UNIVERSITY of the WESTERN CAPE

Faculty of Dentistry

Department of Forensic Dentistry

The incidence of dental anomalies in a Qatari population sample

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Declaration

I declare that this thesis submitted in partial fulfilment of the requirements for the degree MSc Forensic Dentistry, Department of Forensic Dentistry, Faculty of Dentistry, University of the Western Cape, has been composed by myself, that the work contained herein is my own except where explicitly stated otherwise in the text, and that this work has not been submitted for any other degree or professional qualification except as specified.

Sabiana Elsayed

Dedication

I dedicate this thesis to the most beautiful girl in the world, my daughter Tala, for her bravery, strength and patience during her surgeries for cleft lip repair. You are my inspiration.

To my son Tamir and my beautiful daughter Talya, for all those nights you spent alone and far from me.

To you Mom, without you I would not be here and to my sister Semsem for being a second mom to my kids.

To my friends, Somi who believed in me, Dina because you were always there for me and Aziz for all your support and guidance.

To my husband Osman. Thank you for joining my journey.

And to the most amazing, funny, motivated teacher, Prof V.M.Phillips, for all the experience he delivered to us.

Abstract

Objective:

There is no data specific to the Qatari population on the incidence of dental anomalies. The aim of this study was to investigate the incidence of dental anomalies in a Qatari population sample of patients between 6 and 65 years of age and to use the record as a key for human identification in forensic odontology.

Materials and Methods:

Records of panoramic radiographs of a Qatari population sample of 457 patients, comprised of (227 females; mean age 16.84 and 230 males; mean age 18.55) were examined to identify all dental anomalies. Dental anomalies were investigated in 4 groups, each group including subdivisions with a total of 15 subdivisions.

Dental anomalies were divided into 4 groups: 1. Tooth form abnormalities including:(Fusion, Gemination, Microdontia, Macrodontia) 2. Tooth number abnormalities including:(Hypodontia, Oligodontia, Hyperdontia) 3.Tooth position abnormalities including:(Transposition, Transmigrant canines, Ectopic eruption, Inversion, Impacted teeth) 4.Structural dental abnormalities including: (Amelogenesis imperfecta, Dentinogenesis imperfecta). All teeth were investigated except third molars.

Results:

The incidence of dental anomalies in a Qatari population sample was 46.7 % (51.69% male and 48.31% female) from a total of 457 patients. Microdontia was reported as the most common dental anomaly with (28%). The second most common dental anomaly was Impaction (7.9%) followed by Hypodontia (7.2%). The supernumerary teeth were recorded (1.7%). Transposition and Transmigration were (1.5%) and (0.2%) respectively. For tooth form anomalies Fusion recorded (0.2%) and no Gemination was found. No positive results for structural dental anomalies were reported.

Conclusions

The incidence of dental anomalies varies between populations which confirms the role of genetic factors and provides forensic odontology with key information to assist in human identification. Microdontia was reported as the most common dental anomaly especially for males followed by Impaction for males. The divergence of these results could be due to ethnic factors, genetic factors or other unknown factors. A low frequency of anomalies was detected for Fusion, Transmigration, and supernumerary teeth.

Keywords: Panoramic radiograph, dental anomalies, Qatari population.

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List of Abbreviation

CME	**Congenital Missing Teeth**
DVI	**Disasters Victim Identification**
MxLB	**Maxillary Lateral Both sides (Right+Left)**
MxLL	**Maxillary Lateral Left**
MxLR	**Maxillary Lateral Right**
MxCB	**Maxillary Canine Both sides (Right+Left)**
MxCL	**Maxillary Canine Left**

MxCR	**Maxillary Canine Right**
MnCLB(AMA)	**All Mandibular Anterior**
Mn2PB	**Mandibular Second Premolar Both sides (Right+Left)**
MnCR	**Mandibular Canine Right**
MnCL	**Mandibular Canine Left**
MnLB	**Mandibular Lateral Both sides (Right+Left)**
Mn2PL	**Mandibular Second Premolar Left**
Mx2PL	**Maxillary Second Premolar Left**
MxLB+MnLB	**Maxillary Lateral Both sides + Mandibular Lateral Both Sides**
MxMn2PB	**Maxillary and Mandibular Second Premolar Both sides**
MnCeB	**Mandibular Central Both sides**
Mx+MnLL	**Maxillary Lateral Left + Mandibular Lateral Left**
Mx2PB	**Maxillary Second Premolar Both sides**
MxC	**Maxillary Canine**
Mx+Mn2PR	**Maxillary and Mandibular Second Premolar Right side**
MxML	**Maxillary Molar Left**
Mn1PR	**Mandibular First Premolar Right**
Mx2PL	**Maxillary Second Premolar Left**
Mn2PR	**Mandibular Second Premolar Right**
MxLL+MxCL	**Maxillary lateral Left + Maxillary Canine Left**

Introduction

The world is becoming smaller as trans-continental flying time is reduced. Societies are becoming altered and mixed with the influx of migratory travelers and refugees. Most countries are now comprised of varying nationalities. This affects the studies of previous generations and affords us the opportunity to investigate and revisit previous literature. Archaeological studies of dental anomalies have rarely been investigated, yet they have proved invaluable in my studies of forensic sciences, odontology, etiology and pathogenesis related to dental anomalies. A current study of the incidence of dental anomalies will be indispensable.

Forensic odontologists should be aware of all dental anomalies including form, number, position and structure that can help in identification since these anomalies can play an important role in the identification of perpetrators or victims of crime and natural or man-made disaster location. They can become a concordant feature for some cases where the identification of human remains is limited to one main feature.

Dental congenital anomalies refer to conditions that present at birth but can develop in utero. They represent any disturbance in the normal function, development or growth of dental tissue, which includes the teeth and jaw. Dental congenital anomalies may occur as a result of many factors, including environmental factors and genetic consequences. Nicholls (2016).

Any congenital and identifiable anomaly can assist in the identifcation of an individual by comparing ante-mortem and post-mortem records. Dental congenital anomalies can present a unique feature and thus help in establishing the identity of the deceased in DVI (Disaster Victim Identification). The aim of forensic scientists, in this instance, is to provide a positive identification and these anomalies are use in almost the same manner as morphological fingerprints and DNA. Krishan et al., (2015)

Studies on the incidence of dental anomalies have been investigated in different ethnic groups and different communities. The results of these studies show incompatible results between and within populations due to the variations in several factors, like methods, race and diagnostic benchmarks.

