A Rubber-Covered Ceramic Weapon Reduces the Incidence of Dental Trauma in Recruits During Combat Basic Training

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ABSTRACT The effect of a rubber-covered ceramic weapon was assessed on the incidence of dental trauma during basic training, since soldiers are more at risk of impact from a personal weapon. Dental files of soldiers ($n = 4,542$), who completed 8 months of training during 2008, were analyzed for incidence and type of dental trauma from a personal weapon. A rubber-covered ceramic weapon ($n = 2,972$) or a conventional one ($n = 1,570$, control) was used. Dental trauma was 0.4% per 8 months (0.6% per year) from the ceramic weapon and 1.5% per 8 months (2.3% per year) from the conventional one ($p < 0.001$). The most prevalent type of injury was a simple/noncomplicated crown fracture (82% in study group, 75% in control group). The ceramic weapon significantly reduced dental trauma by diminishing the impact while in direct contact with the teeth or by absorbing and/or distributing the impact force. In conclusion, when possible a rubber-covered ceramic weapon should be preferred for basic combat training.

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INTRODUCTION

A population at risk for dental traumatic injuries are soldiers.[1–3] In an epidemiologic study conducted in the U.S. Army during the 1970s,[2] the mean accidental dentofacial injuries during a 9-month period was 0.4% per year. However, this rate varied greatly for specific subgroups with high-risk factors that included young males, lower enlisted ranks, recent recruits, and combat training posts.

Although military equipment and training have changed significantly since this time, only two additional studies have been found in the English literature that evaluate the incidence of dental trauma injuries among soldiers in recent years.[1,3] In the Israel Defense Forces (IDF), an incidence of 1.6% per year of traumatic dental injury was found among soldiers during their basic combat training. The most frequent etiology was recoil from the personal weapon (53%).[1]

Dela Cruz et al[3] evaluated the incidence of dental traumatic injuries among military personnel during basic training at Fort Leonard Wood Missouri after using boil-and-bite mouthguards. The incidence varied from 0.0189 to 0.03 per year depending on the frequency of wearing the mouthguard during various training activities.

Recently, a new rubber-covered ceramic personal weapon was supplied to several units of the IDF. The aim of the present study was to evaluate whether use of a rubber-covered ceramic weapon reduced the incidence of dental traumatic injury associated with the personal weapon among soldiers during basic combat training.

MATERIALS AND METHODS

Units of combat training in which the soldiers used a metal or rubber-covered ceramic personal weapon were selected for the present study, according to inclusion criteria. The inclusion criteria for the study group were: units of combat training, all the soldiers use a rubber-covered ceramic weapon, the units have a dental clinic and a dentist who worked in the same clinic for at least 1 year, and the location of the unit was inside Israel in a secured area.

The inclusion criteria for the control group were: units of combat training, all the soldiers use a metal weapon, the units have a dental clinic and a dentist who worked in the same clinic for at least one year, and the location of the unit was inside Israel in a secured area.

Dental files of 4,542 soldiers from several combat military camps were analyzed for incidence and type of dental trauma caused by a personal weapon. Only soldiers who completed 8 months of basic combat training during 2008 in the IDF were included. A rubber-covered ceramic weapon was used during training by 2,972 soldiers, and a conventional one was used by 1,570 soldiers (control).

In the IDF, comprehensive clinical and radiographic examinations are mandatory by the dentist in charge before providing treatment or signing a dental report. The standard report includes data regarding time and place of injury, eye witnesses to the event, type and site of injury, diagnoses, kind of treatment provided, and additional comments such as evidence of previous tooth injury. All available data and radiographs were analyzed.

Relevant files were screened for documentation of any dental traumatic injuries caused by the weapons during training. The study included 35 dental trauma reports (11 in study group, 24 in control group).

A structured form was designed to record information from the dental files regarding the frequency and variables associated with traumatic dental injury, as detailed below.

Type of personal weapon: A rubber-covered weapon composed primarily of ceramic materials, and a conventional weapon composed of metallic materials.

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Type of traumatic dental injury occurring during training: No evidence of pathology, enamel crack, noncomplicated crown fracture, complicated crown fracture, crown-root fracture, root fracture, luxation, avulsion, evidence of additional dental pathology unconnected to the current injury, and damage to tooth restoration with root canal treatment.
Necessity of treatment: Yes/no.
Type of operative treatment provided: None (either unnecessary or the patient objected), analgesic or antibiotic prescription, composite restoration, pulp capping, pulp extirpation, root canal treatment, extraction, fixation, reimplantation after avulsion, smoothing sharp enamel edges, temporary crown cementation, selective grinding of the enamel of the opposing teeth to relieve occlusal interference.

Fisher's exact tests were used to calculate the association between weapon type and the parameters being measured (SPSS 10.0, Chicago, Illinois).

The Ethics Committee of the Medical Corps, IDF, approved the study.

RESULTS

Incidence of Dental Trauma

An incidence of 1.2% per year of traumatic dental injury that occurred during basic training was found in 35 files (0.8%). The incidence of dental trauma among soldiers who used a rubber-covered ceramic weapon was 0.4% (11 of the 2,972 soldiers) per 8 months (0.6% per year) compared to 1.5% (24 of the 1,570 soldiers) per 8 months (2.3% per year) who used a conventional metallic weapon ($p < 0.001$) (Table I). Injuries in two of their teeth were found in 5 soldiers (3 in study group, 2 in control group). During training, 14 (study) and 26 (control) teeth were injured (Table II).

