Aim The aim of this study was to evaluate the degree of knowledge in the management of different scenarios of dental trauma in a population of Italian dentists.

Materials and methods A closed-ended questionnaire consisting of 5 clinical cases of common traumatic dental injuries was asked to be filled out by dentists in the area of Milan, Italy. A total of 500 questionnaires were collected; after a descriptive analysis of the population, results of correct answers were expressed in frequency distribution and computed in percentages. To examine possible associations between the level of knowledge for each question (number/percentage of correct answers) and independent variables of the population (sex, number of years after graduation, attendance of dental trauma courses, type of clinical activity) appropriate correlation tests were performed (Pearson chi-square, or Fisher’s exact; level of significance = 0.05) for identification of statistically significant differences.

Results More than 75% of participants answered correctly to the questions regarding crown fracture and extrusive luxation injuries; only 40% of dentists responded correctly about the duration and type of splinting following avulsion; 60% of participants incorrectly chose immediate invasive therapies (tooth extraction or endodontic procedures) for horizontal middle-root fracture. There was a trend towards slightly better knowledge (in 7 out of 9 questions) for dentists 1) working in hospitals and 2) who had attended a postgraduate course in traumatology.

Conclusion The level of knowledge in the group of dentists considered was heterogeneous; problems in the management of traumatic dental injuries were restricted to specific clinical cases and topics.

Keywords Italian dentists; Knowledge; Questionnaire; Traumatic dental injuries.

Treatment of traumatic dental injuries: evaluation of knowledge among Italian dentists

ABSTRACT

Recent epidemiological data pointed out a high prevalence of traumatic dental injuries (TDI) in primary and permanent dentition [Glendor, 2008], which ranges from 13.5 to 44.2% in Europe (20.3% in Italy). Despite the geographical differences, about one third of preschool children have a history of a trauma to deciduous teeth; one fourth of all schoolchildren and almost one third of adults experienced a trauma to the permanent dentition [Glendor, 2008]. Known predisposing factors [Glendor, 2009] to TDI have been classified as oral (increased overjet/maxillary protrusion), environmental, and factors related to human behaviour (i.e. emotionally stressful conditions or attention-deficit hyperactivity disorder). Major causes of injuries include falls and collisions associated with sport or leisure activities [Traebert, 2011], traffic accidents [Epstein et al., 2010], violence or physical abuse [Glendor, 2009].

While small enamel loss or cracks represent minor TDI, prompt emergency treatment of severe TDI that involve both hard and soft tissues (i.e. tooth avulsion) is required for pain control, restoration of function/aesthetics and prevention of social or psychological consequences [Lee and Divaris, 2009]. Technical knowledge and clinical experience are thus essential to establish an accurate diagnosis and provide a rational treatment.

Poor levels of knowledge on first-aid dental trauma management have been identified in different groups like laypeople [Traebert et al., 2009], physicians [Qazi and Nasir, 2009], and schoolteachers [Fux-Noy et al., 2011]. A number of studies have been focused on the knowledge of dentists (both general practitioners and specialists) about tooth avulsion [Cohenca et al. 2006; de Vasconcellos et al., 2009; Qazi and Nasir, 2009; Westphalen et al., 2007; Zhao and Gong, 2010], and most of them found a specific lack of adherence to international guidelines. Cohenca et al. [2006] and de Vasconcellos et al. [2009] reported respectively that only 37% and 24% of clinicians, would choose or suggest immediate treatment (replanting the tooth into its socket) at the site of injury whenever possible. Lack of information was also identified on correct splinting...
time following replantation of the avulsed tooth [Yeng and Parashos, 2008; Zhao and Gong, 2010]. Looking at other clinical scenarios, restorative dentistry Brazilian specialists had problems in establishing an adequate treatment plan for crown-root fractures [de Castro et al., 2010]. In Europe, studies from Germany [Krastl et al., 2009] and the United Kingdom [Kostopoulou and Duggal, 2005] have underlined a lack of knowledge among dentists on the management of other types of trauma, like complicated crown fractures (i.e. incorrect answers on indications about pulpotomy according to type and extent of pulp exposure).

The evaluation of the level of knowledge on the management of dental trauma is of outmost importance for the accurate development of educational projects, aimed to discuss the less familiar topics of the discipline, both in graduate and post-graduate courses. To date no information is available about Italian dentists. The objective of this investigation was to assess the level of specific knowledge on the management of TDI among dental practitioners in Milan and surrounding area, in Northern Italy, by using information collected from closed-ended questionnaires.

