ASSESSMENT OF DIGITAL INTRAORAL PERIAPICAL RADIOGRAPH FOR THE DETECTION OF APICAL ROOT RESORPTION IN INFLAMMATORY PERIAPICAL PATHOLOGIES- A RADIOVISIOGRAPHY STUDY.

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LIST OF ABBREVIATIONS

ARR	:	Apical root resorption
AIRR	:	Apical inflammatory root resorption
CR	:	Conventional radiographs
DDR	:	Direct Digital Radiography
RVG	:	Radiovisiography
cm	:	Centimetre
mm	:	Millimetre
kV	:	Kilovolts
mA	:	Miliamperes
P Value	:	Probability value
SD	:	Standard deviation
RANK	:	Receptor activator of nuclear factor kappa.
RANKL	:	Receptor activator of nuclear factor kappa l ligand.
OPG	:	Osteoprotegerin
CCD	:	Charge-coupled device
PSP	:	Photo-stimulable phosphor
SEM	:	Scanning electron microscopy
IRR	:	Internal root resorption
IIR	:	Internal inflammatory resorption
ERR	:	External root resorption
EIR	:	External inflammatory resorption lesions (EIR) lesions
OPG	:	Orthopantomogram
CBCT	:	Cone beam computed tomography
2D	:	Two dimensional

3D	:	Three dimensional
CT	:	Computed tomography
ROC	:	Receiver operating characteristic
NPVs	:	Negative predictive value
PPVs	:	Positive predictive value
DDI	:	Direct digital imaging
CBCTPAI	:	Cone-beam computed tomography periapical Index.
PA	:	Periapical Radiograph
IOPA	:	Intra-oral periapical radiograph

INTRODUCTION

Teeth are strong and healthy until their roots are safe. Roots play an important role in providing strength and nourishment to the tooth and also anchor the tooth in position. Any problem with the root will ultimately affect the normal functioning of the tooth. One such problem is root resorption.[1]

Root resorption in deciduous teeth is a normal physiologic response, resulting in exfoliation of the deciduous teeth with the replacement by the permanent dentition. However, the process of root resorption in the permanent teeth may be broadly classified into internal and external resorption. Internal eruption has its origin in the

dental pulp whereas, external resorption begins in the periodontal ligament. Internal resorption is relatively rare and occurs as a result of trauma or caries related inflammation of the pulp. External root resorption has various causes, including infective/inflammatory conditions, traumatic injuries, pressure/mechanical stimulation, neoplastic conditions, systemic disorders and idiopathic.[2, 3, 4, 5]

The terms external inflammatory root resorption, inflammatory resorption, periapical inflammatory resorption and apical inflammatory resorption are used to describe this common form of external resorption. Most teeth with apical periodontitis or apical cyst will exhibit some degree of external resorption at the apex of the involved tooth. Apical inflammatory resorption results from either caries extending to the pulp, traumatic intrusive luxation, or avulsion with re-implantation resulting in necrosis of the root canal system and development of periapical cysts and tumours. However, root resorption is most frequently associated with inflammation of microbial origin.[6]

Apical root resorption (ARR) is a frequent complication of periapical pathologic process emerging as a result of inflammatory process in pulp and periapical tissue. The tenacious experience among micro-organisms and host resistances at the periapical site is a local inflammatory process releasing various chemical mediators such as cytokines IL-1a, IL-1b, TNF-alpha, prostaglandins and lipopolysaccharides, consequently beginning the pathological process in periapical tissue. The process is normally asymptomatic, and the apical periodontitis is normally of long duration. All these factors, ultimately lead to root resorption which involves complex interaction between the inflammatory cells, resorbing cells, cytokines and

enzymes, this further leads to delayed wound healing due to which the prognosis and success of the endodontic treatment is affected. As these resorbed sites are out of reach for the root canal instruments, it gets difficult to get apical seal. And in some cases of the periapical pathologies, severe apical root resorption leads to failure of endodontic treatment and may need extraction of the involved teeth.[1]

So, the knowledge of apical root resorptions is essential for the treatment planning and for better prognosis. Most frequently apical root resorption is discovered accidentally during routine radiographic examinations and is usually found in its late stage. Thus, unfortunately if the lesion is advanced the only viable solution is tooth extraction. Therefore, the accurate diagnosis of incipient root resorption is very important as it will lead to an appropriate treatment.

Conventional radiographs (CR) are routinely employed in diagnosis, treatment procedures and follow-up in case of periapical lesions. However, lesions in cancellous bone cannot be detected radiographically because of the bone density and randomness of cancellous bone structure. Thus, research has lead to development of alternative imaging techniques that provide dental professionals with more accurate information, while at the same time reducing radiation exposure.

One such imaging technique, Direct Digital Radiography (DDR), is the direct replacement of an X-ray film with an electronic image receptor or sensor and an image displayed on a computer. The most significant advantage to the Direct Digital Radiography style devices is the near instantaneous (a few seconds) availability of the images after exposure without removing the sensor from the mouth. This allows multiple angles to be taken to help in location of canals, identification of root

curvatures and verification of periapical region. It has given the dentist the ability to perform radiographic examination with up to 80% reduction of radiation dose when compared with conventional plain film radiography. In addition, digital radiography has advantage of various tools like image enhancement, brightness and contrast, sharpening and smoothening, colour, etc. This makes identification of the abnormalities better as compared to conventional intraoral periapical radiograph.[7]

So, the present study is planned to evaluate efficacy of digital intraoral periapical radiographs in determining the apical root resorption (ARR) associated with periapical pathologies.

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AIM AND OBJECTIVES

To assess the efficacy and accuracy of digital intraoral periapical radiographs in determining the apical root resorption in inflammatory periapical pathologies.

Primary Objectives

- To assess the efficacy of digital intraoral periapical radiographs in determining the apical root resorption in inflammatory periapical pathologies.

- To evaluate the accuracy of digital intraoral periapical radiographs in determining the apical root resorption in inflammatory periapical pathologies.

REVIEW OF LITERATURE

Resorption is defined as the destruction, disappearance, or dissolution of a tissue or part by biochemical activity, as the loss of bone or of tooth dentin. Whereas, resorption of teeth is defined as a condition associated with either a physiologic or a pathologic process resulting in loss of dentin, cementum or bone. Physiological resorption is mainly seen in deciduous dentition, resulting in variable tooth mobility before exfoliation of the primary teeth and allows eruption of their permanent teeth. The process of resorption in permanent dentition is usually pathological and may occur due to traumatic injuries, orthodontic tooth movement, or chronic infections of the pulp or periodontal structures, neoplastic processes associated with systemic

diseases and lesions, idiopathic origin and if left untreated it will result in the premature loss of the teeth.[8, 9, 10,11]

PATHOGENESIS AND REQUIREMENTS FOR THE PRESENCE OF RESORPTION :[3,4,11,12]

Osteoclasts are multinucleated giant cells that are responsible for the bone resorption. They are formed by the fusion of mononuclear precursor cells that ultimately arrive at the resorption site through the blood stream. Their differentiation is under the control of factors produced by bone marrow stromal cells or are found on the mature osteoblast. Two such factors are RANK (receptor activator of nuclear factor kappa B) ligand (RANKL) and osteoprotegerin (OPG). The receptor of RANKL is receptor activator of nuclear factor kappa B(RANK) and is localized on the surface of the progenitor osteoclast. Therefore, physical contact between the osteoblast or stromal cells and the progenitor osteoclast is essential for a direct interaction of RANKL and RANK for osteoclast formation and activation. osteoprotegerin (OPG) acts as a decoy receptor so as bind to RANKL and interferes with its ability to bind to RANK receptors, thus inhibiting osteoclast formation. Thus, both RANKL and osteoprotegerin (OPG) play an important role in osteoclasteogenesis. Root resorption of tooth is a clinical condition associated with physiological or pathological process that ultimately results in the loss of mineralized tissues such as dentin, cementum and alveolar bone.

From a dental perspective physiological resorption is an essential process in the exfoliation of the primary dentition. There is a constant equilibrium between osteoclastic activators and inhibitors. When there is an insult to a tissue, cytokines are produced and the repair process includes osteoclastic activity. It is thought the

RANKL system is integral to the process of repair in dental hard tissues. If tooth tissue is irretrievably damaged complete resorption may occur.

At a histological level resorption is common. When the attachment apparatus of a tooth is damaged or traumatised, it is common for a resorptive process to follow but unless the stimulation is continuous it will cease. In small lesions with no bacterial presence, this is followed by repair. Clinically, resorptive lesions are rare. Biological protection mechanisms exist to prevent the resorption of teeth. These barriers being a vital periodontal ligament, healthy cementum and the extra-cellular predentine layer:

Teeth with vital periodontal membranes have been shown to undergo less resorption than those compared with necrotic periodontia. In experiments in which the periodontal ligament is selectively damaged or necrosed there is a greater incidence of resorption. The nature of the resorptive process has been suggested to be related to the size of the area of necrosed periodontal membrane. The healing capacity of the periodontal ligament may be upto 1.5 mm initially. Thus, larger areas of damage may not heal and may be prone to resorption. It has also been shown that periodontal ligament cells can produce RANKL (receptor activator of nuclear factor kappa B ligand). It may be that damage to the periodontal ligament produces such a large inflammatory response that the cementoid layer is damaged too.

The presence of an intact cementum layer offers resistance to resorption, cementum being much more resistant to resorption than dentine. The external surface of cementum is formed by a layer of cementoblasts over a layer of cementoid. It may be that this non-mineralised layer is the barrier. In addition, cementum is thought to lack those proteins found in bone that may stimulate osteoclastic activity.

Furthermore, it has also been postulated that cementum contains inhibitory factors for osteoclastic processes. Andreasen has hypothesised that the fate of the cells closest to the root dentine, that is, the cementum, is significantly related to the process of resorption. Another function of cementum is to prevent the spread of bacteria and toxins from the dentine to periodontal ligament, which in turn prevents the initiation of an inflammatory response and possible resorptive activity. Thus, for resorption to occur there must be significant damage to the cementum.

Wedenberg and Linskog hypothesised that internal resistance to resorption is due to the presence of a non- collagenous component found in predentine. In a further study accumulation of marcophages was demonstrated on predentine and demineralised dentine when the tissue had been treated to remove organic components with guanidium hydrochloride. Thus it has been conjectured that the odontoblastic layer and surrounding predentine may also be inhibitory against resorption in a similar way to that seen on the external aspect of cementum. It has therefore been postulated that the creation of a predentine like layer on the root surface can promote regeneration and new attachment and inhibit resorption. This can be achieved by the selective demineralisation with acid. It is thus evident that cementum and periodontal ligament are barriers to external root surface resorption and predentine to internal root surface resorption. Thus, the root is protected and damage to these barriers allows osteoclasts to bind to the root and if an inflammatory response occurs adjacent to the root surface this in turn may initiate resorption. It has been further postulated that prior activation and/or persistent stimulation is essential before resorption can proceed. Where the stimulus is persistent a clinical resorptive lesion may develop.

CLASSIFICATION:[1,2,3,4,11]

According to Andraesen tooth resorption can be classified into internal (inflammatory and replacement) and external (surface, inflammatory, replacement).[11] Internal resorption may be classified as internal inflammatory resorption and internal replacement resorption. External resorption is further classified into external surface resorption, external inflammatory resorption, external cervical resorption and transient apical resorption.

Internal Root Resorption

Internal root resorption (IRR) has been described as a resorptive defect of the internal aspect of the root following necrosis of odontoblasts as a result of chronic inflammation and bacterial invasion of the pulp tissue. Two types of internal root resorption were described by Ne., *et al.* and Heithersay: Internal inflammatory resorption and internal replacement resorption.

Internal Inflammatory Root Resorption

It involves a progressive loss of intraradicular dentin without adjunctive deposition of hard tissue adjacent to the resorptive sites. The coronal pulp is usually necrotic, whereas the apical pulp must remain vital. One hypothesis suggest that the necrotic coronal part of the infected pulp provides a stimulus for inflammation in the apical part of the pulp. Second hypothesis is based on the recent understanding that osteocytes participate in bone homeostatis by inhibiting osteoclasteogenesis. The symptoms of acute or chronic apical periodontitis may be seen after the entire pulp has undergone necrosis and the pulp space has become infected. Radiographically, appearance of an oval-shaped enlargement is seen within the pulp chamber. Histologically presents as granulation tissue with multinucleated giant cells.

Internal replacement resorption

It is characterized by an irregular radiographic enlargement of the pulp chamber, with discontinuity of the normal canal space, obliterated by a fuzzy appearing material of mild to moderate radio density. Appears to be caused by low grade inflammatory process of the pulpal tissue such as chronic irreversible pulpitis or partial necrosis. One hypothesis suggests that the metaplastic tissues are produced by postnatal dental pulp stem cells present in the apical, vital part of the root canal as a reparative response to the resorptive insult. Second hypothesis proposes that both the granulation tissues and metaplastic hard tissues are derived from the vascular compartments or originated from the periodontium. This form of resorption is typically asymptomatic, and the affected teeth might respond normally to thermal or electric pulp testing unless the resorptive process results in crown or root perforation. Radiographically, the enlarged canal space is obliterated by a fuzzy appearance material of mild to moderate radiodensity. Histologically, resorption of the intraradicular dentin is accompanied by subsequent deposition of a metaplastic hard tissue that resembles bone or cementum instead of dentin.

EXTERNAL ROOT RESORPTION

External root resorption defines (ERR) as irreversible processes lyses in cement or cement-dentinal started to root surface of the teeth. It is strictly local process and its onset is associated with a significant necrosis of cementoblasts or injury to periodontal ligament. Root resorptions occurrence may be induced by traumatic or infectious factors. Dental trauma is an important etiological factor of resorptions, although these may be occur due to a chronic inflammatory process of pulp or periodontal tissue, also, root resorptions may be induced by a variety of local

factors such as impacted teeth, excessive mechanical force applied during orthodontic treatment, tumors and cysts, luxated or reimplanted teeth, periradicular inflammatory lesions, periodontal disease and tooth bleaching. Systematic disturbances such as hypoparathyroidism, hyperparathyroidism, calcinosis, Turner's syndrome, Gaucher' s disease and Paget's disease. Apical root resorption is also a frequent complication of periapical pathologic process emerging as result of inflammatory process in pulp and periapical tissue. The tenacious experience among micro-organisms and host resistances at the periapical site is a local inflammatory process releasing various chemical mediators such as cytokines IL-1a, IL-1b, TNF-alpha, prostaglandins and lipopolysaccharides, consequently beginning the pathological process in periapical tissue. The process is normally asymptomatic, and the apical periodontitis is normally of long duration. Pulp tests should be nonresponsive, and the affected tooth may exhibit pain on percussion. A draining fistula may be observed near the adjacent tooth. So, ultimately root resorption process involves complex interaction between the inflammatory cells, resorbing cells, cytokines and enzymes which ultimately leads to delayed wound healing due to which the prognosis and success of the endodontic treatment is affected. As these resorbed sites are out of reach for the root canal instruments, it gets difficult to get apical seal. And in some cases of the periapical pathologies, severe apical root resorption leads to failure of endodontic treatment and may need extraction of the involved teeth.

DIAGNOSIS:[1,2,3,4,5,11,13]

Teeth affected by resorption lesions are often asymptomatic and may present as an incidental finding upon radiographic examination so it is essential that the

clinician should pay particular attention to aspects of the history that may play a role in the development of resorption. These factors include:

- History of trauma
- History of crown preparation
- Orthodontic history
- Use of intra-pulpal chemicals such as internal bleaching products
- History of removal of multiple extractions
- History of surgical procedures in proximity to the affected roots
- History of periodontal disease and its management

CLINICAL EXAMINATION:[5,11,14]

Full extra and intra oral clinical examinations should be performed before more specific investigations of the relevant teeth are carried out. The colour of the tooth should be noted with specific reference to precise site of any discolouration. In the cervical portion of the teeth pinkish colouration is indicative of resorption. The presence of all restorations should be recorded and note made of primary disease, leaking margins and recurrent caries. The use of percussion is of relevance in resorption cases and thus should be noted and compared to adjacent teeth: a metallic sound may suggest a diagnosis of ankylosis. An increase in mobility may indicate attachment loss or pathological fracture due to extensive external resorption. This should be compared by recording the mobility of the adjacent teeth. A complete loss of physiological mobility may also indicate an ankylosed. One should also check for sign and symptoms of periapical pathologies for apical root resorption.

RADIOGRAPHIC EXAMINATION: [1, 7,14,15,16]

External root resorption (ERR) is a condition associated with physiological and pathological dissolution of mineralized tissues by odontoclastic cells. Early diagnosis is the key factor to detect and preserve the involved teeth. Root resorption usually does not present with any clinical sign or symptom. Hence, the diagnosis is generally based on its detection during radiographic examinations. Numerous imaging modalities are currently accessible. Digital radiography using sensors *i.e* charge-coupled device (CCD), or photo-stimulable phosphor (PSP) technology, which are also known as a semi-direct or indirect acquisition modality with several tools improves image acquisition and makes it easier. However, the conventional intraoral film radiography (CR) is another option that compresses the three-dimensional anatomy into a two-dimensional image and thus greatly limits the diagnostic performance as the important features of the tooth and its surrounding tissues are detectable in the proximal plane (mesiodistal direction) only. Similar features presenting in the buccolingual plane (*i.e.* the third dimension) may not be fully visible; however, this shortage could be overcome by taking several intraoral views at different angles.

