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Epidemiology of traumatic dental injuries – a 12 year review of the literature

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Abstract – *Background/Aim*: A traumatic dental injury (TDI) is a public dental health problem because of its frequency, occurrence at a young age, costs and that treatment may continue for the rest of the patient's life. The aim of this paper is to present a12-year, international review of the prevalence and incidence of TDIs including some background factors and a quick, easy method in registering TDIs to receive a primary understanding of the extent and severity of dental trauma. *Material and method*: The databases of Medline, Cochrane, SSCI, SCI and CINAHL from 1995 to the present were used. *Result*: The results indicate a high prevalence of TDIs in primary and permanent teeth and that TDIs exists throughout the world. The prevalence show that one third of all preschool children have suffered a TDI involving the primary dentition, one fourth of all school children and almost one third of adults have suffered a trauma to the permanent dentition, but variations exist both between and within countries. Activities of a person and the environment are probably more determining factors of TDIs than gender and age. A risk profile why some patients sustain multiple dental trauma episodes (MDTE) is necessary to present. All dental clinics should have a prospective ongoing registration of TDIs. The NUC method (N = no TDI, U = uncomplicated TDI, C = complicated TDI) presents if there has been any TDI and the severity of that trauma. *Conclusion*: The trend of TDIs seems to be stable on a high level with variations largely reflecting local differences. Because of the complexity of TDIs, every dental clinic should have a prospective ongoing registration of number and severity of TDIs.

Is a traumatic dental injury (TDI) a public dental health problem today? The answer is an overwhelming 'yes' and the reasons are fourfold. First, trauma to the oral region occurs frequently and makes up 5% of all injuries for which people seek treatment in all dental clinics and hospitals in a county(1). Second, TDIs tend to occur at a young age during which growth and development take place (2). In preschool children, for example, the figure is as high as 18% of all injuries (1). Third, treating a TDI can often be complicated and expensive (3), frequently involving participation of specialists in several disciplines. Fourth, in contrast to many other traumatic injuries treated on an outpatient basis, a TDI is mostly irreversible and thus treatment will likely continue for the rest of the patient's life (2, 3).

Other questions about TDIs are of interest. Will TDIs in the future look the same as they do today? Will it still be 10 to 12-year-old boys that are the most likely victims of dental trauma (4)? Or, will it be an increase among girls because of their increasing interest in sports? Or, are we going to see elderly people who still have their own teeth, with an increased risk of a TDI because of falling (5)? Another new category could be individuals who have lost an anterior tooth because of a TDI and, as an elegant solution, have received an implant. What happens to the implant and the bone when they encounter another TDI? Recent case reports have focused on this type of problem (6–8).

Evidence suggests that there is also an impact of treatment of dental trauma on the quality of life (QoL) of the individual. Recent studies of adolescents have indicated that treatment of permanent incisors with enamel-dentin fractures does not eliminate the impact of trauma on daily life (9, 10). On average, children with an untreated TDI were 20 times more likely to report an impact on QoL because of the injury when compared with children without any TDI (9). More adolescents with a history of treatment of an enamel-dentin fracture suffered from reduced QoL than adolescents with no history of dental trauma. Until now, only a few studies have presented findings on this subject matter (10).

The aim of this 12-year review is to present a broad international review of the prevalence and incidence of TDIs including back ground variables. A quick, easy method of registering TDIs to receive a primary understanding of the extent and seriousness of dental trauma in every dental clinic will also be presented.

Search methodology

The review started with an electronic search of Medline (Pub Med), Cochrane, SSCI (Social Citation Index), SCI (Science Citation Index) and CINAHL (Nursing and Allied Health) databases from 1995 to the present, using the following search words: tooth injuries, tooth trauma, traumatized teeth, dental trauma, dentoalveolar trauma, oral trauma, epidemiology, etiology, prevalence, incidence, prevention and review. Only reports in English were considered for inclusion in the review.

The search methodology in this review cannot guarantee that all articles pertinent to the topic have been found. This is because other databases than the ones used in the present study may also include information of interest. The majority of articles included in this review were found in Medline, probably because this database is the first choice when publishing material in dental traumatology. The quality of this review could therefore be regarded as sufficient.

