



Importance of cone-beam computed tomography (CBCT) in the pre-evaluation of surgical removal of an impacted canine, premolar and supernumerary tooth

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ABSTRACT

Impacted teeth could be defined as unsatisfactory tooth eruption at its suitable position. Mostly impacted teeth are wisdom teeth, and after followed by upper canine and lower premolar, respectively. During and after removal of impacted teeth, some complications may be seen such as damage to adjacent teeth, nerve damage, teeth/root escape, maxillary sinus, and nasal base perforation. Proper radiographic evaluations have great interest to eliminate these complications. Conventional radiograph in dentistry such as periapical, occlusal, cephalometric and panoramic radiographs(OPG) provide only(2D) examination. Thus, they provide limited information about the anatomical structures, size, and location of any problems. Also, there are many disadvantages of (2D) imaging methods such as cross-bite, magnification, distortion of images, and perspective problems. Due to insufficiency of (2D) imaging methods, a novel method named cone-beam computed tomography (CBCT), which is specially developed to use in head and neck imagines. CBCT has several advantages including low radiation dose, faster scan, accurate precise evaluation, lesser artifact, and magnification. In our study, in the pre-evaluation of 108 impacted canines, premolar and supernumerary teeth, OPG and CBCT images of 70 patients were assessed and resulting data were compared. In this study we confirm the importance of CBCT evaluation before the surgical removal of impacted teeth in jaws, we concluded that in the removal of regarding teeth together with the OPG, CBCT imaging is a necessity not an option in today's technology.

Keywords:

CBCT (Cone Beam Computed Tomography), Panoramic radiograph (OPG), 2D, Impacted teeth..

Introduction

Three-dimensional (3D) cone-beam computed tomography (CBCT) was advanced from conventional computed tomography in the 1990s. The first profitable CBCT unit, the

NewTom 9000 (Quantitative Radiology, Verona, Italy), as defined in 1998 (1). Subsequently, then innovative and developed CBCT systems have been developed. CBCT is well appropriate to dentistry because it

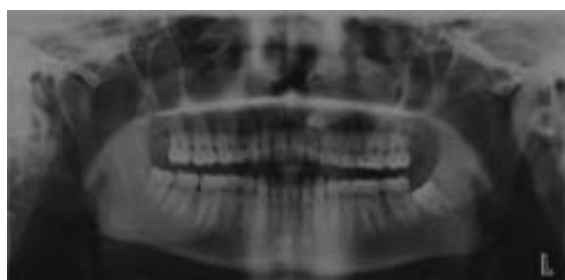
delivers excellent images of great dissimilar structures, for instance, the conventional computed tomography(CT). Contrasting the fan-shaped X-ray used in conventional CT, CBCT uses a conical or pyramidal X-ray beam to obtain a large volume of information through a flat factor. In CBCT imaging a conical X-ray beam which circles in a single or partial rotation about the patient to generate multiple two-dimensional(2D) projections. By using reconstruction algorithms, the developed 2D images are converted to a three-dimensional data set that can be viewed in the (axial, sagittal and coronal) planes. Using functionalities such as magnification and visual enhancement (for instance: greyscales, brightness and contrast level); the CBCT gives clinicians a powerful tool for diagnosis of various pathologies and dental treatment planning. Compared to CT, CBCT knowledge proposals a comparable diagnostic rate for numerous indications while allowing for minor radiation dose, lower price, and a faster, easier image achievement and display (2). While the radiation dose in CBCT is greater than that from the unoriginal radiographs routinely used in dentistry (2,3). 3D CBCT has benefits over 2D unoriginal radiographs in that it describes a more accurate three-dimensional relationship between anatomic structures, thus eliminating two major problems that usually plague conventional radiographs: geometric distortion and superimposition of surrounding anatomical structures. Marmulla et al (4), reported that a major advantage of CBCT is its three-dimensional geometric exactness matched with unoriginal radiographs. CBCT can reveal hidden anatomy as well as occult pathology, reducing the possibility of missing a clinically appropriate disease. Nakata et al (5) establish that CBCT may distinguish the occurrence of formerly undiagnosed periapical infection where previous clinical assessment