Most of these injuries occurred by accidental strike of the weapon to the face area while turning around, crawling, or moving quickly holding the weapon and being hit by oneself or peer.

Type of Traumatic Injuries

Table I shows that the most prevalent type of injury was the noncomplicated crown fracture (78.6% in study group, 76.9% in control group). Severe dental traumatic injuries, such as complicated crown fractures and luxations, were 90% higher among the control group (0.1%) compared to the study group (0.19%). However, since these numbers were low, significant statistical analysis was not performed. The most prevalent injured teeth were the maxillary central incisors (85.7% in study group, 69.2% in control group).

Type of Provided Treatment

The most common treatment provided was composite restoration (60%) and root canal (12.5%). No treatment was given to 13.9% of the soldiers because the injury was minimal or the soldiers preferred treatment by their personal dentist (Table III).

DISCUSSION

It has been shown that during basic combat training, the incidence of dental traumatic injuries was 1.1% per 8 months (1.6% per year), and the most frequent etiology was injury from the personal weapon (53%).[1] The reason for the relatively high incidence could be that during this time, soldiers handle heavy equipment including a personal weapon throughout most of their physical activities while their skills and ability are still inadequate.

TABLE I. Distribution of Traumatic Dental Injuries Occurring in Soldiers During 8 Months of Combat Training Using Either a Rubber-Covered Ceramic Weapon (Study Group) Or a Conventional Weapon (Control Group)

Type of Injury	Number of Teeth (Number of Soldiers)	
	Study	Control
Damage to a Restoration	0 (0)	2 (2)
Enamel Crack	0 (0)	1 (1)
Enamel Dentin Fracture[4]	11 (9)	20 (18)
Enamel Dentin Fracture Involving the Pulp[4]	3 (2)	2 (2)
Luxation	0 (0)	1 (1)
Avulsion	0 (0)	0 (0)
Total Injured Soldiers (Teeth)	14 (11)	26 (24)

TABLE II. Distribution of Traumatized Teeth of Soldiers During 8 Months of Training Using Either a Rubber-Covered Ceramic Weapon (Study Group) Or a Conventional Weapon (Control Group)

Type of Injured Teeth	Number of Teeth	
	Study	Control
Maxillary Central Incisor	12	18
Maxillary Lateral Incisors	1	6
Mandibular Central Incisor	0	1
Mandibular First Molar	0	1
Unreported	1	0
Total Injured Teeth	14	26

TABLE III. Distribution of Provided Treatments in Soldiers During Training Using Either a Rubber-Covered Ceramic Weapon (Study Group) Or a Conventional Weapon (Control Group)

Type of Treatment Provided	Number of Teeth (Number of Soldiers)	
	Study	Control
No Treatment	2 (1)	4 (4)
Smoothing Sharp Edge	0 (0)	3 (2)
Composite Restoration	9 (8)	15 (14)
Root Canal Treatment	3 (2)	2 (2)
Temporary Cementation of Crown	0 (0)	1 (1)
Grinding Tooth to Reduce Occlusal Trauma	0 (0)	1 (1)
Total Teeth (Soldiers)	14 (11)	26 (24)

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Generally, a common measure used to prevent traumatic dental injury is to wear a mouthguard during risk activities.[3,5–7] Soldiers at Fort Leonard Wood Missouri significantly decreased the risk of dental traumatic injuries by 1.76 times when a mouthguard was used during basic military training.[3] However, the effectiveness of preventing dental injuries depends on the frequency of wearing the mouthguard, and unfortunately compliance is low.[3,6,7]

In this study, the effect of a rubber-covered ceramic weapon was compared to a conventional one. Soldiers who used a conventional weapon during combat training suffered from dental traumatic injuries 4 times more than those who used a rubber-covered ceramic weapon. Similarly, the incidence of severe dental traumatic injuries (complicated crown fracture and luxation) was nearly double among soldiers who used a conventional one. The mechanism of this preventive measure is probably similar to that of a mouthguard, by diminishing the impact from the weapon while in direct contact with the teeth, or by absorbing and/or distributing the impact force compared to a conventional weapon. It should be emphasized that the weight of both weapons is similar, and therefore the difference cannot be attributed to this factor.

This study is the first to demonstrate a new efficient means to decrease the incidence of traumatic dental injuries caused by a personal weapon during basic combat training. Moreover, the advantage of using a rubber-covered ceramic weapon over a mouthguard is that its effectiveness does not depend on the soldier's compliance. Notwithstanding, it should be emphasized that mouthguard is still more effective than rubber-covered weapon (0.0189–0.03 injuries per year depending on the frequency of wearing the mouthguard during various training activities vs. 0.6% per year when using rubber-covered weapon). Accordingly, all preventive measures should be accompanied by raising the awareness of soldiers and their superiors regarding prevention of dental trauma during basic training, and when possible from military point of view, a rubber-covered ceramic weapon should be preferred for basic combat training.

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