Prevalence of Developmental Dental Anomalies in A Sample of Adult Libyan Patients: An Orthopantomographic Study

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University of Benghazi **Faculty of Dentistry**

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Dedication

I am dedicating this thesis to the beloved people who have meant and continue to mean so much to me. Although they are no longer of this world, their memories continue to regulate my life. to my father whose love for me knew no bounds and, who taught me the value of hard work. Thank you so much I will never forget you.

And, my mother who raised me, loved me, and stand by me , I love you all and miss you all beyond words. May Allah (Subhanah Wa taala) grant you Jannah Firdaws.

Amen.!

Last but not least I am dedicating this to my lovely family and my freinds I will make sure your memory lives on as long as I shall live.

I dedicate my thesis

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Declaration

I confirm that this thesis entitled *"Prevalence of Developmental Dental Anomalies in A Sample of Adult Libyan Patients: An Orthopantomographic Study"* is a record of research carried out by myself. Except where otherwise stated, the research design and analysis were my own work, subject to the help and advice received from those who were acknowledged. I have consulted all the references cited. This research has not previously been submitted for a high degree.

Magdi S Hamad

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List of abbreviation

CT	Computed Tomography
CBCT	Cone beam computed tomography
MIH	Molar Incisor Hypomineralization
PNJ	Portable Network Graphic
JPEG	Joint Photographic Expert Group
SPSS	Statistical Package for Standards Social Sciences
BS	British Standard Institute

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Abstract

Objectives: The prevalence of dental anomalies in different populations as demonstrated in several studies. So far, little is known about developmental anomalies in Libyan population. This research was aimed to: investigate prevalence of dental anomalies among a selected adult Libyan sample using panoramic radiograph.

Materials and Methods: Retrospective study of digital panoramic radiographs of (412) Libyan adult patients of both sexes (males and females) was collected from different Clinics in Benghazi district in period of six months. The radiographs were studied on computer screen to find out the prevalence of developmental dental anomalies. Descriptive statistics and bivariate analysis by age and gender were conducted using SPSS software.

Results: A total of 412 panorama radiographs were used in the data analysis. The majority were females (no=273, 66%), aged between 18 and 70 years old. The most common type of dental anomalies was dilaceration (no=130,31.6%), followed by impaction of wisdom teeth (no=66, 16%) and impaction of other teeth (no=23, 5.6%). A few cases of other anomalies were reported. These included one case of odontome, ectopic eruption of lift upper 8 and mesodens. were also seen

Conclusions: Dilaceration and impaction were the most common types of developmental dental anomalies among study population, with rare cases of supernumerary teeth and odontome. Multiple anomalies are common in the present study, suggestion genetic origin. The study showed that the prevalence of dental anomalies increases with the age of participants.

INTRODUCTION

1. Introduction

Developmental dental anomalies are marked deviations from the normal presentation of the primary or permanent dentition. Local, as well as systemic factors, may be responsible for these disturbances. Dental anomalies consist of a wide range of conditions, including changes in the number, morphology, eruption, and size of teeth (Neville et al., 2015).The developmental anomalies of teeth are caused during tooth development, whereas the acquired anomalies are caused after tooth development (White and Pharoah, 2014).Anomalies of tooth structure (enamel and dentin defects) can be symptoms of syndromes (Jukić et al., 2002).

Some dental disorders and developmental defects of enamel may lead to a number of problems such as increased sensitivity and esthetic problems, while severe tooth decay can be prevented by the timely detection of problems and appropriate intervention (Harris et al., 2008). Some other dental anomalies, such as impaction, play an effective role in the etiology of different types of malocclusions (Afify and Zawawi, 2012). Anomalies affect the occlusion and length of the jaw arch and their identification, particularly in the anterior region in young adults, and hence, are extremely important in the esthetic and orthodontic treatment plan (Kositbowornchai, 2011).

Several studies have addressed the prevalence of dental anomalies; however, the results of these studies were inconsistent between and within populations. These differences are a reflection of variations in race, sampling methods, and different diagnostic criteria (Fardi et al., 2011). Therefore, researching the prevalence of these countries at local and country level is important to provide data for policy maker and dental educator and to help in planning interventions and health care strategies to tackle these problems.

Dental anomalies' incidence and distribution in different populations can provide important information for genetic studies, which help to understand variations within and between the different populations, and has an important contribution to the multidisciplinary clinical team approach to treatment (Brook et al., 2014). Early diagnosis allows optimal patient management and treatment planning and can reduce

complications and the amount and complexity of the planned treatment. So the aim of tthis study is to investigate prevalence of dental anomalies among a selected adult Libyan sample using panoramic radiograph.

Literature review

2.Literature review.

2.1Back ground of developmental anomalies

The occurrence of dental anomalies and its associated factors vary in different populations and groups. The causative factors of developmental abnormalities are generally classified to be either genetic such as inheritance, metabolic and mutations or environmental factors including physical, chemical, environmental and biological factors. However, combination of these two factors is not impossible (White and Pharoah, 2014). Several abnormalities are believed to have a common hereditary link, manifested as a developmental disturbance during embryonic growth. The tooth is an example of a typical vertebrate organ starting as an epithelial bud and undergoing complex morphogenesis, regulated by interactions between epithelial and mesenchymal tissue layers. During recent years, advances in technology and genetics enabled the assessment of role of genes that have been linked with early tooth morphogenesis .So far, all genes that have been linked with early tooth morphogenesis have developmental regulatory functions in other organs, too (Thesleff, 2000). Mutations in numerous of these genes in humans have been identified as causes of dental anomalies. More than 300 genes have been reported associated with tooth development, mainly in mouse embryos. The majority of them are associated with conserved signalling pathways mediating cellular communication, in particular between epithelial and mesenchymal tissues. Necessary functions of many signals, receptors and transcription factors have been identified (Thesleff, 2006).

2.1.1 Supernumerary teeth

A supernumerary tooth is one that is additional to the normal series, that exceed the normal dental formula and can be found in solitary or multiple form, may be unilateral or bilateral, and affect one or both dental arches (Garvey et al., 1999). It is estimated that

prevalence of supernumerary teeth in permanent dentition is quite low ranging from 1.5-3.5% (Mahabob et al., 2012). There are two types of supernumerary teeth according to shape: supplementary or rudimentary. The supplementary are those having a normal shape and size, whereas, rudimentary have an abnormal shape and smaller size and maybe conical, tuberculate or molariform (Primosch, 1981). The aetiology of supernumerary teeth is not completely understood, though it is believed to be multifactorial, comprising of a combination of environmental and genetic factors. Various theories have been proposed to explain different types of supernumerary teeth. For example, supernumerary tooth can be the result of a dichotomy of the tooth bud, or the result of local, independent, conditioned hyperactivity of the dental lamina (Garvey et al., 1999, Ata-Ali et al., 2014). Heredity may also play a role in the occurrence of this anomaly, as supernumeraries are more common in the relatives of affected children than in the general population (Prasada Ravo and Chidzonga, 2001).

Supernumerary teeth can be asymptomatic and only diagnosed casually in the course of radiographic examination (Rajab and Hamdan, 2002). However, the majority are associated with complications that include dental impaction, delayed eruption, ectopic eruption, overcrowding, spacing anomalies and the formation of follicular cysts (Bayrak et al., 2005). (Rajab and Hamdan, 2002). Both clinical and radiographic examination is essential for detecting supernumerary teeth. Occlusal or periapical radiography is important for diagnosing supernumerary teeth in the incisor region, although recently computerized tomography has been used as a complimentary diagnostic test (Rajab and Hamdan, 2002). However, panoramic radiography being the most effective diagnostic method. Treatment depends on their type, position and possible complications. Although surgical extraction is the most common treatment, another option is to reposition supernumerary teeth in the dental arch (Garvey et al., 1999, Ata-Ali et al., 2014).

2.1.2 Hypodontia:

Hypodontia is developmental absence of one tooth or multiple teeth. The very severe form of hypodontia is rare condition characterised by the absence of all teeth, and known as anodontia (Dhanrajani, 2002). Hypodontia individuals often present a significant clinical challenge for orthodontists because, in a number of cases, the treatment time is prolonged and the treatment outcome may be compromised. Hence, the identification of genetic and environmental factors may be particularly useful in the early prediction of this condition and the development of prevention strategies and novel treatments in the future. Hypodontia is believed to be hereditary condition, however, no family history has been reported. In addition, hypodontia is associated with several systemic conditions and syndromes, suggesting genetic origin. For example, hypodontia is often associated with oral clefts cleft lip and/or palate, and is more common in these patient than that in general population (Al-Ani et al., 2017). Other conditions that have hypodontia as one of their features include Down's Syndrome and ectodermal dysplasia, that is usually different from the general population (Al-Ani et al., 2017). Moreover, recent data suggests that hypodontia shares some common pathways with particular kinds of cancer (Küchler et al., 2013). Besides genetic possibility as causative of hypodontia, several environmental factors such as trauma, infection, and toxins have been implicated in the aetiology (Brook, 2009). However, hypodontia is considered a multifactorial condition (Brook, 1984).

Diagnosis of hypodontia is often made when there is no sign of crown calcification on the radiograph and no evidence of loss attributable to oral diseases could be seen, excluding third molars (Al-Abdallah et al., 2015). In the permanent dentition, the second premolars, the upper lateral incisors and the lower central incisors are the most frequently absent teeth (Kirkham et al., 2005). Microdontia, retained primary teeth, ectopic positioning of the permanent teeth and tourodntism are common encounters in hypodontia case reports and case

series(Haselden et al., 2001, Schalk-Van Der Weide et al., 1993, Peck et al., 2002). It has been proposed that hypodontia is linked genetically to other anomalies in tooth size, given that a tooth will fail to develop if the tooth germ does not reach a particular tooth size and tooth number of "thresholds"(Brook, 1984) . Hypodontia is also associated with enamel hypoplasia, peg shaped lateral incisors, primary molar infra-occlusion, and impacted maxillary canines as well as generalised spacing and rotations of teeth adjacent to missing teeth (Baccetti, 1998) . Some of these features are evident in Figure 1.