and unoriginal radiographic conclusions miscarried to expose the pathology. It has also been suggested that CBCT may detect periapical findings earlier and more accurately than conventional radiographs. (6, 10) Asymptomatic or occult pathology possibly will lead to the postponed diagnosis, which possibly will unfavorably disturb treatment strategy and outcome. Premature detection, prevention, and developed diagnostic correctness are necessary for ensuring improved patient care and treatment outcomes. It can also reduce the treatment period, complications, difficulty, and prices. The protagonist of CBCT is quickly developing in the fields of dental implantology (7) Orthodontic treatment (8), endodontic evaluations (9,10), and oral surgery (11). It has also found applications in the evaluation of pathology (12) assessment of the temporomandibular joints (TMJs) (13), and airway analysis (14) It has been used in the precise localization of impacted ectopic canines (15) supernumerary teeth (16), and foreign bodies (17). It is also being used in the assessment of third molar relationship (18), dental trauma (19) and root fracture (20). Despite the advantages, CBCT is known to have its limitations that include poor soft tissue contrast (21) and image noise due to scattering radiation. CBCT cannot be used with any reliability on the typical patient at high risk for caries due to the presence of false-positive lesions resulting from the presence of metallic restorations. (22) The purpose of this study is to found the benefit of CBCT in comparison to OPG in the preevaluation of surgical removal of impacted: canine, premolar, and supernumerary teeth, to prevent of any pre or post-surgical complications during surgical removal of them, rather than incidental findings.

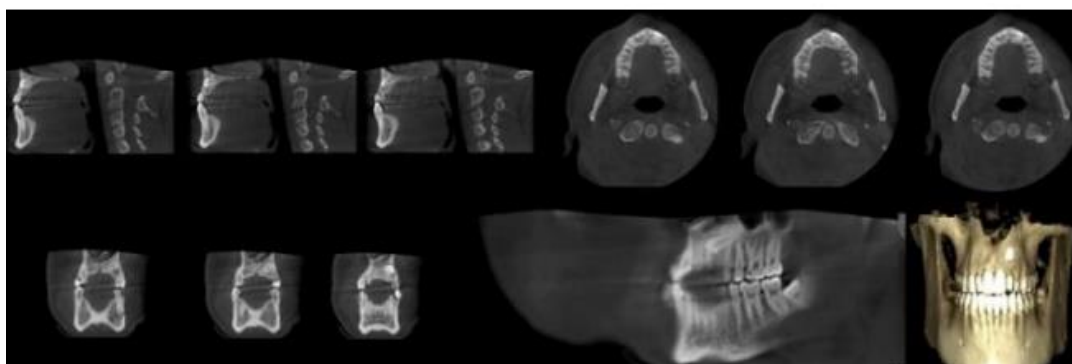
Material and method

Our research was approved and decided by No 406 / 2014 from a committee of ethical clinical research - health science institute faculty of dentistry at Gaziantep University at 15.12.2014. In study we collected the data from those patients that they attend our clinic during the periods of (1. Jan.2015) to (31. march.2015), in which they suffering from pain due to presence of impacted canine, premolar, and supernumerary teeth that they are necessary surgically removal of them, and some of them need to be extracted for either preprosthetic or orthodontic purpose and prevention of any pre or post-operative complications due to the removal of them. Also,

our research aims to establish the benefit of CBCT in the pre-evaluation of surgical removal of impacted teeth. For obtain that purpose we collected all OPG films that previously taken from those patients that they attended the clinic of diagnostic department in faculty of dentistry in Gaziantep University in where before anything they took OPG for every patient, thus to confirm our thought about the benefit of CBCT than OPG, we taken CBCT for every patient and collected also ,and after that we start the evaluation of every patient (our seventy-70) pre-operatively to prevent any undesirable complications that may encounter the surgeon during or postoperatively, if only assessed the cases by OPG films. (Figure 1&2).



(Figure 1): OPG was taken from a patient. Only allows examination of a single plan.



(Figure 2): CBCT obtained from the patient. Axial, coronal, sagittal, panoramic and permit 3D inspection.

We took OPG for all of the patient by Planmeca Promax (Helsinki, Finland) device (Figure 3) for each film we obtained by 64 kVp, 6 mA and the average dose of them is about 16 seconds and for obtained CBCT images by using

Planmeca ProMax 3D MID (Helsinki, Finland) device (Figure 4) and for obtaining each film we must utilize 90 kVp and 12mA in approximately 27 seconds using an average doses (mGy 2,300 / cm²) were taken.



(Figure 3): Orthopantomogram (OPG) device (Planmeca ProMax, Helsinki, Finland).



