Longitudinal study on types of injury, complications and treatment in permanent traumatized teeth with single and multiple dental trauma episodes

Pissiotis A, Vanderas AP, Papagiannoulis L. Longitudinal study on types of injury, complications and treatment in permanent traumatized teeth with single and multiple dental trauma episodes.

Abstract – The purpose of this study was to compare the type of injuries, complications and treatment in permanent traumatized teeth with single and multiple dental trauma episodes (MDTE). One hundred and fifty-five children, aged 6–14 years, sustaining one or more traumatic episodes to permanent teeth were included in this investigation. After the medical and dental history the patients were examined clinically and radiographically and the diagnosis of trauma, the treatment plan and the applied treatment were recorded. Also, information regarding the number of traumatic episodes, the number of injured permanent teeth and the vitality of the pulp was collected. In follow-ups, traumatized teeth were examined clinically and radiographically to evaluate the treatment applied and to detect any complication. The *t*-statistic was used to test differences in the mean number of teeth per patient with different types of injury, complications and treatment between permanent traumatized teeth with single and multiple trauma episodes. A 95% probability level was used. The results showed that MDTE significantly affected the mean number of teeth per patient with fractured restoration, root fracture, concussion, pulp canal obliteration, root replacement resorption, filling therapy, surgery and prosthetic treatment. It was concluded that MDTE increase the risk of having certain types of injury, complications and treatment.

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Studies conducted on children and adolescents reported that 16-30% of these individuals sustain dental trauma more than once (1-4). Also, it is well known that a percentage of permanent traumatized teeth, depending on the type of injury, develop complications. It is likely, that multiple dental trauma episodes (MDTE) increase the possibility of sustaining a more serious injury to permanent teeth resulting in an increased risk of developing complications and demand for treatment. One study reported that an increased number of trauma episodes per patient resulted in an increased number of follow-ups, filling therapy, information and prosthetic treatment (5). It is conceivable, therefore, that the relationship between MDTE and type of injury, complications and treatment needs further investigation.

The purpose of this study was to compare the type of injuries, complications and treatment in

permanent traumatized teeth with single and MDTE.

Materials and methods

One hundred and fifty-five children aged 6-14 years sustaining one or more traumatic episodes to permanent teeth, came to the postgraduate pediatric dental clinic from October 1997 to March 2004. All children were examined by the postgraduate students and the diagnosis was verified by a faculty member. After the medical and dental history were taken, each patient was examined clinically and radiographically and the diagnosis of trauma, treatment plan and applied treatment were recorded. Information was also collected regarding the number of traumatic episodes, the number of injured permanent teeth and the vitality of the pulp, using an electrical pulp tester. The criteria used to diagnose dental injuries were those proposed by Andreasen & Andreasen (6).

Dental injuries were classified as follows:

- **1** Injuries to hard tissue including infraction, enamel fracture, enamel and dentin fracture, enamel, dentin and cementum fracture and fracture of the restoration.
- **2** Injuries to hard tissue and pulp such as enamel and dentin fracture with pulp exposure, enamel, dentin and cementum fracture with pulp exposure and root fractures.
- **3** Injuries to periodontal tissue including concussion, subluxation, lateral luxation, extrusion, intrusion and avulsion.

In follow-ups, traumatized teeth were examined clinically and radiographically to evaluate the applied treatment and to detect any complication such as necrosis of the pulp, inflammatory resorption, pulp canal obliteration and ankylosis or replacement resorption. The criteria used to diagnose these complications were those described by Andreasen & Andreasen (6). All the above information was recorded in forms specifically designed for the examination of traumatized teeth.

On the basis of the occurrence of trauma episodes, patients were classified as those with one episode and those with more than one or MDTE (5). With respect to teeth, those sustaining a dental injury once were classified as single traumatized teeth (STT) and those with repeated dental traumas as repeated traumatized teeth (RTT) (3, 5).

Statistical methods

The data were computerized and the statistical package STATA 5.0 was used for the analysis. The *t*-statistic was used to test gender differences in the number of episodes. Also, the same statistic was

applied to test differences in the mean number per patient of different types of injury, complications and treatment between permanent traumatized teeth with single and multiple trauma episodes. A 95% probability level was used.

Results

The sample consisted of 158 patients, 101 boys and 57 girls, with dental trauma. Fifty of them, 32 boys and 18 girls, had MDTE. The number of MDTE ranged from two to six with a mean of 2.28 episodes per patient. The *t*-test did not show significant gender differences in the number of episodes. The mean age of the first trauma episode for patients with single episodes was 9.38 years, while for those with MDTE the corresponding value was 5.82 years. Table 1 presents the number of patients with single and RTT in relation to number of trauma episodes.