Conventional radiographs (CR) are routinely employed in diagnosis, treatment procedures and follow-up in case of periapical lesions. However, lesions in cancellous bone cannot be detected radiographically because of the bone density and randomness of cancellous bone structure. Whereas, direct Digital Radiography (DDR), is the direct replacement of an X-ray film with an electronic image receptor or sensor and an image displayed on a computer. The most significant advantage to the Direct Digital Radiography style devices is the near instantaneous (a few seconds) availability of the images after exposure without removing the sensor from the mouth. This allows

multiple angles to be taken to help in location of canals, identification of root curvatures and verification of periapical region. It has given the dentist the ability to perform radiographic examination with up to 80% reduction of radiation dose when compared with conventional plain film radiography. In addition, digital radiography offers software controlled image enhancement. Accuracy of imaging techniques in diagnosing periapical lesions is a topic of debate.

In addition to this, visualisation of the extent of apical root resorption is equally important as, it may affect the outcome of endodontic treatment, severe apical root resorption may even lead to open apex increasing the chances of obturating materials extruding into the periapical region. This may in turn sustain periapical irritation, initiate a foreign body reaction and possibly induce further root resorption. Moreover, resorbed roots may pose difficulty in limiting the instrumentation due to the loss of cementum-dentin junction and to achieve the correct apical seal, ultimately affecting the prognoses. So, the present study was planned to evaluate the efficacy of the digital intraoral radiograph for the detection of apical root resorption in periapical pathologies.

E Reukers, G Sanderink, A M Kuijpers-Jagtman and M van 't Hof (1998)[17] conducted a study to assess, the reliability of measuring apical root resorption semi-quantitatively in vitro, after mathematical image reconstruction and second, the prevalence and degree of apical root resorption in vivo following orthodontic treatment. A gold standard for root resorption in vitro was developed from 10 extracted upper central incisors using calipers. Radiographs made with five projection angles were reconstructed mathematically by two observers. The calculated loss of

length was compared with the gold standard. Eighty-two upper central incisors from 61 patients were radiographically evaluated for the prevalence and degree of apical root resorption after orthodontic fixed appliance therapy. The relative amount of reduction was calculated after mathematical reconstruction. The results of the study showed that the inter-observer error in vitro was 1.8%. The 95% confidence intervals for the difference with the gold standard are small. The duplicate measurement in vivo error was 2.2% and the correlation between duplicate measurements was 0.94. The mean loss of tooth length was 7.8%. From which they concluded that, that the application of digital reconstruction to radiographs of orthodontically-treated upper central incisors can provide a good diagnostic performance in detecting the prevalence and relative degree of apical root resorption.

Eva Levander, Rusalin Bajka and Olle Malmgren in (1998)[18] conducted a study to evaluate the sensitivity of digital radiographs for detection of (i) simulated root resorption cavities in an experimental model and (ii) apical root resorption in vivo. In vitro, material consisted of 44 conventional radiographs and an equal number of digital radiographic images of premolars in the mandible of a dry skull. In each tooth, two small cavities (diameter 0.6 mm, depth 0.3 mm), two medium (diameter 1.2 mm, depth 0.6 mm), and two large cavities (diameter 1.8 mm, depth 0.9 mm) were made. All radiographs and digital images were evaluated by three experienced observers, who were unaware of the experimental design. They were instructed to record presence and location of cavities observed in the premolar roots. In vivo, the material consisted of 92 maxillary incisors in 45 consecutive patients treated with fixed edgewise, straight wire appliances. At the starting of the treatment, the teeth were separated into two groups according to radiographic appearance: group I

(ordinary risk) comprised 56 teeth with normal apical root form, and group II (enhanced risk) comprised 36 teeth with blunt or pipette-shaped roots. The teeth in group II were recorded in 18 patients: five patients had one tooth, and 13 had two or three teeth with enhanced risk. With the digital dental imaging system, instant intra-oral radiographic images of the teeth were obtained before treatment, and after 3 and 6 months. The distance from the cervical border of the bracket bases to the tooth apices was measured to the nearest 0.1 mm (true value) with a ruler for measuring distances in the software program. The amount of root resorption was evaluated as the difference between the measurements. The measurements were performed twice with an interval of 1 month. The results showed that, the sensitivity of digital radiographs for diagnosis of apical root resorption during orthodontic treatment is comparable to conventional film-based radiographs. The method offers the benefits of image processing and a reduction in radiation dosage. It also suggested that, to monitor apical root resorption associated with orthodontic treatment with fixed appliances the standard procedure is a radiographic examination after 6 months of treatment.

M. Laux, P. V. Abbott, G. Pajarola & P. N. R. Nair in (2000)[8] conducted a study to assess the reliability of routine single radiographs in the diagnosis of inflammatory apical root resorption by correlating the radiographic and histological findings. The material comprised serial and step serial sections of plastic-embedded root-apices with attached apical periodontitis lesions that were prepared for a previous study and the diagnostic radiographs. The histological sections of 114 specimens were analysed by light microscopy and categorized into three groups: (i) those without any resorption (0); (ii) those with moderate resorption (+); and (iii) those with severe resorption (+ +). The radiographs were also examined by a categorization of no

resorption (0); moderate (+); and severe (+ +) apical resorption. The results showed that, radiographically, 19% of the teeth were diagnosed as having apical inflammatory root resorption, whereas histologically, 81% of the teeth revealed apical inflammatory root resorption. A correlative radiographic and histological assessment (n = 104) revealed a coincidence of diagnosis in 7% of the specimens and noncoincidence of diagnosis in 76% of the specimens. From which, they concluded that radiography has considerable limitations to achieve precise diagnosis of the majority of apical root resorptive defects developing as a consequence of apical periodontitis.

Glenn T. Sameshima, Kati O. Asgarifar in (2001)[19]conducted a study, to determine if the root shape could be evaluated as accurately on panoramic films as they can on periapical films and also whether root resorption could be measured as accurately on panoramic films as it can on periapical films. Pre-treatment and post-treatment panoramic films and full-mouth periapical films from 42 patients who completed fixed orthodontic treatment were assessed for tooth length and root shape. Panoramic films showed significantly greater average apical root resorption than periapical films for the 743 teeth surveyed. The greatest differences were found in the lower incisors, the least in the maxillary incisors. Classification of root shape was significantly different between the 2 types of radiographs. Root dilacerations and other abnormal shapes, clearly visible on periapical films, often appeared normal on panoramic films. The findings strongly suggest that, root shape is much harder to assess on panoramic films. We conclude that, in cases where the apices are obscured or other factors are present that might suggest higher risk for root resorption or vertical bone loss, periapical films should be ordered. The use of panoramic films to

measure pre- and posttreatment root resorption may overestimate the amount of root loss by 20% or more.

Vier FV, Figueiredo JA in (2002)[6] conducted a study to determine the prevalence of various periapical pathologies and their association with the presence and extent of apical external inflammatory root resorption in human teeth. One hundred and four root apices from extracted teeth with periapical lesions were examined. Semi-serial sections of soft tissue lesions were stained with HE. The lesions were classified as non-cystic or cystic, each with different degrees of acute inflammation: 0, 1, 2 and 3, increasing in severity. The root apices were analysed by Scanning electron microscopy (SEM). External root resorption was classified according to site, as peri-foraminal or foraminal, and the extension of the resorbed area graded in increasing area as 0, 1, 2 or 3. The results suggested that, cysts accounted for 24.5% of the samples, 84% of which were associated with marked inflammation. The most prevalent diagnosis was non-cystic periapical abscess with varying degrees of severity (63.7%). Periapical granuloma was not a frequent finding. SEM analysis showed that 42.2% of the root apices had peri-foraminal resorption extending over 50% of their circumference. When the foraminal resorption was evaluated, 28.7% had resorption affecting >50% of the periphery. Only 8.9% of the samples showed no peri-foraminal or foraminal resorption. On the basis of the study of extracted human teeth, it was concluded that:

- Cystic lesions accounted for 24.5% of chronic periapical lesions;
- The majority of chronic periapical lesions (84.3%), whether cystic (20.6%) or noncystic (63.7%), had large collections of acute inflammatory cells;

- Periforaminal and foraminal resorptions were present in 87.3 and 83.2% of roots associated with periapical lesions;
- The pattern of periforaminal resorption was independent of the pattern of foraminal resorption;
- There was no correlation between the histopathological diagnosis of the periapical lesion and the presence and extension of apical external root resorption.

Vânia portela ditzel westphalen, **Ivaldo gomes de moraes, Fernando henrique westphalen in (2004)**[20] conducted in vitro study evaluated and compared the efficacy of conventional and a digital radiographic imaging for diagnosis of simulated external root resorption cavities. Human mandibles containing teeth were covered with bovine muscle slices in order to simulate the soft tissues. Nine teeth out of each group of teeth were investigated. Initially, three periapical radiographs of each tooth were taken using a tube shift technique with mesial and distal angulations in both methods. All teeth were subsequently extracted and had 0.7 and 1.0-mm deep cavities prepared on their buccal, mesial and distal surfaces at the cervical, middle and apical thirds. Each tooth was replaced on its socket and new radiographs were taken. Three examiners, an endodontist (1), a radiologist (2) and a general dentist (3), evaluated the images. Within the limitations and results of this study, it can be concluded that: the examiners, on the following decreasing order, exhibited different potentials to detect cavities of different sizes with the conventional method: radiologist, general dentist and endodontist; The endodontist and the general dentist exhibited superior potential than the radiologist to detect cavities of different sizes

with the digital method; The radiologist detected more cavities with the conventional method than with the digital, in comparison to the endodontist and general dentist; The general dentist exhibited the highest potential to detect small cavities with the digital method, followed by the endodontist and the radiologist; for medium cavities, the radiologist exhibited the highest potential followed by the general dentist and endodontist. Regardless the size of the cavities, the digital radiographic imaging method detected a higher number of cavities compared to the conventional method.

Alexander Dudic, Catherine Giannopoulou, Michael Leuzinger, Stavros Kiliaridis Geneva and Winterthur in (2009)[21]conducted a study to compare the efficacy of OPG and CBCT in the detection of apical root resorption after orthodontic tooth movement using **scoring system of lavender and Malmgren**. The study sample comprised 275 teeth in 22 patients near the end of orthodontic treatment with fixed appliances. Two calibrated examiners assessed blindly the presence or absence and the severity of apical root resorption on the OPG images after treatment and the corresponding reconstructed CBCT images. Resorption was evaluated as no, mild, moderate, severe, and extreme. The results suggested that On the OPG images, 17 teeth (6.2%) could not be evaluated. Statistically significant differences were found between the 2 methods: 56.5% and 31% of the showed no resorption by OPG and CBCT, respectively; 33.5% and 49% of the teeth showed mild resorption, whereas 8% and 19% showed moderate resorption by OPG and CBCT, respectively. Severe resorption was found in only 2 teeth by CBCT. From which it was concluded, that apical root resorption after orthodontic tooth movement is underestimated when evaluated on OPG. CBCT might be a useful complementary diagnostic method to conventional radiography, to be applied when a decision on continuation or

modification of the orthodontic treatment is necessary because of orthodontically induced root resorption.

Carlos Estrela, Mike Reis Bueno, Ana Helena Gonc¸ alves De Alencar, Rinaldo Mattar, Jose´ Valladares Neto, Bruno Correa Azevedo and Cyntia Rodrigues De Arau´jo Estrela in (2009)[22] conducted a study was to evaluate and compare cone beam computed tomography (CBCT) scans and periapical radiographs, so as to measure inflammatory root resorption (IRR). In the method inflammatory root resorption sites were classified according to root third and root surface, and inflammatory root resorption extension was measured on the axial, transverse, and tangent views of 3-dimensional CBCT scans by using the Planimp software. A 5-point (0–4) scoring system was used to measure the largest extension of root resorption. A total of 48 periapical radiographs and CBCT scans originally taken from 40 patients were evaluated. The result suggested that the extension of IRR was >1–4 mm in 95.8% of the CBCT images and in 52.1% of the images obtained by using the conventional method. From the which, it was concluded that CBCT scans were better at detecting IRR than periapical radiographs when root third, root surface, and extension was determined. This method provided an accurate diagnosis with high-resolution images and little observer interference.

S. Patel, A. Dawood, R. Wilson, K. Horner & F. Mannocci in (2009)[23] conducted a study to compare the accuracy of intraoral periapical radiography with cone beam computed tomography (CBCT) for the detection and management of resorption lesions. Digital intraoral radiographs and CBCT scans were taken of patients with internal resorption, external cervical resorption and no resorption. A ‘reference standard’ diagnosis and treatment plan was devised for each tooth. In each

case there was only one correct diagnosis and treatment option that had been previously established by the consensus committee and in resorption cases confirmed after the completion of the treatment of the lesion. The result showed that, there was a significantly higher prevalence (P = 0.028) for the correct treatment option being chosen with CBCT (%) compared with intraoral radiographs (%). From which, it was concluded that CBCT was effective and reliable in detecting the presence of resorption lesions. CBCT's superior diagnostic accuracy also resulted in an increased likelihood of correct management of resorption lesions.

C. Durack, S. Patel, J. Davies, R. Wilson & F. Mannocci in (2010)[24] conducted a study to compare in an ex vivo model, the ability of digital intraoral radiography and cone beam computed tomography to detect simulated external inflammatory root resorption lesions, and to investigate the effect of altering the degree of rotation of the CBCT scanners X-ray source and imaging detector on the ability to detect the same lesions. Small and large simulated external inflammatory resorption lesions were created on the roots of 10 mandibular incisor teeth from three human mandibles. Small volume CBCT scans with 180 and 360 degree of X-ray source rotation and periapical radiographs, using a digital photostimulable phosphor plate system, were taken prior to and after the creation of the external inflammatory resorption lesions (EIR) lesions. The teeth were relocated in their original sockets during imaging. The sensitivity and specificity of 180 and 360 degree CBCT were significantly better than intraoral radiography. CBCT, regardless of the degree of rotation had superior NPVs (Negative predictive value) and PPVs (positive predictive value) to periapical radiography. The intra and inter-examiner agreement was significantly better for CBCT than it was for intraoral radiography. The results of this

study highlight the limitations of intraoral periapical radiography in the detection of simulated (EIR) external inflammatory resorption lesion. CBCT overcomes these shortcomings and provides a reliable and valid method of detecting artificially created external inflammatory root resorption defects.

Cláudio afonso lermen, Gabriela salatino liedke, Heloísa emília dias da silveira, Heraldo luis dias da silveira, Alessandro andré mazzola, José antônio poli de figueiredo in (2010)[25] conducted a study to assess the accuracy of coronal and sagittal CT sections to detect cavities simulating root resorption. 60 mandibular incisors were embedded in plaster bases, and cavities with 0.6, 1.2 or 1.8 mm in diameter and 0.3, 0.6 or 0.9 mm in depth (small, medium and large cavities) were drilled on the buccal surfaces with high-speed round burs with diameters of 0.6, 1.2 and 1.8 mm to simulate external inflammatory root resorption. Simulations in the cervical, middle and apical thirds of each tooth root were made randomly. The Dental Scan software was used to obtain 1-mm-thick axial images from direct scanning, which were reconstructed in the coronal and sagittal planes using 3D software. Fourteen images of each tooth were reconstructed in the coronal plane and 14 in the sagittal plane. A total of 1,652 images were obtained for analysis. Series information, tooth number and the plane reconstructed were stored. Images were analyzed by a previously calibrated blinded, radiologist. The result showed no statistically significant difference in the diagnosis of simulated resorption between the cervical, middle and apical thirds of the teeth. From which, it was concluded that when tomographic sections are requested for the diagnosis of buccal or lingual external root resorption, sagittal sections afford the best image characterization of the resorption process.

Ahmed M.F. El-Angbawi, Grant T. McIntyre, David R. Bearn, Donald J. Thomson in (2012)[15], conducted a study to compare the accuracy and agreement of scanned film and digital periapical radiographs for the measurement of apical root shortening. Twenty-four film and digital periapical radiographs were taken using the long-cone paralleling technique for six extracted teeth before and after 1 mm of apical root trimming. All teeth were mounted and the radiographs were recorded using a film holder and polysiloxane occlusal index for each tooth. The film radiographs were scanned and the tooth length measurements for the scanned film and digital (PPS) images were calculated using Image-J-ink 1.4 software for the two groups. The results showed, a high level of agreement was found between the scanned film and digital (PPS) radiographs for the measurement of tooth length. From which, it was concluded that film and digital (PPS) periapical radiographs are accurate methods for measuring apical root shortening with a high level of agreement.