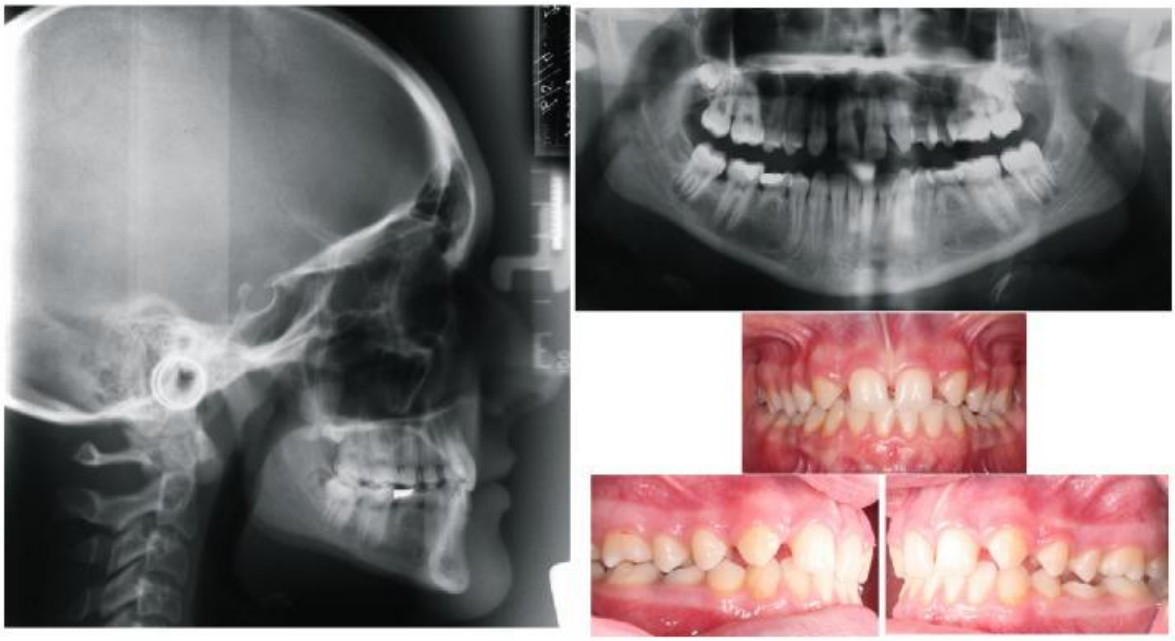

Figure 2:Shows some features of Hypodontia

The prevalence of hypodontia vary across populations studies, however, it ranges from 1.6% to 36.5% (Matalova et al., 2008). A meta-analysis investigated the prevalence of non-syndromic hypodontia found a higher prevalence in Europe and Australia than in the United states , commonly one or two missing permanent teeth (Polder et al., 2004).

2.1.3 Impaction

The eruption process for any tooth can result in two distinct end-points. Where present, many can erupt into a functional non-impacted position, however, many teeth become impacted

having failed to erupt into a functional position. Impacted teeth are those with a delayed eruption time or that are not expected to erupt completely based on clinical and radiographic assessment (Richardson and Russell, 2000). The third molars generally erupt between the ages of 17 and 21 years and are the most commonly impacted teeth (Bouloux et al., 2007). However, the eruption time of third molar varies with races (Santosh, 2015) and gender(Kruger et al., 2001), which is ascribed to myriad of factors such as the nature of the diet that may lead to attrition, reduced mesiodistal crown diameter, degree of use of the masticatory apparatus and genetic inheritance also affect the timing of third molar eruption (Hattab and Alhaija, 1999).

Permanent maxillary canines are the second most frequently impacted teeth; the prevalence of their impaction is 1-2% in the general population (Richardson and Russell, 2000). This is most likely due to an extended development period and the long, tortuous path of eruption before the canine emerges into full occlusion (Becker et al., 1984). Inadequate arch space and a vertical developmental position are often associated with buccal canine impactions. Palatally displaced cuspids rarely erupt without requiring complex orthodontic treatment (Bishara, 1992). It is common for maxillary canine impaction to occur bilaterally, although unilateral ectopic eruptions are more frequent (Shapira and Kuftinec, 1998).

Two common theories may explain the palatal canine displacement. First, known as guided theory and it proposes that this anomaly is a result of local factors interfering with the path of eruption of the canine, such as congenitally missing lateral incisors, supernumerary teeth, odontomas, transposition of teeth and other mechanical barriers (Brin et al., 1986), resulting in displacement and, thus, impaction. The second hypothesis suggests impaction is due to a genetic cause which is based on the fact that impacted maxillary cuspids often present with other dental abnormalities, including tooth size, shape, number and structure (Richardson and Russell, 2000). For example, the co-occurrence of impacted canines has been reported in

patients with congenitally absent maxillary lateral incisors, hypoplastic enamel, infra-occluded primary molars and aplastic second bicuspids (Shapira and Kuftinec, 1998).

While the diagnosis of impacted or congenitally missing third molars can be easily made using radiographic assessment, the presence and position of the impacted cuspid teeth requires visual inspection, palpation and radiography. Clinical signs that may indicate ectopic or impacted permanent cuspids include lack of a canine bulge in the buccal sulcus by the age of 10 years, over retained primary cuspids, delayed eruption of their permanent successor and asymmetry in the exfoliation and eruption of the right and left canines (Bishara, 1992). This can be supported by palpating buccal and palatal mucosa, using the index fingers of both hands simultaneously, to assess the position of the erupting maxillary canines (Jacobs, 1999).

Accurate radiographs, however, are essential for determining the position of impacted canines and their relation to adjacent teeth, and determining the prognosis and best mode of treatment (Caminiti et al., 1998). A panoramic radiograph taken in conjunction with 2 periapical views obtained using Clarke's Rule (Buccal Object Rule) or a 60% maxillary occlusal film allows the impacted teeth to be located either palatally or buccally relative to adjacent teeth (Ericson and Kurol, 1987). Lateral cephalometric radiographs are also helpful in assessing the anterior–posterior position of the displaced tooth, as well as its inclination and vertical location in the alveolus (Caminiti et al., 1998).

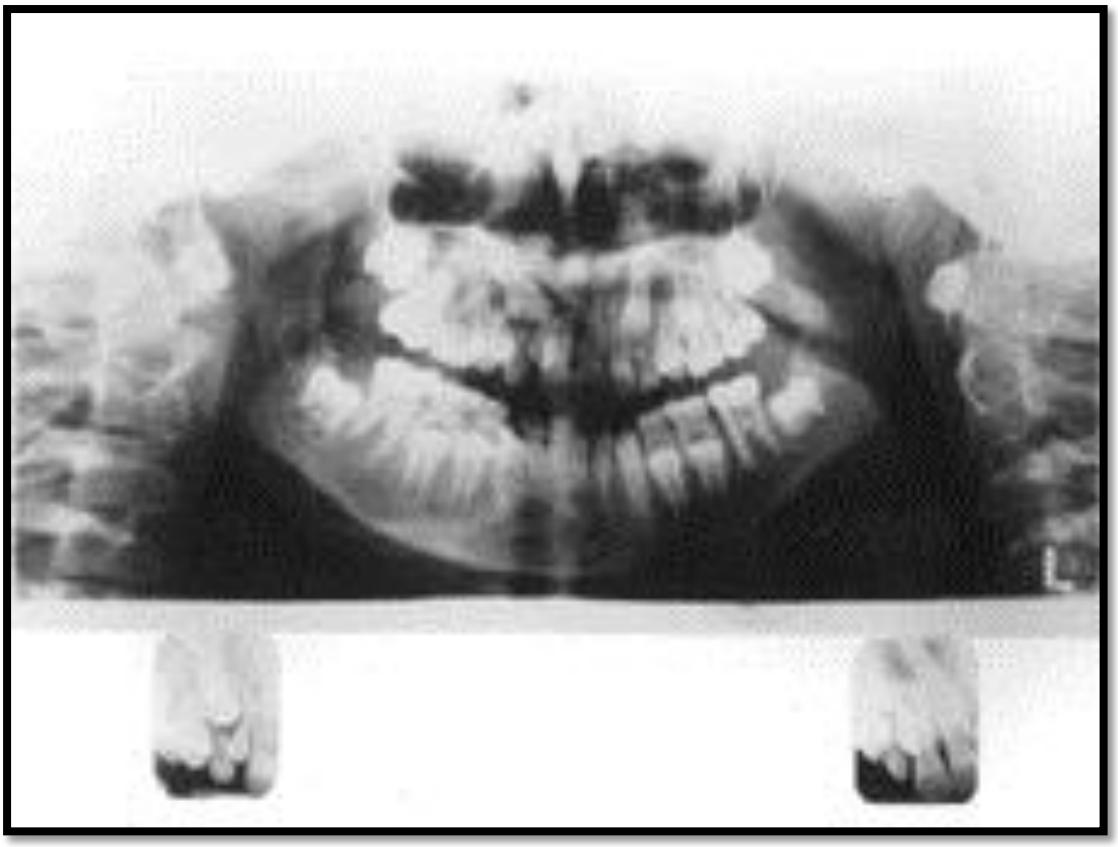

Figure 3: Panoramic and periapical radiographs were used to locate the upper left canine on the palate(.BISHARA, S. E. 1992. : a review. Am J Orthod Dentofacial Orthop, 101, 159-71).