Prevalence and incidence of traumatic dental injuries

The occurrence of TDIs can be described as prevalence or incidence. The difference is that prevalence refers to all cases, new or old, in a population at a given time, whereas incidence refers to the number of new patients with a TDI during a given period, generally 1 year, in a specified population. The prevalence rate is therefore higher than the incidence rate. For example, by comparing the results from Kaste et al. in the USA in 1996 (11), the prevalence was 18.4% in the age interval 6–20 years, whereas the incidence in Sweden in the age interval 6–19 years presented by Glendor et al. (12) the same year was 12.1 per 1000 individuals. A comparison of the two results in almost the same age interval is therefore 18.4% and 1.21%, respectively. Consequently, 18.4% of the individuals in the age interval 6–20 years in the USA had sustained at least one TDI to their permanent teeth during their lifetime, whereas 1.21% of the individuals in the age interval 6–19 years in Sweden had suffered from at least one TDI during the year of investigation. In other words, incidence conveys information about the risk of contracting a TDI, whereas prevalence tells us how widespread TDIs are.

Prevalence

In the USA, two large national surveys have presented the prevalence of TDIs (11, 13). The results of these two surveys indicated that approximately one in six adolescents and one in four adults had evidence of a TDI (Table 1). In the UK, O'Brien demonstrated that one in five children had experienced a TDI to their permanent anterior teeth before leaving school (14). These results compare well with the results from Andreasen & Ravn, who in 1972 reported that 22% of the children in their study had experienced a TDI to their permanent teeth before leaving school (15).

The prevalence of TDIs in primary and permanent teeth is high throughout the world (Table 1 and 2) even though the oral region comprises as small an area as 1% of the total body area (1). Statistics from most countries show that one third of all preschool children have suffered a TDI involving the primary dentition and one fourth of all school children and almost one third of adults have suffered a trauma to the permanent dentition, but variations have been observed between and within countries. Otuyemi et al., for example, explained the high prevalence of TDIs in primary teeth in Nigeria to children of preschool age as being more accident prone, especially in societies where toddlers are in the care of children who are only a few years older themselves (16).

In Table 2 the majority of the registrations of TDIs in primary teeth were performed in day care centres (16–18), whereas the rest were performed as traditional recalls in dental clinics (19, 20) or with questionnaires (21). All studies in Table 2 showed high values of prevalence (15.0–36.8%), compared to Oliveira et al.(9.4%) (73). The difference in prevalence between e.g. Oliveira et.al and Granville-Garcia et al.(72) may partly depend on that Oliveira et.al did not register dislocation of primary teeth (lateral, intrusive and extrusive displacement) because of trauma. The variation of the prevalence of TDIs in permanent teeth can be seen not only between and within countries but also within the same age groups (Table 1). TDIs in permanent teeth were mostly registered at school and only a small number in dental clinics.

Very few comparable studies allow a trend to be identified in dental trauma. Data from the past 30 years indicate that there has not been a significant increase in the prevalence of TDIs in children and adolescents in the Scandinavian countries and in the UK (22). The data from the UK showed a small reduction, but not a clear trend (14, 23–25). Probably there will be an increase in the prevalence of TDIs in the future simply because more individuals will be at risk. This is because inhabitants in countries with growing economies can afford cars, bicycles, sport utilities, etc., but have not yet gained sufficient knowledge regarding safety. The increasing violence among individuals is another alarming factor. Kontio et al. (78) suggested that maxillofacial fractures resulting from assaults are unlikely to increase. They reported that violence between individuals increased severity from 1981 to 1997. In 1981, nearly 30% of assaults from kicking resulted in maxillofacial fracture; in 1997, this rate increased to 40%. Other factors could be the increasing interest among girls participating in traditionally male dominated sports (26–28) and that a greater percentage of older adults have their own teeth rather than dentures (5).

Incidence

The number of studies presenting incidence is low. Those studies that have been found are listed in Table 3. The low number of studies is probably due to the rather costly and complicated process of presenting studies of incidence compared with studies of prevalence. This situation is partly because registration of incidence is performed by all dentists in Public Dental Health clinics in an area during 1 year after a period of information and calibrations, which can be compared with only a few

Table 1. Prevalence of traumatic dental injuries (TDIs) to permanent teeth in population-based surveys in different regions of the world