Oana Patarnichie, Sorina Aolomon, Silvia Teslaru, Liliana Pasarin, Silvia Martu in (2012)[12]conducted a study to identify: the incidence of external root resorption (ERR) in current practice, the etiologic factors that could lead to ERR, the possible associations with other local and general factors, and also criteria indices upon that, teeth recovery with ERR is possible. The study group included 264 patients, 153 women and 111 men who required at least one X-ray complementary diagnosis per tooth. The study group included 264 patients, 153 women and 111 men. All examined teeth that presenting endodontic apex damage and / or incorrect endodontic treatment were diagnosed with ERR. The results suggested that, in the entire study group, mostly aged between 40-60 years, ERR percentage level was in males at 13% of cases and at 16% in women. The most affected teeth by ERR were

molars (59%) and premolars (29%) and the most common etiological factors were by endodontic way (81%). In 10% of cases ERR involved more than one tooth or it was combined with internal root resorption (IRR). From which, it was concluded that, external root resorption defines (ERR) as irreversible processes lyses in cement or cement- dentinal started to root surface of the teeth. This process could be present in both teeth with and without vitality. If for temporary teeth ERR is a physiological process, but permanently dentition ERR becomes pathological leading to tooth loss in some cases.

Abbas Mesgarani, Sina Haghanifar, Maryam Ehsani, Samereh Dokhte Yaghub, Ali Bijani in (2014)[16], conducted a study to evaluate the accuracy of conventional intraoral radiography (CR) in comparison with digital radiographic techniques i.e. charge-coupled device (CCD) and photo-stimulable phosphor (PSP) sensors, in detection of External root resorption (ERR). This study was performed on 80 extracted human mandibular premolars. After taking separate initial periapical radiographs, the artificial defects resembling ERR with variable sizes were created in apical half of the mesial, distal and buccal surfaces of the teeth. Ten teeth were used as control samples without any resorption. The radiographs were then repeated with 2 different exposure times and the images were observed by 3 observers. The result showed that the CCD had the highest percentage of correct assessment compared to the CR and PSP sensors, although the difference was not significant. It was shown that the higher dosage of radiation increases the accuracy of diagnosis; however, it was only significant for CCD sensor. Also, the accuracy of diagnosis increased with the increase in the size of lesion. From which, it was concluded that statistically

significant difference was not observed for accurate detection of ERR by conventional and digital radiographic techniques.

Carlos Estrela1, Orlando Aguirre Guedes, Luiz Eduardo G. Rabelo, Daniel Almeida Decurcio1, Ana Helena G Alencar1, Cyntia R.A. Estrela, José Antonio Poli de Figueir in (2014)[26] conducted a study to detect apical inflammatory root resorption (AIRR) associated with periapical lesion using cone beam computed tomography (CBCT) and scanning electronic microscopy (SEM). This clinical study evaluated AIRR in 88 root apexes, from 52 permanent teeth of 14 patients, extracted for different reasons. CBCT images were obtained from the patients with the aim of diagnosing the periapical diseases which showed complex or doubtful conditions. Two examiners assessed the presence or absence of AIRR. Apices were also analyzed under SEM. The results suggested that, AIRR was detected in 23.9% and 61.4% of cases by CBCT and SEM images, respectively. The microscopic analysis remains the reference standard against imaging methods to identify AIRR. It could be speculated that CBCT may improve with time and, in the future, may allow increased diagnostic power for this very challenging clinical situation.

Tadas Venskutonis, Povilas Daugela, Marijus Strazdas, Gintaras Juodzbalys in (2014)[27] conducted a study to compare the accuracy of intraoral digital periapical radiography and cone beam computed tomography in the detection of periapical radiolucencies in endodontically treated teeth. CBCT scans and digital periapical radiography images from 60 patients, were retrieved from databases. Overall, it was observed a statistical significant difference between the number of periapical lesions observed in the CBCT (n = 42) and digital periapical radiography (n

= 24) examinations. In molar teeth, CBCT identify a significantly higher amount of periapical lesions than with the digital periapical radiography. From which, it was concluded that cone beam computed tomography scans were more accurate compared to digital periapical radiographs for detecting periapical radiolucencies in endodontically treated teeth. The difference was more pronounced in molar teeth.

Gbadebo SO, Akinyamoju AO, Sulaiman AO (2014)[28]conducted a study to compare the clinical/radiographic diagnosis of periapical pathology with the histopathological diagnosis and to evaluate the accuracy of clinical/radiographic diagnosis of periapical cyst. A 22 years retrospective analysis of records of teeth diagnosed with periapical lesions that had periradicular surgery and the specimen sent for histopathological examination were included. The clinical diagnoses recorded include chronic periapical abscess, chronic apical periodontitis, apical periodontitis, perioendo lesion, infected periapical cyst, periapical cyst, and radicular cyst. Radiographic reports included well circumscribed radiolucency with sclerotic border and diffuse radiolucency with ill defined border, while histology reports recorded include periapical granuloma, and periapical cyst. Cases were then analysed according to age, gender, site of the lesions, clinical diagnoses and histopathological diagnoses. The results showed that, 19 cases were analyzed in patients within age range of 17 to 57 years and male to female ratio of 1.1:1. All the affected teeth were upper incisors. Majority of the cases were clinically diagnosed to be periapical cyst. While on histological analysis, majority of the total cases were diagnosed as periapical granuloma. Ten cases out of 13 diagnosed clinically to be periapical cyst had sclerotic border. From which, it was concluded that sensitivity and specificity of radiographs in detecting periapical lesions were reduced when compared with histology. The

insufficiency of conventional radiography in diagnosing periapical lesions could lead to unnecessary surgery for the patient, thus the need for advanced imaging to provide improved quality of diagnosis, treatment planning and prognosis.

Adriana Gabriela Creanga, Hassem Geha, Vidya Sankar, Fabricio B. Teixeira, Clyde Alex McMahan, Marcel Noujeim in (2015)[29] conducted a study to evaluate and compare the efficacy of cone-beam computed tomography and digital intraoral radiography in diagnosing simulated small external root resorption cavities. Cavities were drilled in 159 roots using a small spherical bur at different root levels and on all surfaces. The teeth were imaged both with intraoral digital radiography using image plates and with CBCT. Two sets of intraoral images were acquired per tooth: orthogonal (PA) which was the conventional periapical radiograph and mesioangulated (SET). Four readers were asked to rate their confidence level in detecting and locating the lesions. Receiver operating characteristic (ROC) analysis was performed to assess the accuracy of each modality in detecting the presence of lesions, the affected surface, and the affected level. The results suggested that, a significant difference in the area under the ROC curves was found among the three modalities , with CBCT having a significantly higher value than PA (0.71) or SET . PA was slightly more accurate than SET, but the difference was not statistically significant. CBCT was superior in locating the affected surface and level. From which, it was concluded that CBCT was capable to provide images with the high level of detail needed to detect external root resorption, even in its early stages.

Arpita Rai, Krishna Burde, Kruthika Guttal, Venkatesh G. Naikmasur in (2016)[30] conducted a study to compare direct digital intraoral periapical images with three-dimensional (3D) images acquired from cone-beam computed tomography (CBCT) for the diagnosis and treatment planning of periapical pathology. Sixty teeth with clinical and/or radiographic evidence of periapical pathology were examined with direct digital imaging and CBCT technique. Both the image dataset were evaluated by three oral radiologists. Numbers of roots and root canals, presence and location of periapical lesions, size of the lesion, root resorption and root fracture, and relation of the lesion to cortical bone and neighbouring structures were studied. The results showed that among 60 teeth, both the techniques demonstrated periapical lesions in 52 teeth, and an additional 5 teeth were found to have periapical lesions in the CBCT images. In regards to individual roots, 67 lesions were found in both the techniques, and 33 more roots were found to have lesions in CBCT images. From which, it was concluded that a high-resolution 3D technique can be of value for diagnosis of periapical problems, especially for multirooted teeth. CBCT is a promising technology for the diagnosis and management of periapical pathology.

Anuj Bhattacharya, Jyothi S Kumar, Neelkant Patil., Ankita Bohra and Santanu Podder in (2017)[7]conducted a study to evaluate the accuracy of diagnosing periapical lesions through conventional radiography (CR) and digital radiography (DR) technique. 250 patients in the age range of 20-39 years with clinically suspected periapical pathosis and 50 normal subjects as control were included in the study. Both the conventional and digital images were taken. One endodontist and two oral radiologists evaluated all conventional and digital images and gave their final diagnosis for each technique separately. The result showed that the intra observer

variation and interobserver variation were high with conventional radiographic technique in diagnosing initial periapical lesions. The difference between the conventional radiography and digital radiography in accurately diagnosing periapical lesion was non-significant. From which, it was concluded that conventional radiography has more diagnostic value as compared to digital radiography in diagnosing periapical lesions and hence, can be employed in routine practice owing to its advantages.

Elham Alamadi, Hisham Alhazmi, Ken Hansen, Ted Lundgren and Julia Naoumova in (2017)[31] conducted a study to evaluate the accuracy of 2D (periapical radiographs and panoramic radiograph) and 3D (cone beam computed tomography, CBCT) radiographic techniques in measuring slanted root resorptions compared to the true resorptions, a histological gold standard, in addition to a comparison of all the radiographic techniques to each other. Radiographs (CBCT, PA, and PAN), in addition to histological sections, of extracted deciduous canines from thirty-four patients were analyzed. Linear measurements of the most and least resorbed side of the root, i.e., “slanted” resorptions, were measured. For classification of slanted root resorptions, a modified Malmgren index was used. Results were suggestive, that panoramic underestimated the root length on both the least and most resorbed side. Small resorptions, i.e., low modified Malmgren scores, were more difficult to record using periapical and panoramic and were only assessed accurately using CBCT. In assessment of linear measures, panoramic differed significantly from both CBCT and periapical radiograph. From which, it was concluded that CBCT is the most accurate technique for measuring root length and detecting root resorptions. Periapical images were comparable with CBCT for blinded and not blinded root length measurements

but were not accurate when assessing root resorptions using the modified Malmgren score. Panoramic is not a good diagnostic tool for measuring blinded and not blinded root length and root resorptions.

Neeta Aryal,Mao Jing in (2017)[10]conducted a review to carry out the narrative integration of the relevant evidences on root resorption and orthodontic treatment from the published literatures. The resulting papers were studied and reviewed thoroughly for the key explanation of root resorption in orthodontic patients. A total of 41 published research articles were reviewed. According to which, it was concluded that root resorption is common iatrogenic outcome in orthodontic treatment. Biological, mechanical, and combined biological and mechanical factors result in external root resorption. Though most clinicians diagnose root resorption by conventional radiography, researches have clearly shown that CBCT is the promising tool. The clinicians need to counsel orthodontic patients and their parents that the root resorption might be a potential consequence of the treatment lasting for long time. In case of severity; it is essential to reassess the patient and minimize the underlying cause. It is necessary to understand the role of orthodontist in preventing root resorption.

Sabina Saccomanno, Pier Carmine Passarelli, Bruno Oliva, and Cristina Grippaudo in (2018)[32] **conducted** a study aims to verify the validity of the radiographic image and the most effective radiological techniques for the diagnosis of root resorption and to verify if radiological images can be helpful in medical and legal situations. 19 dental elements without root resorption extracted from several patients were examined: endooral and panoramic radiographs were performed, with traditional

and digital methods. Then the root of each tooth was dipped into 3-4 mm of 10% nitric acid for 24 hours to simulate the resorption of the root and later submitted again to radiological examinations and measurements using the same criteria and methods. The result showed that, for teeth with root resorption the real measurements and the values obtained with endooral techniques and digital sensors are almost the same, while image values obtained by panoramic radiographs are more distorted than the real ones. From which, it was concluded that, Panoramic radiographs are not useful for the diagnosis of root resorption. The endooral examination is, the most valid and objective instrument to detect root resorption in medical and legal fields. Although the literature suggests that CBCT is a reliable tool in detecting root resorption defects, the increased radiation dosage and expense and the limited availability of CBCT in most clinical settings accentuate the outcome of this study.

Lim Xin Wei et al in (2018)[1] conducted a study to assess the distribution and severity of apical root resorption (ARR) in common inflammatory periapical pathologies. A cross‑ sectional radiographic study was conducted on 333 patients. Digital intraoral periapical radiographs of patients with clinically diagnosed as periapical pathologies were taken, so as to check the association between apical root resorption (ARR) and periapical pathologies radiographically. Each periapical radiograph were assessed by the experienced radiologist, to assess the morphology of the root surface, width of periodontal ligament space and continuity of the lamina dura. The diagnosis of different periapical lesions were made based on the radiographic findings. The results suggested that, out of 333 patients with inflammatory periapical pathologies, 135 (40.5%) showed definite ARR. Among 135 patients with apical root resorption, 97 (71.9%) had moderate resorption and 38

(28.1%) had severe resorption. ARR was significantly greater in periapical granuloma and cyst (72.8%) followed by periapical abscess (35%) and acute apical periodontitis (18.1%). Young adults (40.7%) and male patients (58.5%) had higher ARR compared to old‑ aged adults and female patients. From which it is concluded that there is high prevalence of apical root resorption in periapical pathologies such as periapical granuloma and cyst as compared to periapical abscess and acute apical periodontitis.

Fayyaz Alam et al in (2019)[33] conducted a study to evaluate the distribution and severity of apical root resorption (ARR) in various periapical pathologies. Patient with clinically diagnosed periapical pathology having periapical radiograph in the record were included in the study. Each IOPA radiograph was evaluated for, the size of the lesion, periodontal ligament space and lamina dura. The result showed that radiographs examined belonged predominately to the male patients. Most of the radiographs examined were of patients who were in the age group of 18-35 years, followed by 36-55 years and > 55 years. Out of 396 radiographs with periapical pathologies, 148 (37.37%) showed apical root resorption (ARR). Among 148 apical root resorption (ARR), 115 (77.70%) had moderate resorption and 33 (22.29%) had severe. Apical root resorption (ARR) was higher in periapical abscess (51.78%) followed by periapical cyst and granuloma (37.63%) and apical periodontitis (20.40%). From which, it can be concluded from this study that there is increased occurrence of apical root resorption (ARR) in periapical abscess than periapical granuloma and cyst.

MATERIALS AND METHODS

After getting clearance from the ethics committee of the institution the Cross-Sectional observational radiographic study was carried out to assess the efficacy and accuracy of digital intraoral periapical radiographs in determining the apical root resorption in inflammatory periapical pathologies.

Radiovisiography (RVG) images of 190 patients' teeth with inflammatory periapical pathologies like periapical cysts, periapical granuloma, periapical abscesses were evaluated for the presence or absence of resorption in the apical area of the root.

Materials Used

- **Diagnostic instruments**: Mouth mirror, probe, explorer.

- **Armamentarium for Radiographic Analysis**

- 14-inch LCD monitor HP intel (R) core TM i3-3227U CPU @1.90 GHz processor, 64-bit operating system having product ID: 00261-30000 AA825.
- X-Ray machine with setting of 70 kvp, 7 mA with 0.8 sec of exposure time using Carestream RVG 5200 sensor with plastic covering sheet.
- CS imaging software version 7 for reconstruction of the data by using various tools of CS imaging software to evaluate the efficacy and accuracy of digital intraoral periapical radiographs in determining the apical root resorption in inflammatory periapical pathologies.

- **Armamentarium for Extraction**

- Mouth mirror, probe, antiseptic agent, extraction forceps, moons probe, local aesthetic agent, syringes, B.P blade no. 15, surgical scissors and tissue forceps and wide mouthed beaker with 10% neutral buffered formaldehyde for collection of extracted tooth specimen with periapical granulation tissue.

- **Armamentarium for Histopathological Evaluation**

- Wide mouthed bottle with 10% neutral buffered formalin at least 20 times the volume of the specimen.
- Agar Media
- Research microscope.
- Glass slide.

INCLUSION CRITERIA

- Clinically and radiologically diagnosed patients with inflammatory periapical pathologies like periapical cysts, periapical granuloma, periapical abscesses.

- Patients with teeth which cannot be saved conservatively.
- Patient's willing for the extraction of the teeth involved with periapical pathologies.

EXCLUSION CRITERIA

- Patients suffering from systemic diseases such as hyperparathyroidism, hypoparathyroidism, hypophosphatemia, hyperphosphatemia.
- Patients not willing for the extraction of the involved teeth with periapical lesions.
- Decayed teeth that can be saved conservatively.
- Patients who have undergone orthodontic treatment.
- Patients with advanced periodontitis.