However, Computed Tomography (CT) is more accurate in terms of locating the impacted cuspid in 3 dimensions and for diagnosing associated lesions such as root resorption of adjacent teeth (Bishara, 1992).

2.1.4 Dilaceration

The term dilaceration comes from Latin word and its means (tear up). It is a developmental malformation of a tooth due to a disturbance between the unmineralized and mineralized tooth structures(BS, 1989). It was first described as an angulation or deviation or sharp bend or curve in the linear relationship of the crown of a tooth to its root (Tiecke et al., 1959) . However, later, dilaceration was defined as abrupt deviation of the long axis of the

crown or root portion of the tooth, which is due to a traumatic nonaxial displacement of already formed hard tissue in relation to the developing soft tissue (ANDREASEN et al., 1971). The degree of deviation to be considered dilaceration varied in dental literature. While some researchers claimed that, a tooth is considered to have a dilaceration toward mesial or distal direction if there is a 90° angle or greater along the axis of the tooth or root, others defined dilaceration as a deviation from the normal axis of the tooth of 20° or more in the apical part of the root (Walia et al., 2016).

The aetiology of dilaceration is largely attributed to two dominant explanations though not fully understood. First, dilaceration is caused by acute traumatic injury of the primary predecessor tooth and subsequently affecting the developing successor and resulted in displacement of the calcified tissue to form an angle (McNamara et al., 1998). However, such cause does not account for all case of dilaceration as demonstrated in several researches (McNamara et al., 1998, Jafarzadeh and Abbott, 2007), and hence it is not the exclusive etiological factor of dilaceration. The second common explanation suggested that dilaceration is caused by an idiopathic developmental disturbance (Kilpatrick et al., 1991). This view is based on the fact that most traumatic injuries occurred at young age before the formation of permanent tooth root and that dilaceration is usually reported in posterior teeth that less likely affected by traumatic injuries (Hamasha et al., 2002). However, several other possible factors have been reported in the dental literature such as infection, tumours, developmental disorders, ankylosis causing mechanical interference, some syndromes and hereditary factors(Walia et al., 2016).

Clinically, a dilacerated tooth may vary from no eruption of permanent tooth, prolonged retention of the primary tooth, apical fenestration buccally or labially or it can be asymptomatic (Yassin, 1999, McNamara et al., 1998, Jafarzadeh and Abbott, 2007, Bimstein, 1978). While the dilaceration of a crown of erupted tooth can be visually observed in the mouth, radiographic

examination is essential to find out if roots are affected. Depending on the direction of root dilaceration, it can take different presentation on radiographs. For example, mesially or distally dilacerated root is clearly apparent on a periapical radiograph. On the other hand, in labial/buccal or palatal/lingual dilacerations , the deviating root portion appears at the end of the no deviating portion as a circular radiopaque region with a dark central radiolucent spot, which is known as a Bull's Eye (Fig.3). The deviating portion of the root appears more radiopaque as compared with the rest of the root because the X-ray beam passes through a higher osseous density portion of the root(Ingle and Bakland, 2002, White and Pharoah, 2014). However, Cone beam computed tomography (CBCT) has provided a better option to accurately identifying dilacerated teeth by overcoming the limitations of traditional radiographs that may produce inaccurate representations of anatomic landmarks and poor visualization of some anatomic structures(Park et al., 2006) (Cevidanes et al., 2007).

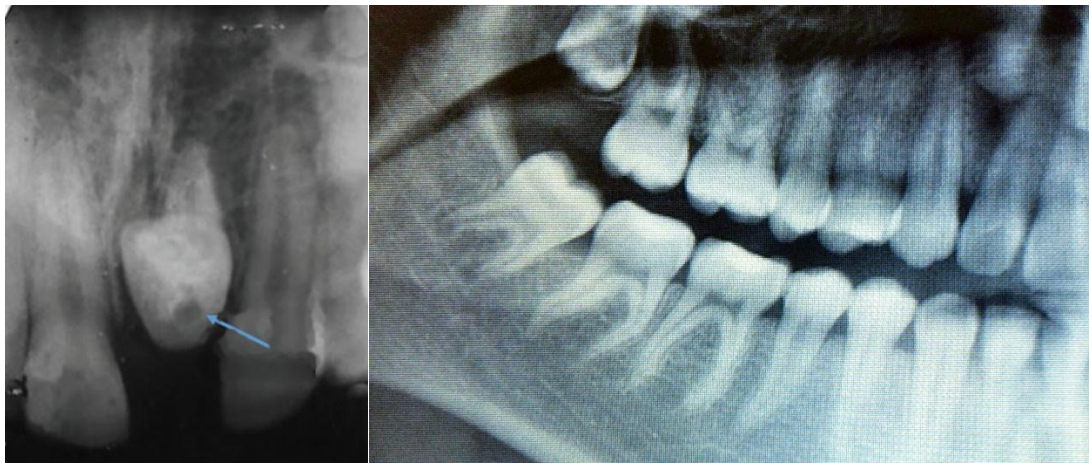

Figure 4: Bulls Eye" phenomenon in a central incisor with dilacerated root
from Int J Clin Pediatr Dent. 2016 Jan-Mar; 9(1): 90–98.

2.1.5 Taurodontism

Taurodontism is a developmental anomaly of the teeth that is characterised by the vertical increase in pulp chamber size, giving it the shape of bovine teeth. the affected tooth has

an enlarged pulp chamber of a multirooted tooth with consequent apical displacement of the floor of the pulp as well as the bifurcation of the root. This pattern of molar tooth formation has been described in ancient Neanderthals where the tooth resembles that of a cud-chewing animal hence the term “tauro” (bull) and “dont” (tooth) (Chetty et al., 2021). Taurodontism is related to a developmental disorder in which the horizontal invagination of Hertwig's epithelial root sheath doesn't occur at a proper level. As a result, the tooth lacks constriction at the junction of the amelocement (Hamner et al., 1964). Its incidence is estimated to affect 11.3% of the population (SILVA et al., 2015). Although it is an isolated anomaly, it can be related to syndromes and other developmental anomalies such as imperfect amelogenesis, ectodermic dysplasia, Down syndrome, Klinefelter syndrome, thricodentalosseous syndrome, Mohr syndrome, Wolf-Hirschhorn syndrome and Lowe syndrome (SILVA et al., 2015).

Affected tooth appears as a clinically normal tooth since its roots are not visible clinically. The diagnosis can only be made by radiographs. The radiographic characteristics of taurodontism include an extension of the pulp chamber into the elongated body of the tooth,

shortened roots and root canals despite a normal sized crown (Fig. 4).

Figure 5: Illistrate molar tooth with TaurodontismChetty, M., Roomaney, I.A. & Beighton, P. Taurodontism in dental genetics. *BDJ Open* 7, 25.

2.1.6 Macrodontia

Macrodontia refers to the teeth that are larger than normal. Macrodontia is a rare type of dental anomaly characterized by excessive enlargement of the mesiodistal and faciolingual tooth dimensions with an increase in the occlusal surface of the crown. The affected tooth exhibits proportionately shortened roots when compared with the body of the tooth. Three different types of macrodontia can be found: true generalized, where many teeth in the mouth are affected (very rare); relative generalized, where all the teeth are affected, and the teeth can either be of normal size in a very small jaw creating the illusion of macrodontia or all the teeth may be slightly enlarged; isolated macrodontia, where only a single tooth is affected (very rare) (Namdar and Atasu, 1999).

Macrodontia is often linked to hyperpituitarism which increases the length of the long bones and teeth. However, hereditary role of large teeth, small jaws and skeleton can result in macrodontia (Rohilla et al., 2017). The prevalence of macrodontia in permanent dentition is 0.03% to 1.9%, and can compromise aesthetics and cause crowding due to the discrepancy in size between tooth and arch and hence its management is mainly related to aesthetic concerns (Gopalakrishna et al., 2018).

2.1.7 Dens in dente

This is a developmental anomaly presented as deep infolding of the enamel organ into the dental papilla during tooth development. Starting from the foramen coecum or tip of the cusps, it can extend deep into the root, with or without pulp involvement, sometimes even resulting in a second apical foramen (Hülsmann, 1997). Dens in dente commonly affect maxillary lateral incisors , bilaterally and often accompanied by other anomalies such as microdontia, macrodontia, hypodontia, taurodontism, fusion and/or supernumerary teeth (Casamassimo et al., 1978).

The aetiology is not fully understood. However, several theories has been suggest and these include buckling of the enamel organ because of growth pressure, focal failure of the growth of the internal enamel epithelium while the surrounding epithelium continues to proliferate and engulf the static area distortion and subsequent protrusion of a part of the enamel organ that will lead to the formation of an enamel-lined channel. In addition, environmental factors such as infection and trauma as well as genetic factors cannot be excluded (van der Vyver et al., 2021).

Clinically, the affected teeth may vary in presentation with an increased crown diameter, incisal notching, hypoplasia at the palatal pit, peg or conical morphology, an exaggerated or bifid cingulum, a talon cusp or a deep foramen coecum. However, symptoms may not arise until caries or pulpal involvement happen. Therefore, An additional X-ray is advised with a horizontal change of 15 degrees in the mesial direction if dens in dent is suspected (Bishop and Alani, 2008).

