insufficient training in the respective field of expertise.^{26-28, 35} Due to lack of knowledge, dentists often fear not to investigate such cases further, which supports why a majority was unable to identify the actual signs which could link a case to abuse. Dental professionals should also be reminded that they are obligated by law to report cases that arise suspicion of child abuse or neglect as long as their intention is to prevent any further consequence of the crime, they should also be taught that they are protected from prosecution by law for breach in confidentiality for reporting if the intent is to help solve a crime. Apart from fear amongst dental professionals, having no awareness of the importance of history taking in such cases and observation of the physical and mental state of the patient (or victim) is also a shortcoming.^{26, 35} In order to identify abuse, one should be sufficiently trained on how to take a proper detailed and consented history, and what signs to look out for in the patients, both physically and mentally. The various methods of managing a child abuse case

are also mentioned in the W.H.O guidelines for the management of child maltreatment cases.³¹

At the end of the survey, participants expressed their opinions about further training on child abuse case management, the responses were again consistent with the previous research conducted in concluding that more training was required on this topic in specific areas such as how to proceed if one encounters such case in the clinic. This can also be tallied with previous survey-based research which also concluded that dentists desired more specific training on how to report such cases should one encounter them clinically.^{4, 30, 36} Apart from this, some participants (n = 6) also wanted to get more training including real-life scenarios for better understanding, this problem of scarcity of publications and availability of real-life images of head and neck injuries in child abuse cases was also confirmed by the integrative literature review performed as part of this study which resulted in only three publications by dentists containing real-life images of injuries including publications by Chalakkal, P et al, Garrucho-Rangel A et al, and Hinchliffe, J.^{34, 37, 38}

According to previous research, it was also evident that dental professionals require more training in child abuse case management^{12, 33, 35, 39, 40} which could be in the form of real-life examples as participants from the survey stated as the preferred option. There is information about various forms and nature of injuries commonly seen in suspected cases of child abuse and neglect,^{2, 3, 8, 33, 34} but it is rarely accompanied by a pictorial representation of the injuries which might be a reason for difficulties in diagnosing non-accidental injuries amongst professionals. The literature review done as part of this study confirmed the scarcity of pictorial representation of the injuries. For some, learning through visual aids is always better than text solely, such individuals are categorized as visual learners, and with the advancements in technology, we have seen a rise in visual learning, hence, there is a need for a tool that allows visual perspective to the injuries commonly seen in cases of child abuse.

There were certain limitations to the study design as it was conducted during a time of the ongoing pandemic, therefore an online survey was thought to be the best possible option. Portal of invitation for various participants was also via e-mail to all participants and there was limited communication subjected to the response of the

e-mail. These limitations can be overcome by doing a similarly structured study in the future when the scenario related to this current pandemic gets better and there is a resumption of face-to-face learning which will allow a better approach to various dentists and perhaps a better response rate and in turn more specific results.

CONCLUSIONS

This research provides an understanding for dentists to know more about common head and neck injuries in child abuse and neglect cases and to investigate how they might look in realistic situations. According to the qualitative and quantitative analysis of the findings from both the integrative literature review and the survey, it was evident that there is a need for further intervention in the form of training that involves more life-like scenarios to reduce the fear in dentists while reporting cases. They should be told about their rights to report and also that they are exempt from any prosecution for reporting such cases provided it is intended to save a life. The results conclude that although 59% of the dentists are aware of various forms of child abuse and neglect, there is a need for further training using more realistic examples. Additionally, it is essential to increase awareness

on how to report suspected cases of child abuse and neglect as evident by 92% of the participants who opted for further training. From the scenarios in the survey, it can be noted that forensic dentists were more well equipped with knowledge related to reporting such cases and signs of child abuse as compared to the pediatric dentists, but since the number of pediatric dentists in this study is not significant, further research can be done to explore the difference in opinions.

To assist with the current lack of pictorial representation, a website was created (<https://3datlasofchildabuse.webflow.io/>) containing a graphical poster that is suggested for use in clinics and for training purposes which gives a brief account of when, how, and why dentists should report suspected cases of child abuse and neglect. Secondly, in order to focus on the more real-life representation of the head and neck injuries which may commonly be seen by dentists first-hand, a three-dimensional (3D) model is made which constitutes of various injuries, which were confirmed by literature, commonly seen in cases of suspected abuse, and may also be termed as non-accidental injuries, as seen in figure 2 and figure 3 respectively.