There is very little literature related to dental anomalies and the Qatari population . A couple of studies regarding dental anomalies specific to a Qatari population have been referenced and it was noted that they only examined one anomaly. Worthy of mention is that these previous studies were conducted on indigenous Qatari nationals. This study sought to assess all types of dental anomalies in a representative sample of the Qatari population (including non-Qatari nationalities) using panoramic radiograph records.

Dental anomalies which were investigated include:

Tooth form abnormalities including:

Fusion

This is the union of two adjacent tooth germs which can be complete or incomplete depending on the time of union that results in the reduction of the number of teeth in the arch by one. Ansari, et al., (2019).

Gemination

This refers to the development of two teeth to form one single tooth germ with no alteration in the number of teeth in the arch. The teeth appear larger in size with a cleft crown which makes it look like two teeth. Ansari et al., (2019)

Conical teeth Microdontia

This is a reduction in the size of the tooth with the crown having a conical shape and reduced mesiodistal width. Ansari et al., (2019)

Macrodontia

This represents an apparent increase in the size of a tooth compared to the normal size of the corresponding arch. Ansari et al., (2019)

Tooth number abnormalities including:

Hypodontia

This refers to a reduction in the number of teeth and is known as congenitally missing teeth, dental agenesis, congenital absence or congenital dental aplasia. The etiology is multifactorial and can be due to environmental factors, or a combination of environmental and genetic factors. However there is still uncertainty as to the exact cause.

Congenitally missing teeth (CMT) can occur in isolation or be associated with approximately 120 syndromes. These include syndromes like: Cleft lip and palate, Down syndrome, Book syndrome, and numerous variants of Ectodermal Dysplasia. The precise cause of both the isolated and syndromic types of CMT is related to numerous genetic mutations with remarkable uncertainty. Tangade et al. (2015).

Oligodontia

(An example of Hypodontia characterized by tooth agenesis)

Hypodontia refers to a mild form of missing teeth which represents fewer than 3 teeth missing. This is differentiated from more than 3 teeth missing termed Oligodontia and lastly, a complete absence of teeth termed, Anodontia. Cakan et al. (2013) regarded 1-6 missing teeth as Hypodontia and more than 6 teeth missing as Oligodontia. CMT can occur in the primary teeth as well as the secondary teeth. If the teeth are missing in the primary dentition, chances are that the succedaneous teeth will not develop and hence the permanent dentition will also have a reduced complement. Tangade et al. (2015). In this study Oligodontia Refers to more than 6 teeth missing while 6 missing teeth or less refers to Hypodontia. Tangade et al. (2015).

Hyperdontia

This represents an increase in the number of teeth compared to the normal complement. A supernumerary tooth is an addition to the normal complement of teeth and can be found anywhere in the dentition. This anomaly does not follow a simple Mendelian pattern and is thought to arise due to one of various theories. The hereditary implication is also assumed as evidence of common presentation can be traced in the relatives of affected patients. Other theories include the possibility of it being a result of a dichotomy of the tooth bud; the hyperactivity theory which implies a possible hyperactivity of the dental lamina. Garvet et al. (1999).

Supernumerary teeth can be seen in a multitude of arrangements. They can be found in the maxilla, mandible, or both jaws, single or multiple, anteriorly or posteriorly, unilaterally or bilaterally, and can either be impacted or fully erupted. The occurrence of multiple supernumerary teeth may be associated with genetic conditions like cleft lip and palate, Gardner Syndrome and Cleidocranial syndrome.

Garvet et al. (1999) classified the supernumerary teeth into 4 morphological types viz.: conical, tuberculate, supplemental and odontome. The conical variant is regarded as the most common type and represents the additional tooth found in the maxillary midline called the Mesiodens. Variations in eruption are seen as it can be normally positioned in the arch between the centrals, higher up in the maxilla/palate, or even inverted.

The tuberculate variant is far less common and according to Garvet et al, (1999) it frequently has a barrel shape with/without invaginations and a comparative delay in the root formation compared to the normal permanent incisors, where it is usually found. The supplemental teeth can be regarded as duplication of teeth in the normal series, the most common being the maxillary lateral incisors. This is followed by the premolars and occasionally the molars. The fourth morphological type is the odontoma, which is regarded as a hamartoma due to the appearance of it being a neoplasm with structures that are normally found in the vicinity. Garvet et al, (1999).

Shah (2008) also classifies supernumerary teeth in terms of location i.e. mesiodens, paramolar, distomolar and para-premolar.

Mesiodens: located between the maxillary central incisors (Same as the morphological variant). Shah, 2008

Paramolar: located in a buccal or palatal relationship to one of the molars, usually the third molars, and is mostly rudimentary. Shah, (2008).

Distomolar: located in a distal relationship to the third molars. This can either be unilateral one jaw, bilateral one jaw, or the same in both jaws (unilateral/bilateral). It is rare to find distomolars in all four quadrants and here the appearance could hint at a genetic condition. Shah (2008).

Tooth position abnormalities including:

Transposition

This happens when two teeth swap their positions in the normal dental arch and alter the positional relationship of each other.

Transmigrant canines

This refers to the migration of a maxillary or mandibular canine tooth across the midline.

Ectopic eruption

This is the partial impaction of a tooth where the disturbance is the result of the path blocked by the adjacent teeth.

Inversion

This refers to the complete reversal of the normal eruption of a tooth in an upward (maxilla) or downward (mandible) direction.

Impacted teeth

This anomaly refers to an impediment of the normal eruption of the primary or permanent teeth. The cause could be another anomaly that results in the impaction, for example, impacted maxillary centrals due to Mesiodens. It also refers to the abovementioned anomalies of Hypodontia wherein supplemental teeth are impacted due to space shortage in the dental arch. Frazer-Bowers et al., (2003).

Structural dental abnormalities including:

Amelogenesis Imperfecta

This refers to a developmental abnormality that affects the enamel formation of the tooth.

Dentinogenesis Imperfecta

This represents a structural alteration of the dentine layer of a tooth and results in structural changes of the dentine or both the dentine and enamel.

The implication of dental anomalies in forensic dentistry

Forensic odontology is important for human identification and makes use of ante-mortem records compared with post-mortem in cases such as plane crash, fires, car accident and mass disaster. The incidence and occurence of dental anomalies have an important role in forensic sciences (human identification) as it can narrow down the suspected people. It is also important in bite mark analysis as some anomalies can be defined according to unique features specific to certain ethnicities. The forensic dentist should be aware of all congenital and developmental dental anomalies that might help him in identification. The incidence of dental tooth anomalies has variation for different ethnic groups providing unique clues and information when tasked with human identification. A group of a study by Tinoco et al, (2010) demonstrated a positive case identification by tooth position anomaly diagnosis. This the current study is proposed to be valuable in the incident of mass disaster.