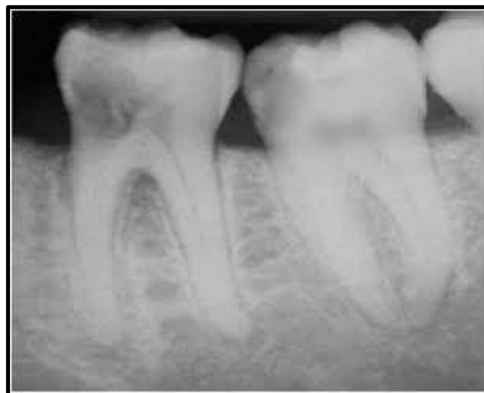
Methodology

- After obtaining written informed consent from the patients, they were examined clinically and detailed case history were recorded in the structured proforma.
- Patients reporting with following clinical signs and symptoms were considered for diagnosis of periapical lesions:
  - History of pain or presence of pain at the time of examination.
  - Sensitivity to percussion
  - Presence of intraoral and extraoral swelling
  - History of recurrent swelling
  - Presence of fistula
  - Root-piece

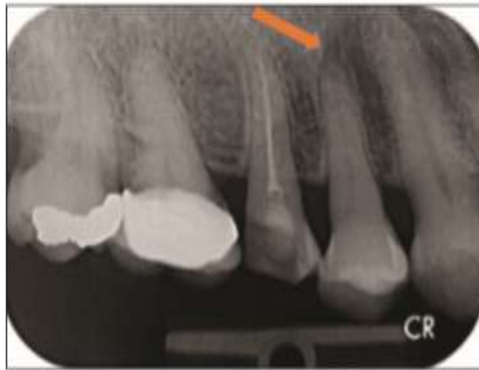
- 190 patients meeting the inclusion criteria and were selected for further evaluation.
- **Radiographic evaluation:** Patients with clinically diagnosed periapical pathologies as per the inclusion criteria were subjected to digital intraoral periapical radiograph using Carestream RVG 5200 sensor with CS imaging software version 7 with acquisition protocol of 70 kvp, 8 mA and 12 bit scale with all protective measures.
- All images was assessed by 1 senior radiologist and 2 post-graduate students to check the morphology of the root surface, width of pdl space and continuity of the lamina dura.
- The diagnosis of different periapical lesions were made based on the following radiographic findings:
- Periapical granuloma and periapical cyst were considered when there was a ill defined radiolucency with corticated margins. Periapical granuloma was considered if the size of the radiolucency is <1.6 cm and lesions measuring more than the size were considered as periapical cyst.
- Acute apical periodontitis was considered if there was widening of periodontal ligament space.
- Chronic periapical abscess was considered when there was a loss of continuity of lamina dura and presence of irregular ill-defined radiolucency at the periapex.

- **Criteria to assess the severity of apical root resorption[1]**: The teeth with periapical radiolucencies were then examined for the presence or absence of resorption in the apical area of the root using the tools, according to following criteria[1]:

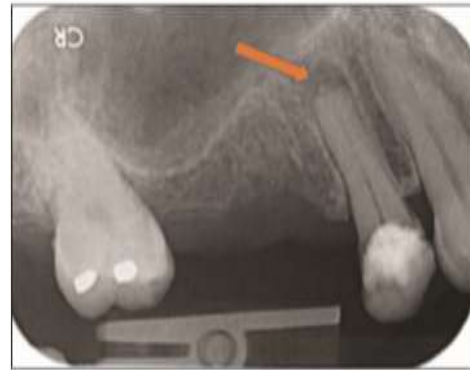
  - **No resorption:** If there is intact outline of root surface with uniform density in root contour**. (fig. 1)**
  - If there is presence of blurred irregularities on the apical root contour with less radio dense areas then there is **moderate resorption. (fig. 2)**
  - If there is presence of distinct radiolucent indentations or shortening of root tip then there is **severe resorption. (fig. 3)**



No resorption



Moderate apical root resorption



Severe apical root resorption

- After the radiographic assessment of the apical root resorption by the 3 observers, extraction of the involved teeth was done under all aseptic conditions. With the help of currete, periapical tissue was removed by scrapping and then collecting it in a wide mouthed bottle with 10% neutral buffered formalin at least 20 times the volume of the specimen. The extracted tooth specimen was evaluated for presence or absence of apical root resorption and the periapical tissue was sent for histopathological examination, where, it was centrifuged and sedimentary segments were placed in Agar media and then sectioned as tissue blocks and viewed under research microscope to determine the periapical pathology associated with the extracted tooth specimen.

Data Collection and Statistical Analysis

The presence and severity of apical root resorption was recorded along with different gender and age groups. Data were collected using a structured proforma consisting of patient's details, type of periapical lesions, presence or absence and severity of apical root resorption. The distribution of clinically diagnosed periapical pathologies will be obtained in terms of numbers and percentages. Further, for each pathology, the absence or presence of ARR, as obtained through radiographs, will be

expressed in terms of numbers and percentage. The statistical significance of difference in ARR prevalence across pathologies will be determined using Pearson's Chi-square test. The analysis will be performed using SPSS ver 20.0 (IBMCorp).

FIGURE 1: ARMAMENTARIUM FOR CLINICAL EXAMINATION

FIGURE 2: CLINICAL PHOTOS OF PATIENT WITH EXTRAORAL SWELLING

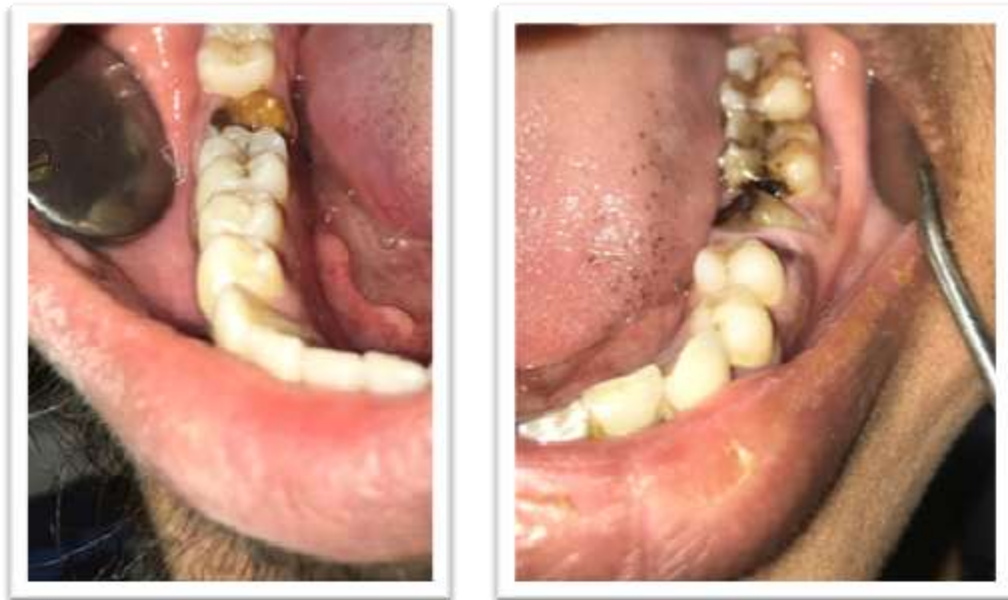


FIGURE 3: INTRA-ORAL PHOTOS OF PATIENT SHOWING ROOT PIECES WITH 47 AND 36

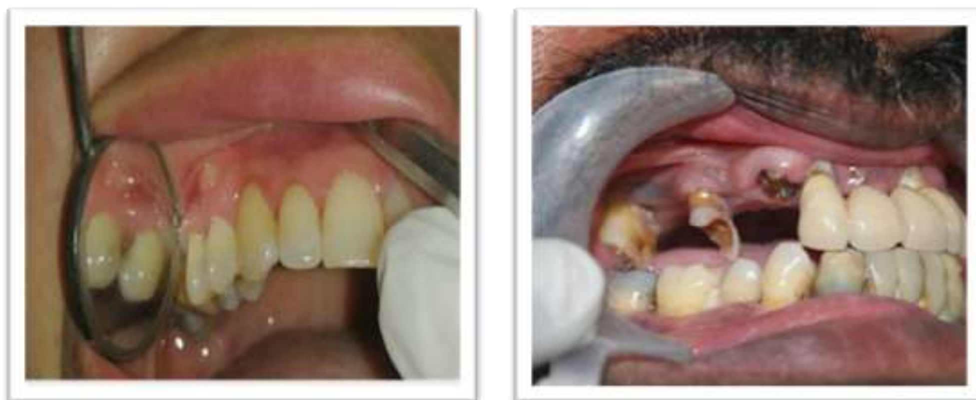


FIGURE 4: INTRA-ORAL PHOTOS OF PATIENT SHOWING PERIAPICAL ABSCESS WITH 13 AND 14

Figure 5: Carestream RVG5200 SENSOR

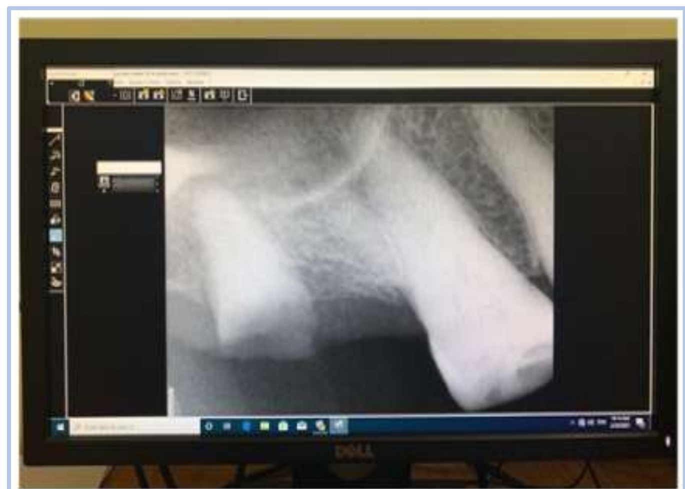


Figure 6: Computer Monitor Cs Imaging Software Version 7

FIGURE 7: INTRA-ORAL RADIOGRAPHY UNIT USED FOR TAKING DENTAL RADIOGRAPH WITH CARESTREAM RVG 5200 SENSOR.

FIGURE 8: RVG IMAGES SHOWING PERIAPICAL PATHOLOGIES

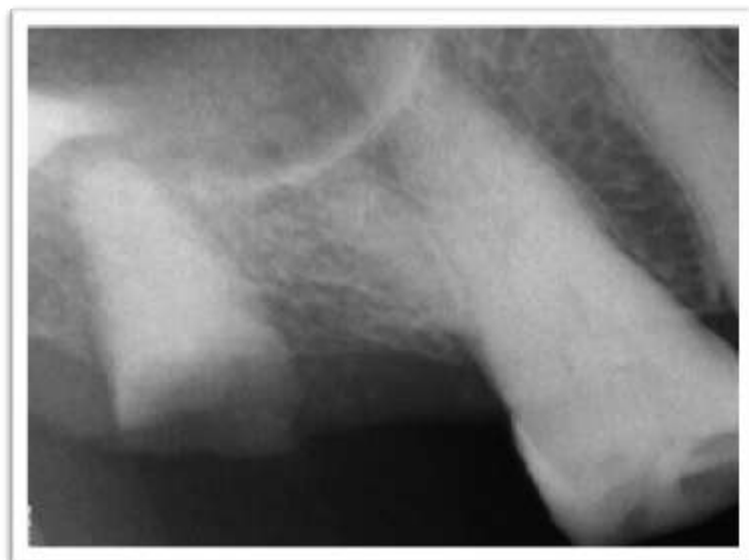


FIGURE 8a: RVG IMAGE SHOWING TOOTH WITH APICAL PERIODONTITIS

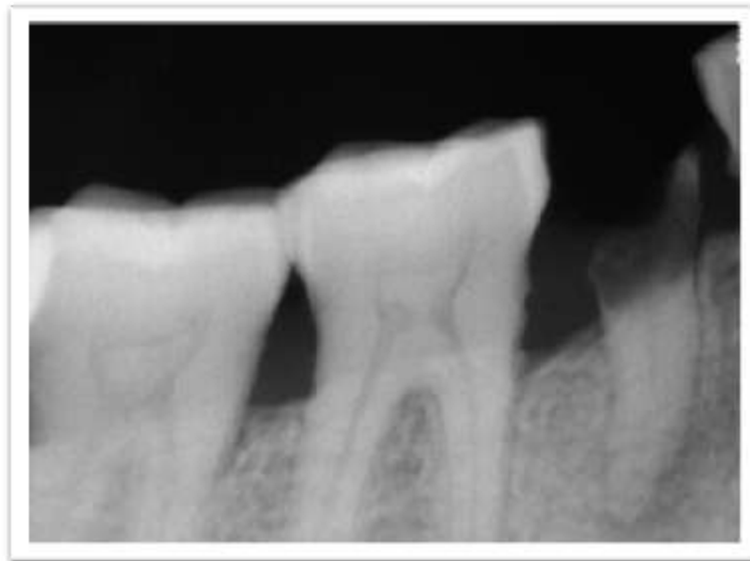


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FIGURE 8b: RVG IMAGE SHOWING TOOTH WITH PERIAPICAL ABSCESS

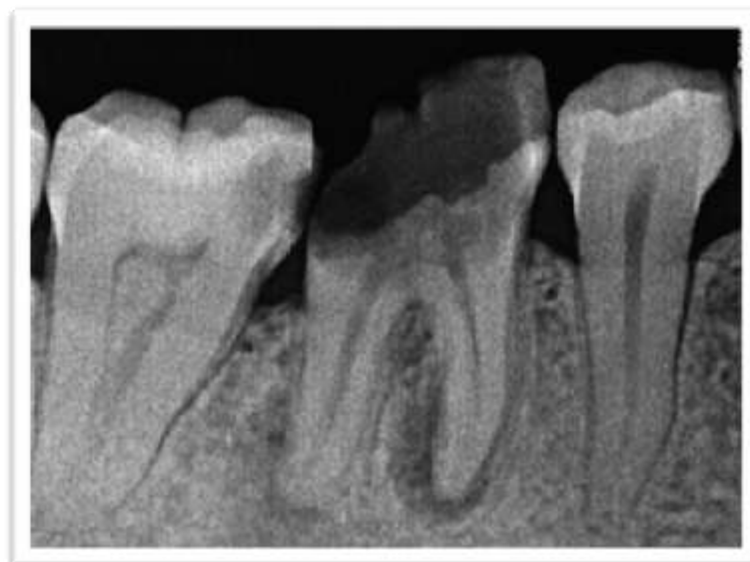

FIGURE 8c: RVG IMAGE SHOWING TOOTH WITH PERIAPICAL GRANULOMA

FIGURE 9: RVG IMAGES SHOWING APICAL ROOT RESORPTIONS.