Materials and methods

Five hundred dentists, randomly selected in the area of Milan, agreed to take part in the study which involved filling out a questionnaire and answering the proposed questions on 5 different scenarios of dental trauma, in order to evaluate the level of knowledge of a population of Italian dentists on the management of TDI. This survey was approved by the Ethical Committee of the University of Milan. Only questionnaires that were returned completely filled were evaluated. The closed ended (multiple choice) questionnaire was divided in two parts: the first section (Fig. 1) was aimed to collect demographic information on the participants like age, sex, year of graduation, main type of occupation (practice predominantly performed in a hospital or in a private setting) and previous training experiences in dental traumatology (attendance to post-graduate, or continuing-education courses). The second part (Fig. 2) consisted of 9 questions (Q1-Q9) focused on five clinical cases.

Clinical scenarios were formulated to simulate actual and common conditions of a traumatic event, according to previous similar studies [Hu et al., 2006; Krastl et al., 2009] to facilitate the subsequent comparison of results: main topics involved coronal fracture (uncomplicated and complicated with dental pulp exposition), tooth avulsion, root fracture, extrusive luxation, type and time of splinting. Some cases contained more than one question. Three or four choices were proposed for each question, with only one correct answer among them (confirmed by the current IADT treatment guidelines and/or evidence-based literature) [Diangelis et al., 2012a; Diangelis et al., 2012b]. In a timeframe of approximately three months, 500 anonymous questionnaires were delivered and collected individually at dental congress events, meetings, public and private clinics. Dentists were not aware in advance about the questionnaire’s details; the average answering time was 10 minutes, although no time limit was set before.

The statistical software SPSS version 20.0 for Mac OS X (SPPS Inc, Chicago, Il, USA) was used for descriptive analysis both of the participating group (Table 1) and of the answers provided (Table 2). Distributions of correct answers related to independent, categorical variables (sex, number of years after graduation, attendance to dental trauma courses, type of clinical activity) are graphically provided in Figures 3-6. In addition, in order to examine possible associations between the level of knowledge for each question (number/percentage of correct answers) and independent variables of the population, appropriate correlation tests were performed (Pearson chi-square, or Fisher’s exact test; level of significance $\alpha = 0.05$) for identification of statistically significant differences.

Results

The mean age of participants at the survey was 41±11; as far as level of experience, near 27% of clinicians had graduated between 10 and 20 years earlier (133/500, Group C); while 35% of them (175/500, Group D) had been practicing dentistry for more than 20 years; 38.4% had been in the field of dentistry for less than 10 years. There was a predominance of males (67%) versus female (32.6%) dentists. Two minorities in the population were recognised: 80 dentists (80/500, 16%) who had attended specific continuing education courses on dental traumatology, and 72 dentists

![FIG. 1 First part of the proposed questionnaire to collect demographic information](image-url)
FIG. 2 Second part of the proposed questionnaire with specific questions on the management of 5 different dental trauma injuries (correct answers in red).

<table>
<thead>
<tr>
<th>CASE</th>
<th>Frequency/Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>case 1 - complicated crown fracture</td>
<td>366 (73.2%)</td>
</tr>
<tr>
<td>Q1</td>
<td>380 (76.0%)</td>
</tr>
<tr>
<td>Q2</td>
<td>465 (93.0%)</td>
</tr>
<tr>
<td>case 2 - tooth avulsion</td>
<td>116 (23.2%)</td>
</tr>
<tr>
<td>Q3</td>
<td>381 (76.2%)</td>
</tr>
<tr>
<td>Q4</td>
<td>455 (91.0%)</td>
</tr>
<tr>
<td>Q5</td>
<td>207 (41.4%)</td>
</tr>
<tr>
<td>Q6</td>
<td>360 (72.0%)</td>
</tr>
<tr>
<td>case 3 - uncomplicated crown fracture</td>
<td>133 (26.6%)</td>
</tr>
<tr>
<td>Q7</td>
<td>440 (88.0%)</td>
</tr>
<tr>
<td>case 4 - root fracture</td>
<td>200 (40.0%)</td>
</tr>
<tr>
<td>Q8</td>
<td>431 (86.2%)</td>
</tr>
</tbody>
</table>

The mean number of correct answers to all questions (Q1-Q9), was 6.6±1.5; the percentages of correct answers to the three proposed cases related to complicated and uncomplicated crown fractures (Q1-Q2 and Q7) and extrusive luxation (Q9) were all above 75%. In contrast, the clinical scenario of tooth avulsion, consisting of 4 questions (Q3-Q6), resulted in 23% of correct answers. The highest concentration of errors (58.6% wrong answers) was recorded at Q5 (Type and duration of splinting). Finally only 40% of respondents would perform an adequate immediate treatment in case of root fracture (Q8).