Literature Review

Dental anomalies:

Dental anomalies can affect any person with no reason and may be associated with other diseases and syndromes. A study performed in India by Patil et al, (2013) to determine the prevalence of dental anomalies including impactions, congenitally missing teeth, supernumerary teeth, ectopic eruption, dilaceration, Odontoma, taurodontism, fusion and gemination, dense in dente, etc. The congenitally missing teeth were reported as the highest prevalence of dental anomalies among the Indian population (16.3%) followed by the impacted teeth with incidence of (15.5%), whereas the least prevalent anomalies recorded were macrodontia (0.2%) and odontoma (0.2%), and the most uncommon dental anomaly was the transposition with (0.1%) incidence.

Among the Iranian population a study by Saberi et al., (2016) to evaluate the developmental dental anomalies reported that dental anomalies have a high prevalence among the Iranian population (18.17%).The study reviewed all dental anomalies like taurodontism, dilaceration, congenitally missing teeth, supernumerary teeth, impaction, peg lateral, tooth transportation dense invagination, gemination and fusion. Taurodontism was the most common (5.38%) followed by dilacerated teeth (5.29%), impaction (3.41%), dense invagination (1.37%) and congenitally missing teeth (1.11%), whereas the least common congenital abnormalities was peg lateral (0.77%), supernumerary teeth (0.51%) and fusion and gemination of (0.09%) for each. The morphological anomaly had a high prevalence (71.36%) followed by malposition (19.72%) and other numerous anomalies (8.92%). The comparison between the congenital anomalies in the Indian and Iranian populations revealed a high incidence of congenital abnormalities among the Iranian population and a big difference regarding the most common anomalies seen in the different populations, for example, the most common congenital dental anomaly in the Indian population was congenitally missing teeth while in the Iranian population taurodontism was the most common.

In a study of dental anomalies in Egypt conducted by Montasser et al, (2012) on orthodontic patients, 32.6% of dental anomalies were reported excluding third molar agenesis. The prevalence of dental anomalies in females was 32.1% and 33.5% in males. Impaction was the most common (12.8%) followed by ectopic eruption (10.8%). Hypodontia was seen in 2.4% and Hypodontia in

2.8%, while Accessory root and Gemination was seen in 0.2%. The study showed that environmental factors in every population influence the prevalence of dental anomalies.

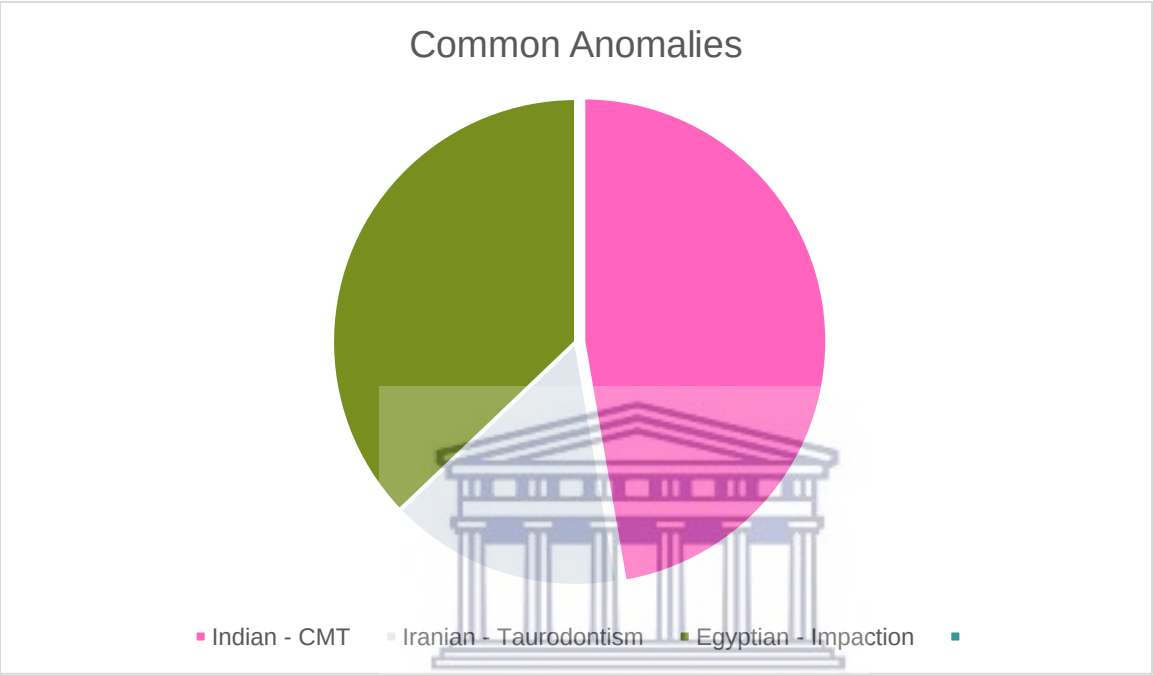

Figure 1 Shows different common anomalies between different population

Hypodontia:

Hypodontia can occur in isolation affecting one tooth or in a generalized form affecting one or both jaws. In a study that compared the pattern and prevalence of Hypodontia in the maxilla and mandible, conducted by Al-Abdallah et al, (2015), it was found that the most frequent anomaly related to tooth agenesis in the maxilla was Microdontia, specific to the lateral incisors. In the mandible the most common form of dental agenesis was retained deciduous teeth followed by impacted permanent teeth. Hypodontia was seen in 2.7 – 12.2% of this Jordanian population and was noted in association with various other anomalies of size and shape. This correlates with Hypodontia of the maxillary lateral incisors (46.7%) in the mandibular, Hypodontia due to

retained deciduous molars (60%), infraocclusion of deciduous molars noted in 7.1% and finally impacted teeth seen in 38.6% of the sample. This study not only showed the clinical importance of diagnosing dental anomalies but also the possible association of conditions and morphological changes that enhance successful treatment.

A study of the prevalence and distribution of hypodontia in a sample of Qatari patients by Hashim. H, El-Said S., (2016) found that the tooth/teeth most frequently found to be missing were in the maxilla compared to the mandible. A greater distribution of missing teeth was noted in the left side compared to the right side. The lateral maxillary incisor was the most frequent missing teeth (14.1%), the second most frequently missing teeth was the mandibular second premolar (12.8%) followed by the maxillary second premolars (6.4%).

