

Knowledge and practice of emergency doctors regarding traumatic dental injuries



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DEDICATION

This thesis is dedicated to

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God bless you with a long healthy life.

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DECLARATION

I declare that “Knowledge and practice of emergency doctors regarding traumatic dental injuries”, is my own work, that it has not been submitted before for any degree or examination at any other university, and that all the sources I have used or quoted have been indicated and acknowledged as complete references.

Nabila Qaseem Ali Yahya

November 2017

Signature......

LIST OF ACRONYMS

TDI	Traumatic dental injury
TDI's	Traumatic dental injuries
EC	Emergency center
EC's	Emergency centers
PDL	Periodontal ligament
TT	Tetanus toxoid
TIG	Tetanus immunoglobulin
MG	Mouth guard
TD	Tongue depressor
HBSS	Hank's balanced salt solution
LMICs	Lower- and middle-income countries
GSH	Groote Schuur Hospital
NSH	New Somerset hospital
KBH	Karl Bremer hospital
IADT	International Association of Dental Traumatology
CME	Continuing medical education
ACIP	Advisory Committee on Immunization Practices

KEYWORDS

Traumatic Dental Injuries

Emergency Center

Emergency Doctors

Trauma Unit

Knowledge

Practice

ABSTRACT

Traumatic dental injuries (TDI's) are an important public health problem in children and adolescents worldwide. The emergency center (EC) serves as the spearhead to the hospital as it has to deal with a broad spectrum of patients with different ailments and injuries. The level of knowledge and doctors' practice at emergency centers (EC's) regarding TDI's has a direct impact on patient outcomes. The current literature reports that EC doctors have insufficient knowledge of the management of TDI's.

Aim

The aim of this study was to evaluate the knowledge and practice of medical doctors related to the management of TDI's in the emergency trauma unit at a district, regional and academic hospital in the Western Cape Province of South Africa.

Methods

A cross-sectional observational study was conducted using a structured questionnaire. The questionnaire consisted of 36 questions which included demographic data of the emergency doctors and general knowledge regarding traumatic dental injuries. The questions also included knowledge and management of the specific clinical types of traumatic dental injuries and knowledge of the preventive measure methods that can be used to reduce the severity of dental trauma on the sports field. A convenience sample was selected from the three hospitals, Karl Bremer with 31 doctors, New Somerset Hospital with 10 doctors and Groote Schuur Hospital with 13 doctors in the respective trauma units. The sample size was 54 (n = 54).

Result

In this study, all the emergency doctors selected for the study completed the questionnaires and a 100% response was achieved. Although two thirds (66.67%) of EC doctors reported that they had to manage a case where some type of dental trauma has occurred, only 2 (3.7%) doctors out of 54 reported that they felt that their knowledge was sufficient to provide the appropriate emergency management for TDI's. The majority of doctors (81.48%) had never received any formal training on TDI.

Conclusion

The study concluded that the majority of EC doctors at the three selected hospitals felt that their knowledge was not sufficient to manage a case with dental trauma injuries. Although two thirds of the sample had to manage a case of dental trauma injury during their clinical activities, less than a fifth had received appropriate training to do so. Additional training which focuses on management of dental traumatic injuries among emergency medicine (EM) doctors might be a key route to disseminate knowledge and changing practice.



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CHAPTER 1: INTRODUCTION

Background to the problem

Trauma is a well-known major disease burden in the lower- and middle-income countries (LMICs), with South Africa falling into the middle-income group (Hardcastle *et al.*, 2016). Trauma is of two main types, namely: non-intentional and intentional. The non-intentional type of trauma includes domestic, sport, recreational, workplace and vehicular injuries. In addition non-intentional trauma is not caused by the victim himself or by another person and occurs as a result of an accident (Berman *et al.*, 2006). The intentional injury includes homicides, suicides, domestic aggression, war and terrorism (Berman *et al.*, 2006). Traumatic dental injury is either non-intentional or intentional.

Traumatic dental injury (TDI) counts as the most common injury and the prevalence of TDI ranges between 3.9% - 58.6% globally (Petersson *et al.*, 1997; Glendor, 2008). Two basic types of TDI's exist, namely: hard tissue injuries that involve the teeth, alveolar bones and surrounding facial bones (Berman *et al.*, 2006; Andreasen and Andreasen, 2011). The other type of TDI affects the soft tissue including the lips, facial skin, cheek and periodontium mucosa, soft and hard palate tissue and the tongue (Berman *et al.*, 2006; Andreasen and Andreasen, 2011). Traumatic dental injuries can cause a multitude of serious consequences for the traumatized person, family, and community (Ramos-Jorge *et al.*, 2007; Díaz *et al.*, 2009; Hecova *et al.*, 2010; Rajab *et al.*, 2013). Dental pain reduces the individual's quality of life, not only in terms of physical disabilities but also results in emotional distress, psychosocial problems, and economic and functional impairment in a variety of life activities (Cortes *et al.*, 2002; Fakhruddin *et al.*, 2008b; Rajab *et al.*, 2013; Zaleckiene *et al.*, 2014).

Traumatic dental injuries occur mainly in preschool children, school-age children and young adults making up 5% of all injuries for which people seek treatment (Petersson *et al.*, 1997; Glendor, 2008; Bucher *et al.*, 2013). A study over a 12-year period reported that 25% of all school children experience dental trauma and 33% of adults had suffered trauma to the permanent dentition, with the majority of TDI occurring before the age of 19 (Glendor, 2008). Children are more prone to TDI due to physical and behavioural factors (Hecova *et al.*, 2010; Bae *et al.*, 2011; Costa *et al.* 2015; Mahmoodi *et al.*, 2015; Nayak, *et al.*, 2016).

Nearly one out of every three children is exposed to a TDI (Andreasen *et al.*, 2010). The prevalence of TDI among children less than 6 years old, ranged from 11% - 30% (Cunha *et al.*, 2001; Arikan *et al.*, 2010).

TDI's are usually sudden, quick and unexpected (Berman *et al.*, 2006). Many patients with TDI, who have no dental insurance cover, might be forced to go to the hospital's emergency center (EC) (Vargas *et al.*, 2002; Lewis *et al.*, 2003; Skapetis *et al.*, 2011). The low socio-economic population groups are also compelled to go to the hospital EC (Lewis *et al.*, 2003; Santos *et al.*, 2011; Samaei *et al.*, 2015). Two South African studies reported that the peak of EC attendees were outside regular office hours, mainly on weekends and Mondays (Balfour, 2002; Wallis and Twomey 2007). There is an increase in the flow of dental trauma patients to hospital EC's since they usually operate and offer services around the clock and throughout the week (Berman *et al.*, 2006; Mahmoodi *et al.*, 2015).

The triage concept which is a term borrowed from military medicine refers to the provision of quick, efficient and high quality care required in EC's (Hughes and Cruickshank, 2011). The percentage of patients presenting to the EC with dental problems is 0.3 - 4% (Skapetis *et al.*, 2011; Trivedy *et al.*, 2012). In South Africa, trauma forms a significant component of the EC workload at public hospitals (Hardcastle *et al.*, 2016). Balfour (2002) reported that about one third of admissions to the EC are due to injuries relative to trauma which constitutes 12% of admissions in America and approximately 8% in the United Kingdom.

TDI's are mostly untreated, over-treated or mistreated by both the medical practitioner and even sometimes by the dentist, which leads to complicated dental procedures in the future or costly treatment (Hamilton *et al.*, 1997; Cvek *et al.*, 2001; Levin *et al.*, 2004; Chadwick *et al.*, 2006). Therefore treatment of TDI not only requires immediate diagnosis but also appropriate management by all primary care providers in order to significantly improve the prognosis (Lin *et al.*, 2006; Díaz *et al.*, 2009; Petrovic *et al.*, 2010; Zaleckiene *et al.*, 2014). Previous studies have shown that the medical practitioners have difficulty in appropriately diagnosing TDI (Levin *et al.*, 2004; Chadwick *et al.*, 2006; Samaei *et al.*, 2015).

The EC consists of primary care providers (e.g. family physicians, paediatricians, nurses, physician assistants, and emergency doctors) who could play a pivotal role in providing primary care following TDI, especially for population groups with limited access to dental care (Lin *et al.*, 2006; Díaz *et al.*, 2009; Zaleckiene *et al.*, 2014).

Traumatic dental injuries are an important public health problem in children and adolescents worldwide (Glendor, 2008; Atabek *et al.*, 2014) due to the tendency that it occurs at a young age during which growth and development take place (Andreasen *et al.*, 2013). TDI, is a significant cause of morbidity (Eilert-Petersson *et al.*, 1997; Marcenes and Murray, 2002), has a negative impact on the individual's quality of life (Hecova *et al.*, 2010) and results in costly treatment (Zaleckiene *et al.*, 2014).

The EC offers the most convenient and cost-effective setting for the majority of the population for treatment of TDI cases e.g. tooth fracture, tooth avulsion luxation injuries, dento-alveolar bone injuries, simple jaw fractures, and soft tissue lacerations (Díaz *et al.*, 2009; Nasr *et al.*, 2013; Needleman *et al.*, 2013; Samaei *et al.*, 2015). Previous studies found that most TDI's do not receive the appropriate management from the EC doctors before they are referred to the dental clinics (Levin *et al.*, 2004; Chadwick *et al.*, 2006).

The possible reason for the lack of appropriate management of TDI by medical doctors in the EC is poor knowledge of the fundamental management of TDI as these doctors have had little training in dental emergencies (Holan and Shmueli, 2003; Qazi and Nasir, 2009; Samaei *et al.*, 2015; Deeb *et al.*, 2016). Therefore EC medical staff may have difficulty in making a specific diagnosis for dental presentations, and often manage these patients symptomatically (Levin *et al.*, 2004; Chadwick *et al.*, 2006; Samaei *et al.*, 2015). Several complicated TDI's could have been avoided if appropriately managed by the medical doctors who initially manage these cases at the trauma unit of the EC (Samaei *et al.*, 2015). Therefore, it is important to investigate the knowledge and practice of the front line care providers such as emergency doctors regarding TDI.

The purpose of this study was to evaluate and identify whether emergency medical doctors working in the trauma unit of the EC have adequate knowledge regarding the management of TDI. This study was conducted in the Western Cape Province of South Africa, at three different public hospitals namely: Groote Schuur hospital (tertiary central academic), Karl Bremer hospital (district) and New Somerset hospital (regional).

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

Traumatic dental injuries (TDI's) can occur in the head, face or mouth (Panzarini *et al.*, 2005). In both children and adolescents, the injury frequently takes place in the primary and permanent dentition as well as the supporting structures such as the upper and lower jaw (Panzarini *et al.*, 2005). Studies from different countries showed that among all preschool children at least one third of them had suffered TDI of the primary teeth (Kargul *et al.*, 2003; Fakhruddin *et al.*, 2008a; Taiwo and Jalo, 2011). In addition, one quarter of all school children and nearly one third of adults had suffered trauma of the permanent teeth (Kargul *et al.*, 2003; Fakhruddin *et al.*, 2008a; Taiwo and Jalo, 2011).

In children, 0-6 years of age, TDI's are ranked as the second most common injury, with bodily injuries making up 20% (Malmgren *et al.*, 2012). Of all the body parts, the oral region is the 6th most frequently injured part (Pettersson *et al.*, 1997; Lin *et al.*, 2008b). Eilert-Pettersson, (1996) indicated that the annual mortality rate from TDI stands at 4 million globally, with half in the age category 10-24 years and trauma is generally the major cause of death in persons younger than 40 years of age.

Many classifications of TDI have been presented over the years (Bastone *et al.*, 2000). The currently accepted system is based on the Application of international classification of diseases to dentistry and stomatology by the WHO (1995), and was modified by Andreasen and Andreasen (2011). The modified Andreasen classification is more comprehensive and contains 19 groups and can be used to classify primary and permanent dentition injuries (Table1).

South Africa (SA) is known to have one of the highest rates of trauma in the world (Perrott, 2003) and trauma is the second main cause of death in the country (Trunkey, 2008). Over 50,000 trauma related deaths were recorded in 2009 across SA, with the majority related to transport and violence (Matzopoulos *et al.*, 2015).

A study by Norman *et al.*, (2007) found injury-related mortality rates in SA to be six times higher, and the incidence of road traffic injuries to be double that of the global rate (Norman *et al.*, 2007). However, information related to dental trauma epidemiology in SA children is lacking.

Table 1: Classification of traumatic dental injuries

Andreasen and Andreasen (2011)	World Health Organization (1995)
Crown infraction, incomplete fracture of the enamel	Fracture of enamel of tooth
Uncomplicated crown fracture. A fracture confined to the enamel or dentine but not exposing the pulp	Fracture of crown without pulpal involvement
Complicated crown fracture. A fracture confined to the enamel and dentine and exposing the pulp	Fracture of crown with pulpal involvement
Uncomplicated crown-root fracture. A fracture involving enamel, dentine cementum, not exposing the pulp	Fracture of root of tooth
Complicated crown-root fracture. A fracture involving enamel, dentine, cementum and exposing the pulp	Fracture of crown and root of tooth
Root fracture. A fracture involving dentine, cementum, and the pulp	Fracture of tooth, unspecified
Concussion. Injury without abnormal loosening or displacement but with marked reaction to percussion	Luxation of tooth
Subluxation (loosening). Injury with abnormal loosening but without displacement of the tooth	Intrusion or extrusion of tooth
Intrusive luxation (central dislocation)	Avulsion of tooth
Extrusive luxation (peripheral dislocation, partial avulsion)	Other injuries including laceration of oral soft tissues
Lateral luxation	
Exarticulation (complete luxation)	
Comminution of alveolar socket	
Fractures of facial or lingual alveolar socket wall	
Fractures of alveolar process with and without involvement of the socket	
Fractures of the mandible or maxilla with and without involvement of the tooth socket	
Laceration of gingiva or oral mucosa	
Contusion of gingiva or oral mucosa	
Abrasion of gingiva or oral mucosa	

A South African study by Hargreaves and co-workers (1995) found that the prevalence of TDI is as high as 16% in primary school children. The prevalence of dental trauma amongst the white population was significantly higher at 21% compared with the black population at 13% (Hargreaves *et al.*, 1995). A study by Naidoo *et al.*, (2009) examined dental trauma to the

permanent teeth in South African school children aged 11-13 years old and found the prevalence of TDI to be 6.4% among this age group.

2.2 The Aetiology of Traumatic Dental Injury

The aetiology of TDI's was found to be related to the age of the patient (Lam *et al.*, 2008; Andreasen *et al.*, 2013). In pre-school children, accidental falls are the main cause of TDI (McTigue *et al.*, 2000; Flores *et al.*, 2007c; Andreasen *et al.*, 2013) while in school age children, the main cause of TDI was activities such as physical sports (Lam *et al.*, 2008; Díaz *et al.*, 2010; Andreasen *et al.*, 2013). In adolescents and young adults, violence and traffic accidents were the main cause of TDI (Glendor, 2009; Guedes *et al.*, 2010; Nayak, *et al.*, 2016). Previous studies have shown that accidental falls were the most common cause of TDI (31.7 to 64.2%) followed by sport activities (40.2%), then cycling accidents (19.5 %), traffic accidents (7.8%), and lastly physical violence (6.6%) (Lam *et al.*, 2008; Eyuboglu *et al.*, 2009; Hecova *et al.*, 2010; Faus-Damia *et al.*, 2011; Murthy *et al.*, 2014). Studies have shown that the home (Blinkhorn, 2000; Fakhruddin *et al.*, 2008a; Naidoo *et al.*, 2009) and the school (Blinkhorn, 2000; Naidoo *et al.*, 2009; Noori and Obaidi, 2009) are the most common places where TDI occur.

In addition to the previously mentioned causes there are also predisposing factors such as the type of occlusion that is associated with TDI's (Bendo *et al.*, 2010; Taiwo and Jalo, 2011; Prabhu *et al.*, 2013). Children with class II division 1 malocclusion are more prone to TDI compared to children with other types of occlusion (Noori & Al-Obaidi, 2009). An overjet larger than 3.0 mm where the anterior teeth are in a prominent forward position creates an increased risk for TDI (Traebert *et al.*, 2006; Baldava and Anup, 2007; Prabhu *et al.*, 2013). Other factors that also contribute to TDI are inadequate lip coverage to protect anterior teeth (Traebert *et al.*, 2006; Robson *et al.*, 2009; Bendo *et al.*, 2010; Taiwo and Jalo, 2011; Prabhu *et al.*, 2013) and the lack of wearing a mouth guard (MG) during sport activities (Bendo *et al.*, 2010; Taiwo and Jalo, 2011).