The level of knowledge of women was found to be generally better than male colleagues: this was statistically significant at questions Q5 (splinting type and duration) and Q7 (uncomplicated crown fracture), (p = 0.001). Moreover, a higher knowledge in the management of clinical cases was demonstrated by: 1) dentists working in public hospitals (in 7 questions out of 9) with respect to private practitioners; and 2)
in dentists who attended post-graduate courses (in 7 questions out of 9); however, the latter association was not statistically significant \((p > 0.05)\). Dentists working in public hospitals revealed statistically significant higher level of knowledge, with respect to private practitioners, at question Q6 \((p = 0.009)\) on prescription of medication/drugs in case of tooth avulsion. In the overall questionnaire, a slight increase in the number of wrong answers was also found with the increase of the number of years after graduation: in group A (0-5 years) the average of incorrect answers throughout all survey was 23.3%. This percentage increased gradually to 25.6% for dentists who had graduated 5-10 years earlier, and reached 28.9% for group D (more than 20 years from graduation).

**Discussion**

Theoretical knowledge of dental traumatology, as of other branches of dentistry, is strictly based on the organisation of university classes, continuing education and post-graduate courses.

The impact and importance of education has been shown by a short, single lecture covering a specific topic of dental traumatology [Frujeri Mde and Costa, 2009]; using a questionnaire, Brazilian researchers measured the mean level of knowledge of a group of dentists before and two months after providing simply one 40-minutes lecture about the emergency management of tooth avulsion, reporting a significant increase in the number of correct answers in the questionnaire.

Previous investigations conducted using questionnaires covering multiple aspects of dental traumatology have reported specific, but not generalised lack of knowledge [de Franca et al., 2007; Kostopoulou and Duggal, 2005; Yeng and Parashos, 2008]. The present survey also revealed mixed results, as underlined by a difference between the highest and the lowest percentage of correct answers at questions Q2 and Q8 (93% and 40%, respectively). The time elapsed since pulp exposure and its extent are important variables in the correct treatment planning of complicated crown fractures, in the effort of preserving tooth vitality [Olsburgh et al., 2002]. Prolonged (>60 minutes) and or/large-size (not pinpoint) pulp exposures are best treated by pulpotomy [Olsburgh et al., 2002; Cvek, 1978] to minimise neurovascular tissue irritations, with high success rates both in immature and mature permanent teeth [Blanco and Cohen, 2002]. This scenario was proposed in the first clinical case (Q1-Q2), and a high percentage of dentists responded correctly...
(366/500, 73.2%). We may speculate that pulpotomy, pulp capping with calcium hydroxide and composite restorations in association with bonding techniques represent well-known and familiar treatments in the practice of general dentistry since similar procedures are performed also for caries or iatrogenic exposures of the pulp. A conservative, dentin-sealing composite restoration is the choice for uncomplicated crown fractures [Diangelis et al., 2012a], a scenario where respondents would perform a correct treatment (Q7= 88.0% of correct answers); overall, it is possible that appropriate knowledge in other branches of dentistry, like operative dentistry, may assist the clinician to solve some specific trauma cases (as complicated or uncomplicated crown fractures).

Tooth avulsion is a dramatic event for the patient, especially during the dento-alveolar developing phase (due to the possible bone resorption if no replantation is performed). In our study, the most difficult part concerning avulsed teeth was the selection of the appropriate type and duration of splinting (Q5, 58.6% of incorrect answers); on the other hand, respondents were well informed about the initial, first-performed emergency treatment of replantation (Q4, 76.0% of correct answers). Manfrin et al. [2007] also report lack of knowledge regarding the treatment of avulsed teeth like root conditioning, splinting (60.6% of incorrect answers) and occlusal adjustments. According to the study of Hu et al. [2006] 99.3% of dentists indicated the correct ideal time limit for replantation (30 minutes); only 59.1% could identify a proper splinting type. After tooth avulsion (or root fractures, especially if associated with dislocation of the coronal fragment) splinting is beneficial to ensure adequate fixation during healing phases, to avoid other new injuries to the tooth or excessive occlusal loading, and to prevent accidental ingestion or inhalation. A functional, flexible splint for 10-14 days is recommended by the current IADT guidelines following tooth avulsion and replantation [Diangelis et al., 2012b].