Figure 2. Commonly seen extra-oral injuries in child abuse

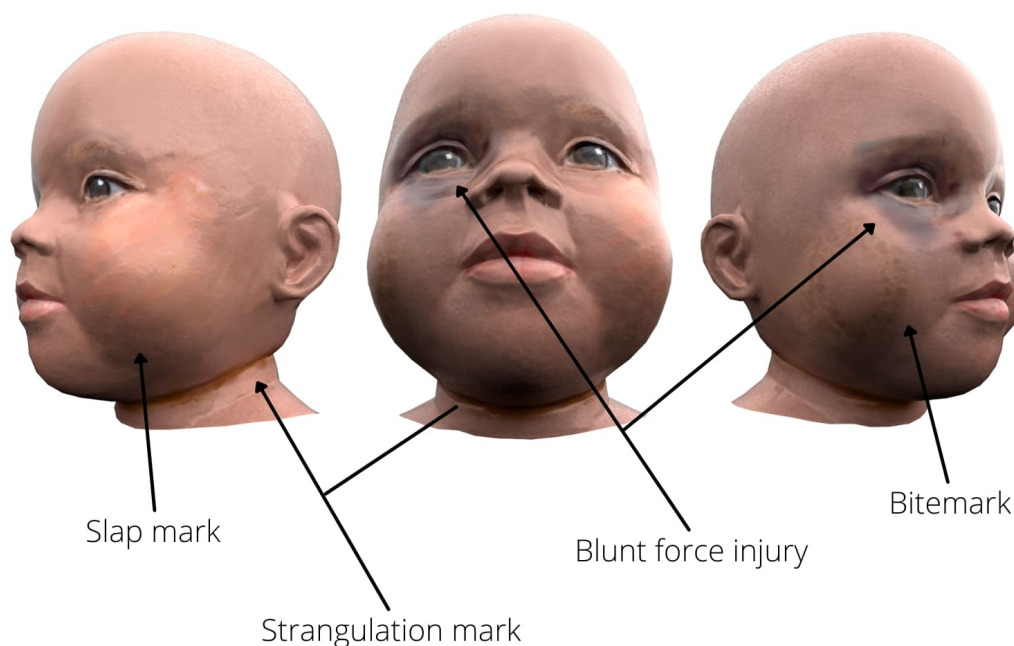
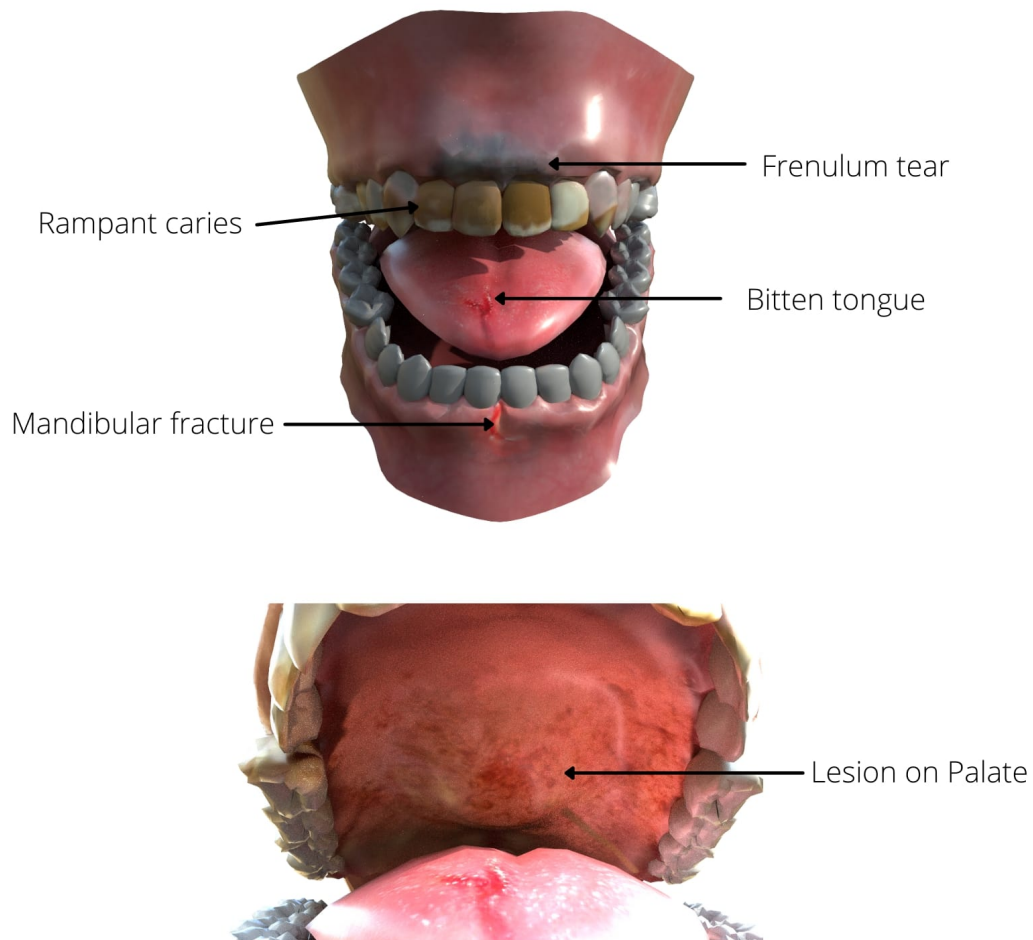


Figure 3. Commonly seen intra-oral injuries in child abuse**Frontal view:**

Although the model represents real-life injuries, it should not be used as the only mean for reporting purpose, but as a source of approximation of injuries to child abuse cases. Reporting of such cases involves a combination of both detailed history and thorough clinical examination, whereas the model only helps in understanding how certain injuries would look in a more realistic setting. These models will be

updated in form of versions to add more features such as being more interactive, representing more injuries and labeling will also be added in the future.

ACKNOWLEDGEMENTS

Special thanks to Mr. Ravi Santosh Krishna for creating the 3d design as part of this study.

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