2.3 Mouth Guard

A mouth guard (MG) is a protective device that fits in the mouth to cover the hard and soft tissue in order to inhibit or minimize the severity of TDI during sport activities (Knapik *et al.*, 2007). Current research states that well fitted mouth-guards decrease the prevalence of TDI

during sport activity (Barbic *et al.*, 2005; Fasciglione *et al.*, 2007; Levin and Zadik, 2012; Ramdas *et al.*, 2014). A meta-analysis to compare MG users and nonusers reported that the risk of TDI's are 1.6 to 1.9 times greater when a MG is not worn than when a MG is worn (Knapik *et al.*, 2007). The American Dental Association and the International Academy of Sports Dentistry recommend that persons who participate in the following 29 sports: gymnastics, skiing, acrobatics, cycling, basketball, boxing, extreme sports, equestrian events, field events, field hockey, football, handball, ice hockey, lacrosse, inline skating, martial arts, volleyball, shot putting, racquetball, skateboarding, skydiving, soccer, squash, softball, surfing, rugby, water polo, wrestling and weight lifting, must wear an accurately fitted MG during sport activity and competitions to prevent and reduce TDI (AAPD, 2016).

Different types of MG (namely stock, boil-and-bite, and custom-fitted) are available and provide a level of protection during sport activities (Levin and Zadik, 2012). Custom-fitted MGs are made by a dental professional and are considered to be the best option because it offers better protection with more comfort, without causing difficulties in breathing and talking during the sport (Eroğlu *et al.*, 2006). Medical doctors can advise the patient or care-giver about dental injury-preventive measures such as use of MG at the playground, home and school as they provide injury-prevention messages during well-child visits to avoid serious complications (Keels, 2014).

2.4 Consequences of Traumatic Dental Injury

TDI has a multitude of consequences and might result in continuous complications and burdens in physical, psychological and economic aspects for the individual. Physically, TDI causes pain and could negatively impact on the growth and development of the teeth and facial bones (Diab and ELBadrawy, 2000; De Carvalho Rocha and Cardoso, 2001; Cortes *et al.*, 2002; Díaz *et al.*, 2009; Hecova *et al.*, 2010; Rajab *et al.*, 2013). TDI can cause damage to the developing tooth germ, ankylosis, and resorption and tooth loss as well as tooth discoloration (Fakhruddin *et al.*, 2008a; Hecova *et al.*, 2010).

TDI might change facial appearance of children and result in aesthetic (Rajab *et al.*, 2013) and psychological problems (Ramos-Jorge *et al.*, 2007; Fakhruddin *et al.*, 2008b) and will affect social behaviour such as the tendency to be lonely (shyness and embarrassment) and avoidance of talking or smiling (Cortes *et al.*, 2002; Marcenes *et al.*, 1999). TDI also leads to economic

implications as injuries are often complicated and need long-term treatment (Zaleckiene *et al.*, 2014; Glendor, 2009).

2.5 Prevalence of Traumatic Dental Injury

Several studies reveal significant levels of dental trauma prevalence globally (Al-Majed *et al.*, 2001; Marcenes & Murray, 2002; Malikaew *et al.*, 2006; Lin & Naidoo, 2008; Hasan *et al.*, 2010; Yassen *et al.*, 2013; Murthy *et al.*, 2014). The great variation in prevalence may be due to different factors such as the dentition studied, the study design, the trauma classification, geographical and cultural differences between study countries as shown in Table 2 (Bastone *et al.*, 2000; Zaleckiene *et al.*, 2014).

Table 2: Prevalence of traumatic dental injuries in different countries and age groups

Country	Age/Age group years	n	Dental trauma prevalence (%)	Author/year
Saudi Arabia	5-6	354	33	Al-Majed <i>et al.</i> , (2001)
	12-14	862	34	
London	14	2242	23.7	Marcenes & Murray (2002)
Thailand	11–13	2725	35.0	Malikaew <i>et al.</i> , (2006)
Canada	12-14	2422	11.4	Fakhruddin <i>et al.</i> , (2008a)
Maseru	10-14	290	9.3	Lin & Naidoo (2008)
Turkey	1-15	653	4.9	Eyuboglu <i>et al.</i> , (2009)
Brazil	11-14	1612	17.1	Bendo <i>et al.</i> , (2010)
Kuwait	2-6	500	11.2	Hasan <i>et al.</i> , (2010)
Nigerian	12	719	15.2	Taiwo & Jalo (2011)
Jordan	12	2560	5.5	Rajab <i>et al.</i> , (2013)
Swiss	6-13	1900	14.3	Schatz <i>et al.</i> , (2013)
Iraq	6-12	294	29	Yassen <i>et al.</i> , (2013)
India	5-16	2,132	9.7	Murthy <i>et al.</i> , (2014)

Although TDI's mainly occur at a young age, TDI's are observed in any age group (Glendor, 2008; Bucher *et al.*, 2013). Nearly one child out of every three children is exposed to TDI (Andreasen *et al.*, 2010). The prevalence of TDI among children less than 6 years ranged from 11% - 30% (Cunha *et al.*, 2001; Arikan *et al.*, 2010). The incidence of dental injuries among children ranges between 1% and 3% of the population (Andreasen *et al.*, 2013). Several studies

showed a relationship between TDI and age. Mahmoodi *et al.*, (2015) found the highest prevalence of TDI between 0–9 year olds, while Costa *et al.*, (2015) reported the highest prevalence in 1-5 year olds. In another study done by Kramer *et al.*, (2009) the highest prevalence was in children aged 2-3 and Andreasen stated that the highest number of TDI is at age 4 (Andreasen *et al.*, 2013).

Children are more exposed to TDI due to physical and behavioural factors such as: lack of motor coordination especially when children learn to walk (Nayak, *et al.*, 2016), an increase in curiosity and exploratory activities (Glendor, 2008; Hecova *et al.*, 2010; Bae *et al.*, 2011; Costa *et al.* 2015; Mahmoodi *et al.*, 2015) when they start physical activity (Andreasen *et al.*, 2013) and lack of attention (Costa *et al.* 2015).

The prevalence of TDI in the primary teeth is approximately 30% (Glendor *et al.*, 2007, Granville-Garcia *et al.*, 2010) but there is controversy regarding the peak age of TDI in primary teeth as Eyuboglu *et al.*, (2009) suggest that it ranges between 0-5 years whereas Flores *et al.*, (2007c) reported that the peak age is the 2-3 year old group. TDI in the permanent teeth is about 20% in children with a higher prevalence observed in the 7-12-year-old age group (Díaz *et al.*, 2009; Eyuboglu *et al.*, 2009 ; Faus-Damia *et al.*, 2011) and adolescents (Andreasen *et al.*, 2013).

Studies have shown an association between TDI and gender in which males experience a TDI twice as often as females (Díaz *et al.*, 2010). The male: female ratio ranged from 1.5:1.0 to 2.5:1.0 (Lam *et al.*, 2008; Glendor, 2009; Díaz *et al.*, 2010). The male predilection has been related to involvement of boys in more dangerous physical activities, fights and car accidents (Altun *et al.*, 2009; Naidoo *et al.*, 2009). However, some of the studies have shown a reduction in the gender ratio due to increased sports activities among girls possibly due to a modern Western society (Traebert *et al.*, 2003; Traebert *et al.*, 2006) where there is an increase in women in sports.

Studies show that the type and causes of the TDI differ between permanent and primary dentition due to the fact that the structure of the alveolar bone is less mineralized in the primary teeth. There is less bone support and the morphology of the roots and the crown are smaller compared to the permanent teeth (Lam *et al.*, 2008; Andreasen *et al.*, 2013; Bucher *et al.*, 2013; Zaleckiene *et al.*, 2014; Mahmoodi *et al.*, 2015).

The teeth that are commonly at risk for injuries are the maxillary central incisors in both primary and permanent teeth (Glendor, 2008; Prabhu *et al.*, 2013; Mahmoodi *et al.*, 2015).

The most common type of TDI to the primary teeth are soft tissue injuries such as; luxation and subluxation (McTigue *et al.*, 2000; Flores *et al.*, 2007c; Lam *et al.*, 2008; Bucher *et al.*, 2013; Mahmoodi *et al.*, 2015). However, in permanent teeth the most common type of TDI are hard tissue injuries such as crown fractures and enamel-dentin-fractures (Lam *et al.*, 2008; Naidoo *et al.*, 2009; Hecova *et al.*, 2010; Bucher *et al.*, 2013; Mahmoodi *et al.*, 2015).

2.6 Selected Traumatic Dental Injuries

There are various types of TDI classified by Andreasen and Andreasen (2011) as shown in Table 2. Some of these types do not require emergency treatment such as: crown infraction, enamel fracture and concussion injury, whereas some of these injuries are serious and need timely management. These include: complicated crown fracture, tooth avulsion, and alveolar bone fracture.

2.6.1 Complicated Crown Fracture

A complicated crown fracture involves the enamel and dentin with the exposure of the pulp tissue (Andreasen *et al.*, 2002). The teeth with complicated crown fracture are frequently sensitive, painful and result in a pink or red blood tinged area visible in the fracture (Roberts, 2000; Jambagi and Joshi, 2015). During a complicated crown fracture a part of the tooth crown is missing (Roberts, 2000; Keels, 2014) and the pulp tissue is at high risk of infection (Keels, 2014). A fracture which is limited to the enamel with or without small amounts of dentine that are not sensitive may not require emergency procedure (Moule and Cohenca, 2016), whereas the complicated crown fractures, require prompt diagnosis and emergency management to achieve the best outcomes (Needleman *et al.* 2013). Pulp perforations are usually prone to infection, as there is no self-healing capacity and the goal of the treatment is to preserve the pulp vitality, therefore the tooth must be properly dressed with a material such as calcium hydroxide that prevents bacterial micro-leakage (Murray *et al.*, 2003; Bakland and Andreasen, 2012; Gungor, 2014). Oral cavity examination should be done using a light source to examine any possible injury to the lips, tongue and intraoral mucosa (Beech *et al.*, 2015). Tooth fragments and debris can be embedded in the lips, intraoral structures or even cheeks (Beech *et al.*, 2015) which may contain dirt and examination is necessary in order to avoid placing the

patient at risk of tetanus infection (McVicar, 2013). The tooth fragment should be preserved and hydrated in saline or water as it can be re-attached providing the best functional and aesthetic result (Douglass and Douglass, 2003; Moule and Cohenca, 2016).

The role of the practitioner is to cover the exposed pulp by application of calcium hydroxide to reduce the pain and sensitivity as well as to decrease the risk of pulp infection (Bakland and Andreasen, 2012; Gungor, 2014). If this procedure cannot be performed immediately, the tooth should be covered with dental foil or gauze (Roberts, 2000). During this procedure pain must be managed and an emergency dental referral recommended (Mehlich *et al.*, 2010; Roberts, 2000; Keels, 2014; Beech *et al.*, 2015).

2.6.2 Tooth Avulsion

Tooth avulsion, in which the tooth is totally displaced out of its socket, is one of the most commonly occurring TDI's (Addo *et al.*, 2007). It makes up 16% of all the TDI's affecting the permanent maxillary central incisor teeth and the highest peak of injuries occurs in 7–12 year olds (Díaz *et al.*, 2009; Andreasen *et al.*, 2013). The prognosis of an avulsed permanent tooth depends on measures taken immediately after the accident (Flores *et al.*, 2007b; Andersson *et al.*, 2012; Keels, 2014; Trope *et al.*, 2015).

The treatment of choice is immediate replantation and splinting the replanted tooth in its correct anatomical position for optimum healing which will ultimately restore the patient's aesthetics and function (Andreasen *et al.*, 2004; von Arx, 2005; Abu-Dawoud *et al.*, 2007; Keels, 2014). Emergency treatment of an avulsed permanent tooth can enhance the prognosis and minimize the complications that could occur such as; tooth loss, long-term expensive and extensive treatment (Abu-Dawoud *et al.*, 2007; Emerich and Wyszowski, 2010). The prognosis of dental injury complications depends to a large extent on the immediate and appropriate emergency management of the TDI by the medical professional as well as caregivers (Lin *et al.*, 2006; Díaz *et al.*, 2009). In light of the fact that the majority of TDI occur either at home, in school playgrounds and sports fields, there is a need even for parents and teachers to also be aware of how to manage a TDI before the child presents at an EC (Zaleckiene *et al.*, 2014).

The crucial factors that can affect the management of the avulsed tooth are: (i) if the tooth has a closed or open apex, (ii) if the tooth is stored in suitable storage media and (iii) the extra-oral dry time out of the socket (Holan and Shmueli, 2003; McIntyre *et al.*, 2009; Andersson *et al.*, 2012).

There are three reasons that contribute to the postponement of an avulsed tooth treatment. Firstly, the traumatized patient, especially children, need to cooperate (Roberts *et al.*, 2000). Secondly, the knowledge of the lay person on TDI at the accident site is important (Blakytyn *et al.*, 2001; Holan and Shmueli, 2003; Al-Jame *et al.*, 2007; Rajab *et al.*, 2013). Thirdly, bleeding and lacerations associated with the avulsion injury make it difficult to identify the loose tooth (Holan and Shmueli, 2003).

Management of the avulsed tooth after the tooth is located include; handling the tooth by the crown part only and not the root to avoid any damage to the periodontal ligament cells (PDL) covering the root, as the PDL assists with further reattachment to the bone (Ceallaigh *et al.*, 2007; Andersson *et al.*, 2012; Keels, 2014). Prior to replantation, it is essential to confirm that the avulsed tooth is a permanent and not a primary tooth (Andersson *et al.*, 2012; Keels, 2014). Primary teeth should not be replanted due to the possible risk of damaging the underlying permanent successors (Andreasen *et al.*, 2013; Keels, 2014). The avulsed tooth should be washed under running water for 10 seconds if the tooth is contaminated in order to remove any debris, and then repositioned in the socket (Ceallaigh *et al.*, 2007; Andersson *et al.*, 2012; Keels, 2014). The tooth must be stabilized in position by using splint techniques or by asking the child to bite on gauze or cloth until he/she reaches the dental clinic (Ceallaigh *et al.*, 2007; Andersson *et al.*, 2012; Keels, 2014). In addition, Tetanus prophylaxis should be administered if the patient's immunization is not up to date (Ceallaigh *et al.*, 2007). Tetanus is a fatal disease caused by the bacterium *Clostridium tetani* which enters the body through a severe wound injury (McVicar, 2013). Mortality is high ranging between 20-50% in developing compared to developed countries due to the preventive tetanus vaccination measures (McVicar, 2013). Approximately 5.8% of EC visits consist of open wound treatment and possible infection complications (Ball and Younggren, 2007).

Hence, the emergency doctor needs to identify which patients attending with wounds need Tetanus prophylaxis. Correct wound assessment and seroprotection status can be achieved by two methods: Firstly, by asking the patient if they have had a full course of primary tetanus vaccine and when they last received a booster injection dose (Cassell, 2002). Evidence revealed that the complete full course of primary tetanus vaccination assures long-term protection (Chapman *et al.*, 2008). Also, the Advisory Committee on Immunization Practices (ACIP) recommends a routine booster with tetanus toxoid (TT) vaccines every 10 years after the full course of childhood tetanus vaccination (Chapman *et al.*, 2008).

Secondly, by determining if the wound is a tetanus prone or non-tetanus prone wound (Cassell, 2002). A tetanus prone wound is a wound or burn that was sustained for more than six hours before any treatment or a wound with any of these features: a significant amount of tissue damage, abscesses, open fractures, a penetrated wound and contaminated wound with soil or rusty object (Rhee *et al.*, 2005; Park, 2009; Chowdhury *et al.*, 2011). In fact a large proportion of patients cannot recall if they have received 5 previous doses and are mainly unsure when they have had the last booster dose (McVicar, 2013). A wound prone related tetanus can be prevented by the administration of the TT booster if the patient has completed the primary tetanus vaccination dose, but the history of the last booster received was more than 5 years (Chapman *et al.*, 2008; Stevens *et al.*, 2014). If the patient has not completed the primary tetanus vaccination dose or was unsure about the vaccination series, then TT and Tetanus Immune Globulin (TIG) should be considered (Broder *et al.*, 2006; Chapman *et al.*, 2008; Ghiya *et al.*, 2017).

In order to identify which patients need tetanus prophylaxis, Tetanos Quick Stick is a single-step immunoassay that can be used to calculate the tetanus seroprotection level in ten minutes with one single drop of blood (McVicar, 2013). This strategy avoids guesswork and unnecessary treatments especially in TDI cases such as tooth avulsion before attempting any replantation management (McVicar, 2013).