A retrospective study of hypodontia prevalence and distribution pattern in a group of Qatari orthodontic and pediatric patients by Al Jawad A. et al., (2015) reported the prevalence of hypodontia in 6.2% (females 8% and males 4.2%; $P < 0.05$).The maxillary lateral incisors where the most frequent missing teeth (36.2%) followed by mandibular second premolar (32.6%) and maxillary second premolar (20.2%). Unilateral hypodontia (63.2%) was more commonly found than bilateral (44.3%).

The identification of the anomalies has a forensic implication as dental records of any congenital feature may assist in identification and forensic sciences.

The third molar can be congenitally missing in some patients and is only diagnosed after the normal eruption age range which is nineteen to twenty one years for most people. A retrospective study in Bangladesh by Sujon et al., (2016) was conducted on third molar agenesis prevalence in a Bangladeshi population. They reported a high prevalence of third molar agenesis (38.4%) with females having a higher third molar agenesis than males ($p<0.025$). They also recorded an overall low prevalence (6.5%) of all dental anomalies where Hypodontia was the most common among the dental anomalies (3.1%).

Supernumerary teeth:

The prevalence of supernumerary teeth is quite different in populations of different countries. They are usually of unknown etiology but the most common theory reveals that it may occur due to hyperactivity of the lateral dental lamina. The supernumerary teeth can cause a range of complications like impaction, crowding, ectopic eruption, teeth spatial disorders, delayed eruption and may be associated with cyst formation. Therefore the early diagnosis and recognition of

supernumerary teeth is quite important to prevent further complication in the permanent dentition. In a study done on the Swiss population to determine the prevalence of supernumerary teeth by Schmuckli et al., (2010), they revealed that the supernumerary teeth are of low significant prevalence among the Swiss population (1.5%). Boys have higher prevalence (1.1%) than girls (0.4%), and the most common side was the anterior maxilla followed by the anterior mandible and the least common was found in the premolar region as a supernumerary premolar. The most common type found in this study was the conical supernumerary tooth (70%), supplemental (25%) and the least common morphological type was tuberculate (5%).

A study of the prevalence and distribution of nonsyndromic hyperdontia in a group of Qatari orthodontic and pediatric patients by Alhashimi et al. (2016) showed that the most common type of supernumerary teeth was supplemental and the accessary lower incisors was the most prevalent. The study reported more than half of the supernumerary teeth identified were impacted and this necessitate careful diagnosis, detection, and monitoring of the developing dentition.

Another study done in China by Fidele et al. (2016) recorded a high prevalence of supernumerary teeth among the children and young adults in North-East Heilongjiang. Males were found to have a higher prevalence than females and the condition was more prevalent in the maxilla than in the mandible. Therefore, early diagnosis and treatment of supernumerary teeth will prevent complications which can vary from teeth displacement and crowding to follicle cyst formation, although this high prevalence of supernumerary teeth among the Chinese population can be used as very important evidence in forensic identification.

In Nigeria, a study by Anibor et al. (2015) reported the prevalence of supernumerary teeth with 12.70% among the Nigerian population, the mandible had a higher prevalence (84%) than the maxilla. The supernumerary teeth were observed most commonly in the anterior region between the central incisors followed by the lateral incisor region and the least common region was the premolar region and molar region with a ratio of 1.4:1 males to females. In this study a higher incidence of supernumerary teeth was observed in the Nigerian population with the most common site in the mandible and a higher incidence for males than females. The study provided the forensic dentist with a significant base for identification as the supernumerary teeth usually occur in the maxilla, except in the Nigerian population where the supernumerary teeth were found in the mandible.

A literature review of the prevalence of supernumerary teeth and its etiology, treatment and the most common complications associated with it, was done by Ata-Ali et al. (2014) who reported a higher frequency of supernumerary teeth in the maxillary than in the mandibular region, found it more common in males than females and most common in permanent teeth. Complications related to supernumerary teeth include crowding, impaction, ectopic eruption, teeth spatial disorder, delayed eruption and follicular cyst formation. The study showed that the treatment of supernumerary teeth may vary according to its position, type and clinical complications.

The supernumerary teeth play a significant role in forensic odontology and identification and can be a concordant feature as the frequency can vary from one country to another and the site was also reported to be different in the Nigerian population. The forensic odontologist should be aware of the congenital abnormalities and prevalence all over the world.

A prospective study on the Australian pediatric population by Dang et al. (2016) reported dental anomalies in 5.15% and revealed a high prevalence of agenesis (4.28%) followed by impaction (0.6%) with supernumerary teeth being the least common (0.28%). The study showed a very low incidence of dental anomalies among the Australian population.

Impacted teeth:

When the tooth is prevented from eruption by another tooth or teeth it becomes impacted. The impacted tooth may be asymptomatic and discovered during the routine radiograph or the dentist may look for it as a missing tooth. All the teeth can be susceptible to impaction but the most common unerupted tooth is the mandibular 3rd molar. Impaction can evoke many complications which range from minor to severe in some cases. Therefore, early diagnosis and treatment can help to minimize unwanted side effects. A study by Topkara et al. (2012) reported the prevalence and distribution of impacted teeth in the Turkish population and their characteristic relation with the dental arch. The study was retrospective and the impacted supernumerary teeth were excluded. 9.10% of the patients showed impaction and both genders were affected similarly with no significant differences (0.897%). The maxillary canine was the most commonly impacted tooth (5.24%) followed by the mandibular second premolar (2.23%) and thereafter the maxillary second premolar (1.11%). The least common was the mandibular canine (0.92%). Other impactions were found at a lower prevalence like impacted supernumerary teeth (0.72%) and impacted firswt or second molars (0.72%). Maxillary impaction had a deficiency in the arch length higher (14%) than mandibular impaction (10%) and there were no square arch forms found in patients with impacted

permanent teeth. The previous study showed a high incidence of impaction among the Turkish population which can be used as a determining feature in forensic odontology and could assist with human identification and bite mark analysis.

A study on non-third molar impacted teeth prevalence and pathogenesis by Gündüz et al. (2011) on the Turkish population revealed that the most familiar impacted teeth were the maxillary canines (71.5%). The mandibular premolars encountered were 8.6% and the overall prevalence was 9.2%. The study examined the placement of the impacted teeth where35.4% of the impacted teeth were in a mesioangular orientation, 28.9% were vertical, and the remaining impacted orientations were 18.9% for distoangular, 16.5% for horizontal, while the buccolingual situation was the least with 0.3%. Cystic transformation associated with impacted teeth was the most common pathogenic variance.

Aims and Objectives

The aim of this study was to assess the incidence of dental anomalies on panoramic radiographs in a sample of the Qatari population.