Tables 2 and 3 show the mean number of single and RTT per patient in relation to different type of trauma to hard tissue and pulp and periodontal

Table 1. Distribution of patients with single (STT) and repeated traumatized teeth (RTT) in relation to number of episodes

STT/RTT		Numbe	r of episod	les per pa	tient	
	1	2	3	4	5	6
STT	108	23	0	0	0	0
RTT	0	17	8	1	0	1
Total	108	40	8	1	0	1

Table 2. Mean number of permanent teeth per patient with trauma to hard tissue and pulp in relation to trauma episodes (standard deviations in parentheses)

		Number of episodes			
Type of injury	Teeth	1	2	3–6	
Hard tissue					
Infraction	STT	0.06 (0.27)	0.13 (0.45)	-	
	RTT	-	0.12 (0.33)	0.00 (0.00)	
Enamel fracture	STT	0.24 (0.54)	0.35 (0.65)	-	
	RTT	-	0.24 (0.56)	0.10 (0.32)	
Enamel and	STT	0.86 (0.90)	0.95 (0.82)		
dentin fracture	RTT	- ` `	1.17 (0.95)	0.90 (0.74)	
Enamel, dentin and	STT	0.00 (0.00)	0.00 (0.00)	_ ` `	
cementum fracture	RTT	- ` `	0.00 (0.00)	0.00 (0.00)	
Fracture of restoration	STT	0.00 (0.00)	0.00 (0.00)	_ ` `	
	RTT		0.41 (0.62)	0.70 (1.25)	
Hard tissue and pulp					
Enamel and dentin	STT	0.17 (0.46)	0.09 (0.42)	-	
fracture with	RTT	- ` `	0.29 (0.59)	0.10 (0.32)	
pulp exposure					
Enamel, dentin and	STT	0.05 (0.21)	0.00 (0.00)	_	
cementum fracture	RTT	- ` ´	0.00 (0.00)	0.00 (0.00)	
with pulp exposure			· · ·	· · ·	
Root fractures	STT	0.05 (0.25)	0.00 (0.00)	_	
	RTT	_	0.06 (0.24)	0.40 (0.70)	
				(•••••)	

Type of injury

Concussion

Subluxation

Extrusion

Intrusion

Avulsion

Lateral luxation

Table 3. Mean number of permanent teeth per patient with trauma to periodontal tissue in relation to trauma episodes (standard deviations in parentheses)

1

0.33 (0.72)

0.29 (0.64)

0.13 (0.43)

0.04 (0.19)

0.14 (0.42)

0.22 (0.71)

_

Teeth

STT

RTT

STT

RTT

STT RTT

STT RTT

STT

RTT

STT

RTT

0.00 (0.00)

0.10 (0.32)

		(standard deviations in	parenthese	es)		
Number of episodes				Nu	mber of episo	des
2	3–6	Treatment	teeth	1	2	
0.52 (0.89)	_	Instructions	STT	0.08 (0.27)	0.13 (0.34)	
1.00 (1.32)	0.70 (0.95)		RTT	_	0.06 (0.24)	0.0
0.30 (0.55)	_	Follow- ups	STT	2.38 (2.33)	1.95 (2.34)	
0.29 (0.77)	0.20 (0.42)		RTT	_	2.76 (2.33)	3.4
0.22 (0.85)	-	Filling therapy	STT	1.46 (1.08)	1.65 (1.23)	
0.00 (0.00)	0.20 (0.42)		RTT	_	2.29 (1.44)	2.4
0.00 (0.00)		Root canal therapy	STT	0.42 (0.74)	0.65 (0.98)	
0.00 (0.00)	0.00 (0.00)		RTT	- ,	0.71 (0.92)	0.5
0.09 (0.42)	- , ,	Surgery	STT	0.02 (0.14)	0.17 (0.49)	
0.12 (0.48)	0.00 (0.00)		RTT	-	0.06 (0.24)	0.2
0.35 (0.57)	_ ` `	Splinting	STT	0.14 (0.38)	0.30 (0.55)	

tissue respectively and to number of episodes per patient. All traumatized teeth were upper and lower central and lateral incisors and canines. Significant differences in the mean number of teeth with different types of dental trauma were not found between STT patients with one and two traumatic episodes. However, the *t*-test showed significant differences in the mean number of teeth with fractured restoration (t = 6.11, P = 0.000), root fracture (t = 2.08, P = 0.038) and concussion (t = 3.09, P = 0.002) between patients with single and RTT.

Table 4 presents the mean number of teeth with different types of complications in patients with STT and RTT related to trauma episodes. Significant differences were detected in the mean value of teeth with pulp canal obliteration (t = 2.12, P =0.03) between STT patients with one and two trauma episodes. Also, the *t*-test showed significant differences in the mean number of teeth with root replacement resorption (t = 2.19, P = 0.03) and pulp canal obliteration (t = 2.18, P = 0.03) between patients with single and RTT.