If immediate replantation is not possible, then the avulsed tooth should not be allowed to dry as the PDL which attaches the tooth to the bone will undergo necrosis after 2 hours (Ceallaigh *et al.*, 2007). The tooth should immediately be placed into a suitable medium that will maintain vitality of the PDL (Keels, 2014). The ideal storage medium should be able to maintain the PDL cells over the root of the avulsed tooth (Sharma, 2016) and preserve the functional capacities of the PDL cells (Ashkenazi and Shaked, 2006; Poi *et al.*, 2013). The recommended storage mediums in order of preference are: Hank's Balanced Salt Solution (HBSS), milk and physiologic saline. HBSS was found to have a greater capacity to preserve the vitality of the PDL for a longer period of time (Ram and Cohenca, 2004; Malhotra, 2011; Andersson *et al.*, 2012).

Although physiologic saline solutions have an osmolality (280mOsm) compatible with that of PDL cells, these solutions lack the essential nutrients required by the PDL cells for their metabolic function such as; calcium, magnesium and glucose for cell metabolism (Gopikrishna *et al.*, 2008). Milk will preserve PDL cells up to 6 hours, due to its osmolality and the pH is

within an adequate biological range (Malhotra, 2011; Andersson *et al.*, 2012). According to literature milk has the following benefits: (I) The physiological properties like pH (6.5-6.8) and osmolality (250mOsm) are compatible with PDL cells (Ashkenazi and Shaked, 2006); (II) the presence of nutrients like amino acids, carbohydrates, vitamins and growth factors (Ashkenazi and Shaked, 2006); (III) pasteurization makes it free from bacteria (Blomlöf *et al.*, 1983).

If the three storage media mentioned above are not available, the tooth can be transported in the mouth between the molar teeth and the cheek (Ceallaigh *et al.*, 2007). Saliva as storage medium is not desirable because it can cause contamination with bacteria but it is better than leaving the tooth surface dry (Ram and Cohenca, 2004). The osmolality of saliva (17mOsm) is much lower than physiological osmolality (60-70mOsm) thus causing cell lysis due to hypotonicity (Panzarini *et al.*, 2008). In addition, it is laden with micro-organisms which can infect the root and cause necrosis (Panzarini *et al.*, 2008). Water is the least desired storage medium because the hypotonic situation causes cell lysis within a few minutes and increased inflammation on replantation (Ram and Cohenca, 2004).

2.6.2.1 Splinting Methods

The stabilization of the injured tooth by using the adjacent sound teeth is considered the best treatment (Andreasen *et al.*, 2004). The splint should allow some physiologic mobility to promote healing of the periodontal tissues (von Arx, 2005). Modern tooth splinting requires splints that can be created quickly using conventional dental materials and that are easy to apply, inexpensive, and easy to remove without damaging dental hard tissue (Berthold *et al.*, 2009). Splints should not interfere with occlusion, dental hygiene, or endodontic treatment (Berthold *et al.*, 2009). The recommended wire-composite splint, with material variations, meets the ideal requirements of current splinting concepts in dental traumatology (von Arx, 2005).

In a hospital setting splinting of an avulsed tooth can be managed easily by using a suture or aluminum foil, which is available in every kitchen or from any chocolate bar as a temporary splinting method (Wyatt, 2005; Lin *et al.*, 2008a; Murtagh, 2016). Also, simple splints can be prepared with moulding blue-tack (Beech *et al.*, 2015) or by applying a piece of malleable metal from a Hudson mask with skin glue (Rosenberg *et al.*, 2011).

The replanted permanent tooth should be splinted for up to two weeks to avoid any complication associated with the longer period splinting, such as ankylosis (Andersson *et al.*, 2012). The only exception to this is when avulsion occurs in conjunction with alveolar bone fractures, when the tooth should then be splinted for a period of four weeks for optimal healing (Flores *et al.*, 2007b; Auld and Wright, 2010).

2.6.3 Dento-alveolar Bone Fracture

Dento-alveolar fractures are the most severe form of TDI which involve a fracture of the supporting alveolar bone (Flores *et al.*, 2007a). Alveolar bone fractures usually present along with other dental injuries such as: luxation, avulsion and tooth root fractures (Flores *et al.*, 2007a).

Dento-alveolar fractures are primarily characterized by: pain, mobile tooth/teeth and sometimes lost tooth /teeth (Flores *et al.*, 2007a; Ceallaigh *et al.*, 2007; Epstein *et al.*, 2010). Dento-alveolar fractures may involve several teeth which will be mobile as a unit or displaced as a segment and cause difficulty in mouth opening, variation in jaw movement, change in occlusion, noises in the temporomandibular joints (TMJs), difficulty in speaking or chewing, numbness of the lip or chin, bleeding gums and floor of the mouth and tongue injury (Andreasen, 1970; Ceallaigh *et al.*, 2007; Flores *et al.*, 2007a; Epstein *et al.*, 2010).

Alveolar bone fractures are managed under local anaesthetic by manually repositioning the loose bone segment using a finger to manipulate the teeth and direct the bone back into proper position (Ceallaigh *et al.*, 2007; Andreasen *et al.*, 2012). The occlusion should be assisted after returning the injured teeth to the normal position in the arch (Power, 2013). A rigid splint is placed on the teeth to hold the fractured bone segments together for optimal healing (Andreasen *et al.*, 2012; Power, 2013). The alveolar bone fracture can be managed with an urgent referral to a maxillofacial surgeon as soon as possible (Andreasen *et al.*, 2012; Power, 2013).

2.7 Treatment Instructions after Traumatic Dental Injury

Proper healing of the TDI depends on the severity of the injury and oral tissue damage (Diangelis *et al.*, 2012; Andersson *et al.*, 2012; Andreasen *et al.*, 2012). Good oral hygiene also plays an important role in the healing process of TDI (Andersson *et al.*, 2012; Andreasen *et al.*, 2012). Advice to the patient should include having a soft diet for 10 days and brushing with a

soft tooth brush (Diangelis *et al.*, 2012; Andersson *et al.*, 2012). In severe TDI cases e.g. tooth avulsion and alveolar bone fracture, an appropriate antibiotic such as amoxicillin 500 mg orally every 8 hours for one week is recommended (Beech *et al.*, 2015). A simple analgesic can be prescribed based on the TDI severity (Mehlich *et al.*, 2010). The use of 0.1% chlorhexidine topically with cotton swabs for children (on the affected area twice a day) and rinsing for adults (for one week) is recommended to avoid plaque accumulation (Diangelis *et al.*, 2012; Andersson *et al.*, 2012).

After the initial emergency visit, the TDI requires immediate attention by a dental professional (Soriano *et al.*, 2007). Studies showed that many patients do not consult a dentist after the initial treatment by emergency doctors (Gabris *et al.*, 2001; Soriano *et al.*, 2007). The patient should be referred by the emergency doctors to the dental clinic as early as possible for further treatment as complications such as pulp necrosis or root resorption may occur (Beech *et al.*, 2015).

In general, whether TDI occurs as a simple dental injury or as a complex maxillofacial injury, patients often initially present at the hospital EC's (Díaz *et al.*, 2009). The patient with a TDI expects that the emergency physician is qualified to diagnose and manage the dental injuries (Díaz *et al.*, 2009).

2.8 The Knowledge and Practice of Emergency Doctors in the Emergency Center

The emergency center (EC) serves as the spearhead to the hospital as it has to deal with a broad spectrum of patients with different ailments and injuries (Beebe *et al.*, 2009). Emergency centers are responsible for managing both urgent medical and dental injuries (Beebe *et al.*, 2009). People with serious damage to their teeth usually report to EC's, where they come by their own means or are brought by ambulances, and expect to receive immediate dental care (Berman *et al.*, 2006).

Patients with TDI present to the hospital EC mostly late evenings, on weekends and after hours, when dental clinics are closed (Pettersson *et al.*, 1997; Lewis *et al.*, 2003; Santos *et al.*, 2011; Samaei *et al.*, 2015). Patients from low socio-economic communities prefer to attend public dental clinics due to affordability (Skapetis *et al.*, 2011). Also concerns of non-attendance at work, transportation difficulties and child-care issues interfere with seeking dental treatment immediately after the injury (Edelstein *et al.*, 2006; Glendor *et al.*, 2008).

In addition, many patients who have no dental insurance cover, might prefer the hospital's EC, or any other medical office who can manage the problem (Lewis *et al.*, 2003) since individuals are more likely to have medical insurance than dental insurance (Vargas *et al.*, 2002). Physicians usually perform emergency dental treatment in hospitals that lack a regular dentist or dental clinics within their emergency services centers (Díaz *et al.*, 2009). Patients presenting with dental problems make up 0.3-4% of all patients visiting the EC (Skapetis *et al.*, 2011; Trivedy *et al.*, 2012).

In fact, the prevalence of dental trauma in EC's varies depending on: the geographical location; the different medical insurance systems; different socioeconomic and cultural behaviour diversities (Mahmoodi *et al.*, 2015). The prevalence of TDI is reported to be quite frequent ranging between 0.4 % -1.2 % of all hospital visits in the US (Waldrop and Ron, 2000), 66 % in Korea (Bae *et al.*, 2011), 8 % in Germany (Mahmoodi *et al.*, 2015), 27.7 % in the United Kingdom (Portman-Lewis, 2007), 8.4 % in France (Tramini *et al.*, 2010) and 11 % in Greece (Lygidakis *et al.*, 1998).

The prognosis for TDI depends on timely and appropriate emergency management provided immediately after the injury (Andreasen *et al.*, 2002; Petrovic *et al.*, 2010). The poor prognosis of the traumatized tooth due to delayed or improper treatment has an economic and psychosocial effect (Marcenes *et al.*, 2001; Needleman *et al.*, 2013).

Unfortunately, many studies have reported that such primary care was not delivered in up to 50% of dental trauma cases that required first aid treatment, while 59 % of patients received inadequate treatment (Hamilton *et al.*, 1997; Chadwick *et al.*, 2006). In another study only 28% of TDI's received any interventions (Traebert *et al.*, 2006). A study by Batstone *et al.*, (2004) in Australia evaluated the time interval in emergency management of TDI in children at a tertiary referral hospital and concluded that there was approximately a nine hour delay between injury and management.

2.9 South Africa's Health Care System

South Africa's health care system is divided into private and public sectors. The public health sector provides care for about 80% of the population while the rest of the population is served by the private sector (Wallis and Twomey, 2007). Approximately 80% of the funds spent on health in SA are spent in the private sector, by only 17% of the population (Cullinan, 2006).

Public health care in SA is supported by government funds with minimal resources. The poor infrastructure serves mainly the poor and uneducated population (Wallis *et al.*, 2008). South Africa's public healthcare system has three categories of hospitals namely: district (level 1), regional (level 2), and tertiary (provincial tertiary and national central) (level 3) hospitals and each one provides different levels of service (Cullinan, 2006).

South Africa's public hospitals constitute 388 hospitals, among them 64% are level 1 while level 2 makes up to 32% and level 3 tertiary hospitals comprise less than 4% of all public sector hospitals (Cullinan, 2006).

District hospitals are the mainstay of care and the first level of referral, staffed by general practitioners who cover all disciplines, including emergency care, with access to basic diagnostic and therapeutic services. Each district hospital refers to a regional hospital where a higher level of investigative support and emergency care is provided and staffed by general practitioners and specialists (Cullinan, 2006). Tertiary hospitals are the highest point of the referral system and offer support to a number of Regional Hospitals (Cullinan, 2006). These hospitals are staffed with specialists and subspecialists in highly specialized national referral units, multi-specialty clinical services, research and emergency care units (Wallis and Twomey, 2007; Cullinan, 2006). An EC is found within every care hospital, yet not every EC is a trauma unit, as is the case in most district hospitals (Hardcastle *et al.*, 2016).

2.9.1 Emergency Medicine in South Africa

Emergency medicine (EM) formal graduate training programs began in developed countries such as the USA in the early 1970s (Arnold and Holliman, 2005), while in South Africa, EM was added to the list of recognized specialties in 2003 and in 2004 when the College of Emergency Medicine (CEM (SA) was officially licensed (Wen *et al.*, 2011). The first 27 specialists who graduated from University of Cape Town (UCT) and Stellenbosch University (SU) programme found their major deficiency of their training in two areas: (74%) found paucity of job options and (70%) found the defect in the academic preparation (Wen *et al.*, 2012). The annual survey of African Federation for Emergency Medicine (AFEM) explored the needs of EM who have graduated since 2012 from Sub-Saharan African. These included one university at Tanzania, Ethiopia, Ghana, and four the Universities in South Africa (Bae *et al.*, 2016). The respondents reported that AFEM can help new EM graduates by continues

supporting the educational materials, development of leadership and mentorship (Bae *et al.*, 2016).

2.9.2 Emergency Centers in South Africa

Trauma forms a significant component of the emergency center workload at public hospitals (Hardcastle *et al.*, 2016). Previous studies have shown that the workload of EC in Cape Town at level 1 district hospital was about 25% (Wallis and Twomey, 2007), at urban level 2 regional hospitals 28% (Hodkinson and Wallis, 2009) and at a rural level 2 regional hospital (Hanewinckel *et al.*, 2010) 36% of cases were trauma related. Over 90% of trauma deaths occur in Low and Middle Income Countries (LMICs), yet facilities that can provide optimal care are lacking in many countries (Hardcastle *et al.*, 2016).

In nearly all cases, early and appropriate management can significantly minimize the distress associated with and improve the prognosis of many of the resulting TDI's (Andreasen *et al.*, 2002). It is nevertheless of the utmost importance that persons who attend to injured individuals in the immediate period following dental trauma have the appropriate knowledge and skill to provide dental trauma first aid.

It is crucial that doctors in EC's of hospitals have the appropriate knowledge to assess and treat dental trauma (Needleman *et al.*, 2013). A lack of appropriate knowledge can lead to premature referral or late referral in cases that can easily be managed by the emergency doctor (Samaei *et al.*, 2015).

Several studies reported that emergency doctors with insufficient knowledge and training may have difficulty in providing an appropriate examination, diagnosis, timely management, and proper referral of dental trauma cases (Holan and Shmueli, 2003; Abu-Dawoud *et al.*, 2007; Skapetis *et al.*, 2011; Needleman *et al.*, 2013; Samaei *et al.*, 2015; Nayak *et al.*, 2016).

Emergency centers mainly treat dental trauma symptomatically by prescribing analgesics, antibiotics and/or referral to a dental clinic (Pennycook *et al.*, 1993). The patients then have to frequently return to the EC's for the same issue at high costs to patients, insurance companies, and the taxpayer (Douglas Von Kaenel *et al.*, 2001; Quinonez *et al.*, 2009).

The knowledge and skills regarding dental anaesthetic techniques are essential in order for the emergency doctors to effectively manage TDI (Skapetis *et al.*, 2011). Dental anaesthesia techniques were recorded as the top six most demanded education topics in a training requirement analysis conducted amongst Australasian College for Emergency Medicine (ACEM) Fellows, (Dent *et al.*, 2008). A study to evaluate the confidence of medical doctors on the delivery of local anaesthesia in the United States showed that most of the participants were inexperienced with local anaesthesia techniques (Deeb *et al.*, 2016).

The avulsed tooth injury is the most common emergency presentation in addition to dental pain (Skapetis *et al.*, 2011). Although the treatment of the avulsed tooth is quite straightforward there was a general lack of knowledge among medical practitioners in managing tooth avulsion (Holan and Shmueli, 2003; Abu-Dawoud *et al.*, 2007; Díaz *et al.*, 2009; Deeb *et al.*, 2016), (Abu-Dawoud *et al.*, 2007; Trope, 2011; Andersson *et al.*, 2012; Keels, 2014).

Studies showed that without adequate dental knowledge, diagnosis, timely assessment and appropriate dental referral might be compromised (Douglass *et al.*, 2005; Sardella *et al.*, 2007). Therefore, oral examination should form part of the physician's normal screening process (Sardella *et al.*, 2007; Yellowitz, 2008).

Several studies showed that the emergency management of TDI conditions by medical practitioners was often difficult and this was due to the lack of education and training in dental emergencies (Díaz *et al.*, 2009; Trivedy *et al.*, 2012; Needleman *et al.*, 2013; Samaei *et al.*, 2015). A study by Lin *et al.*, (2006), found that only 5.9% of all doctors had education on dental trauma. Sixty one point eight percent indicated that they came across dental injury in their military service period (Lin *et al.*, 2006). Another study reported that 50% of the participants had not received any information on dental trauma management (Holan and Shmueli, 2003).

A study conducted in England found that only 6% of EC medical doctors received some sort of dental training in medical school (Nasr *et al.*, 2013). In Iran a study surveyed 151 physicians who reported that more than 90% of them had not received any dental first aid training (Raouf *et al.*, 2013). Similar results were also found by Díaz *et al.*, (2009), who conducted research at an EC to evaluate the level of knowledge and the attitudes regarding first aid management of TDI amongst doctors and paramedical technicians (Díaz *et al.*, 2009). The authors found that the majority of them were not educated regarding the management of TDI (Díaz *et al.*, 2009).