The objective was to determine the incidence of various dental anomalies including alteration in dental form, number, position and structure and to correlate the anomalies across gender and age distribution in order to demonstrate the most common dental anomaly incidence in the Qatari population and to use the records in human identification.

Materials and Methods

A retrospective study was conducted using 457 radiographic records of patients that presented to the Dental Specialist Center, Doha, Qatar, between 2012-2017. The Data was only accessed upon approval of the institution and the medical director of the center. The inclusion criteria were digital panoramic radiographs of patients between the ages of 6 and 65 years. The exclusion criteria were Panoramic radiographs of patients below the age of 6 and above 65 years of age, poor quality radiographs due to unforeseen technique errors and inadequate diagnostic ability, patients who had teeth extracted that would hamper the detection of some types of anomalies, patients with a history of trauma or fractured jaw that afflicted the eruption of teeth.

Digital panoramic radiographs that met the exclusion and inclusion criteria were assessed on a workstation with the supplier provided software (Vatech Easydent Viewer® Version 4) using an LCD monitor. Ambient light in the examination room was kept to a minimal. Examination of radiographs were conducted by the primary researcher,The study mimicked other studies related to dental anomaly identification. Panoramic radiographs were diagnosed for dental anomalies and captured on the data sheet (Microsoft Excel 2011® spreadsheet appendix A). All digital radiographs were analyzed in batches of 50 and analyzed for the following anomalies: 1. Anomalies of tooth form including: (Fusion, Gemination, Microdontia, Macrodontia); 2. Anomalies of tooth number including: (Hypodontia, Oligodontia, Hyperdontia); 3. Anomalies of tooth position including: (Transpositon, Transmigrant canines, Ectopic eruption, Inversion, Impaction of non-third molar); 4. Structural dental anomalies including: (Amelogenesis imperfecta, Dentinogenesis imperfecta) [**Table 1**]

Data was captured on a spreadsheet and sent to the statistician for analysis with only corresponding generated numbers. No personal information of any patients were recorded or divulged in this study.

Results

Table 1. Incidence and prevalence of the dental anomalies in the Qatari population sample: main groups and subdivisions

Types of Anomalies	Incidence (%)	Prevalence (%)
Tooth Form	129 (28.2%)	0.282
Fusion	**1 (0.2 %)**	**0.002**
Male	1 (0.2 %)	0.002
Female	0 (0.0 %)	0.000
Microdontia	**128 (28 %)**	**0.280**
Male	69 (15.1%)	0.151
Female	59 (12.9 %)	0.129
Tooth Number	42 (8.9%)	0.092
Hypodontia	33 (7.2%)	0.072
Male	12 (2.6%)	0.026
Female	21 (4.6%)	0.046
Supernumerary	9 (1.7%)	0.020
Male	8 (1.5%)	0.018
Female	1 (0.2%)	0.002
Tooth Position	44 (9.6%)	0.096
Transposition	7 (1.5%)	0.015
Male	2 (0.4%)	0.004
Female	5 (1.1%)	0.011
Transmigration	1(0.2%)	0.002
Male	1(0.2%)	0.002
Female	0(0%)	0.000
Impaction	36 (7.9%)	0.079
Male	20 (4.4%)	0.044

Female	16 (3.5%)	0.035
Total	215 (46.7)	0.470
Prevalence (%) = number of anomalies/total population		

Panoramic radiographs of 457 patients were used in this study. The mean age of the patients was 17.7 ± 8.54 years (range 6-65). The study sample comprised of 227 (49.67%) female and 230 (50.33%) male patients. Sample demographics are shown in **Table 2**.

The incidence of dental anomalies in the sample of a Qatari population revealed in this study was 46.7 % (50.6% male and 48.31% female) from a total of 457 patients.

Table 2. Descriptive data of patients included in the study

Gender	Count of Samples	% Gender	Average Age
Female	227	49.67%	16.84
Male	230	50.33%	18.55
Grand Total	**457**	**100%**	**17.70**

Tooth form abnormalities:

The incidence of fusion in the present study was 0.22%. A total of 1 fusion was identified in the 457 patients. **Table 3**

Table 3. Distribution of fusion by gender

Gender	Number of Positive Cases	Prevalence %
Female	0	0
Male	1	0.22%
Grand Total	**1**	**0.22%**

No prevalence was identified for Gemination in both genders in the study sample.

Table 4. Chi-Square Tests: Gender differences in the distribution of Tooth Form

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	0.989[a]	1	0.320		
Continuity Correction[b]	0.000	1	1.000		
Likelihood Ratio	1.375	1	0.241		
Fisher's Exact Test				1.000	0.503
Linear-by-Linear Association	0.987	1	0.320		
N of Valid Cases	457				
a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is .50.					
b. Computed only for a 2x2 table					

The Microdontia identified in this study was 28.01% for the overall sample, with 12.91% females with an average age of 16.71 and 15.09% males with an average age of 16.03. The male to female ratio recorded was 1.16%.

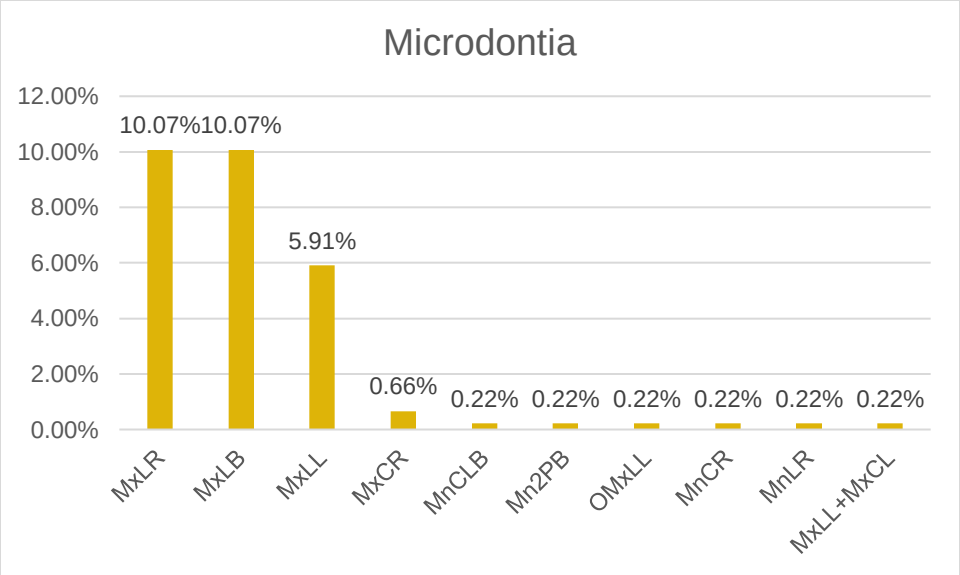

Figure 2 Shows the incidence of Microdontia in Maxillary teeth, Mandibular teeth, Right and Left

Tooth number abnormalities:

Among the tooth number abnormalities, Hypodontia represented 7.22% of the overall sample in the study with an average age of 17.69 years.