Radiographically, the pulpal morphology of affected teeth usually appears more complex than normal with an alteration in the pulp outline form and associated periapical lesions. It is classified as Type 1: minor invagination limited to the crown, not extending beyond the cementoenamel junction; Type II: apical extending invagination not limited to the coronal region but extending beyond the cemento-enamel junction, forming a blind sac inside the root that may or may not communicate with the pulp; Type III: severe apical extension of the invagination into the root and exiting into the periodontium (van der Vyver et al., 2021).The invagination may appear as a radiolucent pocket often, but not always, surrounded by a radiopaque enamel border (Gotoh et al., 1979). When the invagination is completely separate from the pulp with its own opening into the periodontal ligament, it can be described as a 'pseudocanal'. Two dimensional radiographs may not provide the true extent of the anomaly,

and it is advised to utilize cone beam computed tomography (CBCT) as a diagnostic tool (Gonçalves et al., 2002).

2.1.8 Fusion and Gemination

Double teeth are referring to both fusion and gemination which are often confused in their diagnosis. Two separate tooth buds may be united at some stage in their development. Depending on the stage they are united, one tooth may have only one pulp chamber, or there may be two pulp chambers, with union only of the dentin and this is known as fusion. This should be differentiated from gemination which is formation of the equivalent of two teeth from the same follicle, with evidence of an attempt for the teeth to be completely separate, indicated clinically by a groove or depression which could delineate two teeth (Rohilla et al., 2017). Double teeth are commonly reported in the anterior region and most often include mandibular lateral incisors and canines (Aydinbelge et al., 2017, Santos et al., 2003).Diagnosis of this phenomenon mainly depends on the case history, as well as the clinical and radiographic examinations. Clinically, both conditions can present as a crown of double size or a bifid crown, or have a normal tooth size. Radiographically, their expression can range from two separate roots to a single root depending on the developmental phase of the fused teeth buds. However, clinically, geminated teeth appear as two fully or partially separated crowns, and radiographically, they result in a single root and root canal (Santos et al., 2003).

2.2 Prevalence of dental anomalies:

The prevalence of dental anomalies in different populations and ethnic groups has been demonstrated in several studies. For example, a study of panoramic radiographs of Black and Caucasian population revealed that 4.4% had congenitally missing teeth and 1.5% had supernumerary teeth, however, supernumerary teeth and odontomas was significantly higher in Blacks than in Caucasians (Bruce et al., 1994). Likewise, a study of 111 Australian orthodontic

patients that 74.77% of their subjects had at least one anomaly. The most prevalent anomaly was invagination, while supernumerary teeth and root dilacerations were the least frequent anomalies. Short roots and dental invagination were significantly more frequent in women than men (Thongudomporn and Freer, 1998). On the other hand, researchers from New Zealand, reported a 21% prevalence of jaw and dental anomalies in the panoramic radiographs of 1607 adolescents. The most frequent anomalies were related to missing and morpholigical deformed teeth (Cholitgul and Drummond, 2000).

The variation in prevalence of dental anomalies has also been noted across different countries. For example, a study of dental anomalies among 6- to 40-year-old Turkish patients by using panoramic radiographs found that the prevalence of dental anomalies diagnosed by panoramic radiographs was 39.2% (46% in male and 54% in female). Anomalies of position (60.8%) and shape (27.8%) were the most common types of abnormalities and anomalies of size (8.2%), structure (0.2%) and number (17%) were the least in both genders. Anomalies of impaction (45.5%), dilacerations (16.3%), hypodontia (13.8%) and taurodontism (11.2%) were the most common subtypes of dental anomalies. Taurodontism was more common in the age groups of 13-19 years. The age range of the most frequent of all other anomalies was 20-29(Bilge et al., 2018). Lower prevalence of dental anomalies was reported in other Middle Eastern country (Iran), were this cross-sectional study was conducted on 1649 people in Hamadan City, in 2012-2013 revealed that the prevalence of dental anomalies diagnosed by panoramic radiographs was 29%. Anomalies of position and number were the most common types of abnormalities, and anomalies of shape and structure were the least in both genders. Anomalies of impaction (44.76%), dilacerations (21.11%), hypodontia (15.88%), taurodontism (9.29%), and hyperdontia (6.76%) were the most common subtypes of dental anomalies. The anomalies of shape and number were more common in the age groups of 7-12 years and 13-15

years, respectively, while the anomalies of structure and position were more common among the other age groups.(Shokri et al., 2014).

Another Iranian study reported another finding though higher proportion of dental anomalies. 40.8% of the patients had dental anomalies. The more common anomalies were dilacerations (15%), impacted teeth (8.3%) and taurodontism (7.5%) and supernumerary teeth (3.5%). Dilaceration, taurodontism and supernumerary teeth were found to be more prevalent in men than women. Family history of dental anomalies was positive in 34% of the cases (Ezoddini et al., 2007).

2.3 Prevalence of hard dental tissue anomalies in Libya

A few studies have explored the prevalence of hard dental tissue anomalies in Libya. In a study of records of 252 orthodontic patients (57 Males and 195 Females), dental anomalies were observed in 54% of the patients, more commonly affecting females (Iman Abdelgader, 2015). The most common anomalies were ectopic eruption of anterior teeth (34.9%), thin pipette-shaped roots (30%) and short blunt root (24%). On the other hand, the least frequent anomalies were supernumerary teeth (1%) and dilaceration (0.4). This data should be interpreted with caution since it was based on orthodontic patients and hence it is not representative of the Libyan population.

Another study investigated the prevalence of Molar Incisor Hypomineralization (M I H) in a convenience sample of school children aged between 7 and 9 years living in Benghazi, Libya, reported very low prevalence of MIH where 11 children out of 378, (7.1%), had developmental enamel defect, with all lesions considered mild. Six children (1.6%) had diffuse opacities and 3 (0.8%) had hypoplastic defects in their first molars (Fteita et al., 2006).

one study conducted among Libyan children and investigated the sequence of eruption in permanent teeth (Ommar, 1994). The study found that the sequence of eruption of permanent

teeth was similar for all children compared by gender and living area (Rural vs Urban), but the eruption time was earlier in females than males, and in rural children than urban children. The author reported that the sequence of eruption is similar to that observed in other countries. The sequence of eruption of permanent teeth for Libyan children was as following:

Maxilla: M1, I1, I2, P1, P2, C, M2

Mandible: M1, I1, I2, C, P1, P2, M2

Obviously, there is paucity of data regarding dental anomalies among Libyan adults. The generalizability of these few reports on dental anomalies among Libyan children is questionable. There are still many unanswered questions about dental anomalies among Libyan adult. Further research should be undertaken to answer explore the incidence of dental anomalies among Libyan adults.

Aims and Objectives

3 . Aims and Objectives

Aims

The study aims to investigate the prevalence of dental anomalies among Libyan patients.

Objectives

1. Assess the prevalence of dental anomalies in panoramic radiographs of adult Libya dental patients
2. Compares the prevalence of developmental anomalies by age and gender of participants
3. Assess the presence of multiple anomalies in the same case.

Materials and Methods

4. Materials and Methods

4.1 Study design:

A cross-sectional study design was used to analyze radiographic data that was collected retrospectively as part of routine dental care. This design was adopted to avoid unnecessary exposure to radiations. Although random sample from the population is usually recommended to study the distribution of oral health conditions, this was not possible in our study due to ethical reasons.

4.2 Setting

is a country in the Maghreb region in North Africa. It is bordered by the Mediterranean Sea to the north, Egypt to the east, Sudan to the southeast, Chad to the south, Niger to the southwest, Algeria to the west, and Tunisia to the northwest. Libya is made of three historical regions: Tripolitania, Fezzan, and Cyrenaica. With an area of almost 700,000 square miles (1.8 million km2), it is the fourth-largest country in Africa and the Arab world, and the 16th-largest in the world. Libya has the 10th-largest proven oil reserves in the world. The largest city and capital, Tripoli, is located in western Libya and contains over three million of Libya's seven million people.("Libya Demographics Profile 2014").(figure 5,6).

Figure 5:Geographic map showing position of Libya among surrounding contries

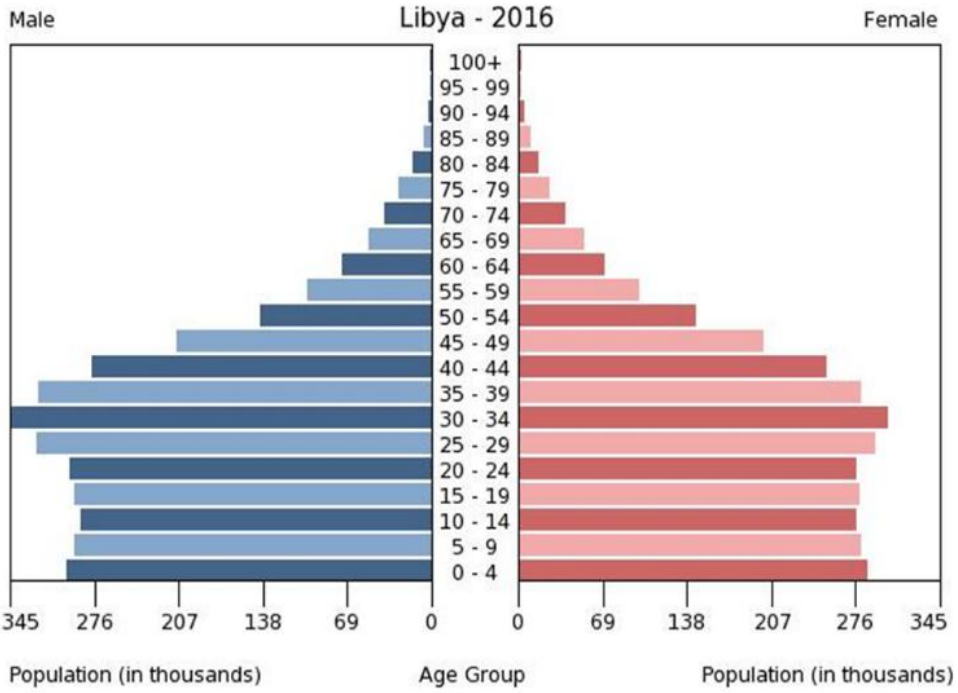

Figure 6: Age distribution of Libyan population

4.3 Study sample

A convenience sample of panoramic radiographs, taken in the last six months for Libyan adult patients of both sexes (males and females), was collected from different Clinics in the city of Benghazi. The radiographs were panoramic views taken as PlaneMeca EC Pro one (Helsinki, Finland) with the maximum KVP of 70, mA=12 and exposure time Sec=18