This finding emphasizes the need for effective medical education and training in increasing the knowledge and skills of the management of TDI at the EC (Díaz *et al.*, 2009). In order to ensure proper diagnosis and appropriate management of patients with TDI, it is of utmost importance that emergency medical professionals have adequate training in the basic information and management of dental trauma (Díaz *et al.*, 2009)

2.10 Ways to improve the Medical Doctors knowledge in managing traumatic dental injuries

The literature clearly shows that there is a lack of knowledge and dental training for medical practitioners (Holan and Shmueli, 2003; Díaz *et al.*, 2009; Trivedy *et al.*, 2012; Nasr *et al.*, 2013) which makes it difficult for the practitioner to adequately diagnose, treat and refer TDI cases. The current literature recommends that dental courses, lectures and seminars should be included in the undergraduate and postgraduate health science curriculum of medical students to address the issue of a lack of TDI knowledge (Holan and Shmueli, 2003; Díaz *et al.*, 2009; Trivedy *et al.*, 2012; Nasr *et al.*, 2013). Furthermore, there should be continued formal education and training with periodic interactive workshops for the graduated physicians. Improving the TDI knowledge among front-line primary care providers together with effective TDI training would improve the management and outcomes of TDI's (Holan and Shmueli, 2003; Díaz *et al.*, 2009; Trivedy *et al.*, 2012; Nasr *et al.*, 2013).

2.10.1 Health Science Curriculum of Medical Students

Most emergency medical physicians might lack the appropriate skills in managing TDI's due to the lack of information on this subject in the undergraduate medical curricula (Addo *et al.*, 2007; Traebert *et al.*, 2009; Skapetis *et al.*, 2011; Nayak *et al.*, 2016).

An active approach to address the above problem may be to include an educational course about TDI emergency management in the medical curriculum (Skapetis *et al.*, 2011). Medical students could take part in interdisciplinary seminars and case discussions within dental departments (Raof *et al.*, 2013).

In recent years, there has been an increased interest in training physicians to provide oral health care (Cohen, 2012). The reason for this interest comes from the understanding that poor oral health outcomes are linked to multiple general health problems, including systemic illness such

as cardiovascular disease (Schiavo, 2011). Reports to integrate medicine and dentistry was published by the Institute of Medicine, the Department of Health and Human Services, and the American Association of Medical Colleges in order to clarify the role of physicians in addressing dental problems and outline medical school curriculum objectives (Cohen, 2012).

Oral health care has become an essential topic in the core curriculum of Chinese medical schools (Lu *et al.*, 2015). In 2002, Chinese medical schools designed and implemented a new strategy of dentistry education for medical students in Capital Medical University Beijing (Lu *et al.*, 2015). A similar approach was applied at the University of Washington Medical School in which they developed and implemented an oral health curriculum for medical students that led to increases in students' knowledge and attitudes toward oral health care (Mouradian *et al.*, 2006).

Since 2006, oral health training has been required to be included in all family medicine residency programs (Douglass *et al.*, 2009). In 2005, New York University placed a college of nursing within the college of dentistry (Spielman *et al.*, 2005). As part of the interdisciplinary educational model, paediatric nurse practitioner students work along with dental students to provide care in school clinics and Head Start programs (Hallas and Shelley, 2009). The challenge is how to make dental health teaching programs effective and attractive in the medical student's curriculum (Mouradian *et al.*, 2006).

Some studies have shown that teaching and training programs in dental health campaigns have stimulated positive interest and enthusiastic attitudes from medical students (Mouradian *et al.*, 2006; de Sousa Eskenazi *et al.*, 2011). Lu *et al.* (2015) reported that more than 95% of students indicated great benefits from clinic-based dental education while studying theoretical information (Lu *et al.*, 2015).

2.10.2 Continuous Education for Post Graduate and Graduate Physicians

Cruz-da-Silva *et al.*, (2016) investigated the effect of an educational intervention in improving the level of knowledge on managing tooth avulsion injury among emergency medical service personnel in Brazil over a six-month period (Cruz-da-Silva *et al.*, 2016) and reported that the level of knowledge increased significantly and remained high after the six month follow-up (Cruz-da-Silva *et al.*, 2016). Furthermore, a Cochrane Systemic Review indicated that solely providing information is unlikely to change professional practice as compared to interactive

workshops which are considered to be the most preferred format of future continuing professional development (CPD) (Thomson O'Brien *et al.*, 2001). In 2015, an Australian study reported that interactive workshops supported by seminars, visual presentations, and case-based conferences were the most effective educational methods (Samaei *et al.*, 2015).

Other countries such as the United States and Puerto Rico have made efforts to include dental education at the postgraduate level and continuing medical education (CME) for graduates such as paediatricians (Krol, 2004).

Systematic reviews on CME have concluded that the most effective CME should cover various dental management procedures, techniques, use several media and be supported by multiple educational experiences and exposure for reinforcement (Moore *et al.*, 2009) and have recommended specific dental topics for inclusion into CME modules such as; oral pathology, dental trauma emergencies (Mouradian *et al.*, 2003), dental numbering system, local and regional anaesthesia and splinting techniques (Skapetis and Curtis 2010).

The provision of leaflets, posters, stickers as well as distribution of informational brochures to EC about basic dental emergency treatment to primary care providers, has also be shown to increase knowledge on the topic (Raof *et al.*, 2013).

Hence, medical practitioners must not only be given education but also be adequately resourced with dental materials and instruments to enable them to perform emergency dental procedures that will result in better patient outcomes (Skapetis *et al.*, 2011). A study in the USA has shown that EC's have inadequate resources to allow for timely and appropriate management of TDI (Needleman *et al.*, 2013).

The New South Wales (NSW) Rural Doctors Network in Australia has developed a dental trauma kit which is available to EC's and includes appropriate TDI training (Skapetis *et al.*, 2011). The limitation of resources might not only be confined to equipment and training but might also extend to textbooks as well (Zadik, 2007). Many people who assist at the site of the TDI would also possibly use medical and first-aid books as an easy and quick reference to improve their knowledge (Emerich and Gazda, 2010).

2.10.3 First-aid textbooks and manuals

First-aid textbooks and manuals can be considered as a means to provide appropriate information on how to proceed at the site of TDI (Emerich and Gazda, 2010). It is therefore important that appropriate and current information regarding TDI is available in medical and first aid textbooks (Emerich and Gazda, 2010). This will allow all primary caregivers access to the latest recommendations and provide appropriate management of TDI (Emerich and Gazda, 2010).

Zadik (2007) reviewed nine first-aid textbooks and manuals from the last two decades regarding dental emergency management and found that only one had relevant topics and accurate information about TDI. Zadik (2007) concluded that there was inadequate information on TDI management in most first-aid textbooks. Another study reviewed 45 first-aid textbooks and manuals published between 1969 and 2007 to evaluate TDI guidelines presented in texts books (Emerich and Gazda, 2010). This review found that among those 45 texts and manuals only 19 included procedures of TDI's and only 13 of those texts mentioned the storage media in detail in case of an avulsed tooth. They also concluded that the information in the reviewed texts was misleading (Emerich and Gazda, 2010). Current, evidence-based recommendations about first-aid management after TDI needs be included in new editions of first-aid textbooks and manuals (Emerich and Gazda, 2010).

In addition to the continuous education and first aid books; telephone calls (Zaitoun *et al.*, 2010; Needleman *et al.*, 2013), online information (Flores *et al.*, 2001; Andersson *et al.*, 2012; Diangelis *et al.*, 2012) and handheld devices (Alnaggar and Andersson, 2015) are also useful methods to provide basic knowledge on how to manage TDI for both medical doctors and the general public.

2.10.4 Telephone calls, online information and handheld devices

In a study in the UK, dental complaints were placed as the top three most common EC telephone enquiries (Crouch *et al.*, 1996). The importance of telephone calls and suitable guidance for patients with TDI has been emphasized in a study from the USA (Needleman *et al.*, 2013).

According to a multi-center assessment from the UK, nearly a quarter of the participants received advice via telephone before presenting to emergency care (Zaitoun *et al.*, 2010). It is important to note that the emergency telephone respondents must have knowledge and experience to provide verbal instructions of trauma first aid advice per telephone or at least have access to emergency protocols (Zaitoun *et al.*, 2010).

Basic information on how to manage a TDI can easily be accessed on the Internet (www.iadt-dentaltrauma.org) (www.dentaltraumaguide.org) (Alnaggar and Andersson, 2015). The International Association of Dental Traumatology (IADT) guidelines for emergency management of TDI has been available since 2001 (Flores *et al.*, 2001) and the present IADT guidelines were updated in 2012 (Andersson *et al.*, 2012; Diangelis *et al.*, 2012).

Also, an application called ‘Dental Trauma’ for handheld devices such as smart phones has been launched for the general public (Alnaggar and Andersson, 2015). This first aid application provides the necessary information about what to do in case of a dental trauma emergency. The application can be found on the IADT web page and downloaded or bought from the application stores (<https://play.google.com/store/apps/details?id=com.dentaltrauma&hl=en>). Handheld devices might be a good method to bring first aid information to the site where the accident has occurred as handheld devices are almost always available in people’s pockets and handbags (Alnaggar and Andersson, 2015).

2.11 Conclusion

Many studies revealed that the majority of emergency doctors lack knowledge regarding the appropriate emergency management of traumatic dental injuries (Holan and Shmueli, 2003; Qazi and Nasir, 2009; Samaei *et al.*, 2015; Deeb *et al.*, 2016). Emergency management of traumatic dental injuries has yet to be incorporated in the medical curriculum of most medical schools (Holan and Shmueli, 2003; Lin *et al.*, 2006; Nasr *et al.*, 2013).

There is a lack of training in emergency dental care and therefore medical doctors generally prefer not to manage traumatic dental injury cases. This may lead to improper management of traumatic dental injuries thereby having a negative effect on the quality of life of the patient presenting with traumatic dental injuries.

CHAPTER 3: AIMS AND OBJECTIVES

3.1 Aim

The aim of the study was to evaluate the knowledge of medical doctors in the emergency trauma unit at a district, regional and central academic hospital in the management of Traumatic Dental Injury (TDI) in Cape Town, in the Western Cape Province, South Africa.

3.2 Objectives

The objectives of this study were:

1. To evaluate emergency doctors' knowledge and practice at a trauma unit in managing TDI.
2. To compare the knowledge and practice of emergency doctors at the different hospitals in managing TDI.
3. To determine the association between age and the knowledge of emergency doctors in management of traumatic dental injury
4. To determine the association between age and practice of emergency doctors in management of traumatic dental injury

CHAPTER 4: MATERIALS AND METHODS

4.1 Study design

This cross-sectional, descriptive study was conducted in the trauma unit of the Emergency Centers of three hospitals in Cape Town, in the Western Cape Province, South Africa. A cross-sectional study is aimed at determining the frequency (or level) of a particular attribute in any health-related event, in a defined population at a particular point in time (Levin, 2006).

4.1.1 Quantitative method

Quantitative research is the numerical representation and manipulation of observations for the purpose of describing and explaining the phenomena that those observations reflect (Creswell, 2013). The type of quantitative research conducted in this study was survey research. Respondents filled out self-administered questionnaires. Particular close-ended questions were structured to be answered in a quantitative way by designing research instruments aimed specifically at converting phenomena that naturally exist in quantitative form into quantitative data, which can be analyzed statistically.

4.2 Study site

This study was conducted in the trauma unit of the Emergency Centers at Karl Bremer Hospital (District hospital), New Somerset Hospital (Regional Hospital) and Groote Schuur Hospital (Tertiary Hospital) in Cape Town, in the Western Cape, South Africa.

4.3 Study population and sample size

A convenience sample was selected for this study to focus on particular characteristics of a population that was of interest. All the medical doctors working in the emergency trauma units at Karl Bremer (31 doctors), New Somerset (10 doctors) and Groote Schuur (13 doctors) hospitals were included in this study (n = 54). Therefore, in this study all the medical doctors at the trauma unit as well as all the doctors who attended the unit in rotation from other departments were included. The number of doctors was provided from the head of the emergency center trauma unit in each hospital.

4.3.1 Inclusion criteria

- medical doctors who worked at the three selected hospitals' emergency center, particularly the emergency trauma unit.

4.3.2 Exclusion criteria

- all other personnel working at the emergency center who are not a medical doctor

4.4 Ethical considerations

Permission to conduct the study was obtained from the following authorities:

1. Dental Faculty Research Committee of the University of Western Cape
2. Senate Research Committee of the University of the Western Cape
3. Department of Health (DoH) Research Committee
4. Superintendents of all the hospitals included in the study

The ethics approval reference number received was 14/10/66.

4.5 Informed consent and information sheet

An information sheet with details regarding the research study process and a consent form was provided to all respondents on an official University letterhead (Appendix 2-3).

4.6 Data Collection

This study used primary data collected in the form of questionnaires from three hospitals viz. Karl Bremer, New Somerset and Groote Schuur hospital in the Western Cape. Ethical approval was provided by the Dental Faculty Research Committee of the University of the Western Cape (UWC) and the Department of Health (DoH) Research Committee, to conduct this research study. Once approval was obtained from the DoH to conduct the study, a letter explaining the research study was sent to the three superintendents of Karl Bremer, New Somerset and Groote Schuur Hospital to request them to accommodate us for the study.

4.7 Methodology

The present study was a cross-sectional study and involved mostly quantitative data which was collected from a questionnaire designed to address the aims of the research. The researcher visited the three hospitals involved in the study in order to ascertain the number of doctors present in each hospital. An appointment was made with the head of the EC trauma unit at the three selected hospitals. The study protocol was given to the three mentioned HOD's together with the Ethical approval documentation. The heads of the EC trauma units provide the researcher with the number of medical doctors in their department. The data was collected by distributing a standardized questionnaire form (Appendix 1) to the target groups, between May and July 2016.

Information explaining the research objectives was handed to all respondents and written informed consent was obtained from the subjects prior to the study. The subjects were informed that anonymity of the responses would be maintained. The respondents' privacy was respected and name and telephone numbers were not included in this study. Confidentiality was strictly maintained.

Questionnaires were distributed to all doctors working at the trauma unit of the emergency centers in the three hospitals; Karl Bremer, New Somerset and Groote Schuur Hospital. The researcher gave the questionnaires to the HOD in each hospital and collected them back between the periods May to July 2016. During this period the researcher was following up with the participants by performing multiple visits as in KBH, by calling and reminding the head of the trauma unit's secretary which was the case at GSH or by following up with HOD such as in NSH.

The questionnaire contained 36 questions and was divided into three parts viz.:

Part I included four questions on personal information (demographic data; such as age, gender, marital status, and type of qualification).

Part II included seven general questions regarding traumatic dental injuries (such as past experience in treating dental trauma, former education regarding diagnosis and treatment of dental trauma and assessment of knowledge regarding TDI).

Part III contained twenty-five questions based on knowledge and management of specific clinical types of TDI; such as avulsed tooth treatment, tooth and alveolar bone splinting as well as method of prevention.

4.8 Validity and reliability

The validity of the questionnaires was established using face validity and content validity conducted by experts in the field, which included the research supervisor and by distributing it among a few colleagues (n = 12) at the UWC Dental Faculty so as to assess the clarity of the questions, language and to estimate the time required to fill in the questionnaires. All participants who reviewed the questionnaires agreed that the questionnaires covered the full range of the issue and was a valid measure of the study concept. The reliability of the questionnaires was evaluated using Cronbach’s alpha measure which is an important concept in the evaluation of assessments and questionnaires (Tavakol and Dennick, 2011). Cronbach’s alpha is the most commonly used objective measure of reliability to provide a measure of the internal consistency (Tavakol and Dennick, 2011). It is stated as a number ranging between 0 and 1 and a reliability alpha of .70 or higher is considered acceptable (Tavakol and Dennick, 2011). Hence in this study with a value of alpha 0.72 (Table 3 below), the questionnaire was considered to be a reliable measure.

Table 3: Questionnaire Reliability Statistics

Cronbach’s Alpha	Cronbach’s Alpha based on standardized items	No of items
0.723	0.725	28

4.9 Data analysis

The collected data was entered into a database (spreadsheet) using Microsoft Excel® 2011. Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS) version 21.0 and Epi Info v. 7. Statistical analysis was conducted using the Chi-square, T-test or ANOVA tests with a level of significance set at $P < 0.05$. Data was expressed in terms of frequencies and percentages.