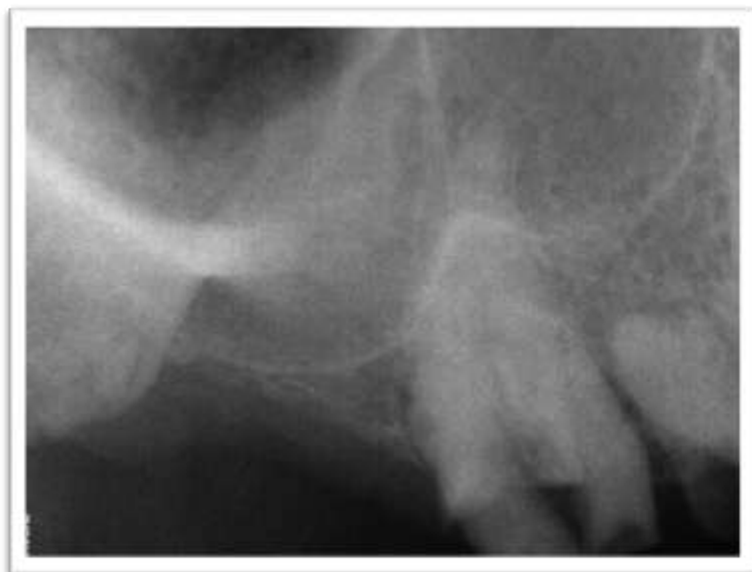

FIGURE 9a: RVG IMAGE SHOWING TOOTH WITH APICAL PERIODONTITIS WITH NO ROOT RESORPTION

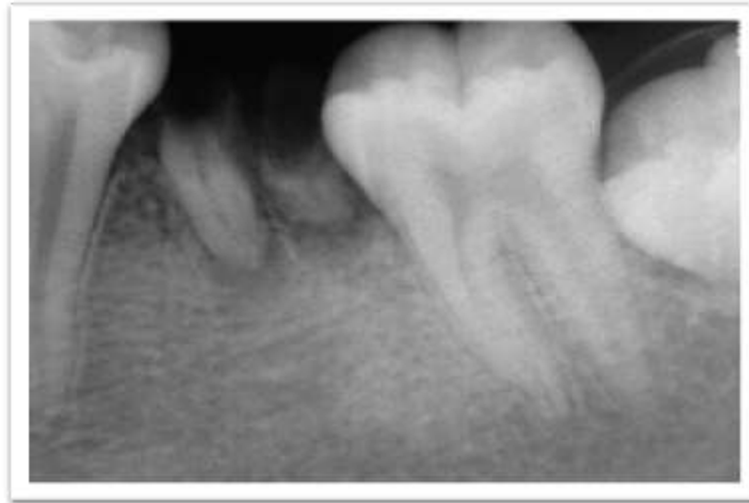

FIGURE 9b: RVG IMAGE SHOWING TOOTH WITH PERIAPICAL GRANULOMA WITH MODERATE ROOT RESORPTION

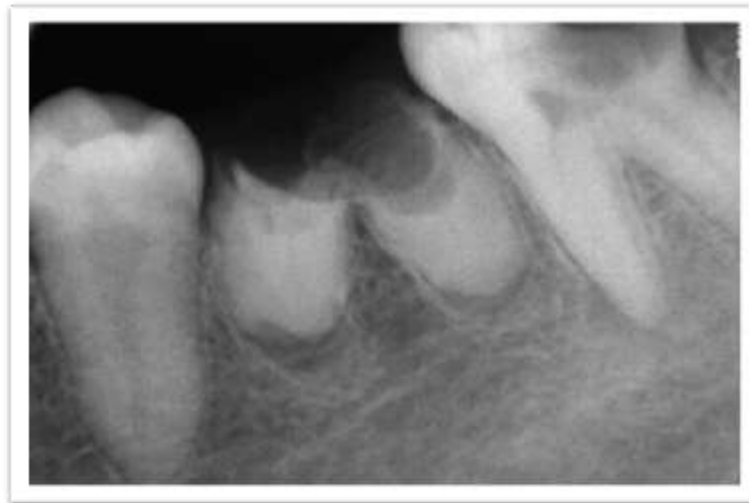

FIGURE 9c: RVG IMAGE SHOWING TOOTH WITH PERIAPICAL ABSCESS WITH SEVERE ROOT RESORPTION

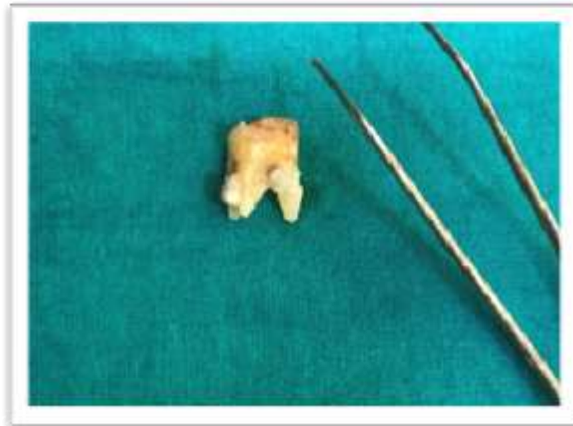

FIGURE 10: SHOWING TOOTH SPECIMEN WITH PERIAPICAL TISSUE

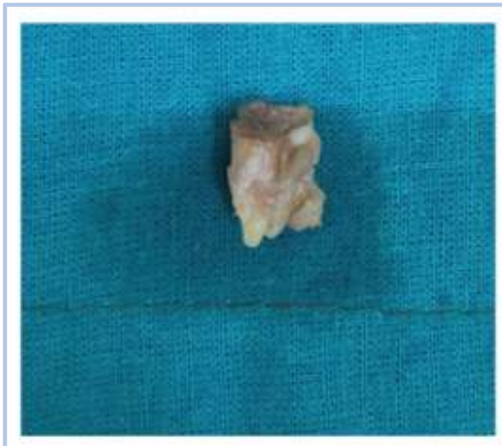

Figure 11: Showing Tooth Specimen without Resorption

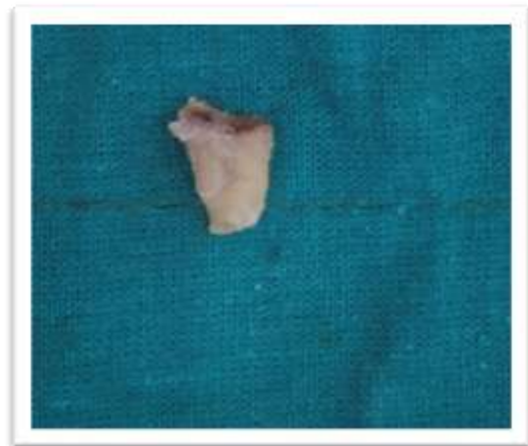

Figure 12: Showing Tooth Specimen with Resorption

FIGURE 13: HISTOPATHOLOGICAL IMAGES SHOWING PERIAPICAL PATHOLOGIES

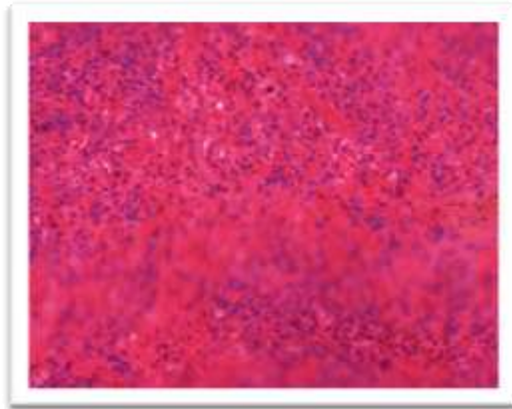

Figure 13 A: Chronic Inflammation

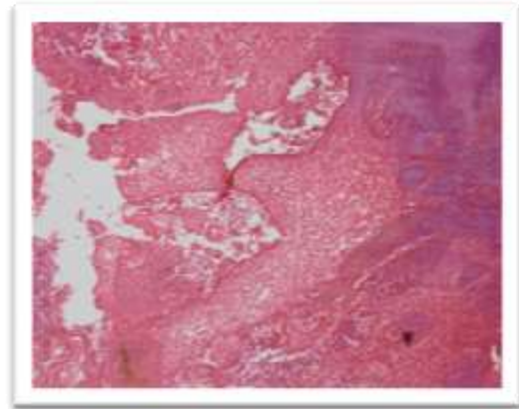

Figure 13 B: Radicular Cyst

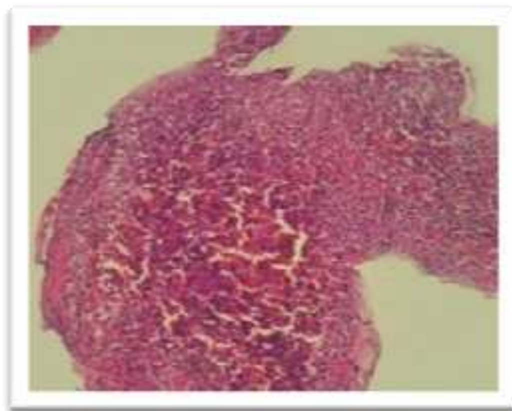

Figure 13 C: Periapical Granuloma

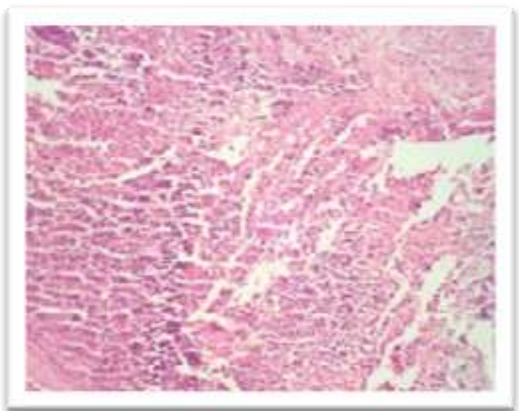

Figure 13 D: Periapical Abscess

RESULTS

Table 1: Descriptive statistics for age of patients included in study

Age in years	Number	%
18-35	81	42.63
36-55	101	53.16
>55	8	4.21
Total	190	100
Mean	38.88	
Standard deviation	8.71	
Median	38	

Table 1 provides the distribution of patients according to age. The maximum, i.e. 101 (53.16%) patients were in the age range of 36-55 years, followed by 81 (42.63%) in the range of 18-35 years, while 8 (4.21%) patients were above 55 years. The mean age of patients was 38.88 years with standard deviation of 8.71 years. The median age was 38 years.

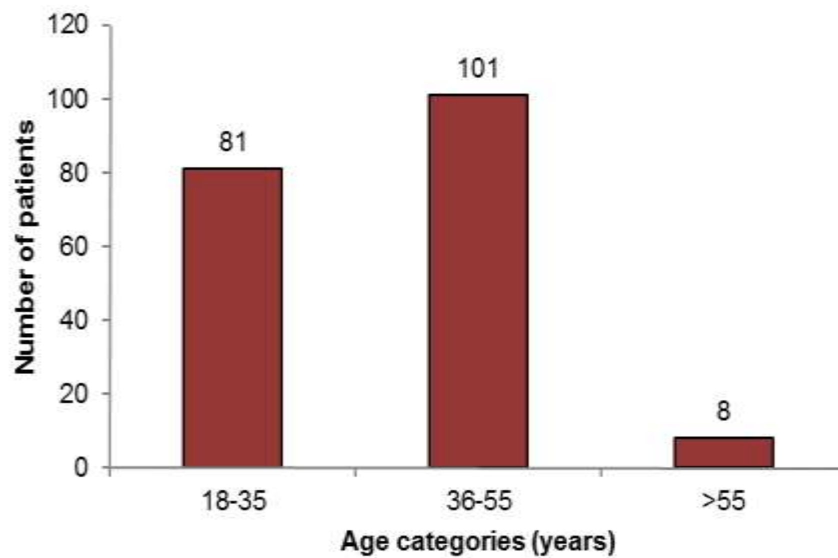

Figure 1: Column chart showing number of patients in each age category

Table 1a: Cross table for age and clinical pathology

Age categories (Years)	Clinical diagnosis [No. (%)]			
	Apical periodontitis	**Abscess**	**Periapical granuloma**	**Total**
18 – 35	32 (39.5)	42 (51.8)	7 (8.6)	81
36 – 55	39 (38.6)	53 (52.5)	9 (8.9)	101
> 55	4 (50.0)	4 (50.0)	0	8
Total	75 (39.5)	99 (52.1)	16 (8.4)	190

The table 1a shows the number of cases according to clinical diagnosis in each age category. In the 18-35 years category, there were maximum 42 (51.8%) cases with abscess, followed by 32 (39.5%) cases with apical periodontitis. In the 36-55 years category, there were 53 (52.5%) cases with abscess, while 39 (38.6%) cases with apical periodontitis and 9 (8.9%) cases with periapical granuloma. In the > 55 years category, there were 4 (50%) cases with apical periodontitis and abscess each. The association between age and type of clinical diagnosis was statistically insignificant (p=0.9156) using Pearson's Chi-square test.

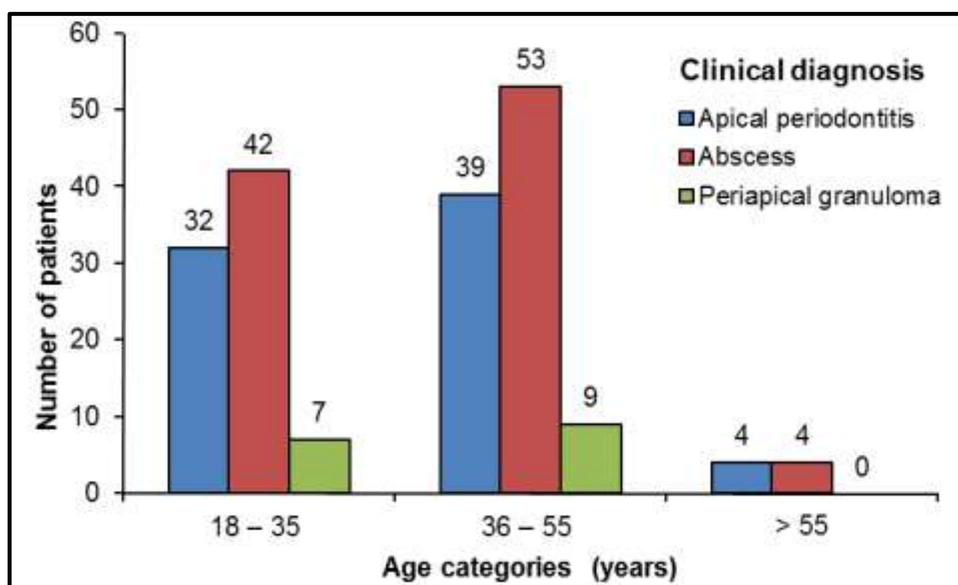

Figure 1a: Column chart showing number of patients as per age and clinical diagnosis

Table 1b: Cross table for age and radiologic resorption

Age categories (Years)	Type of resorption [No. (%)]			
	No	Moderate	Severe	Total
18 – 35	12 (14.8)	35 (43.2)	34 (41.9)	81
36 – 55	15 (14.8)	47 (46.5)	39 (38.6)	101
> 55	1 (12.5)	4 (50.0)	3 (37.5)	8
Total	28 (14.7)	86 (45.3)	76 (40.0)	190

The table 1b shows the number of cases according to type of radiographic root resorption in each age category. In the 18-35 years category, there were maximum 35 (43.2%) cases with moderate resorption, followed by 34 (41.9%) with severe and 12 (14.8%) with no resorption. In the 36-55 years category, there were 47 (46.5%) cases with moderate resorption, while 39 (38.6%) with severe and 15 (14.8%) with no resorption. In the > 55 years category, there were 4 (50%) cases with moderate resorption, while 3 (37.5%) had severe resorption and 1 (12.5%) had no resorption. The association between age and type of clinical diagnosis was statistically insignificant (p=0.9885) using Pearson's Chi-square test.

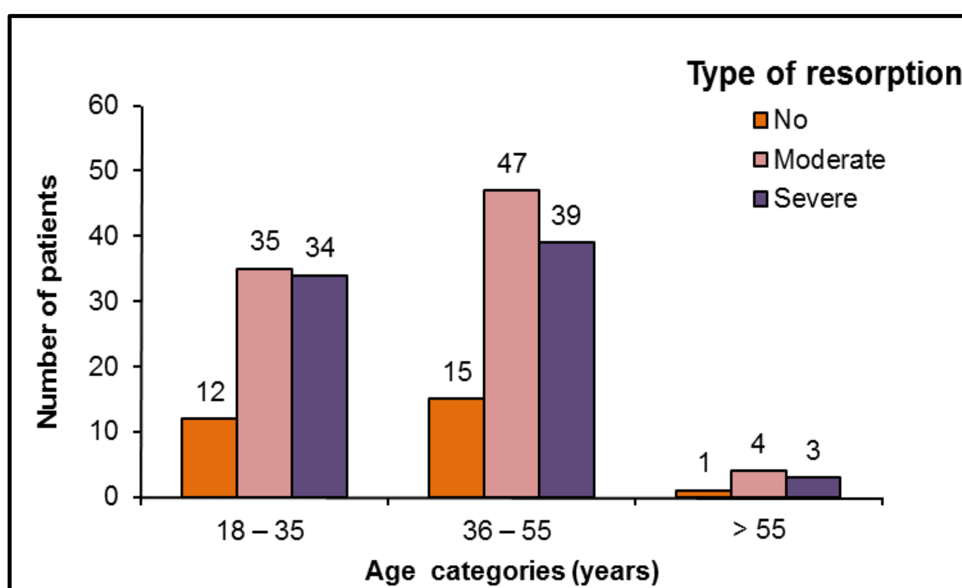

Figure 1b: Column chart showing number of patients as per age and type of radiographic root resorption

Table 1c: Cross table for age, clinical and radiological resorption

Age	Clinical resorption	Radiologic resorption						Total
		No		Moderate		Severe		
		No.	%	No.	%	No.	%	
18 – 35	Present	2 (6.7)		8 (26.7)		20 (66.6)		30
	Absent	10 (19.6)		27 (52.9)		14 (27.5)		51
35 – 55	Present	1 (2.6)		15 (38.5)		23 (58.9)		39
	Absent	14 (22.6)		32 (51.6)		16 (25.8)		62
> 55	Present	0		1 (50.0)		1 (50.0)		2
	Absent	1 (16.7)		3 (50.0)		2 (33.3)		6

The table 1c shows the distribution of patients as per clinical and radiological resorption in each age category. In the 18-35 years category, clinical resorption was present in 30 patients, out of which, 20 (66.6%) had severe resorption on radiology, 8 (26.7%) had moderate and 2 (6.7%) had no resorption. In the 35-55 years category, there were 39 cases with clinical resorption, out of which, 23 (58.9%) had severe resorption on radiography, 15 (38.5%) had moderate and 1 (2.6%) had no resorption on radiography. In the > 55 years category, only 2 patients showed clinical resorption out of which 1 patient each had moderate and severe resorption on radiography.