(Figure 4): Cone Beam Computerized Tomography (CBCT) device (Planmeca ProMax 3D MID, Helsinki, Finland)

Also from patients' age, gender and data related systemic conditions were taken. Pregnant with pregnancy is suspected, the chief who had received radiotherapy in the neck area, systemically using bisphosphonates or

derivative drugs, cancer treated with the data of patients taking drugs to suppress their immune system is blocked or immune system are not included in the study. In the research also registers all impacted teeth that can be

seen in radiograph of all patients, except wisdom teeth, that may have indications for the extraction or not. Also, with the localization of impacted teeth that they need surgical removal also registers the relations with anatomic structures, relations with neighboring tooth roots, and data on whether they lead to the adjacent tooth root resorption were recorded. Also in our study, only with OPG imaging of impacted reliability of the position of the surgical approach for determining the place also tested accordingly, for this purpose, we take thought for all OPG that collected in in research from three of my friends in Oral and Maxillofacial Surgery ;one has not started to yet surgeries, one of them has about 6 month surgery experience, one of them that have approximately 2-year surgery experience residency in the evaluation only the crown localization of impacted teeth evaluate the OPG radiographs that were requested. These three separate evaluations still CBCT images by comparison with data obtained from the evaluation of the reliability of the position of the impacted tooth crown alone OPG

confirmed. On the other hand, in our research, rather than impacted canine, premolar and supernumerary teeth, in all OPG radiographs, we recorded the presence of any: dental caries, periapical lesion, impacted wisdom teeth, cysts or tumors.

Results

In our research from a total of 70 patients (41 males (%58.6) and 29 female (%41.4)), we evaluated all cases and collected 136 impacted teeth, excluding wisdom teeth, all composed of 60 canines, 19 premolars, 44 supernumerary teeth and others 13 are composed of impacted central and lateral incisors (Table 1). Excluding wisdom teeth, we did extraction for 108 impacted teeth that they have an indication for extraction, and we can classify them as follows: 55 canines, 12 premolars, 1 central incisor and 40 supernumerary teeth (Table 1). Also, we don't do extraction for 4 other impacted supernumerary teeth that they indicate extraction because the patients don't come back in the second session.

Table 1: Distribution according to the type of impacted teeth was recorded in our study

Teeth type	Total Number of impacted	Numbers of the surgical removal of impacted teeth was done in our study
Canin	60 (% 44.1)	55 (% 50.9)
Premolar	19 (% 14.0)	12 (% 11.1)
Supernumerary	44 (% 32.4)	40 (% 37.1)
central incisor	5 (% 3.7)	1 (% 0.9)
Lateral incisor	8 (% 5.8)	0 (% 0)
Total	136 (% 100)	108 (% 100)

The age of the patients was arranged between (7-70) years old. The mean age of them was 23.13 and the evaluation was carried out

mainly on the data of younger patients. Also more than half of the patient's age is range between (16) to (30) years old. (Table 2).

Table 2: Distribution of the patients according to the age

Ages	Patients number
I. Decade (Between 0-10 years old)	9
II. Decade (Between 11-20 years old)	24
III. Decade (Between 21-30 years old)	20
IV. Decade (Between 31-40 years old)	9
V. Decade (Between 41-50 years old)	7
V. Decade (Between 51-60 years old)	1

In our study, we can observe that the obvious superiority of the incident in the upper jaw (96 (71%)) than the lower jaw (40 (29%)). Also in our study the incidence of the impacted teeth in more than one teeth in the same patient is about (37) patients (17 males and 20 female); In those patients (24) of them they have two impacted, (7) of them they have three impacted, (2) of them they have four impacted, (2) of them they have five impacted, (1) of them have seven impacted and (1) of them have nine impacted teeth. Also among these (37 patients) for about (26) patients, we did more than one surgical extraction, in which the number of the incidence according to the sex is as following:(13) patients are female (%50)

and (13) patients are male (%50). Also among those (26) patients the incidence of two teeth extraction among them is (18), (5) of them we did three teeth extraction, (2) of them we did four extractions and (1) of them we did five teeth extraction. On the other hand, we don't see any pathological lesion, only among extracted teeth (4) of them, they have small cyst around their crowns. Also in our study by the aid of the recorded data from CBCT of the patient's we did planning for an exact surgical path for extraction of them. These data were obtained from a total of 97 different flaps in 70 patients and was reported from a total of 108 extracted teeth. They are summarized in (Tables 3).