CHAPTER 5: RESULTS

5.1. Demographics Characteristics

In this study, data was collected from Groote Schuur hospital (GSH), Karl Bremer hospital (KBH) and New Somerset hospital (NSH). These three hospitals represent a tertiary (central academic) hospital, a district hospital and a regional hospital respectively. The doctors who work in the trauma unit of the Emergency Centers in these hospitals were selected for the study and completed the research questionnaires. A total of 54 doctors were sampled for the survey. The demographic characteristics of the respondents are illustrated below in Table 4. The sample was almost equally presented by males and females. The majority (59.3%) was single and the mean age was 30 years.

Table 4: Demographic characteristics of the respondents

		n	%
Gender	Female	26	48.1
	Male	28	51.9
Hospital	GSH	14	25.9
	Karl Bremer	30	55.6
	Somerset	10	18.5
Marital Status	Single	32	59.3
	Married	21	38.9
	Divorced	1	1.90
Age group	24 - 29	32	59.3
	30 - 47	22	40.7

5.2 General knowledge of the emergency doctors on traumatic dental injury

The questions on prior training of doctors on TDI showed that 18.5% (10) of doctors acknowledged to having received a training program. The sources of training received by 4 respondents showed that 54.5% had obtained information such as reading articles about dental trauma during their practice at the hospital, while 60% (6) had received lectures during their undergraduate program. Although 64.8% (35) of emergency doctors indicated that someone they know had experienced TDI in the past, 81.5% (44) indicated that they had not received

any form of training on TDI. The respondents were asked about their skills on the management of TDI's. From the analysis 66.67% (36) reported that they had come across cases of dental trauma during their clinical activities in the hospital. On the other hand, the respondents were asked if they were competent to splint an avulsed tooth as a treatment method their responses are illustrated in table 5.

Table 5: Competence to splint an avulsed tooth

		n	%
Do you feel competent to splint an avulsed tooth?	Very likely	1	1.85
	Likely	3	5.56
	Unlikely	50	92.59

Regarding participants' response about the knowledge to appropriately manage TDI, the majority (96 %) of doctors reported to have insufficient knowledge to manage TDI.

5.3 Management of TDI in specific clinical scenarios

5.3.1 Tooth avulsion

In the case of transport media for an avulsed tooth, among given choices respondents have selected option/s that can be used as transport media and their responses are illustrated in table 6. Almost half (46.3%) (25) of doctors preferred saline as a means to preserve an avulsed tooth compared to 35.2% (19) who preferred to use the patient's mouth, while 14.8% (8) of doctors preferred milk as transport medium (Table 6).

Table 6: Knowledge about the best transport media for an avulsed tooth

		n	%
Chlorhexidine	Yes	1	1.9
	No	53	98.1
Water	Yes	4	7.4
	No	50	92.6
Saline	Yes	25	46.3
	No	29	53.7
Milk	Yes	8	14.8
	No	46	85.2
Patient mouth	Yes	19	35.2
	No	35	64.8

Three point seven percent (2) of emergency doctors were unaware about time of re-implantation of avulsed tooth while 25.9% (14) responded that an avulsed tooth should be re-implanted within 0-1 hours. The majority of the respondents (70.4 %) stated that the ideal time for re-implantation is between 1 and 24 hours.

Similarly, 46.3% (25) of emergency doctors responded that the permanent anterior teeth should be re-implanted, while 37% (20) were not sure. Conversely, 16.7% (9) of emergency doctors indicated that an avulsed permanent tooth should not be re-implanted. The majority of respondents (77.8 %) stated that primary teeth should not be re-implanted compared with 1.9% (1) who stated that it should be re-implanted. Twenty point nine percent indicated that they were not sure about whether primary teeth should be re-implanted or not.

Respondents were asked about the factors that might affect the future prognosis of an avulsed tooth. Considering the choices respondents have selected and which conditions can affect an avulsed tooth prognosis, their responses were illustrated in Table 7. The majority of the respondents (35.2 %) stated that the maturity of an avulsed tooth root and the time that the tooth was out of the mouth are the crucial factors that can affect the prognosis of an avulsed tooth. The majority of the doctors 87% (47) reported that they feel incompetent to re-implant an avulsed tooth (Table 7).

Table 7: Competence to re-implant an avulsed tooth

		n	%
Do you feel competent to re-implant a tooth that has been knocked out?	Very likely	2	3.7
	Likely	5	9.26
	Unlikely	47	87.04

Factors which can affect the prognosis of an avulsed tooth among doctors were also investigated. Almost three quarters (74.1%) did not know which factors can affect the prognosis of an avulsed tooth (Table 8). Almost three quarters (74.1%) reported that the transport medium does not affect the prognosis of an avulsed tooth. Only 35% felt that the time the tooth is out of the mouth had an effect on prognosis.

Table 8: Emergency doctors' knowledge about the factors which can affect the prognosis of an avulsed tooth

		n	%
Don't know	Yes	14	25.9
	No	40	74.1
The medium in which the tooth was transported	Yes	12	22.2
	No	42	77.8
Time that the tooth was out of the mouth	Yes	19	35.2
	No	35	64.8

5.3.1.1 Tooth splinting

The participants' response about the knowledge on when an avulsed tooth should be splinted after TDI is illustrated in Table 9. More than half (53%) of doctors did not know when to splint an avulsed tooth.

Table 9: Knowledge about when a tooth should be splinted after TDI

When should you splint the avulsed tooth?		
	n	%
Always after knocked out	6	11.11
Don't know	29	53.70
Never after knocked out	2	3.70
When crown fracture	6	11.11
When the tooth is mobile	8	14.81
When more teeth are mobile	3	5.56
Total	54	100

In the case injury including alveolar bone fracture, more than half 51.9% (29) of the doctors did not know that the alveolar bone splint must be rigid. Only 14.81% (8) answered correctly and 31.5% (17) answered incorrectly.

The participants' response regarding the materials that can be used to splint the tooth and alveolar bone was also investigated. The majority (79%) had no idea which material was to be used for tooth splinting. About 9.3% (5) reported plastic strap, 7.4% (4) indicated a mouth guard as splint method and 3.7% (2) said that a tongue depressor could be used for tooth splinting.

Regarding tooth fracture together with alveolar bone fracture the majority (75.9%) of the doctors were not aware of the alveolar bone splint materials and the rest indicated measures as follows using a bandage 11.1% (6), wire 11.1% (6) and plate 1.9% (1) to splint an alveolar bone fracture.

The questions about the duration of splinting revealed that 74.1% of doctors were not aware about the time an avulsed tooth should be splinted, 16.7% (9) indicated a time of more than 4 weeks, 5.6% (3) indicated a time within 24 hours and 1.9% (1) indicated a time of one week

Only 1.9% of doctors reported the correct answer of two weeks. Relating to the splint duration for alveolar bone, 38.9% (21) of doctors were not aware about the time alveolar bone should be splinted compared to 33.3% (18) of doctors who indicated the correct answer of four weeks. The rest of the doctors indicated alveolar bone splinting duration as follows: 13% (7) indicated a time of two weeks,

11.1% (6) indicated a time of more than four weeks and 3.7% (2) of doctors indicated a time of one week. However, 92.6% (50) of doctors reported that they are unlikely to splint an avulsed tooth.

5.3.2 Tetanus Prophylaxis administration

Regarding the question on the clinical TDI circumstances for the administration of tetanus prophylaxis, 53.7% (29) of doctors indicated that the tetanus prophylaxis should be administered for contaminated wounds, while 24.1% (13) reported that the tetanus prophylaxis should be administered for all trauma and 22.2% (12) were not sure.

5.3.3 Complicated crown fracture

The knowledge of the respondents on what they would expect to see in a tooth with a pulp exposure, revealed that 70.4% (38) of doctors were not aware of the signs of tooth fracture including pulp exposure while 24.1% (13) and 5.1% (3) reported bleeding and broken tooth, respectively. Also, respondents were asked about the signs of an alveolar bone fracture and their answers are illustrated in Figure 1. The most common answer was that they “don’t know”. Almost a third reported pain (30%) and a quarter mentioned swelling (24%) as the signs of an alveolar bone fracture. Less common signs were bleeding (20%), tenderness (17%) and loose teeth/ occlusion problem (15%).

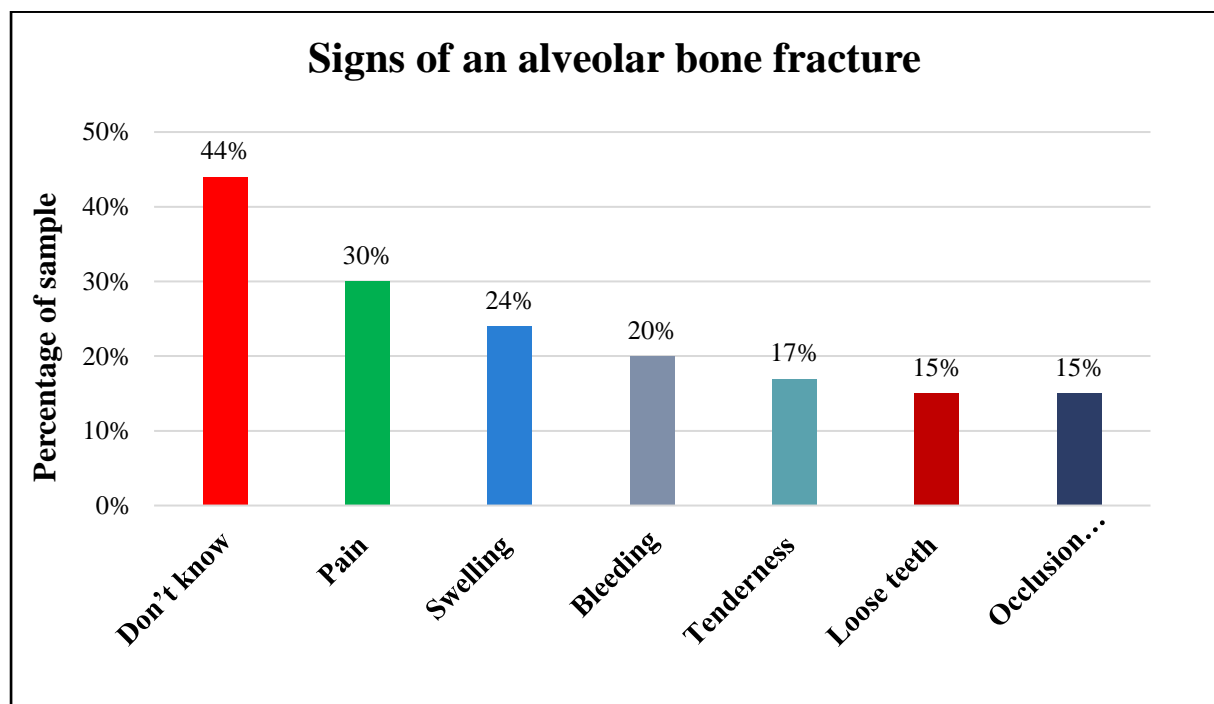


Figure 1: Signs of an alveolar bone fracture

5.3.4. Treatment instructions follow-up after Traumatic Dental Injury

The majority 59.3% of doctors indicated that measures such as a soft diet, use of chlorhexidine mouth rinse and antibiotics prescription can help in the healing process after placement of a splint.

Respondents were asked about when the patient must present for a follow up after an avulsed tooth injury. While 57.4% (31) of doctors correctly indicated that the patient must present after 10 days, 27.8% (15) and 7.4% (4) indicated follow up after 2 weeks and one month respectively.

5.3.5. Role of mouth guards

The knowledge of the respondents about the role of mouth guards (MG) in reducing TDI revealed that 77.78% (42) of doctors indicated that the MG's can prevent hard and soft trauma, whereas 12.96% (7) of doctors indicated that the MG's cannot prevent hard and soft trauma and 9.3% (5) were unaware about the role of MG's as a preventive measure.

Only 7.4% reported that its "True" that all mouth guards can protect against contact sport while the majority (85%) of doctors said that the statement: "All mouth guards provide adequate protection during contact sports", was "False". Almost two third (61%) of doctors reported that they recommend MG's for routine sport while 39% did not know whether they would recommend MG's. The doctors who supported the use of MG's indicated that the motivation was 'to prevent TDI' for 'contact sport'.

5.4 Correlation between the demographic variable and the doctors' knowledge

The percentage of doctors in the study who had training on how to manage TDI was 18.52% (Table 10). However, a higher proportion (22.7%) of doctors was in the older age group (30-47) compared to 19% of doctors in the younger age group (24-29). In regards to managing TDI cases during clinical activities, the results indicate that (68.8%) of doctors in the younger age group had managed TDI during clinical activities compared to (68.2) in the older age group. The total percentage of doctors who had managed TDI amongst the two age groups was 66.7%.

Among the two age groups only 3.7% reported to having sufficient knowledge to manage TDI's. The proportion of the doctors was higher in the older age group (9.1 %), while no doctors in younger age group reported to have adequate knowledge on TDI management.

Questions about emergency doctors' knowledge and practice on tooth and alveolar bone splinting, revealed that only 3.7% of the doctors in both age groups had knowledge about tooth splinting (Table 10). None of the doctors in the younger age group had performed splinting of a tooth, while the proportion was 9.1% in the older age group. In contrast, a higher proportion (9.4%) of doctors in the younger age group had performed alveolar bone splinting compared to 4.5% in the older age group.

An association was found between age group and whether primary front teeth that have been knocked out should be re-implanted ($p = 0.3$). Furthermore, an association was also found between age groups and selection of material for tooth splinting ($p = 0.02$). The younger age group was more likely to prefer bandages vs wire technique which was preferred by the older age group as splinting material.

Table 10: Analysis of the association between the age group and the knowledge and practice of emergency doctors in management of traumatic dental injury

Knowledge and practice regarding traumatic dental injury		Age group n (%)		p	Significance
		24-29	30-47		
Have you received any training on how to manage a dental trauma?	Yes	6 (18.8)	5 (22.7)	0.72	No
	No	26 (81.3)	17 (77.3)		
Have you ever had to manage a case where some type of dental trauma has occurred?	Yes	22 (68.8)	15 (68.2)	0.96	No
	No	10 (31.3)	7 (31.8)		
Do you feel that your knowledge is sufficient to appropriately manage a dental injury?	Yes	0 (0.0)	2 (9.1)	0.08	No
	No	32 (100)	20 (90.9)		
Have you ever had to splint alveolar bone?	Yes	3 (9.4)	1 (4.5)	0.50	No
	No	29 (90.6)	21 (95.5)		
Should permanent front teeth that have been knocked out be re-implanted?	Yes	13 (40.6)	12 (54.5)	0.13	No
	No	8 (25)	1 (4.5)		
	Don't know	11 (34.4)	9 (40.9)		
Should primary front teeth that have been knocked out be re-implanted?	Yes	0 (0.0)	1 (4.5)	0.03 $\chi^2= 6.842^a$	Yes
	No	22 (68.8)	20 (90.9)		
	Don't know	10 (31.3)	1 (4.5)		
What would you use to splint the tooth?	Mouth guard	3 (9.4)	1 (4.5)	0.46	No
	Plastic strap	2 (6.3)	3 (13.6)		
	Tongue depressor	2 (6.3)	0 (0.0)		
	Don't know	25 (78.1)	18 (81.8)		
What would you use to splint the alveolar bone?	Bandages	6 (18.8)	0 (0.0)	0.02 $\chi^2= 14.60^a$	Yes
	Plates	0 (0.0)	1 (4.5)		
	Wire technique	0 (0.0)	6 (27.3)		
	Don't know	26 (81.3)	15 (68.2)		
Mouth guards can prevent hard and soft tissue trauma during contact sports?	True	23 (71.9)	18 (81.8)	0.60	No
	False	6 (18.8)	2 (9.1)		
	Don't know	3 (9.4)	2 (9.1)		
All mouth guards provide adequate protection during contact sports?	True	2 (6.3)	2 (9.1)	0.08	No
	False	30 (93.8)	17 (77.3)		
	Don't know	0 (0.0)	3 (13.6)		

5.5 Comparison of results from the three hospitals

In this study the second objective was to compare the knowledge and practice of emergency doctors at the different hospitals in managing TDI. No significant difference was found between the three hospitals.

5.5.1 Knowledge and Experience with TDI

A higher proportion of doctors had prior training on how to handle TDI cases at KBH (23.3%) compared to 20% and 14% in NSH and GSH respectively (Table 11). About a fifth (20.4%) of the sample in the three hospitals had prior training on how to manage TDI cases. This difference was not significant ($p > 0.1$). The percentage of doctors in the study who had experienced TDI or someone they know had experienced an incident in the past was 66.7%. However, a higher proportion (90%) of doctors at NSH had experienced TDI in the past compared to doctors in KBH (63.6%) and GSH (57.1%). This difference was not significant (Table 11).