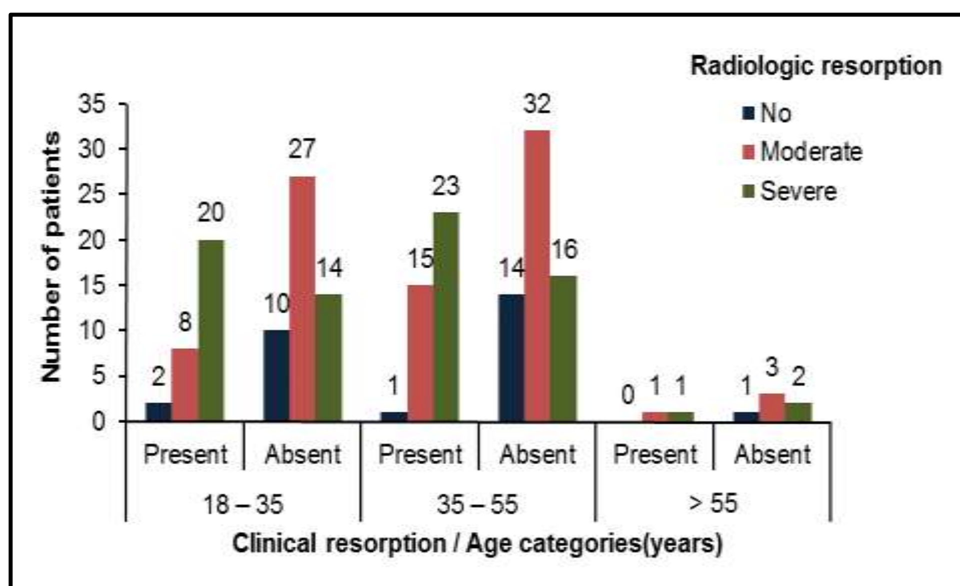

Figure 1c: Column chart showing number of patients as per clinical resorption, age and radiologic resorption

Table 2 gives the distribution of patients according to sex. There were 98 (51.58%) males and 92 (48.42%) females included in the study.

Sex	Number	%
Male	98	51.58
Female	92	48.42
Total	190	100

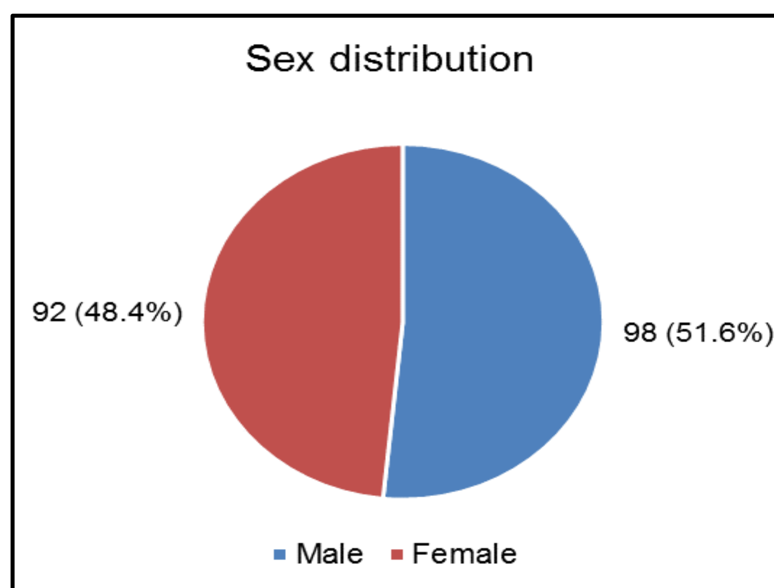

Figure 2: Pie chart showing sex distribution

Table 2a: Cross table for sex and clinical pathology

Sex	Clinical diagnosis [No. (%)]			Total
	Apical periodontitis	**Abscess**	**Periapical granuloma**	
Male	39 (39.8)	48 (48.9)	11 (11.2)	98
Female	36 (39.1)	51 (55.4)	5 (5.4)	92
Total	75 (39.5)	99 (52.1)	16 (8.4)	190

The table 2a shows the number of cases according to clinical diagnosis in each sex category. In males, there were maximum 48 (48.9%) cases with abscess, followed by 39 (39.8%) cases with apical periodontitis and 11 (11.2%) with periapical granuloma. In females, there were 51 (55.4%) cases with abscess, while 36 (39.1%) cases with apical periodontitis and 5 (5.4%) cases with periapical granuloma. The association between age and type of clinical diagnosis was statistically insignificant (p=0.3208) using Pearson's Chi-square test.

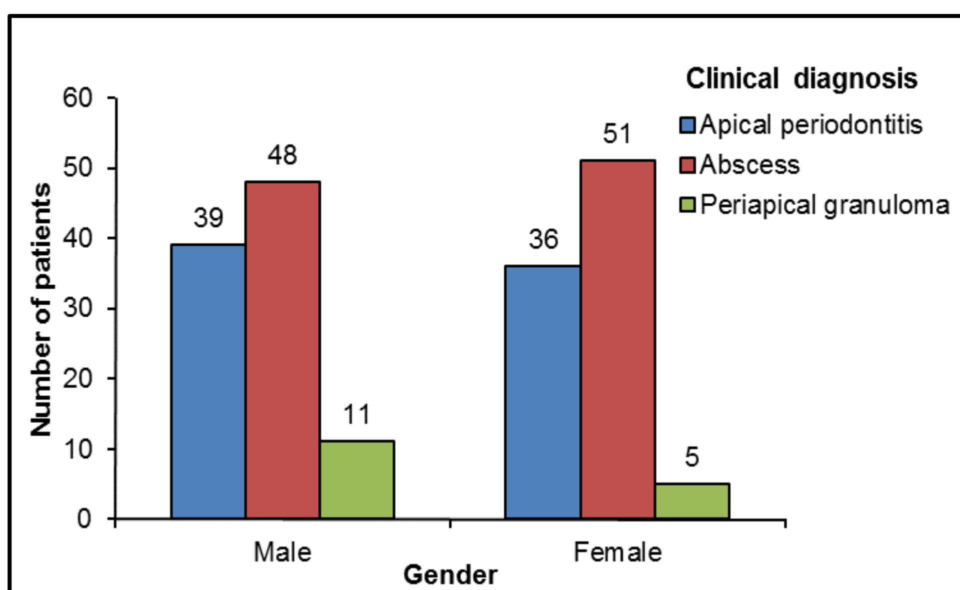

Figure 2a: Column chart showing number of patients as per sex and clinical diagnosis

Table 2b: Cross table for sex and radiologic resorption

Sex	Type of resorption [No. (%)]			
	No	Moderate	Severe	Total
Male	19 (19.4)	43 (43.8)	36 (36.7)	98
Female	9 (9.7)	43 (46.7)	40 (43.5)	92
Total	28 (14.7)	86 (45.3)	76 (40.0)	190

The table 2b shows the number of cases according to type of radiographic root resorption in each sex category. In males, there were maximum 43 (43.8%) cases with moderate resorption, followed by 36 (36.7%) cases with severe and 19 (19.4%) with no resorption. In females, there were 43 (46.7%) cases with moderate resorption, while 40 (43.5%) cases with severe and 9 (9.7%) cases with no resorption. The association between age and type of clinical diagnosis was statistically insignificant (p=0.1656) using Pearson's Chi-square test.

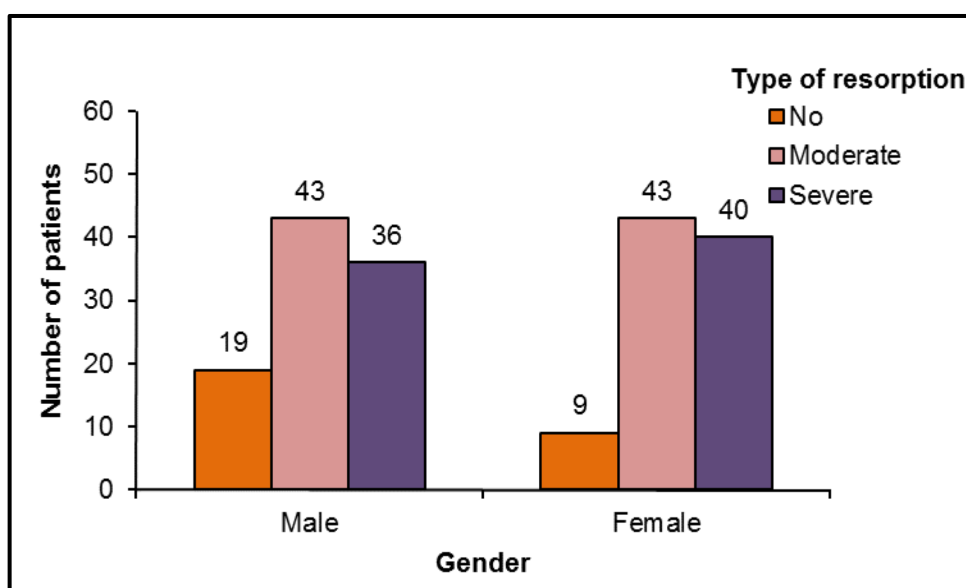

Figure 2b: Column chart showing number of patients as per sex and type of resorption

Table 2c: Cross table for sex, clinical and radiological resorption

Age	Clinical resorption	Radiologic resorption						Total
		No		Moderate		Severe		
		No.	%	No.	%	No.	%	
Male	Present	1	3.3	12	40	17	56.7	30
	Absent	18	26.5	31	45.6	19	27.9	68
Female	Present	2	3.9	12	23.5	27	52.9	51
	Absent	7	17.1	31	75.6	13	31.7	41

The table 2c shows the distribution of patients as per clinical and radiological resorption in each gender type. In males, the clinical resorption was present in 30 patients, out of which, 17 (56.7%) had severe resorption on radiology, 12 (40.0%) had moderate and 1 (3.3%) had no resorption. In females, there were 51 cases with clinical resorption, out of which, 27 (52.9%) had severe resorption on radiography, 12 (23.5%) had moderate and 2 (3.9%) had no resorption on radiography.

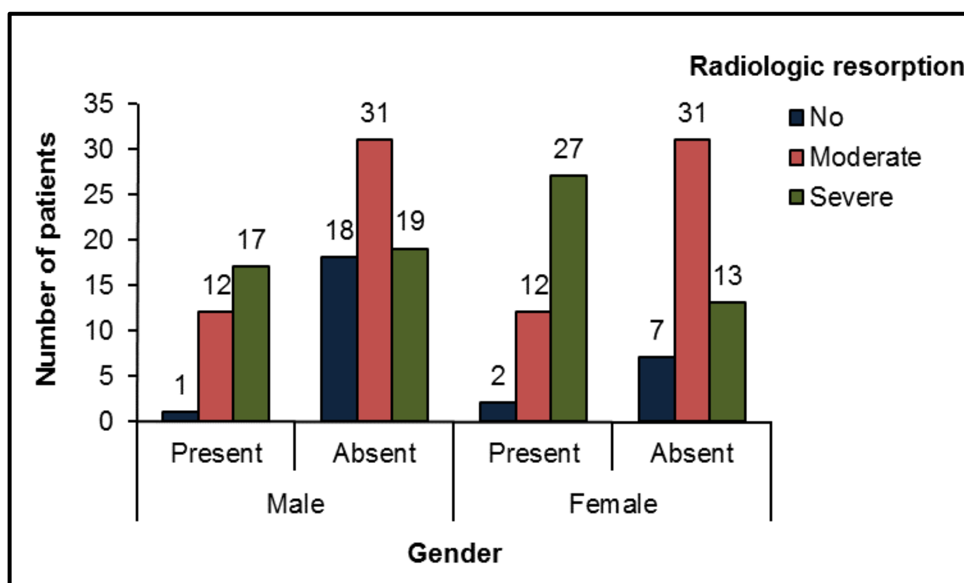

Figure 2c: Column chart showing number of patients as per clinical resorption, sex and radiologic resorption

Table 3: Distribution of patients according to type of resorption in each clinical diagnosis category

Clinical diagnosis	Type of resorption			
	No	**Moderate**	**Severe**	**Total**
Apical periodontitis	13 (17.33)	47 (62.67)	15 (20)	75
Abscess	12 (12.12)	34 (34.34)	53 (53.54)	99
Periapical granuloma	3 (18.75)	5 (31.25)	8 (50)	16
Total	28 (14.74)	86 (45.26)	76 (40)	190

Table 3 gives the number of patients according to type of resorption in each clinical diagnosis category. There were 75 cases diagnosed as apical periodontitis, out of which maximum i.e. 47 (62.67%) had moderate resorption, followed by 15 (20%) with severe resorption and 13 (17.33%) with no resorption. There were 99 cases diagnosed with abscess and among these, 53 (53.54%) showed severe resorption, 34 (34.34%) showed moderate and 12 (12.12%) showed no resorption. There were 16 cases of periapical granuloma, out of which 8 (50%) showed severe resorption, 5 (31.25%) had moderate while 3 (18.75%) had no resorption. Overall, there were 86 (45.26%) cases with moderate resorption, followed by 76 (40%) with severe and 28 (14.74%) with no resorption.

The difference in the proportion of patients as per resorption type in three clinical diagnosis categories was statistically significant with p-value of 0.0002 using Pearson's chi-square test. The proportion of severe cases were significantly higher in abscess as compared to other diagnosis categories.

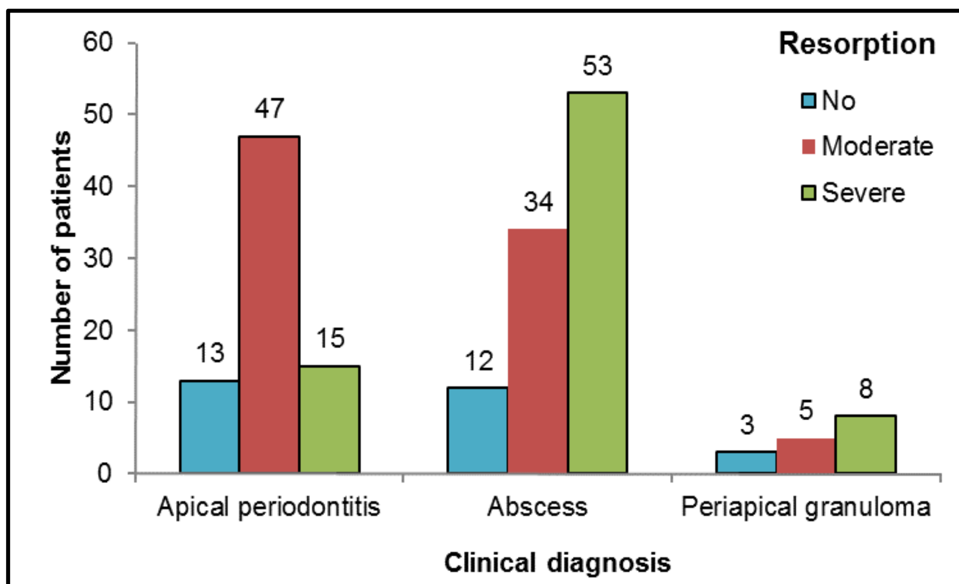

Figure 3: Column chart showing number of patient with resorption type in each clinical diagnosis category

Table 4: Distribution of patients according to type of resorption in each radiographic diagnosis category

Radiographic diagnosis	Resorption			
	No	**Moderate**	**Severe**	**Total**
Apical periodontitis	8 (15.09)	34 (64.15)	11 (20.75)	53
Abscess	19 (16.1)	45 (38.14)	54 (45.76)	118
Periapical granuloma	1 (5.26)	7 (36.84)	11 (57.89)	19
Total	28 (14.74)	86 (45.26)	76 (40)	190

Table 4 gives the number of patients according to type of resorption in each radiological diagnosis category. There were 53 cases diagnosed with apical periodontitis, out of which maximum i.e. 34 (64.15%) had moderate resorption, followed by 11 (20.75%) with severe resorption and 8 (15.09%) with no resorption. There were 118 cases diagnosed with abscess and among these, 54 (45.76%) showed severe resorption, 45 (38.14%) showed moderate and 19 (16.1%) showed no resorption. There were 19 cases of periapical granuloma, out of which 11 (57.89%.) showed severe resorption, 7 (36.84%) had moderate, while 1 (5.26%) had no resorption.

The difference in the proportion of patients as per resorption type in three radiological diagnosis categories was statistically significant with p-value of 0.0058 using Pearson's chi-square test. The proportion of severe cases were significantly higher in abscess and periapical granuloma categories as compared to apical periodontitis.

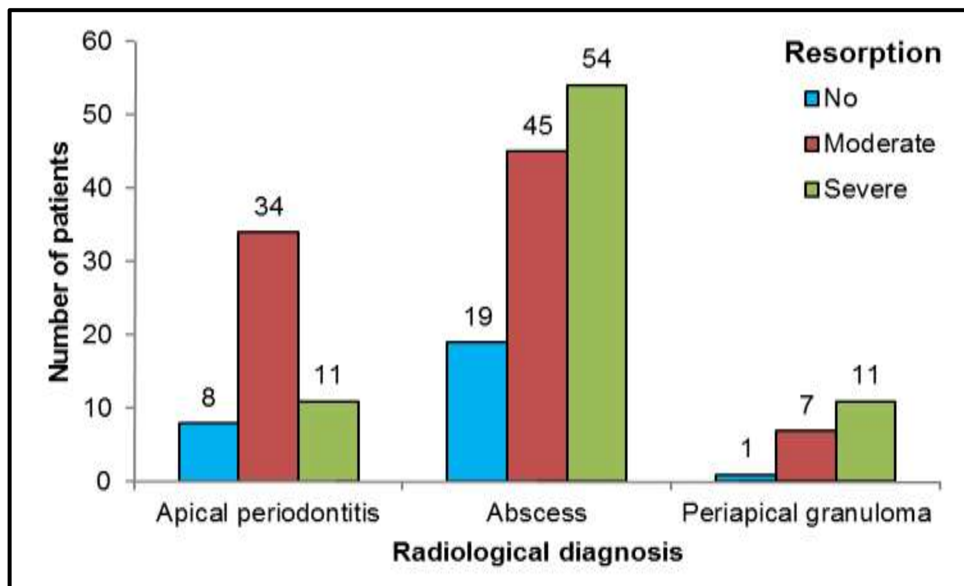

Figure 4: Column chart showing number of patient with resorption type in each radiological diagnosis category.