Figure7:Show the Plane Meca panoramic device

The radiographs were used in the digital form after being uploaded on computer device DELL 15inch windows10 Pantum5&500 Gp

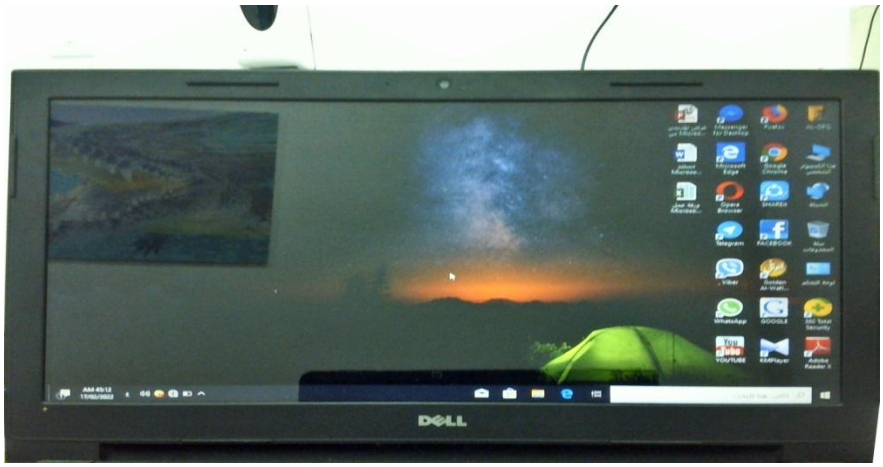

Figure 8:The computer used in the study

As JPEG&PNJ pictures with maximum resolution. opened with Windows photo viewer.

Fiure 9:The programe used to open JBEG&PJN Pictures

.Two major clinics were identified and provided consent to use their data(ALBERKA DENTAL CLINIC& ELMMARJDENTAL CENTER). A total of 412 panoramic radiographs were retrieved for analysis which have at least information on patients; age and gender and satisfy following inclusion and exclusion criteria:

Inclusion criteria:

- Libyan dental patients
- Aged 18 years of age or older
- Good quality radiograph:

Exclusion criteria

- Unclear panoramic view
- patients known for hereditary syndromes associated with dental anomalies
- Trauma or fracture of the jaw which may affect the normal growth
- History of orthodontic treatment

4.4 Quality assessment of radiographs:

Each image was scored subjectively with a 4-point ordinal grading scale covering three major aspects which consisted of anatomical coverage, density and image contrast and also anatomical structures. The anatomical structures on panoramic image were divided into 6 anatomical zones namely: dentition (zone 1), nasal and sinus (zone 2), mandibular body (zone 3), temporal-mandibular joint (zone 4), ramus-spine (zone 5) and hyoid bone (zone 6) as in figure10. The average score was then calculated from those 6 anatomical zones, anatomical coverage, image density and contrast so as to represent the diagnostic quality of each panoramic image. The score was descriped in table (1).The lower score (score of 1 or 2) indicating poorer image quality and excluded from the study. (Sabarudin and Tiau, 2013)

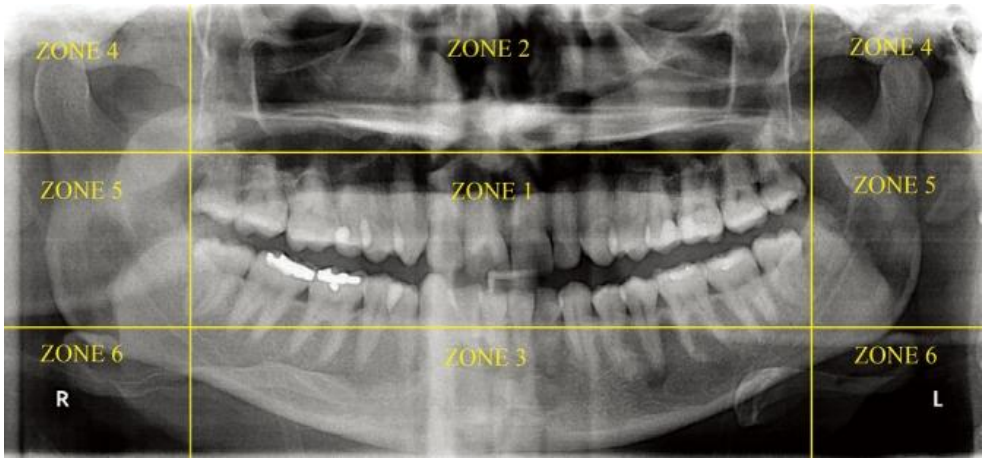

Figure10: Orthopantomographe zones

Table 1: evaluation of image quality

Evaluation aspect	***score***	***Description***
Anatomy coverage	1	Inappropriate coverage and irrelevant to clinical needs.
	2	Sign of suspected coverage worthy for further inspection.
	3	Visibility of coverage relevant to the clinical needs.
	4	Appropriate and optimal coverage depending upon the clinical application.
Density and contrast	1	Poor density and inadequate contrast between the enamel and the dentine.

	2	Unsatisfactory density with adequate contrast between the enamel and the dentine.
	3	Satisfactory density and contrast between the enamel and the dentine.
	4	Excellent density and contrast between the enamel and the dentine.
Anatomical structures	1	Significant structures are not visible and no diagnosis is possible.
	2	Only broad detail seen, diagnosis is uncertain.
	3	Small details are visualize and probably possible for diagnosis.
	4	Fine details are visualized with certain possible diagnosis.

4.5 Interpretation of radiographs

The radiographs were assessed for the presence of developmental dental anomalies which include disorders of shape, number, structure and position. The developmental anomalies are summaries in Table 2.

The interpretation of the radiographs was performed by one observer and reviewed by the other observer in a separate setting. The two observers conducted agreement training before starting the interpretation of the radiographs. This included interpreting 10 radiographs with different anomalies and conflicts in the agreement were solved by discussion. Over 90% agreement was reached before commencing radiographs interpretation.

.In the present study the tooth is considered to have dilaceration if it has angulation above 20 degree

Figure11: Template used to measure the angle of dilacerations

Table 2: categories of dental anomalies assess in the present study

Numbering	• Supernumerary:
	  ○ mesiodens, paramolar and distomolar.
	• Hypodontia
	  ○ lateral incisors,canines,premolars
	  ○ excluding third molars

Shape and size	• Microdontia • Macrodontia • Fusion • Gemenation • Dilacerations • dens in dent • Taurodontism
Impaction	• Third molars • Others

4.6 Statistical analysis

The interpretation data and available demographic data for dental patients were uploaded on excel sheet and coded as numbers. The dental anomalies for each type were coded as present or absent. If more than one anomaly of same type were present in one patient, they coded more than one. Each anomaly was coded separately. The data was then imported into SPSS statistical package (version 25). Descriptive statistical analysis was conducted to describe the demographic characteristics of study participants and the proportions of dental anomalies. The mean age of dental patients was compared among anomalies and anomaly free subgroups using independent samples t test. The distribution of anomalies by gender was conducted using Chi-square test. The level of significance will be set at p=0.05.

4.7 Ethical issues

This study comprises collection of data from patients' files and interpretation of panoramic views in a period of about six months. Storage of the data was in software form in the lab-top of the researcher till they needed in further research. No information that identifies the identity of participants were used in results presentation.The research was approved by Research Ethics Committee at the Faculty of Dentistry,University of Benghazi (approval number 67-2021)

Results

5. Results

5.1 Sample

A total of 412 panoramic radiographs were used in the data analysis. The majority were females (no=273, 66%), aged between 18 and 70 years with an average age of 37.45±11.73 years (Table 3).

Table 3: Description of study sample (n=412)

Variable		N (%)
Gender	Male	139 (34)
	Female	273 (66)
Age	Mean ±SD 37.45±11.73	Min-Max 18-70

5.2 Prevalence of dental anomalies

Figure 13 shows the distribution of dental anomalies. The most common type of dental anomalies was dilaceration (no=130,31.6%), followed by impaction of wisdom teeth (no=66, 16%) and impaction of other teeth (no=23, 5.6%). A few cases of other anomalies were reported. These included one case of odontome, ectopic eruption, and mesodens. were also seen.