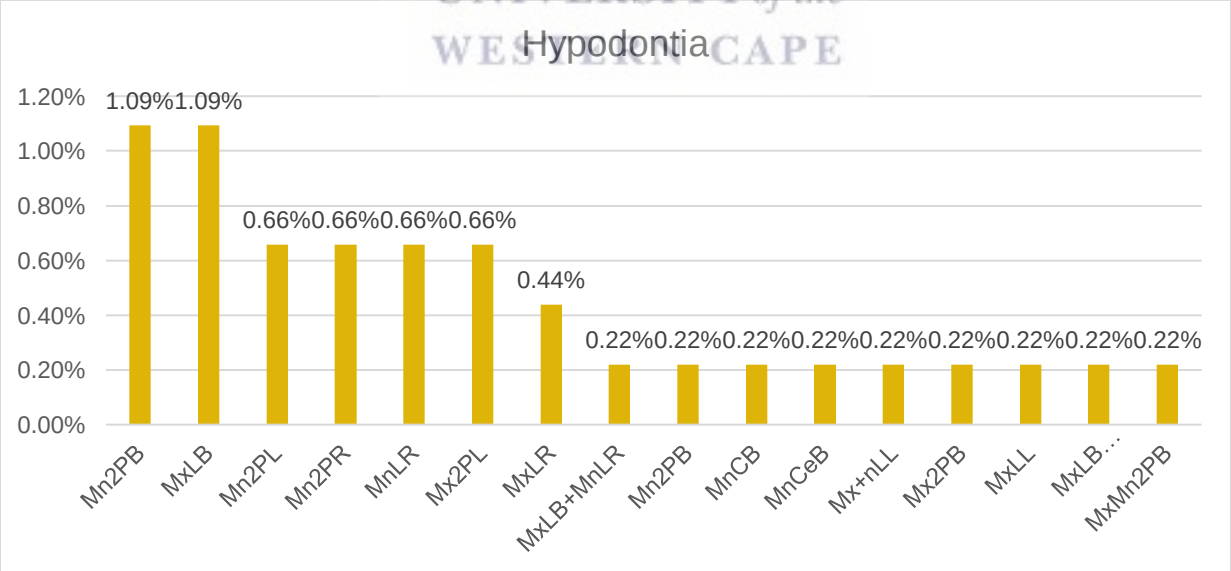

Figure 3 Shows the incidence of hypodontia in Maxillary teeth, Mandibular teeth, Right and Left

Oligodontia showed no positive readings (in this study Oligodontia referred to more than 6 teeth missing).

Hyperdontia (supernumerary teeth):

The supernumerary teeth recorded in this study was 1.75% in all genders, with a higher frequency in males (1.53%) than females (0.22%).

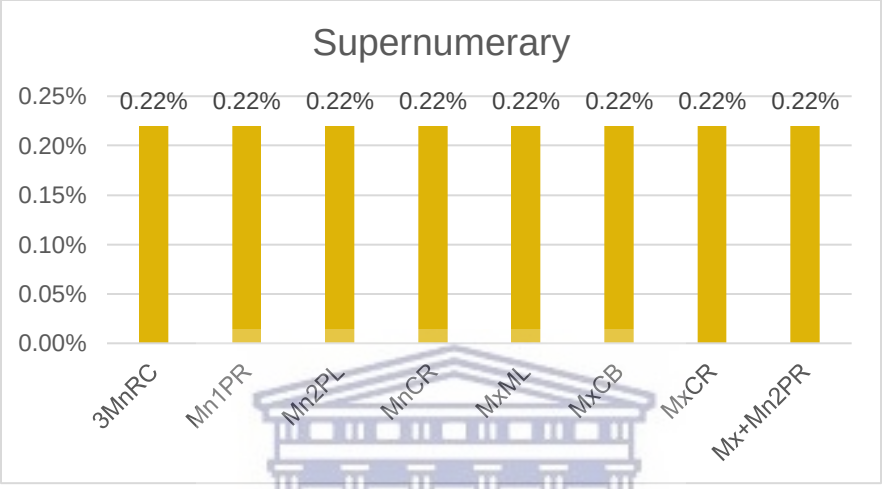

Figure 4 shows the incidence of supernumerary teeth in maxillary teeth, mandibular teeth, Right and Left

Table 5. Chi-Square Tests of gender differences in the distribution of tooth number

Table 5. Chi-Square Tests of gender differences in the distribution of tooth number			
	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	21.454a	15	0.123
Likelihood Ratio	28.019	15	0.021
Linear-by-Linear Association	0.525	1	0.469
N of Valid Cases	457		
a. 30 cells (93.8%) have expected count less than 5. The minimum expected count is .50.			

The Pearson chi-square statistic showed a probability value (ρ) greater than the 5% benchmark. Since ρ>0.05, we concluded that there was no statistically significant difference in gender in the distribution of Fusion and Hypodontia as a parameter for tooth form and tooth number, respectively.

Tooth position abnormalities:

Transposition:

Only 1.53% of the sample in this study had a Transposition dental anomaly, females recorded were 1.09% and males 0.44%.

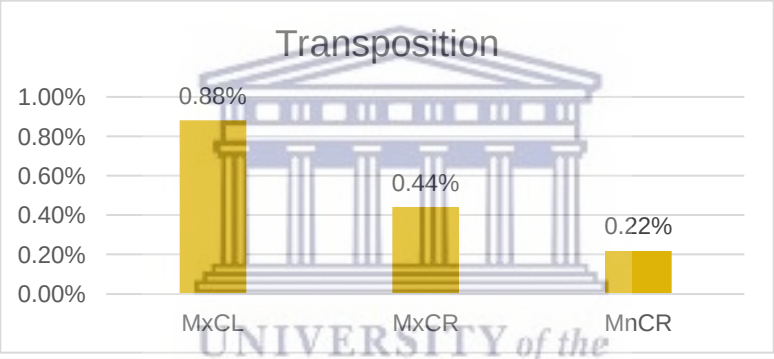

Figure 5 Shows the incidence of transposition in Maxillary teeth, Mandibular teeth, Right and Left

Transmigrant canines:

One case was recorded for the transmigration canine (0.22%) in a male patient.