In the study, the results indicate that a lower proportion (60%) of doctors had managed TDI during clinical activities at KBH, compared to GSH (71.4%) and NSH (90%). However, the difference was not significant.

Table 11: Analysis of the association between the three hospitals' emergency center and the knowledge of emergency doctors in management of traumatic dental injury

Questions reflect EC doctor's General knowledge about TDI		GSH (14)	KBH (30)	NSH (10)	p	Significance
		n (%)	n (%)	n (%)		
Have you received any training on how to manage a dental trauma?	Yes	2 (14.3)	7 (23.3)	2 (20)	0.78	No
	No	12 (85.7)	23 (76.7)	8 (80)		
Have you or someone you know ever experienced dental trauma ?	Yes	8 (57.1)	19 (63.3)	9 (90)	0.20	No
	No	6 (42.9)	11 (36.7)	1 (10)		
Have you ever had to manage a case where some type of dental trauma has occurred?	Yes	10 (71.4)	18 (60)	9 (90)	0.20	No
	No	4 (28.6)	12 (40)	1 (10)		
Do you feel that your knowledge is sufficient to appropriately manage a dental injury?	Yes	1 (7.1)	0 (0.0)	1 (10)	0.25	No
	No	13 (92.9)	30 (100)	9 (90)		

With respect to tooth splinting, only 2 doctors (3.7%) at the three hospitals had performed tooth splinting on patients compared to 4 doctors (7.4%) who had splinted an alveolar fracture. Only 2 doctors (3.7%) at the three study hospitals reported to having sufficient knowledge to manage TDI's (Table 11).

5.5.2 Emergency Doctors' practice on managing Traumatic dental injury cases

Respondents were asked to give an account of the steps involved in avulsed tooth re-implanting. The proportion of doctors who answered correctly regarding the steps of avulsed tooth re-implanting were the highest at NSH (30%) compared to KBH (10%) and GSH (7.1%). However, the difference was not significant. Overall, 13% of the total number of doctors in all three hospitals provided an accurate description of the procedure. Generally, it is well known that an avulsed permanent tooth should be re-implanted, whereas an avulsed primary tooth should not be re-implanted in any situation. From the survey, 46.3% of the total number of doctors in the study responded correctly that an avulsed permanent tooth must be re-implanted.

The proportion of doctors who acknowledged that the avulsed permanent tooth should be re-implanted was highest at NSH (50%) compared to KBH (46.7%) and GSH (42.9%). The difference was not significant. In the case of an avulsed primary tooth, the majority of doctors (77.8%) at the three hospitals reported that the avulsed primary tooth should not be re-implanted, compared to 1.9% who reported that the primary tooth should be re-implanted. The proportion of doctors who answered incorrectly that the avulsed primary tooth should be re-implanted was only in GSH (7.1%). The alveolar bone splint must be rigid unlike the tooth splint which must be flexible. In this regard the respondents were asked if the alveolar bone splint must be rigid. The total percentage of doctors who answered correctly amongst the three hospitals was 16.7%. The proportion of doctors who answered correctly was highest in KBH (23.3%), compared to NSH (10%) and GSH (7.1%). The difference was not significant.

Respondents were asked about the clinical TDI circumstances that indicate administration of tetanus prophylaxis, 53.7% of the total number of doctors in the study responded correctly that tetanus prophylaxis should be administered in contaminated wound injury. The proportion of doctors who answered correctly was the highest at NSH (60%), compared to (57.1%) and (50%) at GSH and KBH respectively (Table 12).

Table 12: Comparison between the three hospitals' emergency center and the practice of emergency doctors in management of traumatic dental injury

EC doctors' practice on managing TDI cases		GSH (14)	KBH (30)	NSH (10)	p	Significance
		n (%)	n (%)	n (%)		
Should permanent front teeth that have been knocked out be re-implanted?	Yes	6 (42.9)	14 (46.7)	5 (50)	0.50	No
	No	1 (7.1)	5 (16.7)	3 (30)		
	Don't Know	7 (50)	11 (36.7)	2 (37)		
Should primary front teeth that have been knocked out be re-implanted?	Yes	1 (7.1)	0 (0.0)	0 (0.0)	0.16	No
	No	12 (85.7)	24 (80)	6 (60)		
	Don't Know	1 (7.1)	6 (20)	4 (40)		
Alveolar bone fracture splint must be rigid	True	1 (7.1)	7 (23.3)	1 (10)	0.68	No
	False	5 (35.7)	9 (30)	3 (30)		
	Don't know	8 (57.1)	14 (46.7)	6 (60)		
In which clinical Traumatic dental injury circumstance would you provide a tetanus toxoid injection?	All trauma	1 (7.1)	10 (33.3)	2 (20)	0.33	No
	Contaminated wound	8 (57.1)	15 (50)	6 (60)		
	Don't know	5 (35.7)	5 (16.7)	2 (20)		

5.5.3 Role of mouth guard

The majority of doctors (75.9%) were knowledgeable about the use of mouth guards to prevent trauma. The proportion of doctors who were aware of the role of MG's in prevention of trauma was highest at NSH (80%), compared to GSH (78.6%) and KBH (73.3%). The MG can reduce the chance of concussion injury and in this regard the respondents were asked if the MG can reduce the chance of concussion injury. The total percentage of doctors who answered correctly amongst the three hospitals was 27.8%. The proportion of doctors who answered correctly was highest in NSH (40%), compared to KBH (30%) and GSH (14.3%). The difference was not significant.

Only 7.4% of the total number of doctors in the current study was not aware that not all MG types can provide protection against TDI. The proportion of the doctors was highest in NSH (10%), followed by GSH (7.1%) and KBH (6.7%) (Table 13).

Table 13: Analysis of the association between the three hospitals' emergency center and the knowledge of emergency doctors regarding the role of mouth guard in traumatic dental injury

Emergency center doctors' about the role of mouth Guard in TDI		GSH (14)	KBH (30)	NSH (10)	p	Significance
		n (%)	n (%)	n (%)		
Mouth Guard can minimize TDI during contact sports?	True	11 (78.6)	22 (73.3)	8 (80)	0.75	No
	False	1 (7.1)	6 (20)	1 (10)		
	Don't know	2 (14.3)	2 (6.7)	1 (10)		
Mouth Guard can reduce the chances of concussion?	True	2 (14.3)	9 (30)	4 (40)	0.15	No
	False	9 (64.3)	20 (66.7)	6 (60)		
	Don't know	3 (21.4)	1 (3.3)	0 (0.0)		
All Mouth Guards provides adequate protection during contact sports?	True	1 (7.1)	2 (6.7)	1 (10)	0.55	No
	False	11 (78.6)	27(90)	9 (90)		
	Don't know	2 (14.3)	1 (3.3)	0 (0.0)		

However, inferential analysis revealed that the differences observed in the questions relating to knowledge and practice of TDI management across the three hospitals were not significant (p-value > 0.05).

CHAPTER 6: DISCUSSION

This study evaluated the knowledge and practice of emergency medical doctors regarding emergency management of TDI at three hospitals in the Western Cape Province of South Africa. EC's are therefore regarded in many hospitals around the world as critical entry points for serious injuries especially for individuals who are not covered by regular medical care policies (Lewis *et al.*, 2003; Berman *et al.*, 2006; Skapetis *et al.*, 2011). The EC offers services around the clock throughout the week (Beebe *et al.*, 2009). Emergency doctors are more likely to be presented with dental trauma cases at the EC compared to the dentist in private practice. Lin *et al.*, (2006) stated that a negligible number of about 7.3% of TDI cases presented to the dental office.

Several studies have been conducted to evaluate the knowledge of non-dental professionals such as lay persons, school teachers and professionals such as physicians regarding the emergency management of TDI (Blakytyn *et al.*, 2001; Lin *et al.*, 2006; Addo *et al.*, 2007; Al-Jame *et al.*, 2007; Al-Asfour *et al.*, 2008; Qazi and Nasir, 2009; Traebert *et al.*, 2009; Fux-Noy *et al.*, 2011; Skapetis *et al.*, 2011; Young *et al.*, 2012; Nayak *et al.*, 2016). There are however few studies relating to medical doctors' knowledge at EC's of TDI management (Holan and Shmueli, 2003; Díaz *et al.*, 2009; Trivedy *et al.*, 2012; Nasr *et al.*, 2013; Needleman *et al.*, 2013; Samaei *et al.*, 2015).

This study was the first in South Africa to assess and provide baseline information on the level of existing knowledge and practice of Emergency Medical Doctors in managing TDI.

In previous studies on the knowledge of physicians on managing TDI (Holan and Shmueli, 2003; Abu-Dawoud *et al.*, 2007; Nayak *et al.*, 2016), the focus was mainly on avulsions of teeth. However, this study evaluated the knowledge and the practice of physicians on tooth avulsion injury, alveolar bone fracture, complicated crown fractures, splinting technique, tetanus prophylaxis injection and mouth guards as preventive measures.

Dental trauma can vary from simple concussions to extensive maxillofacial damage involving periodontal structures and displacements or avulsion of teeth (Addo *et al.*, 2007). Previous reports have shown that 16% of dental injuries eventually lead to tooth loss and could potentially result in complications such as alterations in a child's facial development and

psychological changes (De Carvalho Rocha and Cardoso, 2001; Fakhruddin *et al.*, 2008b; Díaz *et al.*, 2009; Hecova *et al.*, 2010; Rajab *et al.*, 2013). Poor knowledge about TDI conditions can lead to a lack of appropriate management and referral, especially in cases that require quick assessment such as tooth avulsion, where management is possible yet not delivered by the emergency doctor.

6.1 Demographic characteristics

A physician's practice is influenced by demographic factors such as: age, sex, qualification and years of experience (van Ryn, 2002). A Canadian study by McAuley *et al.*, (1990) found a correlation between physicians' age and clinical performance. There were significant differences between the age groups and certain knowledge areas such as the materials to splint the alveolar bone (p -value=0.02) and whether primary front teeth that have been knocked out should be re-implanted (p -value=0.03). Generally, in this study, the younger age group of emergency doctors had more knowledge based on the number of correct answers. The current literature supports the fact that younger physicians have more knowledge and reports that older physicians have less accurate knowledge, performed less well and might have more adverse patient outcomes than younger physicians (Norman *et al.*, 1993; Sample *et al.*, 2001; Eva, 2002; Choudhry *et al.*, 2005). Also, the New England Health care Institute (NEHI) survey in 2007 investigated the physician's use and adherence to clinical practice guidelines and 36% of younger physicians (≤ 40) used the clinical guidelines compared to 25% of older physicians (> 40) (Kenefick *et al.*, 2008).

The findings regarding the age demography could have four possible reasons: Firstly, older physicians are less likely to have up-to-date knowledge (Day *et al.*, 1988; Hartz *et al.*, 1999; Carthy *et al.*, 2000; Kalda *et al.*, 2003). Vast advances occurring frequently in the medical field as well as change over time in medical education may result in the older physician's knowledge becoming out of date (Kidd, 2003). The second possibility is that older physicians are more likely to depend on their past experience with fewer tendencies to gain new advanced information (Eva, 2000). The third possibility is related to the human memory as younger adults have a better memory than older ones (Tulving and Craik 2000; Pearman *et al.*, 2014; Thakur *et al.*, 2017). The final reason is related to the emergency center's unique situation in which younger practitioners are probably more likely to tolerate stress better than older doctors (del Arco-Galan *et al.*, 1994) and are more willing to take risks (Pearson *et al.*, 1995).

6.2 General knowledge of emergency medical doctors on traumatic dental injury

This study showed that in the EC, the emergency medical doctors at the three selected hospitals in the Western Cape Province in Cape Town, South Africa, have insufficient knowledge as only 4% of doctors reported to having sufficient knowledge to manage TDI, while the majority (96%) reported to having insufficient knowledge to manage TDI. This was also true for countries such as Israel (Holan and Shmueli, 2003), Kuwait (Abu-Dawoud *et al.*, 2007), India (Nayak *et al.*, 2016), Australia (Samaei *et al.*, 2015) and the United States (Needleman *et al.*, 2013). All these studies have shown that the EC physicians had inadequate knowledge regarding TDI management and the benefits of accurate timely care (Holan and Shmueli, 2003; Abu-Dawoud *et al.*, 2007; Needleman *et al.*, 2013; Samaei *et al.*, 2015; Nayak *et al.*, 2016).

Dental injuries are usually neglected by the non-dental practitioners (Díaz *et al.*, 2009). Dental professionals are educated separately from other health care providers although they have much in common (Fenton *et al.*, 2003; Mouradian *et al.*, 2003). The study indicated that the medical school involved in the training of the medical doctors interviewed, did not teach the basics of dentistry and the possible reasons for this exclusion are based on four assumptions: (1) So much is to be learned in medical school that the oral cavity is relatively minor with limited curricular time. (2) The dental professional can handle oral injury and diseases (Lorber, 1978). (3) The traumatized tooth is untreatable. (4) Dental injuries are not life threatening (Raouf *et al.*, 2013).

The lack of knowledge about TDI by medical practitioners may lead to a negative prognosis on the oral health-related quality of life of the patient. It is therefore crucial for the medical doctors to have a solid fundamental knowledge regarding dental trauma management which can improve communication between the professions (Loster and Likeman, 2012; Nayak *et al.*, 2016).

In this study 80% of emergency doctors in the EC reported that they did not receive any formal training in the management of TDI's which is comparable to another study that reported that the majority of the respondents had not received formal training on emergency management of dental trauma (Díaz *et al.*, 2009). A study conducted in the UK reported that the majority (76.5%) of doctors had not received any formal training in emergency management of TDI and they were not confident to handle such injuries (Trivedy *et al.*, 2011). Holan and Shmueli

(2003) also found that 55% of the respondents had not received any information on dental trauma management.

The lack of knowledge regarding the management of TDI amongst EC doctors is mainly due to medical schools not adequately including the management of TDI in the medical school curriculum (Lin *et al.*, 2006; Skapetis *et al.*, 2011; Needleman *et al.*, 2013; Samaei *et al.*, 2015; Nayak *et al.*, 2016). A study in England found that only 6% of EC medical doctors had received dental training in medical school (Nasr *et al.*, 2013). Similarly McCann *et al.*, (2005) reported that the respondents had not received information about TDI during their study. Another similar study reported that 96.7% of the physicians had no dental education course during their undergraduate studies (Abu-Dawoud *et al.*, 2007).

Besides the inadequacy of TDI information in the medical school's curriculum, there is also insufficient information on management of TDI in first-aid textbooks and manuals, which could facilitate access to information (Emerich and Gazda, 2010). Zadik (2007) reported that nine first-aid textbooks and manuals from the last two decades did not contain sufficient information about TDI management. This could also possibly contribute to the lack of knowledge among emergency doctors. The comparatively low percentages of respondents who reported to have sufficient knowledge to appropriately manage a dental injury in relation to the high percentage (68.5%) of the respondents who reported that they had exposure to such TDI cases during their medical activities at the hospital, was disconcerting.

This finding is compatible with another study in which about 75% of the respondents had experienced at least one incident of dental trauma during their professional activities (Díaz *et al.*, 2009). A recent study in India by Nayak *et al.*, (2016) revealed that 58.7% of the doctors responded that they had come across cases of dental trauma during their professional activities. The question that the above studies raise is how do these doctors who have insufficient knowledge, manage these cases?

Interestingly enough, a UK study revealed that only 3.9% of EC doctors would choose to be treated by an EC doctor if they had a TDI. Most of the EC doctors (72.5%) preferred to be seen by a maxillofacial surgeon and 23.5% by a dentist (Trivedy *et al.*, 2012). This alarming result might reflect the attitudes of emergency doctors on how they deal with dental trauma cases (Trivedy *et al.*, 2012; Samaei *et al.*, 2015).

The EC doctors might be more likely to follow the “specialty system” by referring the TDI patient to the dental specialist who has more knowledge in such cases (Samaei *et al.*, 2015), and they might consider the referral system as important between parties (Mouradian *et al.*, 2003).

The referral off-site to a dentist increases the time lapse between the injury and treatment, placing the patient in more pain and stress as well as affecting the prognosis. A patient with a TDI presents to the EC due to the following symptoms: severe pain, difficulty in talking, eating and even opening the mouth. Emergency doctors usually prescribe analgesics to reduce the pain. In an Australian study, 82.9% of the respondents reported confidence in pharmacological management of toothache (Samaei *et al.*, 2015). However, dental pain responds slowly to oral analgesics compared to local anaesthesia (Skapetis *et al.*, 2011). Facial pain is often severe because the face has a large cerebral cortical representation (Skinner, 1997). Current literature reported that medical doctors are inexperienced with local anaesthesia techniques (Skapetis *et al.*, 2011; Deeb *et al.*, 2016). Also, referral can be acceptable in minor trauma cases or where hospital services provide an in-house, 24-hour, dental clinic service, whereas in critical cases of TDI where time is an essential factor for good future prognosis, the EC doctor is responsible to deliver the proper diagnosis and timely treatment for better patient outcomes.