Reference	Region	Year	Age/Age group (years)	Sample size	Percent	Place of registration
	Africa					
(55)	South Africa, Hargreaves et al.	1995	11	1035	15.4	At school
	Asia					
(42)	Central Taiwan, Chen et al.	1999	8	1200	16.5	At school
(36)	Thailand, Malikaew et al.	2005	11–13	2725	35.0	At school
	Europe					
(34)	Ireland, Holland et al.	1994	16–24	400	13.5	Clinic/Home
			25–34	346	15.0	Clinic/Home
(56)	Italy, Petti & Tarsitani	1996	6–11	824	20.3	Dental clinic
(41)	Sweden, Borssén & Holm	1997	16	3007	35	Dental clinic
(57)	U.K., Hamilton et al.	1997	11–14	2022	34.4	At school
(58)	U.K., Rodd & Chesham	1997	14–15	557	44.2	Questionnaire
(59)	U.K., Marcenes & Murray	2001	14	2242	23.7	At school
(60)	U.K., Marcenes & Murray	2002	14	411	43.8	At school
(61)	Finland, Perheentupa et al.	2001	31	5737	43.3	Questionnaire
	Middle East					
(62)	Syria, Marcenes et al.	1999	9–12	1087	8.0	At school
(63)	Israel, Sgan-Cohen et al.	2000	10–11	1195	32	At school
(64)	Israel, Sgan-Cohen et al.	2005	9–13	1195	29.6	At school
(65)	Malaysia, Nik-Hussein	2001	16	4085	4.1	At school
(66)	Jordan, Rajab	2003	7–15	2751	14.2	Paediatric clinic
(67)	Jordan, Hamdan & Rajab	2003	12	1878	13.8	At school
(68)	Kuwait, Årtun et al.	2005	13–14	1583	14.5	At school
	North America					
(11)	U.S.A., Kaste et al.	1996	6–20	3337	18.4	Dental clinic
			21–50	4232	28.1	
			6–50	7569	24.9	
(13)	U.S.A., Shulman & Peterson	2004	6–20	6558	16.0	Dental clinic
			21–50	8806	27.1	
			6–50	15 364	23.5	
(69)	Canada, Locker	2005	14	3010	18.5	Dental clinic
	South America					
(70)	Brazil, Cortes et al.	2001	9–14	3702	12.1	At school
			12	649	13.6	At school
(35)	Brazil, Marcenes et al.	2001	12	652	58.6	At school
(71)	Brazil, Nicolau et al.	2001	13	652	20.4	At school
(28)	Brazil, Traebert et al.	2003	12	307	18.9	At school
(29)	Brazil, Traebert et al.	2006	12	260	17.3	At school
(38)	Brazil, Soriano et al.	2007	12	1046	10.5	At school

Table 2. Prevalence of traumatic dental injuries (TDIs) to primary teeth in population-based surveys in different regions of the world

Reference	Region	Year	Age/Age group (years)	Sample size	Percent	Place of registration
	Africa					
(16)	Nigeria, Otuyemi et al.	1996	1–5	1401	30.8	Day care centre
(21)	South Africa, Hargreaves et al.	1999	1–5	1466	15.0	Questionnaire
	Europe					
(19)	Belgium, Carvalho et al.	1998	3–5	750	18.0	Dental clinic
	South America					
(17)	Brazil, Mestrinho et al.	1998	1–5	1853	15.0	Day care centre
(20)	Brazil, Cunha et al.	2001	0–3	1654	16.3	Dental school
(18)	Brazil, Kramer et al.	2003	0–6	1545	35.5	Day care centre
(72)	Brazil, Granville-Garcia et al.	2006	1–5	2651	36.8	Preschool
(73)	Brazil, Oliveira et al.	2007	½–5	892	9.4	Preschool

specially trained dentists involved in prevalence studies during a very short period. Prospective incidence studies mostly include X-ray, whereas retrospective prevalence studies do not. Another difference is that TDIs not visible in prevalence studies are not registered, whereas registration is not performed in incidence studies if the

Table 3. Reported incidence of traumatic dental injuries (TDIs) in longitudinal surveys during a 1-year period in different regions of the world