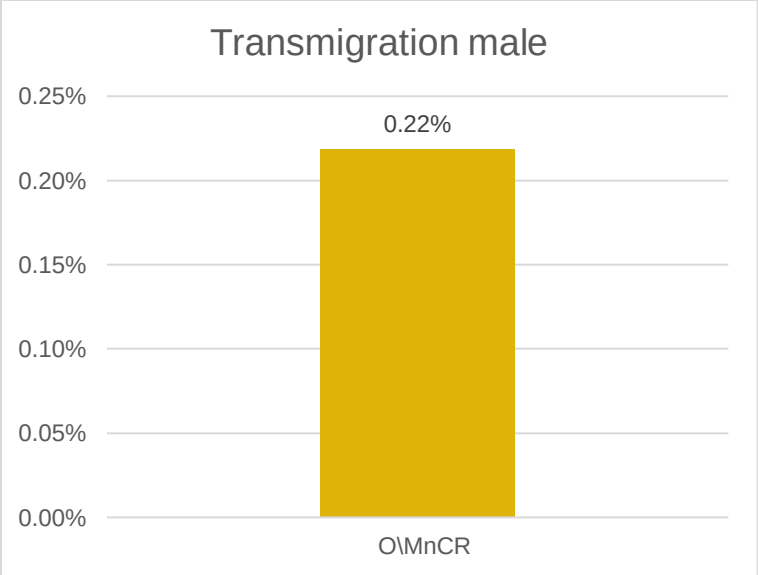

Figure 6 Shows the incidence of transmigration canines in right mandibular teeth

The study shows a null result for both Ectopic eruption and Inverted teeth.

Impacted teeth:

Impacted teeth were found in 37 cases of the study samples (7.9%) with an average age of 13.75. Most cases were male patients 4.40% while the female patients recorded 3.50%. Third molars were not investigated in this study.

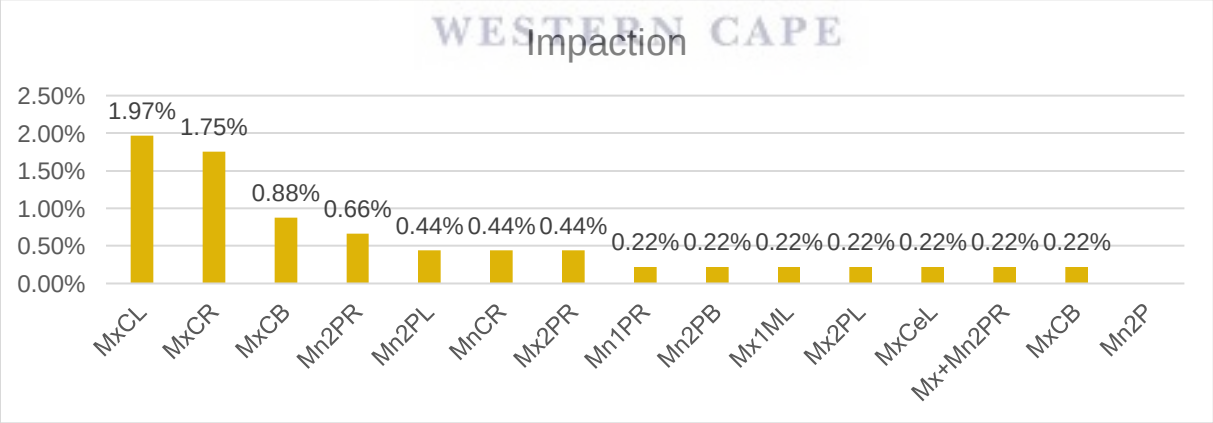

Figure 7 Shows the incidence of impaction in Maxillary teeth, Mandibular teeth, Right and Left

Table 6. Chi-Square Tests: gender differences in the distribution of tooth position

	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	19.684a	15	0.184
Likelihood Ratio	25.267	15	0.046
Linear-by-Linear Association	0.991	1	0.319
N of Valid Cases	457		
a. 30 cells (93.8%) have an expected count less than 5. The minimum expected count is .50.			

The Pearson chi-square statistic shows a probability value (ρ) greater than the 5% benchmark. Since ρ>0.05, we concluded that there is no statistically significant difference in gender in the distribution of Impaction as a parameter for tooth position.

Table 7. Correlation between anomalies

		Gender	Fusion	Hypodontia	Impaction
Gender	Pearson Correlation	1	-0.047	0.034	-0.047
	Sig. (2-tailed)		0.321	0.469	0.320
	N	457	457	457	457
Fusion	Pearson Correlation	-0.047	1	.280**	-0.002
	Sig. (2-tailed)	0.321		0.000	0.963
	N	457	457	457	457
Hypodontia	Pearson Correlation	0.034	.280**	1	-0.012
	Sig. (2-tailed)	0.469	0.000		0.805
	N	457	457	457	457
Impaction	Pearson Correlation	-0.047	-0.002	-0.012	1

	Sig. (2-tailed)	0.320	0.963	0.805	
	N	457	457	457	457
**. Correlation is significant at the 0.01 level (2-tailed).					

The correlation between Fusion and Hypodontia showed a statistically significant relationship. (p<-0.002, and -0.012 respectively). However, other tooth parameters are not statistically significant in terms of degree of co-existence and inter-relationship.

Statistical Analysis

All the collected data were captured on an Excel® spreadsheet. Data was analyzed with the Statistical Package for Social Sciences (SPSS® version 12.0 (or later), Chicago, IL, USA).
Dental anomalies were assessed for distribution and location with regard to right and left sides of the jaws as well as for their occurrence in the maxillary or mandibular jaw. The categorical data were assessed using the Pearson chi and Fisher exact tests to determine gender differences in the distribution of all the dental anomalies. A p-value of <0.05 was considered statistically significant.

Discussion

The incidence of dental anomalies has been studied extensively all over the world with different results. Dental anomalies are related to genetic or environmental factors. Therefore, in this study the sample represented all persons in the Qatari population, not only Qatari nationals. Most of the studies reveal different results with different ethnic groups which are very useful for forensic odontologists, especially in cases where bones and teeth are the only way of identification and the soft tissue is completely destroyed. However, any shift from normality can play a key role in human identification which added value to this study.