Table 5: Distribution of patients according to type of resorption in each histopathology diagnosis category

Histologic diagnosis	Resorption [No. (%)]			
	No	**Moderate**	**Severe**	**Total**
Chronic abscess	2 (4.76)	13 (30.95)	27 (64.29)	42
Chronic inflammation	25 (20.49)	65 (53.28)	32 (26.23)	122
Periapical granuloma	1 (7.14)	5 (35.71)	8 (57.14)	14
Radicular cyst	0 (0)	3 (25)	9 (75)	12
Total	28 (14.74)	86 (45.26)	76 (40)	190

Table 5 gives the number of patients according to type of resorption in each histological diagnosis category. There were 42 cases diagnosed with chronic abscess, out of which maximum i.e. 27 (64.29%) had severe resorption, followed by 13 (30.95%) with moderate resorption and 2 (4.76%) with no resorption. There were 122 cases diagnosed with chronic inflammation and among these, 65 (53.28%) showed moderate resorption, 32 (26.23%) showed severe and 25 (20.49%) showed no resorption. There were 14 cases of periapical granuloma, out of which 8 (57.14%.) showed severe resorption, 5 (35.71%) had moderate, while 1 (7.14%) had no resorption. The radiological cyst was observed in 12 patients, out of which, 9 (75%) showed severe resorption and 3 (25%) showed moderate.

The difference in the proportion of patients as per resorption type in histology diagnosis categories was statistically significant with a p-value < 0.0001 using Pearson's chi-square test. The proportion of severe cases were significantly higher in abscess and periapical granuloma categories as compared to other categories.

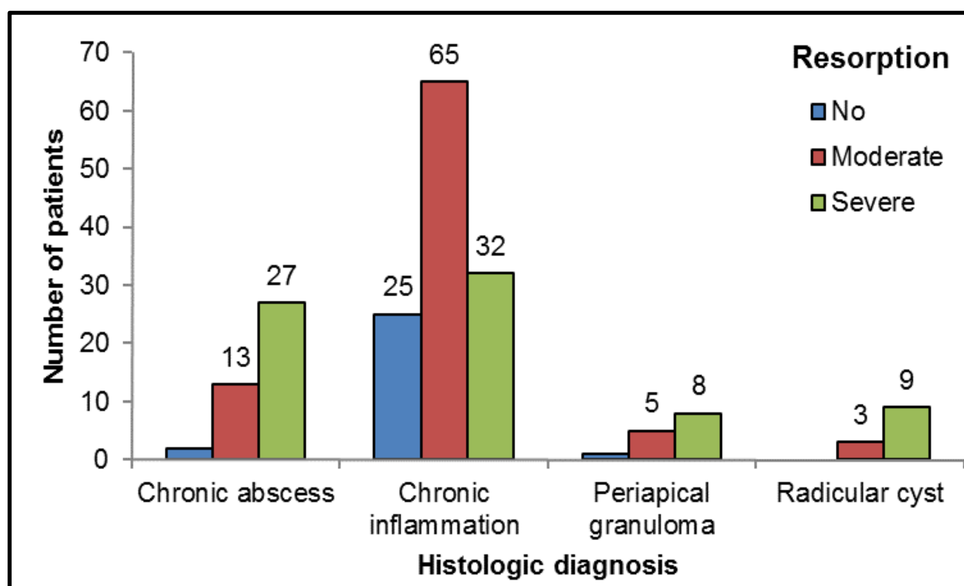

Figure 5: Column chart showing number of patient with resorption type in each histological diagnosis category

Table 6: Distribution of patients according to clinical and radiological resorption

Clinical resorption	Radiological resorption [No. (%)]			
	No	Moderate	Severe	Total
Present	3 (4.23)	24 (33.8)	44 (61.97)	71
Absent	25 (21.01)	62 (52.1)	32 (26.89)	119
Total	28 (14.74)	86 (45.26)	76 (40)	190

Table 6 gives the number of patients according to clinical and radiological resorption. There were 71 cases showing presence of resorption by clinical method, out of which maximum i.e. 44 (61.97%) showed severe radiological resorption, 24 (33.8%) with moderate resorption and 3 (4.23%) with no resorption. There were 119 cases with absence of clinical resorption, out of which 62 (52.1%) showed moderate radiological resorption, 32 (26.89%) showed severe and 25 (21.01%) showed no radiological resorption. The association between the types of resorption was statistically significant as indicated by a p-value < 0.0001 using Pearson's Chi-square test.

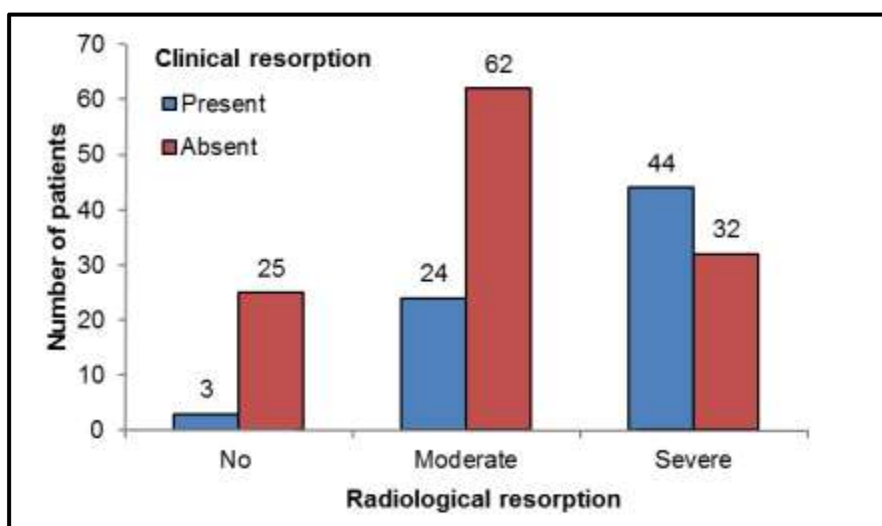

Figure 6: Column chart showing number of patients with clinical resorption and radiological resorption

Table 7: Association of clinical, radiologic and histologic diagnosis with clinical resorption

Clinical Diagnosis	Radiologic Diagnosis	Histologic Diagnosis	Clinical resorption			
			Absent		Present	
			No.	%	No.	%
Abscess (99)	Apical periodontitis (2)	Chronic abscess (1)	0	0.0	1	100.0
		Chronic inflammation (1)	1	100.0	0	0.0
	Periapical abscess (90)	Chronic abscess (27)	0	0.0	27	100.0
		Chronic inflammation (52)	51	100.0	1	1.9
		Periapical granuloma (4)	0	0.0	4	100.0
		Radicular cyst (7)	0	0.0	7	100.0
	Periapical granuloma (7)	Chronic abscess (1)	0	0.0	1	25.0
		Chronic inflammation (3)	3	100.0	0	0.0
		Periapical granuloma (2)	0	0.0	2	50.0
		Radicular cyst (1)	0	0.0	1	25.0
Apical periodontitis (75)	Apical periodontitis (50)	Chronic abscess (5)	1	20.0	4	80.0
		Chronic inflammation (45)	43	95.5	2	4.5
	Periapical abscess (23)	Chronic abscess (5)	0	0.0	5	100.0
		Chronic inflammation (17)	16	94.1	1	5.9
		Radicular cyst (1)	0	0.0	1	100.0
Periapical granuloma (16)	Apical periodontitis (1)	Periapical granuloma (1)	0	0.0	1	100.0
	Periapical abscess (5)	Radicular cyst (1)	0	0.0	1	100.0
		Chronic inflammation (1)	1	100.0	0	0.0
		Chronic abscess (1)	0	0.0	1	100.0
	Periapical granuloma (10)	Chronic inflammation (3)	3	100.0	0	0.0
		Periapical granuloma (1)	0	0.0	1	100.0
		Chronic abscess (2)	0	0.0	2	100.0

Table 7 gives the association of clinical, radiological and histological diagnosis and clinical resorption. There were 99 cases of abscess diagnosed clinically. Out of these, 2 cases were diagnosed with apical periodontitis on radiology, and on histology one case each showed chronic abscess and chronic inflammation respectively. One case of abscess showed clinical resorption. There were 90 cases of periapical abscess as diagnosed radiologically. Among these, 27 were diagnosed with chronic abscess histologically, 52 were diagnosed with chronic inflammation, 4 with periapical granuloma and 7 with radicular cyst. All 27 cases of clinical abscess, 4 cases of granuloma and 7 cases of cyst showed clinical resorption, while only 1 (1.9%) case with chronic inflammation showed clinical resorption. There were 7 cases of periapical granuloma in radiology, out of which one case each was diagnosed as chronic abscess and radicular cyst on histology, while 3 cases were diagnosed as chronic inflammation and 2 as periapical granuloma on histology. The cases of abscess, granuloma and cyst showed clinical resorption.

There were 75 cases of apical periodontitis diagnosed clinically. Among these, on radiology, 50 cases had same diagnosis. Further, on histology, 5 showed chronic abscess while 45 showed chronic inflammation. Out of 5 cases of abscess, 4 (80%) showed clinical resorption, while out of 45 cases of inflammation, only 2 (4.5%) showed clinical resorption. There were 23 cases of periapical abscess on radiology, out of which 5 showed chronic abscess on histology and all cases had clinical resorption. There were 17 cases of inflammation and only 1 (5.9%) showed resorption. There were 2 cases of periapical granuloma on radiology and they both showed clinical resorption.

There were 16 cases of periapical granuloma on clinical diagnosis. Out of these, 1 case was radiologically diagnosed as apical periodontitis without clinical resorption. There were 5 cases with periapical abscess on radiology out of which one case each showed chronic abscess and periapical granuloma on histology and both showed clinical resorption. Out of 10 cases of periapical granuloma on radiology, 2 showed chronic abscess on histology and both showed clinical resorption. There were 6 cases of periapical granuloma on histology and all showed resorption, while 2 cases of radicular cyst also showed clinical resorption.

Table 8: Association of clinical, radiologic and histologic diagnosis with radiologic resorption

Clinical Diagnosis	Radiologic Diagnosis	Histologic Diagnosis	Clinical resorption			
			Absent		Present	
			No.	%	No.	%
Abscess (99)	Apical periodontitis (2)	Chronic abscess (1)	0	0.0	1	100.0
		Chronic inflammation (1)	0	0.0	0	0.0
	Periapical abscess (90)	Chronic abscess (27)	2	7.4	7	25.9
		Chronic inflammation (52)	9	17.3	21	40.4
		Periapical granuloma (4)	0	0.0	1	25.0
		Radicular cyst (7)	0	0.0	1	14.3
	Periapical granuloma (7)	Chronic abscess (1)	0	0.0	0	0.0
		Chronic inflammation (3)	1	33.3	2	66.7
		Periapical granuloma (2)	0	0.0	1	50.0
		Radicular cyst (1)	0	0.0	0	0.0
Apical periodontitis (75)	Apical periodontitis (50)	Chronic abscess (5)	0	0.0	3	60.0
		Chronic inflammation (45)	8	17.8	29	64.4
	Periapical abscess (23)	Chronic inflammation (17)	5	29.4	11	64.7
		Radicular cyst (1)	0	0.0	1	100.0
Periapical granuloma (16)	Apical periodontitis (1)	Chronic inflammation (1)	0	0.0	1	100.0
	Periapical abscess (5)	Chronic abscess (1)	0	0.0	0	0.0
		Chronic inflammation (3)	2	66.7	1	33.3
		Periapical granuloma (1)	1	100.0	0	0.0
	Periapical granuloma (10)	Chronic abscess (2)	0	0.0	0	0.0
		Periapical granuloma (6)	0	0.0	2	33.3
		Radicular cyst (2)	0	0.0	1	50.0

Table 8 gives the association of clinical, radiological and histological diagnosis with radiological resorption. There were 99 cases of abscess diagnosed clinically. Out of these, 2 cases were diagnosed with apical periodontitis on radiology, and on histology one case each showed chronic abscess and chronic inflammation respectively. One case of abscess showed moderate resorption, while the other case of inflammation showed severe resorption. There were 90 cases of periapical abscess as diagnosed radiologically. Among these, 27 were diagnosed with chronic abscess histologically, 52 were diagnosed with chronic inflammation, 4 with periapical granuloma and 7 with radicular cyst. Out of 27, 18 (66.7%) cases showed sever resorption, while 7 (25.9%) showed moderate and 2 (7.4%) showed absence of resorption. Out of 52 cases of chronic inflammation, 22 (42.3%) showed severe resorption, 21 (40.4%) showed moderate, while 9 (17.3%) showed no resorption. The severe resorption was observed in 3 (75%) cases of periapical granuloma, while 6 (85.7%) cases of radicular cyst showed severe resorption. There were 7 cases of periapical granuloma on radiology, out of which 1 case was diagnosed as chronic abscess, 3 as chronic inflammation, 2 as periapical granuloma, and 1 as radicular cyst on histology. One case each of abscess, periapical granuloma and radicular cyst showed severe resorption.

There were 75 cases of apical periodontitis diagnosed clinically. Among these, on radiology, 50 cases had same diagnosis. On histology, 5 showed chronic abscess while 45 showed chronic inflammation. Out of 5 cases of abscess, 3 (60%) showed moderate resorption and 2 (40%) showed severe. Out of 45 cases of inflammation, 29 (64.4%) showed moderate resorption, while 8 (17.8%) each showed severe and no resorption. There were 23 cases of periapical abscess on radiology, out of which 5

showed chronic abscess on histology and among these, 2 (40%) showed moderate, while 3 (60%) showed severe resorption. There were 17 cases of inflammation, among which 11 (64.7%) had moderate resorption, 5 (29.4%) had no resorption and only 1 (5.9%) had severe. There were 2 cases of periapical granuloma on radiology and one showed moderate, while other showed severe resorption.

There were 16 cases of periapical granuloma on clinical diagnosis. Out of these, 1 case was radiologically diagnosed as apical periodontitis showing severe resorption. There were 5 cases with periapical abscess on radiology out of which one case each showed chronic abscess and periapical granuloma on histology. The abscess case showed severe resorption, while the other case showed no resorption. Out of 3 chronic inflammation cases, 2 (66.7%) showed absence of resorption, while 1 (33.3%) showed moderate resorption. Out of 10 cases of periapical granuloma on radiology, 2 showed chronic abscess on histology and both showed severe resorption. There were 6 cases of periapical granuloma on histology and 4 (66.7%) showed severe resorption, while 2 (33.3%) showed moderate. The 2 cases of radicular cyst also showed moderate and severe resorption each.

Table 9: Association of clinical and radiologic diagnosis with clinical resorption

Clinical Diagnosis	Radiologic Diagnosis	Clinical resorption			
		Absent		Present	
		No.	%	No.	%
Abscess (99)	Apical periodontitis (2)	1	50.0	1	50.0
	Periapical abscess (90)	51	56.7	39	43.3
	Periapical granuloma (7)	3	42.8	4	57.1
Apical periodontitis (75)	Apical periodontitis (50)	44	88.0	6	12.0
	Periapical abscess (23)	16	69.6	7	30.4
	Periapical granuloma (2)	0	0.0	2	100.0
Periapical granuloma (16)	Apical periodontitis (1)	1	100.0	0	0.0
	Periapical abscess (5)	3	60.0	2	40.0
	Periapical granuloma (10)	0	0.0	10	100

Table 9 shows the association of clinical, radiological diagnosis with clinical resorption. There were 99 cases of abscess diagnosed clinically. Out of these, 2 cases were diagnosed with apical periodontitis on radiology, and one showed clinical resorption. There were 90 cases of periapical abscess as diagnosed radiologically. Among these, 39 (43.3%) showed clinical resorption. Out of 7 cases of periapical granuloma, 4 (57.1%) showed clinical resorption.

There were 75 cases of apical periodontitis diagnosed clinically. Among these, on radiology, 50 cases had same diagnosis and 6 (12%) showed clinical resorption. There were 23 cases of periapical abscess on radiology and 7 (30.4%) showed clinical resorption. There were 2 cases of periapical granuloma and both showed clinical resorption.

There were 16 cases of periapical granuloma on clinical diagnosis. Out of these, 1 case was radiologically diagnosed as apical periodontitis without clinical resorption. There were 5 cases with periapical abscess on radiology out of which 2 (40%) showed clinical resorption. All the 10 cases of periapical granuloma on radiology showed clinical resorption.