Table 3: Classification of operation according to the surgical approach

Jaw	Removed flap region or position	Number (Percentage)	
Maxilla	Palatal	46 (%47.4)	(%63.9)*
	Buccal (upper jaw)	26 (%26.8)	(%36.1)*
Mandibule	Buccal (lower jaw)	13 (%13.4)	(%50)*
	Lingual	13 (%13.4)	(%50)*

*

According to the aspect of the jaw that approach.

When patients are examined for determination the relations of the impacted with the mental nerve or mandibular canal by OPG only (3) patients that have indications for extraction, in which established that 5 teeth they have relations with mental nerve, also proved that in (4) patients that have indications for extraction established that 6 teeth they have relations to the maxillary sinus, also confirm that in (3) patients that have indications for extraction established that (3) of them have relations with the floor of the nose. As an outcome, if compared the reliability of the evaluation of the relationship between anatomical structures by OPG has seen that 85% of the errors result from solely utilizing of only dental OPG for evaluations of them. On the other hand, established that in about 14 patients, in which the 14 impacted produced resorption to the neighboring teeth. The obtained data are compared with data that obtained from the assessment of all OPG radiographs in about (13) patients we found that they produced resorption in about (15) of the neighboring teeth. With the data that also obtained from the CBCT images, based on the CBCT examination. According to the CBCT examination as an outcome if compared the reliability of the evaluation of the resorption to the neighboring teeth by OPG images seen that 65% of the errors result from solely utilizing of dental OPG for evaluations. Rather than these results in our research in (2) patients, we don't find any impacted supernumerary teeth when evaluated by CBCT we found they have (4) impacted teeth and then extracted. Also as an outcome: expertise students have made that assessment is not yet begun to surgery residency (M.G.) approximately 49% of the way to approach the wrong guess, the second

residents have about 6 months' surgery experience (N.K.) by about 27% approach path incorrectly guessed, and the third one that has two years of surgery experience (O.A.) seems to be the approach roads have estimated that approximately 25% incorrectly. In the average prediction rate, it was approximately 34% to be determined incorrectly.

Discussion

Surgical removal of impacted teeth needed accurate knowledge of their location in the jaw and its relation to other surrounding structures, before preparation of the patient for the removal of their impacted must be checked the tomographic correlation between anatomical structures and their spaces, to avoid complications like nerve injury (23,24). The frequency of impacted teeth may vary between populations. The lowest incidence of maxillary impacted canine seen in the Japanese is about (%0.27), whereas this percentage can increase up to %1.57 in the American community (25,26). Aydin et al. (27) in their study that had been done in the Turkish population, reported that the rate of occurrence is %3.29, this ratio is quite high if compared to other populations. Yavuz et al (28) reported that the incidence of impacted mandibular canine in the Turkish population is about %1.29 which is a high proportion. Rui et al (29) in 2010 found that the incidence of permanent teeth impaction, excluding the wisdom and this rate, was found to be about %6.15. Although our study an incidence, are similar to findings that were presented by Rui et al (29). In our study, we found that about %38.2 of the occurrence in maxillary canine, about %10.3 in mandibular premolar, about %4.41 in maxillary central, about %3.68 in maxillary premolars, and about %1.47 in mandibular central. In our study, the

percentage of impacted supernumerary teeth is about %32.4 among all impacted incidence, but rather than impacted canine, the decrease in this ratio of the impacted incisors in our study may be related to concentration on impacted canine, premolar and supernumerary teeth. Rui et al. (29) except impacted wisdom teeth, all impacted teeth in the classified the ratio of the female to male is (1.32: 1) when reported that favor for women. Ericson and Kurol (30) this higher rate in women may be associated with more frequent orthodontic treatment vision of women and women can be a higher proportion of recognized more frequently impacted teeth, because they consider orthodontic treatment and thus being reported an impaction incidence of women favor broken. At the same time, they also consider hormonal changes in women because of higher rates of an impaction as other factors (30). In our study, this ratio is in favor of men %58.6 to %41.4. This ratio limited our study, the data rate (total 70 patients) is calculated also because of the male population with the development of technology in higher rates of radiography opportunity puller may be corrupted in favor of men. When patients are generally classified according to age it appears to impacted teeth more often recognized in childhood. Rui et al. (29) reported that children ages between 7-15 cover approximately 33% of patients with impacted. Approximately half of the patients in our study, patients located within the first 2 decades. Kaan et al. (31) reported that in their studies the incidence of multiple impacted teeth, excluding wisdom teeth solely about %1.71. In our study, the ratio of incidence finding of more than one impacted teeth in the same person is about %51.4 which is higher than the findings of Kaan and et al (31). Also in our study, the rate of only one impacted tooth is about %48.6, the ratio of two impacted teeth %34.2, three impacted teeth %8.6, four