Digital panoramic radiographs of 457 patients ranging between 6 and 65 years of age were evaluated for incidence of dental anomalies. The median age was relatively low at 16.84 for females and 18.55 for males. The sample that met the inclusion and exclusion criteria required radiographs of patients with no history of extractions. This resulted in a lower age range as the majority of older patients did not meet the criteria for inclusion. The use of panoramic radiographs was superior due to their low dose radiation, low cost and all the teeth can be examined at the same time including maxillary and mandibular jaws and their structure.

The incidence of dental anomalies indicated in this study was 46.7% which was higher in males (51.69%) than in females (48.31%). A study of the prevalence of dental anomalies by (Bilge et al. 2018) on the Turkish population indicated 39.2% with a higher incidence in females (54%) than males (46%). (Saberi & Ebrahimipour . 2016) reported (18.17%) among the Iranian population. The difference in the percentages in different studies can be explained by the different ethnic groups, environmental factors or the diagnostic criteria used in different studies.

The most common type of dental anomaly was tooth form (28.9%) followed by tooth position (9.6%) and tooth number (8.9%), while no data were recorded for tooth structure anomalies.
In terms of subgroups Microdontia was the most common anomaly (28%) followed by Impaction (7.9%) and Hypodontia (7.2%). Bilge et al. (2018) recorded impaction (45.5%) as the most common subtype of dental anomalies, followed by Dilacerations (16.3%), Hypodontia (13.8%) and (11.2%) recorded for Taurodontism. In this study the third molar was not included (relative to

the above mentioned anomalies) which explains the disparity in results between this study and others.

Microdontia (28%) represented the most common tooth form anomaly with a higher incidence in males (15.1%) than females (12.9%). Where the maxillary laterals are the most common tooth with Microdontia (10.1%), however, the maxillary lateral right (10.1%) represent higher percent than the maxillary lateral left (5.1%). A study by Gupta et al. (2011) on the Indian population revealed Microdontia as the most common anomaly with (2.58%). The large deviation in the results between Gupta et al. (2011) and this study could be due to the different ethnic groups and populations.

The second most common tooth anomaly recorded in this study was for tooth position Impaction (7.9%). The incidence in males (4.4%) was higher than in females (3.5%). The most common impacted teeth were left maxillary canines (1.97%) followed by right maxillary canines (1.75%). Both maxillary canines showed almost the same percentage for Impaction, while some showed the same impaction for the maxillary canine on the right and left side of the same patient (0.88%). The second most common impacted teeth were mandibular second premolars (1.1%) with no significant difference in percentage between right and left (Diagram 6).

A study by Gündüz et al. (2011) on non-third molar impacted teeth prevalence and pathogenesis in the Turkish population showed that the most commonly impacted teeth were the maxillary canines (71.5%) followed by the mandibular second premolars (8.6%).

Hypodontia represented the most common tooth number anomaly and the third most common dental anomaly with (7.2%). Females recorded a higher percentage (4.6%) than males (2.6%). Bilge *et al.*, (2018) recorded the prevalence of Hypodontia in the Turkish population (13.8%). In the present study the most common missing teeth were mandibular left and mandibular right second premolars (1.9%) as well as maxillary right lateral (1.9%) (Diagram 2).

In this study supernumerary teeth recorded were 1.7%, with males having a higher prevalence (1.5%) than females (0.5%). A study by Schmuckli et al., (2010) on the Swiss population determined that the prevalence of supernumerary teeth was significantly low (1.5%). Although males were recorded higher (1.1%) than females (0.4%), this prevalence was quite similar to the

results presented in this study. However, different results were reported with different ethnic groups in a study by Anibor & Mabiaku. (2015) in Nigeria which revealed the prevalence of supernumerary teeth with (12.70%) (Diagram 3).

Transpositions were recorded in this study for only 1.53%, females recorded a higher incidence (1.09%) than males (0.44%). The most common tooth with transposition dental anomaly was the left maxillary canine (0.88%) followed by the right maxillary canine (0.44%) and one case was recorded for the right mandibular canine (0.22%). In the study for prevalence of dental anomalies in the Turkish population by Bilge et al. (2018) transpositions were recorded for 0.41% only. Therefore we can conclude that the incidence of transposition was relatively higher in the Qatari population than in the Turkish population which can mainly be due to genetic factors or the differences in ethnic groups, or some other criteria. Only one case with a Transmigrant canine was recorded (0.22%) in a 21 year old male patient (Diagram 4).

Fusion was the least common dental anomalies (0.22%); while no record of Gemination was found. The Dental anomaly related to alteration of tooth structure: Amelogenesis imperfecta nor Dentinogenesis imperfecta showed no prevalence. This could not be related to the studies mention in a Qatari population as they did not present any findings on these anomalies. This implies a need for future comprehensive studies to include these and other dental anomalies.

The difference of these results could be due to ethnic factors, genetic factors or iatrogenic factors. The use of morphological features and unique variations of the teeth in human identification is well accepted in forensic examination and in the court of law. Riaud X., (2014) Therefore, the forensic odontologist should be careful about population specificity in determination of sex and age from teeth, as different groups of population show variations in human dental traits. Krishan et al., (2015). In order to facilitate human identification for forensic dentists, additional studies regarding the dental anomalies of different populations would be helpful. The comprehensive and comparative information of pure ethnic groups would be invaluable in the global population dynamics of today's world and attempts should be made to find representative information.

Conclusion

The incidence of dental anomalies in the Qatari population is very varied compared to other population as presented in international epidemiological studies. Microdontia was reported as the most common dental anomaly in the Qatari population sample. This could be a vital tool in human identification and a vital adjunct to post mortem evaluation.

The knowledge of prevalence and incidence of anomalies could streamline the forensic sciences in the event of a mass disaster – God Forbid!

The chaos that ensues a mass disaster and response time to human aid and relief could make a meaningful impact if information is readily available. The current global pandemic proved that there was always a delay when we didn't know what to do or expect. The information of dental anomalies in this population could help reduce emotional suffering.

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Appendix

Ethical Approval and Data Sheet

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School of Public Health & School of Pharmacy
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Ethics Reference Number: BM19/3/22

Project Title: The incidence of dental anomalies in a Qatari population sample

Approval Period: 27 August 2019 – 27 August 2020

I hereby certify that the Biomedical Science Research Ethics Committee of the University of the Western Cape approved the scientific methodology and ethics of the above mentioned research project.

Any amendments, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.

Please remember to submit a progress report in good time for annual renewal.

The Committee must be informed of any serious adverse event and/or termination of the study.

Ms Patricia Josias
Research Ethics Committee Officer
University of the Western Cape

BMREC REGISTRATION NUMBER -130416-050

FROM HOPE TO ACTION THROUGH KNOWLEDGE.