Table 5 shows the mean values of different types of treatment in patients with STT and RTT related

Table 4. Mean number of teeth with various types of complications per patient for single (STT) and repeated permanent traumatized (RTT) teeth in relation to trauma episodes (standard deviations in parentheses)

	Number of episodes			
Complications	Teeth	1	2	3–6
Pulp necrosis	STT	0.39 (0.71)	0.50 (0.86)	-
	RTT	-	0.69 (0.87)	0.44 (0.73)
Inflammatory resorption	STT	0.13 (0.48)	0.17 (0.38)	- , ,
	RTT	- , ,	0.19 (0.75)	0.11 (0.33)
Replacement resorption	STT	0.09 (0.36)	0.28 (0.57)	- ` `
	RTT	- ` ´	0.38 (0.72)	0.22 (0.67)
Pulp canal obliteration	STT	0.08 (0.32)	0.44 (1.46)	- ` ´
	RTT	- ` ´	0.38 (0.72)	0.11 (0.33)

Table 5. Mean number of treatment per patient with single (STT) and repeated permanent traumatized teeth (RTT) in relation to trauma episodes

3–6

0.00 (0.00)

3.40 (3.20)

2.40 (2.07)

0.50 (0.71)

0.20 (0.42)

0.30 (0.48)

0.00 (0.00)

0.13 (0.34)

	RTT	-	0.06 (0.24)	0.20 (0.42)		
Orthodontic reposition	STT	0.10 (0.30)	0.09 (0.42)	-		
	RTT	-	0.12 (0.48)	0.00 (0.00)		
Pulpotomy	STT	0.06 (0.23)	0.00 (0.00)	-		
	RTT	-	0.00 (0.00)	0.00 (0.00)		
Direct pulp treatment	STT	0.02 (0.14)	0.00 (0.00)	-		
	RTT	-	0.06 (0.24)	0.00 (0.00)		
Smoothing of the fracture	STT	0.07 (0.32)	0.17 (0.49)	_		
	RTT	-	0.06 (0.24)	0.00 (0.00)		
ences were found in the mean number of surgical						
(t = 2.79) $P = 0.003$ and prosthetic treatments						
(t-210, P-0.03) between STT patients with						
v = 2.10, $r = 0.00$ between 011 patients with one and two traumatic episodes. Also, the differ						
one and two traumatic episodes. Also, the differ-						
ences were significant in the mean number of filling						
therapy $(t = 3.29, P = 0.001)$, surgical $(t = 2.26, $						
P = 0.02) and prosthetic treatments ($t = 1.98$,						
P = 0.05) between patients with single and RTT.						

0.03 (0.17)

RTT

STT

Discussion

Prosthetics

The present longitudinal study investigated differences in the mean values of different types of injury, complications and treatment between patients with one and MDTE. The tested hypothesis was that MDTE do not significantly affect the mean number of different types of injury, complications and treatment. The t-test, however, rejected this null hypothesis as significant differences were found in certain types of injury, complications and treatment. More specifically, significant differences were detected in the mean values of teeth with fractured restorations, root fractures and concussion between patients with single and RTT. The higher mean number of teeth with these types of injuries was found in patients with RTT. This finding implies that MDTE increase the risk of sustaining these types of injury.

With respect to complications, pulp canal obliteration and root replacement resorption were significantly higher in patients suffering from MDTE than in those with one traumatic episode. This result shows that repeated traumatic episodes have an effect on pulp and periodontal healing which increases the risk of developing pulp canal obliteration and root replacement resorption. The finding of the present investigation is in agreement with the result of another study which reported that MDTE are responsible for the development of complications in traumatized teeth (7).

Regarding treatment, significant differences were found in the mean values of filling therapy between patients with and without MDTE. As mentioned above, MDTE significantly increase the risk of having fracture of the restoration, resulting in an important increased need for filling therapy. Other studies reported that filling therapy was the most frequent treatment in patients with MDTE (5) and this finding was due to the frequent loss of composite restorations (8).

Another type of treatment which was affected significantly by the MDTE in the present study was surgery. As is known, a certain percentage of traumatized teeth develop complications. The results of this study showed that root replacement resorption was significantly higher in patients with MDTE. Root replacement resorption, however, results in the loss of teeth and consequently in an increased need for extraction. The significantly higher mean values of surgery found in the patients with MDTE, therefore, is justifiable by the significantly higher mean number of root replacement resorption developed in this group. Furthermore, as an increased loss of teeth was present, an increased demand for prosthetic treatment would be expected. As a matter of fact, the results of this study confirmed the above argument as statistically significant differences were found in the mean values of prosthetic treatment between patients with one and MDTE. Glendor et al. (5) reported that more treatment was performed on patients suffering from MDTE than on those with one trauma episode. However, in that study, no hypothesis testing was conducted for the existence of statistical differences.

An interesting question emerges about the clinical implication of the results from the present investigation. As MDTE significantly affect certain types of injury, complications and treatment as well as the loss of traumatized teeth, primary concern should be given to the development of preventive measures to avoid MDTE. It has been demonstrated that personality traits, cross-situational behavioral characteristics, or a combination of multiple psychological factors can increase accident risk (9). It is important, therefore, to develop a risk profile for patients with MDTE to help prevent or reduce the repeated dental traumas.

Conclusion

On the basis of the results from the present investigation, it can be concluded that MDTE increase the risk of having certain types of injury, complications and treatment.

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