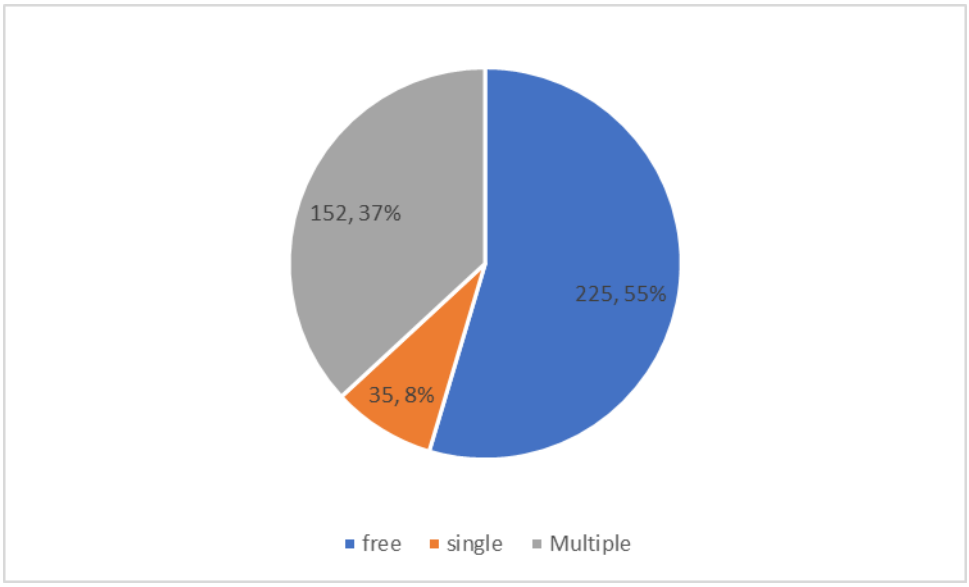

Figure12: Distribution of dental anomalies by presence&multiplicity

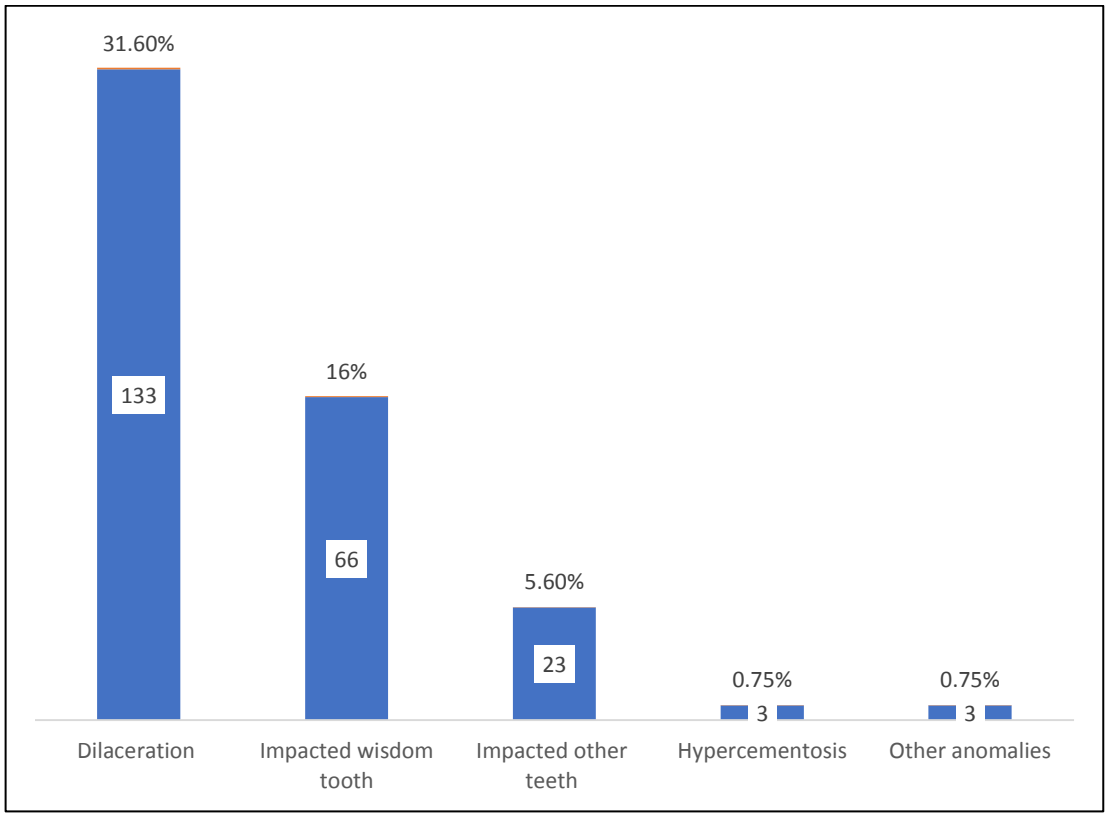

Figure 13: Distribution of dental anomalies according to type.

5.3 Prevalence of Impacted teeth

The proportion of impacted teeth is presented in figure 14. Overall impaction was observed in 21.6% of radiographs. Impaction of one tooth was the most common form of impaction, followed by 2 teeth, 3 teeth and four teeth.

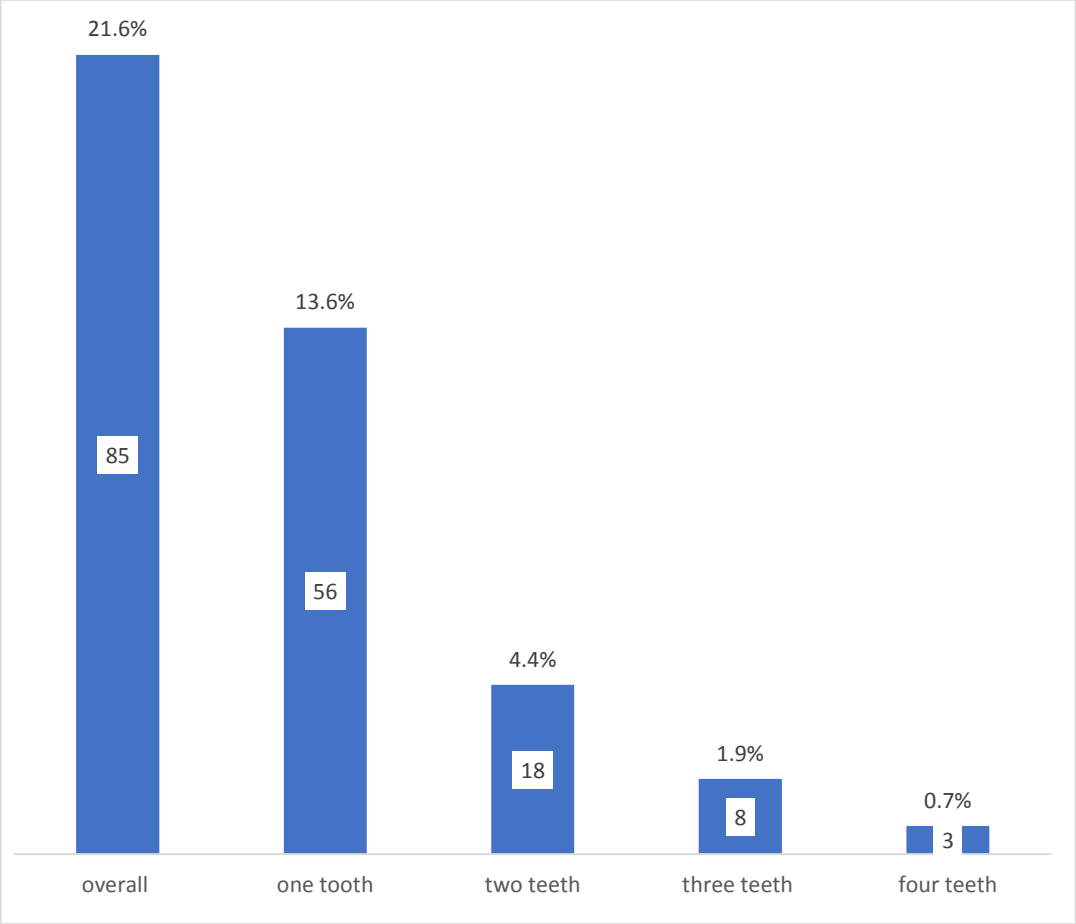

Figure 14: Frequency of impacted teeth according to number .

Figure 15: shows the distribution of impacted third molars by side. The impaction was more in lower than upper teeth (11.6% and 7.7%, respectively). Single impaction was higher than 2-sided impaction in both maxilla and mandible.