Results from this study indicate that there is a definite need for an educational intervention to increase the knowledge of emergency doctors on the issue of TDI management. This goal can be accomplished by periodic lectures, seminars and dental education courses added to the health science curriculum of medical students and formal education and training with interactive workshops for the postgraduate physicians in South Africa.

6.3 Management of Traumatic Dental Injury in specific clinical scenarios

6.3.1 Avulsion Injury

Tooth avulsion is one of the most commonly occurring dental traumatic injuries (Addo *et al.*, 2007). The prognosis of an avulsed permanent tooth depends on measures taken immediately after the accident (Flores *et al.*, 2007b; Andersson *et al.*, 2012; Keels, 2014). The treatment of choice is immediate re-implantation and splinting (Ram and Cohenca, 2004; Abu-Dawoud *et al.*, 2007; Trope, 2011; Andersson *et al.*, 2012; Keels, 2014).

The majority (87%) of emergency doctors in this study indicated that they do not feel competent to re-implant an avulsed tooth. This is supported by a study by Holan and Shmueli (2003) where 50% of the respondents indicated they would not re-implant an avulsed permanent tooth under any conditions. Another study showed that 43.9% of respondents would also not re-implant an avulsed permanent tooth (Díaz *et al.*, 2009). Furthermore, in a study by Deeb *et al.*, (2016) only 10.6% of respondents indicated that they would re-implant the avulsed permanent tooth. Contrary to this an American study reported that the majority of the EC doctors (89%) had good knowledge in management of dental trauma cases (avulsions) (Needleman *et al.*, 2013). The large difference between the current study and Needleman's study could be due to several reasons: the survey was conducted by emailing the participants and it was unsupervised which could result in a higher positive response rate. Furthermore, half of the EC hospitals surveyed reported the availability of on-site dental consultation and the majority of respondents (80.4%) had received formal training in TDI during their residency (Needleman *et al.*, 2013). In addition, the United States is one of the countries that takes concerted steps to increase the knowledge on TDI among medical physicians (Hallas and Shelley, 2009; Cohen, 2013). Moreover, 12.5% of the physicians were qualified as paediatric and 80% as emergency medicine specialists.

6.3.1.1 Storage Medium

Contrary to the current study, in a study by Nayak, *et al* (2016), the authors reported that 27.3% of respondents indicated milk as storage medium and only (5.3%) preferred saline. In another study, 40% of respondents indicated milk as transport medium (Díaz *et al.*, 2009). The variation between this study and previous studies could be related to the study population, sample size, doctors' qualifications and country of the study.

Saline is the third option among recommended storage media in order of preference after Hank's Balanced Salt Solution (HBSS) and milk (Ram and Cohenca, 2004; Malhotra, 2011; Andersson *et al.*, 2012). The reasons why medical doctors indicated that the appropriate medium is saline could be due to: saline availability at any hospitals on a regular basis and its recommendation for many medical procedures (such as flesh wounds, for intravenous infusion, nasal irrigation, and a variety of other purposes) and medical doctors are familiar with using it. On the other hand, to save the vitality of PDL cells over the root of the avulsed tooth, a more sensitive storage medium is required especially if the re-implantation will not be carried out immediately. Although physiologic saline solutions have an osmolality compatible with PDL

cells, they lack the essential nutrients such as calcium, magnesium and glucose which are required for PDL cells' metabolic functions (Gopikrishna *et al.*, 2008).

The reason why Hank's Balanced Salt Solution (HBSS) preserves the vitality of the PDL for a long period (Ram and Cohenca, 2004) is because it contains metabolites necessary to maintain normal metabolism of PDL cells and a balanced pH (Gomes *et al.*, 2008). However, HBSS is difficult to obtain at the accident scene (Trope, 2002).

In this study 35.2% of the respondents indicated that the patient's mouth is the best storage medium. This number was higher than that in the Lin *et al.*, (2006) study where 13.2% of the respondents indicated that saliva is the best transport medium for an avulsed tooth. This finding emphasizes the need for an effective strategy to increase the knowledge of South African ED doctors on TDI management. Saliva as storage medium is not desirable because it can cause contamination with bacteria and infect the injured tooth causing necrosis (Panzarini *et al.*, 2008). In addition the osmolality of saliva (17mOsm) is much lower than the physiological medium (60-70mOsm) and this causes cell lysis (Panzarini *et al.*, 2008). Even though the patient receives dental treatment afterwards, the chance for the avulsed tooth to reattach to the bone is low due to the damage which might already have occurred to the PDL and root.

Furthermore, using the patient's mouth to keep the avulsed tooth has a high risk of aspiration especially with children (Beech *et al.*, 2015). Alternatively, asking the child to spit in a plastic container is (Beech *et al.*, 2015) an undesirable option due to the traumatized child's condition. Saliva can however be used when the other recommended storage media are not available (Ram and Cohenca, 2004).

6.3.1.2 Knowledge and practice on splinting

The second principle in managing the avulsed tooth is stabilization to support the tooth and bone at the right position for proper healing and function (Andreasen *et al.*, 2004). No previous studies have been conducted to investigate the knowledge of EC doctors about splinting methods and period in order to compare with the current study.

The knowledge of EC doctors related to the appropriate splinting technique, type of splint and duration of splint revealed significant gaps in their knowledge.

In this study only 3.7% of doctors reported to have used splint techniques on teeth and 7.4% of doctors reported to have used splint methods on teeth with alveolar bone fractures. The respondents' answers might be related to: (i) insufficient knowledge about TDI (ii) whether the splint materials are available or not at the EC (iii) EC doctors rely on the maxillofacial surgeon present on-site at the hospital (iv) TDI is the responsibility of the dentist (v) the replanted tooth has a high risk of causing infection because of possible contamination (vi) the other trauma injuries associated with TDI are more life threatening and (vii) an avulsed tooth cannot be treated.

With regard to the splint duration in case of tooth avulsion, only 1.9% of EC doctors provided the correct answer of 2 weeks, whereas for alveolar bone splinting, 33.3% of EC doctors gave the correct answer of 4 weeks. Although the emergency doctor might not follow up with TDI patients after the initial emergency treatment, the knowledge about the splint period can reveal the EC doctors' understanding about the consequences of inadequate or long splint periods such as: tooth ankylosis and root resorption. Also, knowledge about the splint period will help the EC doctors deliver clear messages for the TDI patient about the necessity of urgent consultation and follow up with the dental professional. Furthermore, the majority of patients are unlikely to follow up with a dental professional due to transport difficulty, financial issues and especially if the pain subsides. Hence, they prefer to follow up with the EC doctors and only the knowledgeable doctor will be aware of the exact time to remove the splint.

The majority (79.6%) of doctors was not aware of the materials that can be used to splint the tooth and the rest of the respondents indicated tongue depressor, MG and plastic strap/glue as a means to splint a tooth. Utilizing the tongue depressor (TD) as a means to splint the avulsed tooth can be understandable from the EC doctor's point of view. The TD has many medical uses such as: examining throats, mixing medications, securing intravenous fluid lines, holding stool samples and in some instances, splinting fractures (Akl, 2010).

However, using TD in the case of tooth splinting is impossible for many reasons: the goal of splinting is to keep the tooth in an anatomically functional place by using the adjacent sound teeth and this cannot be prepared using TD intraorally. Also, asking the patient to bite over it temporarily is an unwise measure which might result in tooth loss, aspiration and further trauma. A Jordanian study (2010) found that the use of the TD, especially in patients with depressed immunity carry a high risk of fungal infection (Akl, 2010).

Although the splint materials in tooth avulsion and alveolar bone fracture are basically the same, the difference is in the technique and duration of splinting (see literature review section, page 17). More than half (75.9%) of the doctors were not aware of the alveolar bone splint materials and the rest indicated measures such as using a bandage, plate and wire to splint an alveolar bone fracture. A bandage had been used during the 12th to early 18th century to stabilize the upper/lower jaw fracture. A bandage was a conservative and classical method due to the lack of anaesthesia at that time (Stimson 1893, cited in Mukerji *et al.*, 2006), while use of a plate is for complicated jaw fractures and requires patient admission because the procedure is carried out under general anaesthesia.

6.3.2 Complicated crown fracture

In this study more than half (70.4%) of the doctors were not aware of the complicated crown fracture signs. Similar findings were reported in another study in which the authors concluded that the EC doctor's knowledge of the appropriate management of dental fractures was generally poor (Needleman *et al.*, 2013). Actually this question provides insight into the emergency doctor's basic common knowledge regarding TDI.

The first aspect is the anatomy of the oral cavity. In this study the answer of the respondents showed that they were uninformed about the dental anatomy. Similarly, 40% of the respondents were unaware that a fractured incisor in a nine-year-old patient is a permanent tooth (Raof *et al.*, 2013). Also, in a study by Díaz *et al.*, (2009a) the authors concluded that only a few subjects could correctly identify the fractured tooth as being permanent or primary. Identifying the type of tooth is crucial as the treatment approach is different in the emergency management of primary and permanent teeth in certain types of TDI. Deeb *et al.* (2016) found that 76% of respondents reported having 1-2 hours or less lectures on oral anatomy and this might clarify the source of the problem.

A basic knowledge of oral anatomy will assist the practitioner to understand and identify the type of tooth, determine the extent of injury as well as the tooth number in the paediatric and adult patient, which will simplify the proper diagnosis and emergency treatment. A previous study reported that 43% of the respondents were unfamiliar with the tooth numbers and had not received any education in tooth numbering systems (Deeb *et al.*, 2016).

The second aspect is the proper examination. Understanding the oral anatomy and tooth numbering system will facilitate the examination for detection of any abnormality such as; missing teeth and/or teeth fragments, presence of any debris or tooth fragment embedded within the oral soft tissue, tooth mobility, tooth misalignment, bite disturbances, the need for a tetanus booster and the exact source of pain. Dental pain is referred pain in most severe injury cases. The pain radiates to sites served by the same division of the trigeminal nerve e.g. pain from the maxilla radiates to the eye, whilst pain from the mandible radiates to the ear (Skinner, 1997). Also, proper examination helps the practitioner to provide accurate documented information to the next provider.

The third aspect is referral with proper documentation of findings and this can be challenging when the referring practitioner lacks the knowledge of oral anatomy, the tooth numbering system and proper oral examination. Studies showed that the lack of dental knowledge among physicians lead to delays in proper referral (Douglass *et al.*, 2005; Sardella *et al.*, 2007).

These documented findings are important for follow-up visits, insurance purposes (Subramanian and Chogle, 2009) and for medico-legal reasons in TDI cases resulting from physical abuse, where the medical practitioner has an obligation by law to report any suspicions of child abuse (Keels, 2014; Moule and Cohenca, 2016; Nayak *et al.*, 2016). The medical practitioner needs to be aware that these aspects form a continuous, well connected chain and losing any link can lead to instability and negative outcomes.

6.3.3 Tetanus prophylaxis

This study is the first in South Africa to probe the knowledge and practice of emergency doctors on TDI related tetanus prophylaxis. In case of providing a tetanus prophylaxis injection, 53.7% of the respondents reported that the tetanus prophylaxis must be administered in TDI with a contaminated wound. Although this answer may reflect some knowledge of the respondents surveyed, it clearly demonstrates a low level of knowledge regarding the importance of the sero-protection status, full primary course of tetanus vaccine and the period since last booster. Twenty four point one percent of the respondents indicated tetanus prophylaxis in all trauma cases while 22.2% answered that they were unsure.

Similarly, an Indian study reported that the respondents had insufficient knowledge regarding tetanus immunization (Dabas *et al.*, 2005). Another two studies found significant under immunization among many patients in the EC (Talan *et al.*, 2004; Ghiya *et al.*, 2017).

Approximately 5.8% of EC visits consisted of open wound treatments and possible infection complications (Ball and Younggren, 2007). The doctor in the EC needs to identify which patients need Tetanus prophylaxis (McVicar, 2013). This can be achieved by correct wound assessment and sero-protection status (Cassell, 2002).

Some studies have shown that patients presenting to the EC with wound injury might receive unnecessary doses of Tetanus prophylaxis (Talan *et al.*, 2004; Stubbe *et al.*, 2007). Over-immunization has economic consequences (McVicar, 2013) and adverse implications such as; allergy reactions, neuritis and neuropathies (Brabek *et al.* 1999; Perriol *et al.*, 2004; Stubbe *et al.*, 2007). Also, over-immunization can lead to a slow booster injection response that compromises the efficiency and may result in tolerance development (Danilova *et al.*, 2005).

Improved awareness of tetanus prophylaxis recommendations is necessary among the EC. An immunization card containing the details of tetanus immunization can be kept with the patient at all times. This will enable the health care personnel to know the immunization status of the patient when needed. In the absence of such a health card the use of rapid tests for tetanus immunity can help in appropriate wound management in the EC.

6.3.4 Knowledge on the role of mouth guards as preventive measures

Participation in sport is a major concern for the health of a population and sport is expected to grow. There are higher incidences of trauma in children, adolescents and young adults due to sport. Previous studies have shown sport activities as being the second most common cause of TDI (40.2%) (Eyuboglu *et al.*, 2009; Murthy *et al.*, 2014; Faus-Damia *et al.*, 2011; Hecova *et al.*, 2010). TDI occurs in everyday life circumstances. In most situations TDI cannot be avoided but there are opportunities to use adequate methods for prevention such as MG's.

No previous studies have been conducted to evaluate the knowledge of physicians about the role of MG's as preventive measures to prevent/minimize TDI, to compare with this study. In this study, EC doctors' generally revealed adequate knowledge about MG's and the majority (75.9%) of doctors indicated that MG's can minimize the severity of TDI. Several studies

reported that wearing MG's can significantly reduce the frequency and severity of TDI in sport (Fasciglione *et al.*, 2007; Ramdas *et al.*, 2014; Spinass *et al.*, 2014). Also, MG's provide a psychological benefit to athletes making them feel more confident when they wear the appropriate protection (Roettger, 2008).

The majority of the respondents (87%) were aware that not all types of MG's can provide adequate protection during sport. Previous studies reported that the reasons for not wearing MG's among sport participants were: uncomfortable bulky nature of the MG, mouth dryness, difficulty in communication during sport, breathing problems, and aesthetic issues (Erođlu *et al.*, 2006; Fasciglione *et al.*, 2007; Spinass *et al.*, 2014). These problems can be reduced if the MG is custom-made (Erođlu *et al.*, 2006; Ramdas *et al.*, 2014).

Although EC doctors provided the correct answer in most MG related questions, more than half of respondents reported that the MG cannot reduce the concussion injury during sport activities.

The knowledge in this particular question is mandatory as it is related to fatal and serious conditions. Mouth guards can reduce trauma to orofacial regions (teeth, soft tissue and the surrounding oral structures) and temporomandibular joints (TMJ) (Ramdas *et al.*, 2014). A mouth-guard also protects the head (Winters, 2001; Ramdas *et al.*, 2014). Without a mouth guard the trauma to the jaw can transfer the impact from the condyles of the mandible against the base of the skull, resulting in a concussion injury (Winters, 2001; Ramdas *et al.*, 2014). Mouth guards decrease the neurologic injury by acting as shock absorber between the maxilla and mandible (Winters, 2001; Ramdas *et al.*, 2014).

From this perspective, it is important to increase the awareness on the positive effects of MG's among coaches, parents and the athletes themselves. Literature revealed that the majority of sport respondents had never before used MG's and were never given advice or information (Spinass and Savasta, 2007; Spinass *et al.*, 2014).

The opinion of healthcare professionals is usually taken into account more readily, therefore they can deliver effective motivational messages on the efficacy of the MG. Several studies reported a significant effect of motivational reinforcement on young athletes to use MG's (Spinass and Savasta, 2007; Spinass *et al.*, 2014).

Health care practitioners have an important role to play in this regard by: promoting the use of the MG and explaining the different types available on the market and the benefits of selecting the correct type. This information should be provided at an early stage to children in the school environment. It is important to stress that the use of MG's must be encouraged in children practicing contact sport for two main reasons: (i) the prevalence of TDI is high in growing children (8-12 years), (ii) the greatest acceptance of MG can be obtained when it is proposed at a young age, to guarantee positive compliance and constant use. Also, such information is helpful for parents of children with occlusal anomalies at high risk for dental traumas.

Preventing the TDI is impossible but reducing it is definitely possible. It is imperative that a developing society such as South Africa makes an effort towards improving knowledge and awareness about TDI, knowing that most sport injury victims are young and healthy individuals who actually have the most to give to societies.