Reference	Region	Year	Age/Age group (years)	Sample size	Per 1000	Place of registration
	Australia					
(44)	Australia, Stockwell	1988	6–12	66 500	17	At clinic
	Scandinavia					
(74)	Denmark, Ravn & Rossen	1969	7–16	43 909	30.1	At clinic
(15)	Denmark, Andreasen & Ravn	1972	0–14	487	40.3	At clinic
(75)	Denmark, Ravn	1974	7–16	≈50 000	30	At clinic
(76)	Norway, Hansen & Lothe	1982	7–18	?	25	At clinic
(22)	Norway, Skaare & Jacobsen	2003	7–18	≈71 000	18	At clinic
(77)	Norway, Skaare & Jacobsen	2005	1–8	≈20 000	13	At clinic
(40)	Sweden, Hedegård & Stålhane	1973	7–15	≈300 000	15	At clinic
(12)	Sweden, Glendor et al.	1996	0–6	21 456	14.9	At clinic
			7–19	41 458	12.5	At clinic
			0–19	62 914	13.2	At clinic
(41)	Sweden, Borssén & Holm[1]	1997	1–16	3007	28	At clinic
(1)	Sweden, Eilert Petersson et al.[2]	1997	All ages	256 510	4.2	At clinic

[1]The yearly incidence of 16-year-olds born in 1975 and followed retrospectively until 1991.
[2]Oral injuries, including traumatic dental injuries (TDI), injuries to the mandible or maxilla and injuries of the oral soft tissue.

patient does not seek treatment. A special benefit of incidence studies is that the occurrence of TDIs over time can be presented, i.e. any variation that is due to the time of the year, week or day.

Except for one study in Australia, no incidence study has been found outside Scandinavia. This may be because the Public Dental Health Service system in Scandinavia provides free, regular dental care for all children and adolescents up to the age of 20.

The results seem to be rather uniform within each country (Table 3). Some of the studies of incidence include both primary and permanent teeth. The results from Eilert-Petersson et al. showed a low total incidence in Sweden when all ages were included, which can be explained by the fact that most TDIs appear early in life. The Norwegian study showed a significantly higher incidence in urban (20 per 1000) than in rural areas (13 per 1000 individuals). The difference in incidences between Denmark and Sweden probably depends on that all dental traumas in Denmark were registered in the city of Copenhagen while in both urban and rural areas in Sweden.

In general, the variation of both prevalence and incidence reflects not only local differences, environmental variations and socio-economic, behavioural and cultural diversities but also the lack of standardisation in methods and classifications presented in the literature. A proposal for a quick and easy method to register the occurrence of TDIs in every clinic is presented later in this review.

Oral and non-oral injuries

A comparison between oral and non-oral injuries in the Eilert-Petersson et al. study in 1997 (1) showed that the incidence of oral injuries was most frequent during the individual's first 10 years of life, decreasing gradually with age and was rare after the age of 30. In contrast, the incidence of non-oral injuries was most frequent in adolescents and present throughout life (Fig. 1). The decrease in oral injuries after the early years of life is the reason for the total low incidence when individuals of all ages are considered.

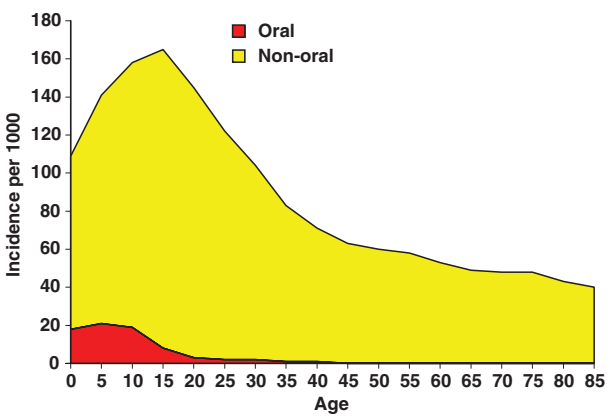

Fig. 1. Incidence of oral and non-oral injuries (from Eilert-Petersson et al. 1997).

Teeth involved

The majority of TDIs still involve the anterior teeth, especially the maxillary central and lateral incisors, regardless of the type of study. This preference for location also applies to the primary dentition. TDIs usually affect a single tooth, but certain trauma events, such as sports, violence and traffic accidents result in multiple tooth injuries.

Background factors

Gender

Gender is a well-known risk variable in which males experience a TDI at least twice as often as females. Yet,

recent studies have shown a reduction in this gender difference in sports, which may simply reflect an increased interest in sports among girls (26–28). This change will probably continue and include other areas of life. Traebert et al. (29) found that girls can be exposed to the same TDI risk factors as boys, which is characteristic of modern Western society. Thus, it is probably the activities of a person and the environment which are more determining factors of TDIs than gender.