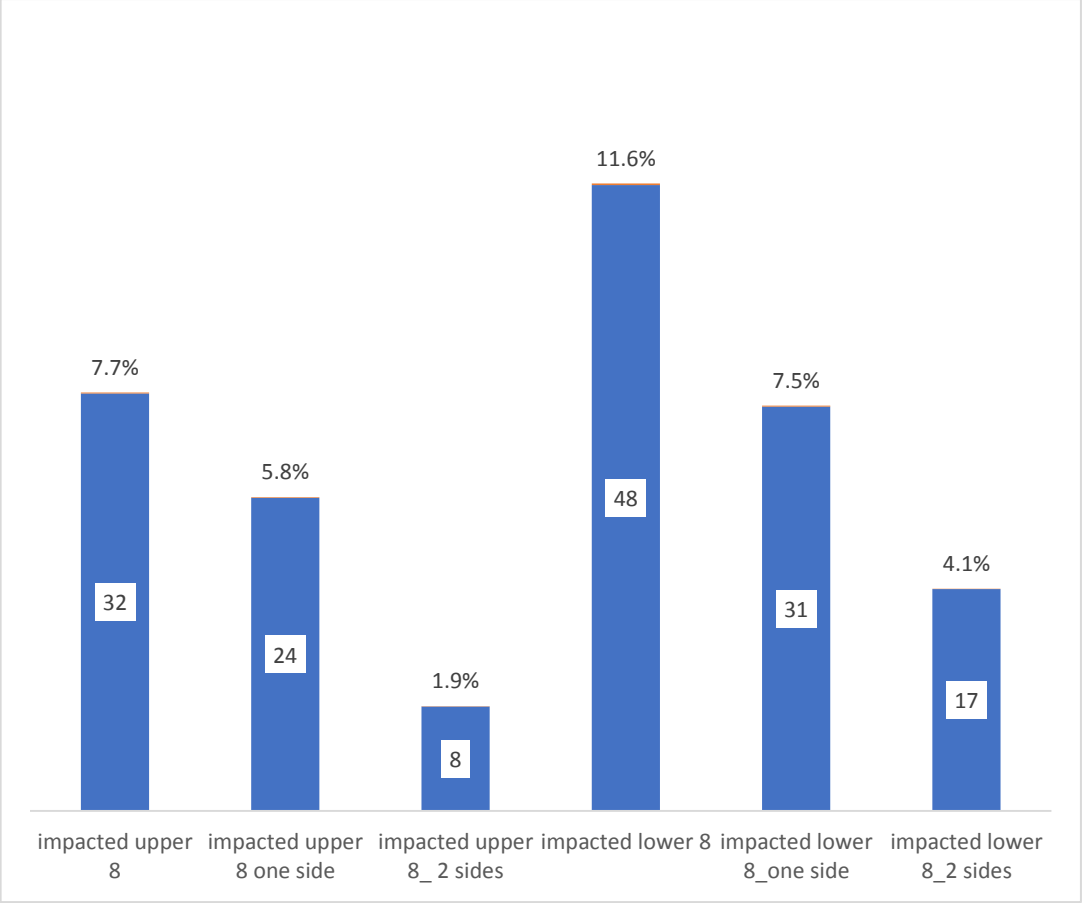

Figure 15: Distribution of impacted third molars by side

Figure 16 describes the distribution of impacted wisdom teeth.according to location The most commonly seen impaction in wisdom teeth was observed on lower right side (8.5%), followed by lower left side (7.3%). The least impacted tooth was upper right eight (4.6%).

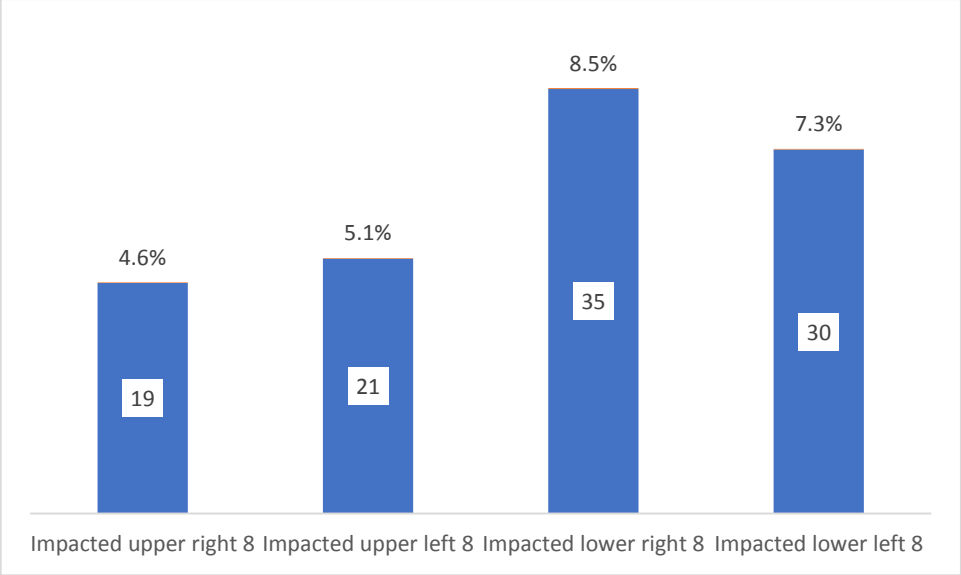

Figure 16: Distribution of impacted third molars according to location

Figure 17 shows the distribution of dilacerated teeth. Dilaceration was seen in nearly one third of radiographs assessed (31.6%). The single tooth dilaceration was less common than multiple teeth dilaceration.

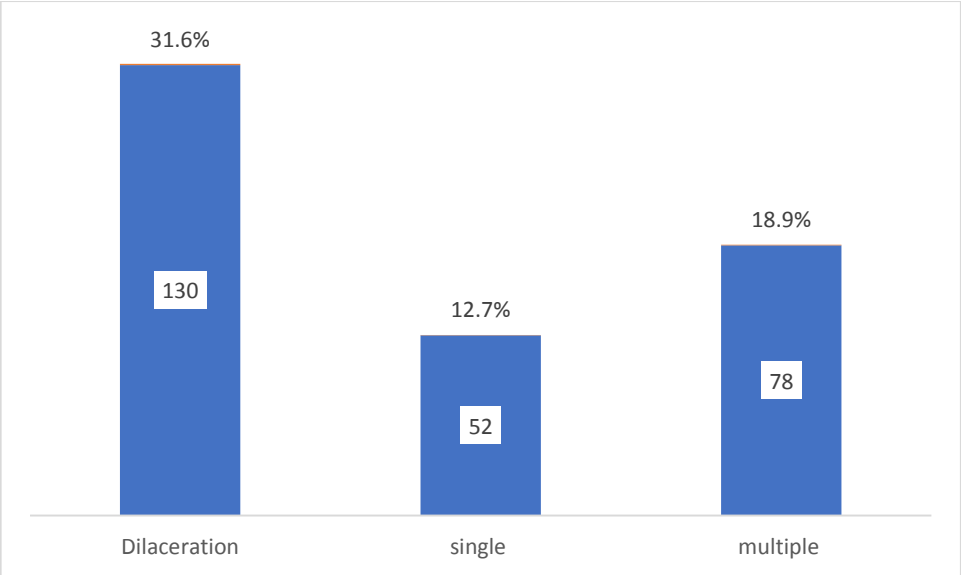

Figure 17: Distribution of dilacerated teeth

5.4 Bivariate Analysis

Comparisons of anomalies by characteristics of the study sample are summarized in Table 4. No statistically significant differences were found when the proportion of anomalies were compared by gender. However, statistically significant differences were found when the age was compared among those who have anomalies and those who did not.

Table 4: comparison of impaction and dilaceration by age

Variable		**Mean ±SD**	**P value**
Dilaceration	Present	33.94 ±10.84	0.000***
	Absent	39.67 ± 11.63	
Impaction of wisdoms	Present	32.76 ± 11.22	0.003**
	Absent	38.24 ±11.65	

Independent sample t test was used to compare subgroups

Table 5: comparison of impaction and dilaceration by gender

Variable		**N (%)**	**P value**
Dilaceration	Male	37 (26.6)	0.124
	Female	93 (34.1)	
Impaction of wisdoms	Male	24 (17.3	0.624
	Female	42 (15.4)	

Chi square test was used to compare subgroups

Discussion

6. Discussion

The present study analyzed panoramic radiographs of adults Libyan dental patients who were outpatients of several dental clinics in the city of Benghazi, in order to describe the prevalence and the pattern of associations of different dental anomalies. Detailed study of these anomalies seems essential as they can lead to malocclusion, cosmetic deformities, and problems during tooth extraction or root canal treatment. In order to diagnose these anomalies, in addition to clinical observations and examinations, paraclinical investigations such as radiography are essential and play an important role in the differential diagnoses of these anomalies (White and Pharoah, 2004). Therefore,

The analysis 412 panoramic radiographs of dental patients aged between 18 and 70 years, showed that 45 % had dental anomalies and the majority of them had multiple anomalies. This figure is relatively higher than that previously in Turkish population (39%) (Bilge et al., 2018) , New Zealand (21%), and Iranian young population (29%) (Shokri et al., 2014) and 40 % (Ezoddini et al., 2007), but lower than that previously reported in India (73%) (Guttal KS, 2010). The present study confirms the notion that the prevalence of dental anomalies was inconsistent between and within populations, which is attributed in race, genetic and methodological factors (Al-Abdallah et al., 2015, Ezoddini et al., 2007). For example, some studies the types of dental anomalies assessed. However, no restrictions were applied on the type of dental anomalies included in the current study.

Dilaceration was the most common type of dental anomalies in the study sample, followed by impaction of wisdom teeth and hypodontia. Similar findings were reported in previous studies in Iran (Ezoddini et al., 2007). On contrary, other studies found different results, for example, impaction was the most common type of dental anomalies in an Iranian study (Shokri et al., 2014). However, comparison of such type of studies should be

approached with caution because of variations in age groups and methodology. For instance, in a study that screened 5005 digital panoramic radiographs in Rome, displaced canine and hypodontia were the most common type of developmental anomalies (Bruce et al., 1994). However, the subjects were from young age group (8-12 years of age).

Interestingly, the prevalence of dilaceration in the current study is relatively high (31.65). which is way higher than that reported in other countries such as in Turkey (9.5%) (Miloglu et al., 2010) in Nigeria (3%), (Udoye and Jafarzadeh, 2009), (Hamasha et al., 2002) in Jordan (3.8%) in Yazd (15%) (Ezoddini et al., 2007). The difference in diagnostic criteria might be the cause of this dissimilarity. In the present study the tooth is considered to have dilaceration if it has angulation above 20 degree. Alternately, a study that included dilaceration at the angle of 90 degree or more, the dilaceration was reported in 7% of patients (Nabavizadeh et al., 2013). Although it is difficult to explain the relatively high rate of dilaceration in the current study, it is possible that recurrent infections in the primary dentition has resulted in injuries of permanent tooth bud (Walia et al., 2016). This explanation is supported by the findings of several studies conducted in Libyan children and adults that indicated high caries rates with no treatment or extraction as common encounters (Byahatti and Ingafou, 2011, Arheiam et al., 2020).