impacted teeth %2.9, while five impacted teeth %2.9 and were also observed the presence more than five impacted teeth is %2.8. The major difference between these two studies, in our study, include the patient population admitted for surgery due to the presence of impacted, while in the other studies the patients admitted to the radiological department for any reason. The presence of asymptomatic impacted remain in the population is quite high because of the Kaan and et al (31) have reported that a single tooth impaction may have been so high. In our study, we found that the ratio of incidence of more than one impacted teeth, excluding wisdom teeth, in both male (%50) and female (%50) is equal. To perform the reliability test by taking the guess thought of three separate Oral and Maxillofacial Surgery residency for OPG's assessment had been done on films were the results obtained compared with data from the CBCT images. The rate of guessed wrong assessment for OPG images by the three separate residencies that they have experience shown that the guessed wrong approach made clear that ranked from less to more is as following: %25, %27 and %49 respectively. The average rate of false estimates was approximately 34%.

Conclusions

In our study, we confirm the benefit of CBCT in the pre-assessment of the surgical removal of impacted canine, premolar, and supernumerary teeth among the Turkish population especially in the Gaziantep region which is located in the west-south of the country. Finally, we can say that the rapid growth of CBCT technology and rapid commercialization in maxillofacial region imaging and the dental community 3D radiographic seems that greatly contributed. According to the results of our studies we have

offered that the CBCT images, compared with the OPG, CBCT used as a support for eliminations of unwanted complications, now a day technology of CBCT imaging compared with OPG imaging especially in suspicious cases is a necessity, not an option

References

1. Mozzo P, Procacci C, Tacconi A, Martini PT, Andreis IA. A new volumetric CT machine for dental imaging based on the CBCT technique: preliminary results. *Eur Radiol* 1998; 8:1558-64.
2. Ludlow JB, Davies-Ludlow LE, and Brooks SL. Dosimetry of two extra oral direct digital imaging devices: NewTom CBCT and Orthophos plus DS panoramic unit. *Dent maxillofac Radiol* 2003; 32:229-34.
3. Ngan DC, Kharbanda OP, Geenty JP, Darendeliler MA. Comparison of radiation levels from computed tomography and conventional dental radiographs. *Aust Orthod J* 2003; 19:67-75.
4. Marmulla R, Wörthe R, Mühling J, Hassfeld S. Geometric accuracy of the NewTom 9000 Cone Beam CT. *Dentomaxillofac Radiol* 2005; 34:28-31.
5. Nakata K, Naitoh M, Izumi M, Inamoto K, Ariji E, Nakamura H. Effectiveness of dental computed tomography in diagnostic imaging of periradicular lesion of each root of a multiradical tooth: a case report. *J Endod* 2006; 32:583-7.
6. Lofthag-Hansen S, Huuonen S, Gröndahl K, Gröndahl HG. Limited cone-beam CT and intraoral radiography for the diagnosis of periapical pathology. *Oralsurg Oral Med Oral Pathol Oral Radiol Endod* 2007; 103:114-9.
7. Hatcher DC, Dial C, Mayorga C. Cone beam CT for pre-surgical assessment of implant sites. *J Calif Dent Assoc* 2003; 31:825-33.
8. Kau CH, Richmond S, Palomo JM, Hans MG. Three-dimensional tomography in orthodontics. *J Orthod* 2005; 32:282-93.
9. Patel S, Dawood A, Ford TP, Whaites E. The potential applications of cone beam computed tomography in the management of endodontic problems. *Int Endod J* 2007; 40:818-30.
10. Patel S. New dimensions in endodontic imaging: Part 2. Cone beam computed tomography. *Int Endod J* 2009; 42:463-75.
11. Pohlenz P, Blessmann M, Blake F, Heinrich S, Schmelzle R, Heiland M. Clinical indications and perspectives for intraoperative cone-beam computed tomography in oral and maxillofacial surgery. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2007; 103:412-17.
12. Closmann JJ, Schmidt BL. The use of cone beam computed tomography as an aid in evaluating and treatment planning for mandibular cancer. *J Oral Maxillofac Surg* 2007; 65:766-71.
13. Tsiklakis K, Syriopoulos K, Stamatakis HC. Radiographic examination of the temporomandibular joint using cone beam computed tomography. *Dentomaxillofac Radiol* 2004; 33:196-201.
14. Aboudara CA, Hatcher D, Nielsen IL, Miller A. A three-dimensional evaluation of the upper airway in adolescents. *Orthod Craniofac Res* 2003; 6 Suppl 1:173-5
15. Mah J, Enciso R, Jorgensen M. Management of impacted cuspids using 3-D volumetric imaging. *J Calif Dent Assoc* 2003; 31:835-41.