Age

Age is another well-known risk variable. Schoolchildren and teenagers are target groups, but less has been documented about very young children. A Swedish study of accidents showed that children aged 1 year suffered TDIs at home more often than expected by chance (30).

Results from many studies demonstrate that the majority of TDIs occur in childhood and adolescence. It is estimated that 71–92% of all TDIs sustained in a lifetime occur before the age of 19 years (12, 31–33); other studies have reported a decrease after the age of 24–30 years (13, 34). Because of an increase in the number of older people in many countries and because most of these people are still in possession of their own teeth, there might be an increase in TDIs in older generations as a result of accidental falls. Thomson et al. reported (i) an increase in the rate and absolute number of injuries among older people, (ii) dental trauma rate was highest among males in the youngest age group (65–74 years), whereas the facial fracture rate was highest among older females (85+ years) and (iii) there was a general increase in the contribution of falls to the occurrence of dental trauma (5).

Race and ethnicity

The relationship between dental trauma and race and ethnicity is obscure. Ethnic minorities tend to experience more financial adversities and live in more deprived areas, making it difficult to disentangle the effects of these factors. Only a few studies have recorded the race and ethnicity of the individuals studied. In one study, however, a similar prevalence of dental trauma was noted in various race-ethnicity categories in the USA (11).

Socio-economic status

Very few reports on dental trauma have included socio-economic indicators and the results so far reported are conflicting. Marcenes et al. (35) reported a higher prevalence among adolescents from higher than from lower socio-economic groups in Brazil, probably related to higher ownership of bicycles, skateboards, access to horse riding, etc. Malikaew et al. (36), however, suggest that TDIs are inversely related to the educational and socio-economic status of the child's parents. Pattussi et al. (37) concluded that social capital (norms and networks enabling people to act collectively) may explain inequalities in rates of TDIs, especially among boys. Soriano et al. (38) found more dental traumas among pupils attending public schools compared to private schools, but the difference was not statistically significant. It is argued in their study that whether the child goes to a private or public school is an indication of its socio-economic condition and consequently determines the type of environment where the pupils live in. Environment and activity probably is of greater importance to the occurrence of TDIs than gender and age. Further research is needed to elucidate these relationships.

Multiple dental trauma episodes

Another important factor is that of multiple dental trauma episodes (MDTE) (39). Frequencies have been reported to range as high as 49% in patients with TDIs (22, 39–43); MDTE to the same teeth (RTT-repeated traumatised tooth) have been reported to range from 8 to 45% (39, 40, 43, 44). The results in Fig. 2 derive from a Danish school material, where all patients were followed during a 12-year period. The blue circles show patients injured only once while the black squares show patients injured 2–7 times. For example, the black vertical line in the figure represents a patient injured seven times during a period of 12 years. Following the red arrows, the first episode appeared when this individual was almost 9 years of age and the last when he was 16 years old. Unfortunately, there was no information in the dental files about why this young boy had been injured so many times. Except oral predisposing factors, such as increased overjet with protrusion and inadequate lip closure in early ages, there are other explanations for MDTE. One explanation could be human behaviour such as risk-taking and emotionally stressful states, while another could be presence of illness, learning difficulties or physical limitations. A more thoroughly presentation of aetiology and risk factors will be presented in a coming paper.

The data in Fig. 2 show that many patients with repeated episodes of a TDI had their first episode quite early in life (39). The question was if there was any pattern to this information? Further investigation revealed that individuals with only one TDI were injured

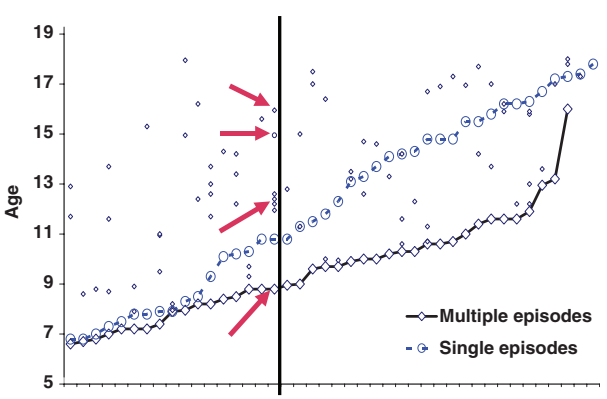

Fig. 2. Single and multiple traumatic dental injury episodes to permanent teeth in children 6 years of age followed during a 12-year period (from Glendor et al. 2000).