The second most common developmental anomaly in the present study was the impacted teeth. Third molars which was reported in 16% of patients. This finding is low compared to studies conducted in other countries such as Yemen , Turkey and Iran were above 40% of adults had at least one impacted third molar tooth (Alhadi et al., 2019, Shokri et al., 2014, Bilge et al., 2018). However, lower prevalence of impaction has been reported in several countries (Ezoddini et al., 2007). In fact, extraction of impacted teeth is one of the prominent causes of tooth extraction in Libyan adult population (Byahatti and Ingafou, 2011). Therefore, the findings reported in the present study can be an underestimation of the actual

impaction prevalence since many patients might remove the impacted teeth surgically, especially older individuals. In addition, the assessment does not include examination to identify impacted teeth and hence many partially impacted teeth may be unrecorded.

Impaction in teeth other than wisdoms was observed in 5.6% of patients. This is comparable to what is reported in studies which suggested that the prevalence of canine impaction ranges between 0.8 and 8.8% among different populations (Aydin et al., 2004, Aktan et al., 2010, Fardi et al., 2011). This dissimilarity in results in different countries is not surprising given that the prevalence of dental anomalies varied widely globally. However, this finding should be approached with caution given that the analysis is based solely on radiographic assessment with no medical records were available. Nevertheless, the present study enrolled older dental patients which minimizes the bias of miss-diagnosis usually occur in younger patients (Rakhshan, 2015). Above all, missing teeth to congenital or other reasons can effect quality of life and social well-being of individuals by compromising the aesthetic, function, and places additional financial burden (Al-Ani, 2016).

In the present study the majority of patients with dental anomalies had two or more co-existing anomalies. This finding is highly suggestive of genetic origin and hereditary aspects of these anomalies. In addition, while no gender differences were observed, the prevalence of impaction and dilaceration increased with age. It is unclear why, however, it could be the case that these the panoramic radiograph is usually taken to older patients to diagnose periodontitis and hence these asymptomatic anomalies are common among older patients who comprised the majority of participants. The data used in this study is for adult patients who received dental care at some point and whose treatment necessitates the radiographic investigation. Therefore, the findings of the present study cannot be extrapolated to general population.

In the present study a few cases of supernumerary teeth and odontome were observed. This is suggesting that supernumerary teeth are relatively rare among Libyan adult. A review of literature indicates that incidence rate of supernumerary teeth ranged between 1.5% and 3.5% (Ata-Ali et al., 2014) .

The study findings were tempered by some limitations which should be discussed here. First, the study used retrospectively collected radiographs with limited additional information such as medical history, dental history, and chief complain. Second, no clinical examination was undertaken at the time of the study which affected the diagnosis of anomalies. Therefore, future prospective studies that included both radiographic and clinical examination should be considered. Another area to investigate the role of dental education in preparing dental work force to meet the diagnostic and treatments needs of patients bearing dental anomalies. Previous studies suggested that dental curricula in Libyan dental schools do not adequately prepare dentists to provide preventive dental services (Arheiam and Bernabé, 2015, Arheiam et al., 2015).

Conclusions and Recommendations

7. Conclusions and Recommendations

7.1 Conclusions:

The present study used a retrospective analysis of panoramic radiographs of adults Libyan dental patients. It demonstrated that developmental anomalies among Libya adults participated in the study are relatively common affecting 45% of cases and the majority of them had multiple anomalies. The most common types of anomalies were dilaceration and impaction, mainly third molars. Rare cases of supernumerary teeth were reported. The study showed that the prevalence of dental anomalies increases with the age of participants.

7.2 Recommendations

- Future research that used prospective study design, history taking and clinical examination should be considered.
- Further studies should be conducted in other parts of Libya to identify potential racial differences.
- Studies that include general population with minimum radiographic risk should be conducted using advanced technology such as CBCT.
- The dental curriculum should be updated to provide Libyan dentists a local data about the prevalence of dental anomalies and to prepare Libyan dentists for early detection and management of these conditions

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Appendices

Appendix

1.Panoramic device used in this study :Plan Meca EC Pro one(Helsinky,Finland)with the maximum KVP of 70,mA=12 and exposure time =18 sec

2.Computer device used in this study : DELL pantum (5) (500) GP &(15)inch viewer

3.The soft ware programe: Windows10 origenal copy

4.The programe used to open the JBNG&PNJ pictures: Windows photo viewer.

5.To measure the angle of dilacerations used prefabricated transparent Template.

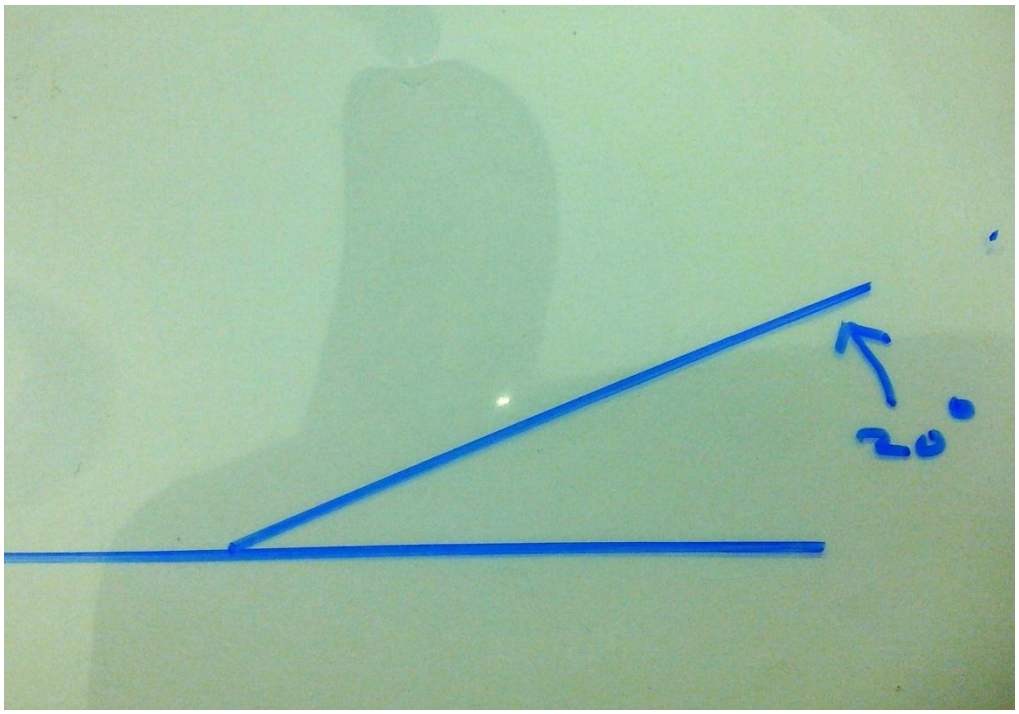

Figure 18:Transparent Template

انتشار تشوهات الأسنان المتطورة في عينة من المرضى الليبيين البالغين: دراسة أشعة بانورامية

قدمت من قبل :

مجدي سليم حمد

تحت إشراف :

د. مرعي أدريس سعيد

الخلفية

انتشار تشوهات الأسنان في مجموعات سكانية وعرقية مختلفة كما هو موضح في العديد من الدراسات. حتى الآن ، لا يُعرف الكثير عن التشوهات التنموية لدى السكان الليبيين. يهدف هذا البحث إلى: التحقيق في انتشار التشوهات السنية بين عينة ليبية بالغة مختارة باستخدام التصوير الشعاعي البانورامي.

المواد والأساليب:

تم جمع دراسة بأثر رجعي للصور الشعاعية البانورامية لـ (412) مريض ليبي بالغ من كلا الجنسين (ذكور وإناث) من عيادات مختلفة في منطقة بنغازي في فترة ستة أشهر. تمت دراسة الصور الشعاعية على شاشة الكمبيوتر لمعرفة مدى انتشار تشوهات الأسنان التنموية. الإحصاء الوصفي والتحليل ثنائي المتغير حسب العمر و أجري الجنس باستخدام برنامج SPSS.

النتائج

تم استخدام ما مجموعه 412 صورة شعاعية بانورامية في تحليل البيانات. كانت الغالبية من الإناث (273 ، 66٪) ، تتراوح أعمارهن بين 18 و 70 عامًا. كان أكثر أنواع التشوهات السنية شيوعًا هو

التمدد (130.31٪) ، يليه انحشار ضرس العقل (66 ، 16٪) وانحشار الأسنان الأخرى (23 ، 5.6٪). تم الإبلاغ عن عدد قليل من الحالات الشاذة الأخرى. وشملت هذه حالة واحدة من اندفاع السن خارج الرحم والأوكار المتوسطة. كما شوهدت ثلاث حالات من الإصابة بفرط الملاط

الإستنتاجات:

كان التمدد والانحشار أكثر أنواع التشوهات السنية التطورية شيوعًا بين مجتمع الدراسة ، مع وجود حالات نادرة للأسنان الزائدة والأسنان السنية. تشيع حالات الشذوذ المتعددة في هذه الدراسة ، مما يشير إلى الأصل الجيني. أظهرت الدراسة أن انتشار تشوهات الأسنان يزداد مع تقدم العمر.

انتشار تشوهات الأسنان المتطورة في عينة من المرضى الليبيين البالغين: دراسة أشعة بانورامية

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قدمت هذه الرسالة استكمالا لمتطلبات الحصول على درجة الماجستير في قسم طب الفم

جامعة بنغازي

كلية طب وجراحة الفم والأسنان

يناير 2022