16. Liu DG, Zhang WL, Zhang ZY, Wu YT, Ma XC. Three-dimensional evaluations of supernumerary teeth using cone-beam computed tomography for 487 cases. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2007; 103:403-11.
17. Eggers G, Mukhamadiev D, Hassfeld S. Detection of foreign bodies of the head with digital volume tomography. *Dentomaxillofac Radiol* 2005; 34:74-9.
18. Robert A Danforth RA, Peck J, Hall P. Cone beam volume tomography: an imaging option for diagnosis of complex mandibular third molar anatomical relationships. *J Calif Dent Assoc* 2003; 31:847-52.
19. Cohenca N, Simon JH, Roges R, Morag Y, Malfaz JM. Clinical indications for digital imaging in dento-alveolar trauma. Part 1: traumatic injuries. *Dent Traumatol* 2007; 23:95-104.
20. Bernardes RA, de Moraes IG, Húngaro Duarte MA, Azevedo BC, de Azevedo JR, Bramante CM. Use of cone-beam volumetric tomography in the diagnosis of root fractures. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2009; 108:270-7.
21. Heiland M, Pohlenz P, Blessmann M, Habermann CR, Oesterhelweg L, Begemann PC, Schmidgunst C, Blake FA, Püschel K, Schmelzle R, Schulze D. Cervical soft tissue imaging using a mobile CBCT scanner with a flat panel detector in comparison with corresponding CT and MRI data sets. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2007; 104:814-20.
22. Haiter-Neto F, Wenzel A, Gotfredsen E. Diagnostic accuracy of cone beam computed tomography scans compared with intraoral image modalities for detection of caries lesions. *Dentomaxillofac Radiol* 2008; 37:18-22.
23. Flygare L, Öhman A.: Preoperative imaging procedures for lower wisdom teeth removal. *Clin Oral Investing*, 2008, 12: 291-302.
24. Neugebauer J., Shirani R., Mischkowski R.A., Ritter L., Scheer M., Keeve E., Zöller J.E.: Comparison of cone-beam volumetric imaging and combined plain radiographs for localization of the mandibular canal before removal of impacted lower third molars. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*, 2008, 105: 633-642.
25. Dr. Prakash. Amit, Dr. Gandhi Saurabh, *Orthodontic Management of Impacted Canine*, the Official Publication of Vyas Dental College, Jodhpur. June 2013, Vol.5, Issue.
26. Bishara SE. Impacted maxillary canines: A review. *Am J Orthod Dentofacial Orthop*. 1992; 101:159–71.
27. U Aydin*, HH Yilmaz and D Yildirim, Incidence of canine impaction and transmigration in a patient Population, Incidence of canine impaction and transmigration in a patient Population. *Dentomaxillofacial Radiology* (2004) 33,164-169.
28. Ishikawa I, Arakawa S, Nagasawa N, Nishihara TK, Nitta H, Koseki T, Watanabe H. Induction of the immune response to periodontopathic bacteria and its role in the pathogenesis of periodontitis. *Periodontol* 2000. 1997; 14; 79-111.
29. Rui Hou, DDS, investigation of impacted permanent teeth except the third molar in Chinese patients through an x-ray study, © 2010 American Association of Oral and Maxillofacial Surgeons. *J Oral Maxillofac Surg*, 2010, 68:762-767.

30. Ericson S, Kuroi J. Early treatment of palatally erupting maxillary canines by extraction of the primary canines. *Eur J Orthod.* 1988; 10:283-95.
31. Kaan GÜNDÜZ, Aydan AÇIKGÖZÖ, Erol EĞRİOĞLU, Radiologic Investigation of Prevalence Associated Pathology and dental anomaly of the non-third molar impaction, Department of oral diagnosis. *The Chinese journal of Dental Research.* January 2011, 55139 Kurupalit Samsung.