Tooth splinting in dental traumatology is a source of discussion in the literature, due to differences in the outcome of animal and human studies. At first experimental animal models have shown that rigid splinting of extracted and autotransplanted teeth resulted in an increase in the frequency of pulp necrosis [Kristerson and Andreasen, 1983] and replacement resorption [Andreasen, 1975a; Kristerson and Andreasen, 1983; Nasjleti et al., 1982]. Moreover, Andreasen [1975a] suggested that functional forces were beneficial as the frequency and extent of replacement resorption was significantly lower in non-splinted teeth compared with the rigidly splinted teeth. More recently a retrospective human study on 400 avulsed and replanted teeth [Andreasen et al., 1995] and two systematic reviews [Hinckfuss and Messer, 2009; Kahler and Heithersay, 2008] found no significant relationship between the type and duration of the splinting and the pulp/periodontal healing. However, functional flexible splints may assist in attaining a physiologic mobility or controlled passive mobilisation of the tooth after injuries. From a biologic point of view, microtension across a healing wound may promote production and maturation of collagen due to anabolic activity of fibroblasts and blood circulation in the healing ligament. After tooth avulsion, shorter splinting period (1-2 weeks vs. 3-4 weeks) are advised [Kahler and Heithersay, 2008] since reattachment of the damaged periodontal ligament is usually completed in one week.

In our study, the other problematic question was about the immediate treatment of a horizontal middle root fracture (Q8); among the three different options (answers) suggested, only one single modality of tooth splinting was proposed. This time the problem was not related to lack of knowledge regarding the type or duration of splinting (like in Q5); instead, a wrong treatment plan/approach was identified, with most of the participants choosing immediate invasive therapies like extraction of the tooth or endodontic procedures. Andreasen et al. [2004] in a retrospective study on 400 root fractures demonstrated a good prognosis for mid-root fractures, with the overall healing rate of about 80%, and with 30% of these cases healed with hard tissue formation between the fractured segments. Repositioning of the coronal fragment (if displaced) and semi-rigid splinting for 3-4 weeks is the recommendation according to the current guidelines [Flores et al., 2007, Diangelis et al., 2012a] for middle root horizontal fracture. It is thus advisable to monitor healing (using pulp tests) for at least 1 year to determine pulpal status; if pulp necrosis develops root canal treatment of the coronal fragment is then indicated [Flores et al., 2007; Diangelis et al., 2012a].

In our study, the few participants (80/500, 16%) who declared to have received additional education in dental traumatology after graduation (post-graduate courses) had a higher percentage of correct answers with respect to their colleagues in 7 out of 9 questions (Fig. 4); the same is true for dentists working in public hospitals (Fig. 3). It is of interest to note that the higher level of knowledge of these two groups of participants, although not statistically significant, also affected the two most problematic questions of the study: Q5 and Q8. Apart from theoretical knowledge, dentists working in public hospitals may be exposed with relatively high frequency to the diagnosis and treatment of traumatic dental injuries; this is also true for those working in other special environments, like emergency departments in military zones. With this respect our findings were in accordance with the study of Hu et al. [2006], where previous trauma experience in the practice of the clinicians involved led to significantly higher knowledge scores.
Although the number of participants (n = 500) in the present survey is relatively high, results cannot be extrapolated to the entire Italian country/territory; moreover, further studies are required to evaluate the knowledge of dentists who have followed different educational experiences in order to compare their effectiveness.

Conclusions

1) The level of knowledge on the management of traumatic injuries to the teeth in the analysed group of Italian dentists was mixed.

2) Lack of knowledge was identified in some specific areas of dental traumatology: tooth avulsion (type and duration of splinting) and root fracture.

3) Educational opportunities should focus on the importance of appropriate management of dental injuries and on specific gaps in knowledge.

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