Table 4. Mean age at first episode in relation to the number of dental trauma episodes per patient to permanent teeth. Number of median years (shown by survival analysis) between episodes in relation to multiple dental trauma episodes per patient (1976–1988) (from Glendor et al. 2000)

Number of episodes/patient	Age at first episode (in years)[2]	Number of median years between episodes[1]		
		1st and 2nd episode	2nd and 3rd episode	3rd and 4th episode
1 (n = 42)	11.4 (3.6)			
2 (n = 17)[3]	8.6 (1.9)	3.9 (1.9;6.1)		
3 (n = 15)	8.9 (2.5)	2.6 (0.6;4.8)	1.4 (0.4;3.5)	
4[4] (n = 8)	8.0 (1.6)	2.1 (0.2;3.5)	1.0 (0.5;1.2)	1.4 (0.3;2.8)
2–4 (n = 40)	8.6 (2.1)	3.0 (0.8;5.1)	1.2 (0.4;3.0)	1.4 (0.3;2.8)

[1]1st and 3rd quartile within parentheses.
[2]Standard deviations within parentheses.
[3]One patient with missing value.
[4]Trauma episodes 5–7 are excluded.

on average at 11.4 years of age, whereas those with MDTE were injured at first episode on average before 9 years of age (Table 4). The risk of sustaining multiple dental injuries was found to be 8.4 times higher when the first trauma episode occurred at 9 years of age as compared with those occurring at 12 years of age. A survival analysis indicated that the risk of sustaining another trauma episode increased by 14.9–30.0% when the first trauma occurred in the age interval 6–10 years, which can be compared with 0–7.4% in the age interval 11–18 years. Another observation in this study was that for every new trauma episode, time became shorter between the subsequent episodes.

The difference, that patients sustaining MDTE were significantly younger at the first trauma episode than those injured only once, has also been shown by Pissiotis et al. (45). They showed a mean age of 9 years of patients with a single episode compared to 6 years for those with MDTE. Glendor et al. (39) also showed that almost every second patient with MDTE injured at least one tooth that had previously been injured. They also showed that for patients with one trauma episode, follow-ups were the most common treatment, with 53% of all type of treatments. In contrast, an increased number of follow-ups, filling therapy, information and prosthetic treatments were noted in patients with repeated trauma episodes. The results from the study presented by Glendor et al. (39) regarding type of treatment of patients with MDTE have to a great extent been confirmed by Pissiotis et al. (45). By using a more sophisticated statistical evaluation than Glendor et al. they confirmed that MDTE increased the risk of having certain types of dental injury, complications and treatments compared with those patients who were injured only once. They showed e.g. an increased risk of sustaining fractured restorations, root fractures and concussions between patients with single traumatised teeth (STT) and repeated traumatised teeth (RTT). Complications, pulp canal obliterations and root replacement resorptions were significantly higher in patients suffering from MDTE than in those with one trauma episode. It has also been found that the ongoing healing of a traumatised tooth is jeopardised if such a tooth receive another trauma incident (46).

The results from these studies stress the idea to develop a risk profile for patients who sustain MDTE to reduce the dramatic effects of repeated dental traumas.

Trauma to anterior implants

Recently, three case reports have described trauma to anterior implants, which implies that there had been an earlier trauma to the maxillary incisors, where the traumatised tooth or teeth had been replaced with one or two implants (6–8). The question is what happens to the surrounding tissues and the implants if there were another trauma episode in the same region? To date, there is very little information in the scientific literature as to what happens when there is trauma to implants. Such lack of information prevents us from drawing general conclusions (6, 7). It is not even known how bending or a fracture of the titanium or ceramic implant will affect the outcome of treatment. Other unknown factors are how this new trauma will affect the cost of treatment and the type of therapy in the future. Allen & Allen (7) showed in a case that the force applied to the implant probably results in bone fracture, which is potentially a very serious outcome of trauma to an implant. Flanagan (8) showed in another case that the impact force caused no apparent damage to the bone, the implant or its components except abutment screw loosening. Prevention of trauma to implants would seem to be important as the consequences of such injuries are not well known and the costs are likely to be high.