6.4 Comparison of results from the different study hospitals

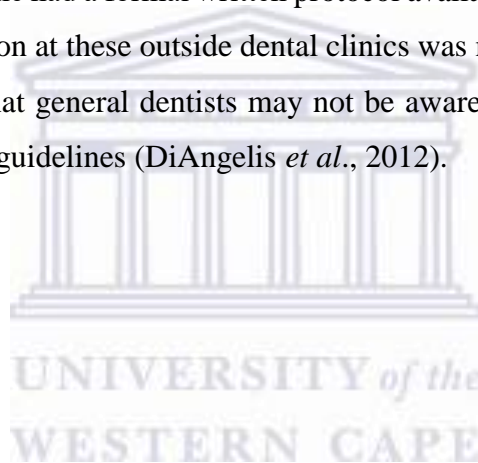
The second objective of this study was to compare the knowledge and practice of emergency doctors at three hospitals in managing TDI. The knowledge and practice of emergency doctors on managing TDI at a district, regional and tertiary (academic) hospital was compared. Groote Schuur is a central hospital and the main teaching hospital of the University of Cape Town's Medical School. GSH has EC divided into trauma units (staffed by trauma surgeons) and medical emergency units (Wallis *et al.*, 2008). Groote Schuur hospital has an in-house dental unit as well as a Dept. of Maxillo-Facial and Oral Surgery (MFOS). This could possibly be a reason why the EC doctors at GSH have insufficient knowledge on managing TDI. The trauma cases (maxillofacial trauma) are mainly seen by Maxillo-Facial and Oral Surgery registrars. In the case of KBH and NSH, there is no in-house dental clinic, hence TDI patients are then referred to either Tygerberg Oral Health Center or GSH.

In this study GSH was an example of a highest point in the referral system providing support to a number of regional hospitals (Wallis *et al.*, 2008). In the South African health care system, community health centers (CHCs) provide the first line of emergency care for the majority of the country's population. If specialist or further care is required these CHCs refer to a district, regional or tertiary hospital (Wallis and Twomey, 2007).

In South Africa, the population who is served by these sectors is predominantly indigent and uneducated (Wallis *et al.*, 2008). This large category of the population uses EC for dental-related problems and follow-ups with referral off-site to dental clinics for a permanent solution are rare, due to: the transportation barrier, lack of education, poverty and waiting time.

An American study which evaluated 16 clinics regarding service accessibility reported that 94% of the clinics required patients to call in order to schedule an appointment. The waiting time for an appointment varied from days to weeks at six of the clinics and two to six months at five of the clinics (Trikhacheva *et al.*, 2015). Although 4 out of 16 clinics provided same day emergency appointments, only a few patients could be seen in one day (Trikhacheva *et al.*, 2015).

In Needleman *et al.*'s, (2013) study, the lists to outside dentists were not available in many of the study's hospitals and none had a formal written protocol available within their departments. Also, the type of qualification at these outside dental clinics was mainly general dentist, while a previous study showed that general dentists may not be aware of the most up-to-date care based on the current IADT guidelines (DiAngelis *et al.*, 2012).



CHAPTER 7: CONCLUSIONS AND RECOMMENDATIONS

7.1 CONCLUSIONS

The study concluded that the majority of EC doctors at the three selected hospitals felt that their knowledge was not sufficient to manage a case with dental trauma injuries. Although two thirds of the sample had to manage a case of dental trauma injury during their clinical activities, it was of concern that only less than a fifth had received appropriate training to do so.

The knowledge and practice of South African EC doctors at the three selected hospitals regarding traumatic dental injuries varied. This study could not determine whether these differences were statistically significant. The knowledge of EC doctors was good in some areas such as Tetanus prophylaxis administration and the use of a mouth guard as a preventive measure.

7.2 RECOMMENDATIONS

This study has shown that there is a need to take effective steps to enhance the medical doctor's knowledge about TDI. The recommendations at the different levels are as follows:

7.2.1 Medical practitioners' curriculum

Dental education subjects in the form of seminars and courses should be implemented into the health science curriculum of medical students in South African where not currently in place. The modules on emergency medicine must include basic information on the management of traumatic dental injuries. Effective formal training with interactive workshops for graduate and postgraduate physicians in South Africa must be considered. Such training should be held regularly in order to improve TDI knowledge and maintain high confidence levels at all times.

7.2.2 Public hospital services

Educational programs could be undertaken in public hospitals, to improve both the resources available to the EC doctors, as well as to improve the knowledge of physicians regarding emergency management of TDI.

These educational programs within the hospitals will provide appropriate information to the medical doctors at EC who have busy schedules and assist them in effectively managing TDI cases. Furthermore, medical doctors will then become aware of their role in delivering objective and motivating messages to TDI victims on how to reduce the occurrence of such events.

Current written TDI protocols such as IADT guidelines and posters should be made available at EC's (Zadik, 2007; Andreasen *et al.*, 2012).

LIMITATIONS OF THE STUDY:

- The survey conducted in this study was unsupervised due to the workload in the EC
- The survey was distributed and collected after a period of time so as not to interfere with the workflow in the EC. This time lapse could possibly have influenced the result.
- In this study, emergency doctors showed limited motivation and interest in oral traumatology as a topic. This has most likely negatively influenced the EC doctors' contribution as generally interested participants are usually more cooperative.
- Specific demographic information about the participant's year of experience, country of qualification and partner's type of qualification were not included in the questionnaires.
- The sample size was relatively small.
- The survey covered areas that have not been covered before and direct comparison with similar studies was not always possible due to the lack of relevant research data.
- The study did not include the Red Cross War Memorial Children Hospital (RWMCH) which is part of the Groote Schuur trauma platform and treats all the paediatric trauma referred to this tertiary centre in the Western Cape. Including this hospital in the study would have been appropriate and relevant.

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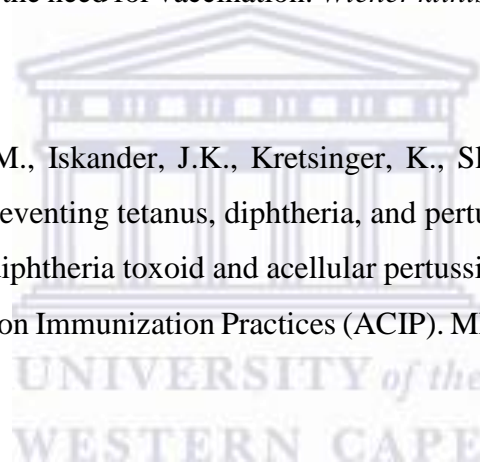
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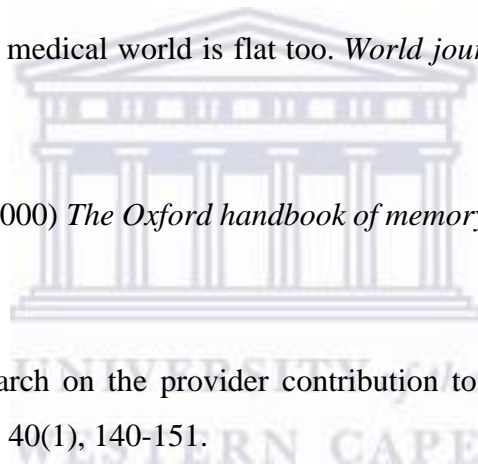
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APPENDICES

1. Appendix A: Questionnaire

Knowledge and practice of emergency doctors regarding traumatic dental injuries

PLEASE CIRCLE THE APPROPRIATE ANSWERS. IN SOME INSTANCES, MORE THAN ONE ANSWER CAN BE CHOSEN

Personal and professional information

1. Gender

Male

Female

2. Age: years

3. Marital status

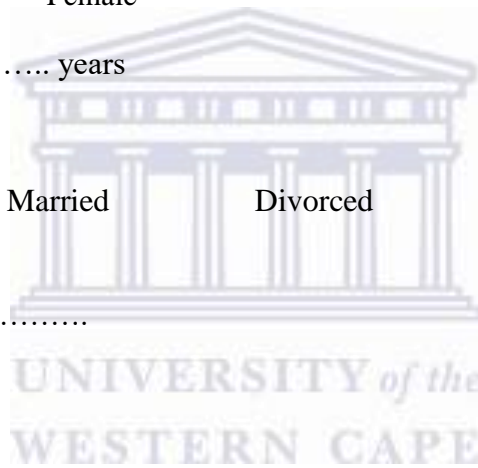
Single

Married

Divorced

Widowed

4. Type of qualification.....



General questions regarding trauma

5. Have you received any training on how to manage a dental trauma?

Yes

No

6. If you answered **yes** to question (5), where was this training obtained?

.....

7. Have you or someone you know ever **experienced dental trauma**?

Yes No

8. Have you ever had to **manage** a case where some type of dental trauma has occurred?

Yes No

9. Have you ever had **to splint teeth**?

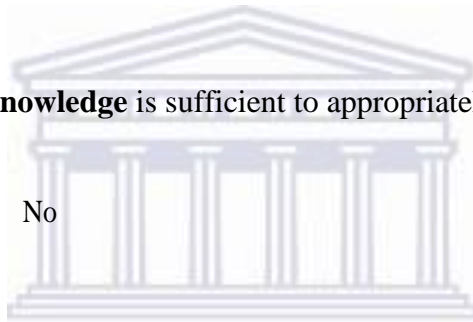
Yes No

10. Have you ever had **to splint** the upper or lower **alveolar bone** of a patient?

Yes No

11. Do you feel that your **knowledge** is sufficient to appropriately manage a dental injury?

Yes No



Knowledge and management of specific clinical scenarios

Avulsed tooth/ knocked out

12. What is the best medium for transporting a front tooth that has been knocked out?

chlorhexidine	Water	Saline	Milk	Patient mouth
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13. For a tooth that has been knocked out, how urgent do you think it is to seek help from a dental professional?

Don't know	1-24 hours	0-1 hour	+ 24 hours

14. Should permanent front teeth that have been knocked out be re-implanted?

Yes No Don't know

15. Should primary front teeth that have been knocked out be re-implanted?

Yes No Don't know

16. The prognosis of a tooth that has been knocked out is affected by the following:

Don't know	The medium in which the tooth was transported	Time that the tooth was out of the mouth	whether the tooth is a primary tooth or a permanent tooth	whether the root of the tooth is fully developed or not
------------	---	--	---	---

17. Do you feel competent to re-implant a tooth that has been knocked out?

Very Likely	Likely	Unlikely

18. How would you go about re-implanting a tooth that has been knocked out? List the steps you would follow when re-implanting a tooth?

19. When must a patient present for a follow up after an avulsed tooth injury?

No need	After 10 days	After 2 weeks	After 1 months

20. In which clinical Traumatic dental injury circumstance would you provide a tetanus prophylaxis injection?

--

Tooth splinting

21. When should you splint the avulsed tooth?

Don't know	When there is a fracture of the tooth crown	Never after a tooth that has been knocked out and been Replaced	Always after a tooth that has been knocked out and been replaced	When a tooth is mobile	When more than one tooth is mobile
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22. What would you use to splint avulsed tooth?

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23. Do you feel competent to splint avulsed tooth?

Very likely	Likely	Unlikely

24. How long an avulsed tooth should be splinted for?

--

25. When must a patient present for a follow up after an avulsed tooth splint?

No need	After 3 moths	After 10 days	After 2 weeks	After 1 month

Alveolar bone fracture and splinting

26. What are the signs of an alveolar bone fracture?

27. How long would you recommend splinting if alveolar bone fracture has occurred:

Don't Know	1 week	2 weeks	4 weeks	>4 weeks

28. Splinting must always be rigid for alveolar bone fracture

True	False	Don't know

29. What would you use to splint the alveolar bone fracture?

30. After placing a splint, which of the following do you recommend:

Don't Know	None of the above	Antibiotics	Soft diet	All answers relevant	Oral hygiene measures	Use of Chlorhexidine mouth rinse

31. When must a patient present for a follow up after alveolar bone fracture splint?

No need	10 days	3weeks	1month	2months

32. What would you expect to see in a tooth with a pulp exposure?

Prevention

33. Mouth guards can prevent hard and soft tissue trauma during contact sports

True	False	Don't Know

34. Mouth guards can reduce the chances of concussion

True	False	Don't Know

35. All mouth guards provide adequate protection during contact sports

True	False	Don't Know

36. Would you recommend the use of mouth-guards for routine sports? Give a reason for your answer.

Very Likely	Likely	Don't Know

2. Appendix B: Information sheet

Information sheet

Dear Doctor

Thank you for agreeing to allow me to interview you. I am a Masters student at the Faculty of Dentistry, University of the Western Cape (UWC), South Africa. I am conducting this research as part of my qualification requirement to complete my mini thesis at the University of the Western Cape. The research aims at investigating the knowledge regarding the treatment of dental trauma in Paediatric Dentistry (Paedodontics) of medical doctors who work in the emergency trauma unit at three major hospitals in Cape Town, South Africa: Karl Bremer Hospital, Grootte Schuur Hospital and Somerset hospital-. Do they have sufficient knowledge?

In order to complete this study, a detailed questionnaire will be administered to the participant. The questionnaire will contain 36 questions written in English and will be divided into three sections. Part I includes four questions on personal information. Part II includes seven general questions regarding traumatic dental injuries (TDI). Part III will contain twenty five questions based on knowledge and management of specific clinical types of traumatic dental injuries; such as avulsion tooth treatment, methods of tooth and alveolar bone splinting as well as methods of prevention.

Research in developing countries like South America and Asia has shown that physicians have had little involvement in dental health. Yet physicians are often in a better position to prevent oral disease than dentists. Significant consequences from neglected oral diseases include poor growth and nutrition, spread of infection from decayed teeth, pain and time lost from school and work. We do not know if this is true in the Western Cape, thus I would be grateful if you would participate in this study to investigate this.

Oral health disparities are a major public health problem. Given the historic separation of medicine and dentistry, a gradual approach to constituency building has been necessary.

Special emphasis should be given to provide primary caregivers with the relevant education to improve their knowledge and ability of dealing with the diagnosis and treatment of dental trauma.

Participants taking part in this study, have the right to withdraw at any time without having to provide a reason. This study is completely voluntary. Not taking part in it, or withdrawing from it, carries no adverse consequence of any kind.

If you have any queries, you can contact me, the researcher: Dr. Nabila Yahya (0610183826). More information may be obtained from my supervisor: Dr. Fathima Peerbhay.

Dr Peerbhay's contact details are as follows:

Department of Paediatric Dentistry at Tygerberg Oral Health Centre

Private Bag X1

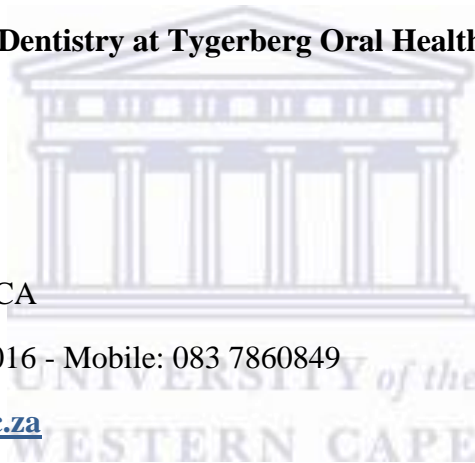
Tygerberg

7505

Cape Town, SOUTH AFRICA

Tel: office: 021 9373076/3016 - Mobile: 083 7860849

Email: fpeerbhay@uwc.ac.za



If you are interested in participating in this study, please read and sign the attached consent form.

Thank you

Supervisor: Dr. Fathima Peerbhay

Researcher: Dr. Nabila Yahya

3. Appendix C: Consent Form

Consent Form

Date.....

Location.....

Explanation of process and the purpose of the survey:

Thank you for agreeing to allow me to interview you. The study hopes to identify factors that affect the utilization of health care service that are available at your primary health care area. I am doing this research as part of my qualification requirement to complete my mini thesis at the University of the Western Cape, South Africa. I will be asking you questions individually and will need your response to the questions.

At all times, I will keep the source of the information confidential and refer to you or your words by a pseudonym. I shall keep any other records of your participation locked away at all times and destroy them after the data has been collected. The interview may touch on issues which you do not feel comfortable discussing. If there is anything that you would prefer not to discuss, please feel free to say so. I will not be offended and there will be no negative consequences if you would prefer not to answer a question. I would appreciate your guidance should I ask anything which you consider intrusive.

I shall keep the contents of the above research interview confidential; your name will not appear in any documents which refer to the interview. The contents will be used for the purposes referred to above, but may be used for published or unpublished research at a later stage without further consent. Any change from this agreement will be renegotiated with you.

If you agree with the above, please sign below:

Signature of the participant: _____

Date: _____