Registration of traumatic dental injuries

The results from this review show the importance to also include new variables in dental traumatology. It is not enough to only present e.g. age, gender, teeth injured, type of injury, and place and cause of injury to understand the complexity of a TDI event. Other variables such as local differences, environmental variations and socio-economic, behavioural and cultural diversities are also of importance. Even knowledge in change in QoL as a result from a TDI is of great importance (9, 10). But to include all these variables in every study of TDIs is not to recommend. Therefore, as a first step, to get an indication of the amount and severity of TDIs the use of a quick and easy method of an ongoing registration would be useful.

Registrations of TDIs are performed clinically in two ways today. Usually a few special trained dentists visit, for example, schools or health centres to study the prevalence of dental trauma in a survey (Table 1, 2). All present children are investigated with the aid of standard illumination or portable lamps and probes. A modified classification of either Andreasen et al. (2) or Ellis (47) is often used. The modification consists of loss of information from dental radiographs and former luxations. Instead, pulp involvement is assessed through the presence of discoloration or fistulous. Another approach is to study the range of TDIs for a defined region in a certain

age interval during a limited period of time. In this case the classification that is mostly used is the one adopted by the World Health Organization (WHO) and modified by Andreasen et al. (2). This type of investigation is mostly presented in special dental clinics, in hospital dental clinics, or by all public dental health dentists in a defined region trained and well familiar with the methods used. Both these methods of portraying the range of TDIs are probably enough to answer the aim or hypothesis in a specific study, but they have one important limitation – the lack of a prospective ongoing registration. Many public dental health clinics and GDPs are not represented in these two approaches. These clinics and GDPs should also register dental trauma to acquire an indication of the amount of TDIs in their own geographical area. Another limitation is the lack of information about changes of the occurrence of traumatic dental injuries over time.

It would therefore be of great importance to register TDIs as a continuously ongoing process without using too much resource. This method should answer two important questions regarding the distribution of TDIs in recall or in other patients visiting the clinic, especially among children and adolescents. The questions are: Has there been a dental trauma incident during the last recall period (if not = N)? If the answer is yes, was the trauma uncomplicated (U) or complicated (C)? By using one of the three letters (N, U or C), it is easily noted whether there has been a TDI as well as the severity of that trauma. By choosing age as a variable (for example, the age group 0–5 years) the individuals would have likely only injured primary teeth; when choosing an age group older than 5 years, it is likely that most of the individuals would have suffered from injuries to permanent teeth. The classification into uncomplicated and complicated traumas has earlier been presented by Glendor et al. (12), where the authors take into account the increased risk of complications, such as pulpal necrosis or root resorption, i.e. when the pulp has been exposed by fracture or the periodontal membrane is injured by dislocation of the tooth (48–51). The method of presenting TDIs as uncomplicated or complicated has been used to show therapeutic and economic implications of TDIs to primary and permanent teeth in Sweden (52) and in Denmark (53). The use of the NUC method (No dental trauma, Uncomplicated trauma or Complicated trauma), makes it possible to acquire important information about whether the number of TDIs is decreasing or increasing and whether the severity is changing, including seasonal changes over the year. By combining these variables with other variables (e.g. age, gender, living area and sport participation) in the patient files, such information could serve as a basis for deciding whether more detailed studies should be performed. Another benefit with an ongoing prospective registration of TDIs is that they could function as a marker for trauma as a whole in a region (54).

By the use of only one square in a computer based program it would be quick and easy to register this information and it would probably also reduce the number of drop outs. This information would be of great use by the national public health institutions in any country. An ongoing registration of TDIs would create a yearly incidence rate and make up the possibility to also present the prevalence rate.

Conclusions

Based on the results from this review of the epidemiology of dental trauma the following guidelines are recommended:

- A TDI is a public dental health problem and there will probably be an increase in the prevalence of TDIs in the future simply because more individuals will be at risk. Therefore it is necessary to continue the registration of TDIs.
- Factors such as gender and age will probably be of less importance to TDIs, compared with other factors such as environment, activity of the individual and socioeconomic status. Research is necessary to elucidate the relationship between environmental and behavioural factors and TDI.
- A risk profile for patients who sustain MDTE should be developed to help preventing young individuals from suffering another trauma event.
- It is essential for every dental clinic to have a prospective ongoing registration of TDIs to catch up early with changes in occurrence and severity.

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