Table 10: Association of clinical and radiologic diagnosis with radiologic resorption

Clinical Diagnosis	Radiologic Diagnosis	Radiologic resorption					
		No		Moderate		Severe	
		No.	%	No.	%	No.	%
Abscess (99)	Apical periodontitis (2)	0	0.0	1	50.0	1	50.0
	Periapical abscess (90)	11	12.2	30	33.3	49	54.4
	Periapical granuloma (7)	1	14.3	3	42.8	3	42.8
Apical periodontitis (75)	Apical periodontitis (50)	8	16.0	32	64.0	10	20.0
	Periapical abscess (23)	5	21.7	14	60.8	4	17.4
	Periapical granuloma (2)	0	0.0	1	50.0	1	50.0
Periapical granuloma (16)	Apical periodontitis (1)	0	0.0	1	100.0	0	0.0
	Periapical abscess (5)	3	60.0	1	20.0	1	20.0
	Periapical granuloma (10)	0	0.0	3	30.0	7	70.0

Table 10 shows the association of clinical, radiological diagnosis with radiological resorption. There were 99 cases of abscess diagnosed clinically. Out of these, 2 cases were diagnosed with apical periodontitis on radiology, and one case each showed moderate and severe resorption. There were 90 cases of periapical abscess as diagnosed radiologically. Among these, 49 (54.4%) showed sever resorption, 30 (33.3%) showed moderate, while 11 (12.2%) showed no resorption. Out of 7 cases of periapical granuloma, 3 (42.8%) cases each showed moderate and severe resorption.

There were 75 cases of apical periodontitis diagnosed clinically. Among these, on radiology, 50 cases had same diagnosis and 32 (64%) showed moderate resorption, while 10 (20%) showed severe and 8 (16%) showed absence of resorption. There were 23 cases of periapical abscess on radiology and 14 (60.8%) showed moderate

resorption, 4 (17.4%) severe, while 5 (21.7%) showed no resorption. There were 2 cases of periapical granuloma and one case each showed moderate and severe resorption.

There were 16 cases of periapical granuloma on clinical diagnosis. Out of these, 1 case was radiologically diagnosed as apical periodontitis and showed moderate resorption. There were 5 cases with periapical abscess on radiology out of which one case each showed moderate and severe resorption, while 3 (60%) showed no resorption. Out of 10 cases of periapical granuloma on radiology, 7 (70%) showed severe resorption, while 3 (30%) showed moderate resorption.

Table 11: Association of clinical and histologic diagnosis with clinical resorption

Clinical Diagnosis	Histologic Diagnosis	Clinical resorption			
		Absent		Present	
		No.		No.	
Abscess (99)	Chronic abscess (29)	0	0.0	29	100.0
	Chronic inflammation (56)	55	98.2	1	1.8
	Periapical granuloma (6)	0	0.0	6	100.0
	Radicular cyst (8)	0	0.0	8	100.0
Apical periodontitis (75)	Chronic abscess (10)	1	10.0	9	90.0
	Chronic inflammation (62)	59	95.2	3	4.8
	Periapical granuloma (1)	0	0.0	1	100.0
	Radicular cyst (2)	0	0.0	2	100.0
Periapical granuloma (16)	Chronic abscess (3)	0	0.0	3	100.0
	Chronic inflammation (4)	4	100.0	0	0.0
	Periapical granuloma (7)	0	0.0	7	100.0
	Radicular cyst (2)	0	0.0	2	100.0

Table 11 shows the association of clinical, histological diagnosis with clinical resorption. There were 99 cases of abscess diagnosed clinically. Out of these, 29 cases were diagnosed with chronic abscess on histology, and all showed clinical resorption. There were 56 cases of chronic inflammation as diagnosed on histology and only 1 (1.8%) showed clinical resorption. All the 6 periapical granuloma and 8 radicular cyst cases showed presence of clinical resorption.

There were 75 cases of apical periodontitis diagnosed clinically. Among these, on histology, 10 cases showed clinical abscess and out of which 9 (90%) showed

presence of clinical resorption. Out of 62 cases of chronic inflammation, only 3 (4.8%) showed clinical resorption. One case of periapical granuloma and 2 cases of radicular cyst showed clinical resorption.

There were 16 cases of periapical granuloma on clinical diagnosis. Out of these, 3 cases showed chronic abscess on histology and all showed clinical resorption. There were 4 cases of chronic inflammation and none showed clinical resorption. All the 7 periapical granuloma and 2 radicular cyst cases showed clinical resorption.

Table 12: Association of clinical and histologic diagnosis with radiologic resorption

Clinical Diagnosis	Histologic Diagnosis	Radiologic resorption					
		No		Moderate		Severe	
		No.		No.		No.	
Abscess (99)	Chronic abscess (29)	2	6.9	8	27.6	19	65.5
	Chronic inflammation (56)	10	17.8	23	41.1	23	41.1
	Periapical granuloma (6)	0	0.0	2	33.3	4	66.7
	Radicular cyst (8)	0	0.0	1	12.5	7	87.5
Apical periodontitis (75)	Chronic abscess (10)	0	0.0	5	50.0	5	50.0
	Chronic inflammation (62)	13	20.9	40	64.5	9	14.5
	Periapical granuloma (1)	0	0.0	1	100.0	0	0.0
	Radicular cyst (2)	0	0.0	1	50.0	1	50.0
Periapical granuloma (16)	Chronic abscess (3)	0	0.0	0	0.0	3	100.0
	Chronic inflammation (4)	2	50.0	2	50.0	0	0.0
	Periapical granuloma (7)	1	14.3	2	28.6	4	57.1
	Radicular cyst (2)	0	0.0	1	50.0	1	50.0

Table 12 shows the association of clinical, histological diagnosis with radiologic resorption. There were 99 cases of abscess diagnosed clinically. Out of these, 29 cases were diagnosed with chronic abscess on histology, and 19 (65.5%) showed severe resorption, while 8 (27.6%) showed moderate. There were 56 cases of chronic inflammation as diagnosed on histology and only 23 (41.1%) cases each showed moderate and severe resorption, while 10 (17.8%) had no resorption. Out of 6

periapical granuloma cases, 4 (66.7%) showed severe, while 2 (33.3%) showed moderate resorption. Out of 8 radicular cyst cases, 7 (87.5%) showed severe resorption, while 1 (12.5%) showed moderate.

There were 75 cases of apical periodontitis diagnosed clinically. Among these, on histology, 10 cases showed clinical abscess and out of which 5 (50%) cases each showed moderate and severe resorption. Out of 62 cases of chronic inflammation, 40 (64.5%) showed moderate resorption, 9 (14.5%) showed severe, while 13 (20.9%) had no resorption. One case periapical granuloma showed moderate, while 2 cases of radicular cyst showed moderate and severe resorption each.

There were 16 cases of periapical granuloma on clinical diagnosis. Out of these, 3 cases showed chronic abscess on histology and all showed sever resorption. There were 4 cases of chronic inflammation and 2 (50%) showed moderate resorption. Out of 7 cases of periapical granuloma, 4 (57.1%) showed severe resorption, 2 (28.6%) showed moderate, while 1 (14.3%) no resorption. Out of 2 radicular cyst cases, one case each showed moderate and severe resorption.

Table 13: Association of radiologic and histologic diagnosis with clinical resorption

Radiologic Diagnosis	Histologic Diagnosis	Clinical resorption			
		Absent		Present	
		No.		No.	
Apical periodontitis (53)	Chronic abscess (6)	1	16.7	5	83.3
	Chronic inflammation (47)	45	95.7	2	4.3
Periapical abscess (118)	Chronic abscess (33)	0	0.0	33	100.0
	Chronic inflammation (72)	70	97.2	2	2.8
	Periapical granuloma (5)	0	0.0	5	100.0
	Radicular cyst (8)	0	0.0	8	100.0
Periapical granuloma (19)	Chronic abscess (3)	0	0.0	3	100.0
	Chronic inflammation (3)	3	100.0	0	0.0
	Periapical granuloma (9)	0	0.0	9	100.0
	Radicular cyst (4)	0	0.0	4	100.0

Table 13 shows the association of radiological and histological diagnosis with clinical resorption. There were 53 cases of apical periodontitis diagnosed radiologically. Out of these, 6 cases were diagnosed with chronic abscess on histology, and 5 (83.3%) of these showed clinical resorption. There were 47 cases of chronic inflammation as diagnosed on histology and only 2 (4.3%) showed clinical resorption.

There were 118 cases of periapical abscess diagnosed radiologically. Among these, on histology, 33 cases showed clinical abscess and all showed clinical resorption. Out of 72 cases of chronic inflammation, only 2 (2.8%) showed clinical resorption. All 5 cases of periapical granuloma and 8 cases of radicular cyst showed clinical resorption.

There were 19 cases of periapical granuloma on radiological diagnosis. Out of these, 3 cases showed chronic abscess on histology and all showed clinical resorption.

There were 9 cases of periapical granuloma and 4 cases of radicular cyst and all showed clinical resorption.

Table 14: Association of radiologic and histologic diagnosis with radiologic resorption

Radiologic Diagnosis	Histologic Diagnosis	Radiologic resorption					
		No		Moderate		Severe	
		No.		No.		No.	
Apical periodontitis (53)	Chronic abscess (6)	0	0.0	4	66.7	2	33.3
	Chronic inflammation (47)	8	17.0	30	63.8	9	19.1
Periapical abscess (118)	Chronic abscess (33)	2	6.1	9	27.3	22	66.7
	Chronic inflammation (72)	16	22.2	33	45.8	23	31.9
	Periapical granuloma (5)	1	20.0	1	20.0	3	60.0
	Radicular cyst (8)	0	0.0	2	25.0	6	75.0
Periapical granuloma (19)	Chronic abscess (3)	0	0.0	0	0.0	3	100.0
	Chronic inflammation (3)	1	33.3	2	66.7	0	0.0
	Periapical granuloma (9)	0	0.0	4	44.4	5	55.6
	Radicular cyst (4)	0	0.0	1	25.0	3	75.0

Table 14 shows the association of radiological and histological diagnosis with radiological resorption. There were 53 cases of apical periodontitis diagnosed radiologically. Out of these, 6 cases were diagnosed with chronic abscess on histology, and 4 (66.7%) of these showed moderate resorption, while 2 (33.3%) showed severe resorption. There were 47 cases of chronic inflammation as diagnosed on histology, out of which 30 (63.8%) showed moderate resorption, 9 (19.1%) showed severe and 8 (17%) showed no resorption.

There were 118 cases of periapical abscess diagnosed radiologically. Among these, on histology, 33 cases showed clinical abscess and 22 (66.7%) showed severe resorption, 9 (27.3%) showed moderate and 2 (6.1%) showed no resorption. Out of 72 cases of chronic inflammation, 33 (45.8%) showed moderate, 23 (31.9%) showed severe, while 16 (22.2%) showed no resorption. Out of 5 cases of periapical granuloma, 3 (60%) showed severe and one case each showed moderate and no resorption. Out of 8 cases of radicular cyst, 6 (75%) showed severe resorption and 2 showed moderate.

There were 19 cases of periapical granuloma on radiological diagnosis. Out of these, 3 cases showed chronic abscess on histology and all showed severe resorption. There were 3 cases of chronic inflammation and 2 out of these showed moderate resorption. There were 9 cases of periapical granuloma and 5 (55.6%) showed severe, while 4 (44.4%) showed moderate resorption. Out of 4 cases of radicular cyst, 3 (75%) showed severe, while 1 (25%) showed moderate resorption.

Table 15: Agreement between experts on radiological resorption

Expert 1	Expert 2	Expert 3	Numbers
No	No	No	5
No	No	Moderate	20
No	No	Severe	3
No	Moderate	No	15
No	Moderate	Moderate	1
Moderate	Moderate	Moderate	48
Moderate	Moderate	Severe	21
Severe	Severe	No	4
Severe	Severe	Moderate	28
Severe	Severe	Severe	45

Table 15: shows the frequencies indicating agreement between three experts on radiological resorption. There were 5 cases for which Expert 1 opined 'No' resorption, Expert 2 and 3 also opined 'No' resorption. There were 20 cases for which Expert 1 opined 'No' resorption, Expert 2 also opined 'No' resorption, while Expert 3 opined 'Moderate' resorption. There were 3 cases for which Expert 1 opined 'No' resorption, Expert 2 also opined 'No' resorption, while Expert 3 opined 'Severe' resorption. Likewise, the interpretation holds for remaining cells of the table.

Accordingly, the extent of agreement between three experts was judged using Fleiss kappa coefficient. The analysis resulted into a value of 0.463 suggesting fair agreement among experts and the coefficient was significantly different than zero as indicated by a p-value < 0.0001.

Statistical Methods

The data on demographic parameter age was summarized in terms of mean, standard deviation and median. Also, frequency and percentage were obtained for various age categories. The other demographic parameter sex was also summarized in terms of frequency and percentage. The radiological resorption status was given by three experts for each patient in terms of 'No', 'Moderate' and 'Severe'. The final impression about resorption was determined based on two out of three criteria. The distribution of patients as per resorption in three clinical diagnosis categories was tested for statistical significance of difference using Pearson's chi-square test. On similar lines, the distribution of patients in radiological and histological categories was tested for significance using Pearson's chi-square test. Further, the cross tables were obtained for the combinations of clinical, radiological and histological diagnosis with clinical and radiological resorption. The agreement between the three experts on radiological resorption was obtained using Fleiss kappa coefficient.

The analyses were performed using SPSS ver 20.0 (IBM Corp USA) and R-3.4.3 programming tool and the statistical significance was tested at 5% level.

The formulations used in the study are as below:

If $x_1, x_2, \ldots x_n$ are the observations on random variable X, then

A. **Sample mean** for a set of observations is given by

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

B. Standard deviation for a set of observations in given by

$$s = \sqrt{\frac{1}{(n-1)}\sum_{i=1}^{n}(x_i - \bar{x})^2}$$

where x_i = observation on each object

n = number of objects

C. Median: It is the middle value of a set of values when arranged in the increasing order of magnitude.

D. Pearson's Chi-square test

Let *X* and *Y* be two variables under study with *r* and *s* levels respectively; and the data on $r \times s$ levels be in the form of counts. Let the null hypothesis be that the two variables are independent. That is, knowing the levels of *X* does not help in predicting the levels of *Y*; against the alternative hypothesis that the two factors are not independent. That is, knowing the level of *X* can help in predicting levels of *Y*. To decide about the acceptance of hypothesis, the Chi-square test statistic is used which is defined as:

$$\chi^2 = \sum_{i=1}^{r}\sum_{j=1}^{s}\frac{(O_{ij} - E_{ij})^2}{E_{ij}}$$

where O_{ij} is the observed frequency count for i^{th} level of variable *X* and j^{th} level of variable *Y*. E_{ij} is the expected frequency count for same cell. The expected count is given by

$$E_{ij} = \frac{n_i \times n_j}{n}$$

where n_i and n_j are the total counts for i^{th} level of variable X and j^{th} level of variable Y; and n is the total count. The calculated Chi-square value is compared with the tabulated one for $(r-1)\times(s-1)$ degrees of freedom. If the corresponding p-value is smaller than the pre-decided significance level, say 0.05, then we reject the null hypothesis and accept the alternative one. If the p-value is more than 0.05, then we accept null hypothesis.

E. FLIESS Kappa Coefficient

Let there be n subjects (i=1,2,…n), k evaluation categories (j=1,2,…,k) and xij be the number of judges that assign category j to subject i. then

$$\sum_{j=1}^{k} x_{ij} = m \text{ and } \sum_{i=1}^{n}\sum_{j=1}^{k} x_{ij} = mn$$

The proportion of pairs of experts that agree in their evaluation on subject i is given by:

$$p_i = \frac{\sum_{j=1}^{k} x_{ij}^2 - m}{m(m-1)}$$

And the mean of p_i is given by

$$p_a = \frac{1}{mn(m-1)}\left[\sum_{i=1}^{n}\sum_{j=1}^{k} x_{ij}^2 - mn\right]$$

The measure for the error term is

$$p_\varepsilon = \sum_{j=1}^{k} q_j^2 \text{ where } q_j = \frac{1}{mn}\sum_{i=1}^{n} x_{ij}$$

Thus, the Fleiss kappa coefficient is given by

$$k = \frac{p_a - p_\varepsilon}{1 - p_\varepsilon}$$

DISCUSSION

Apical root resorption is a clinical condition, that is associated with physiological or pathological process resulting in the loss of mineralized tissues such as dentin, cementum and alveolar bone.

The mineralized tissues located at the inner surfaces of the root canal are protected by the pre-dentin and the odontoblast layer, while the tissues at the outer surfaces are protected by the pre-cementum, cementoblasts and periodontal ligament. Such barriers avoid resorption of these tissues in normal conditions. However, the mineralization of some of these structures, as well as the dislodgment and/or damage

of the pre-cementum due periapical pathologies, traumatic injuries, pressure/mechanical stimulation, neoplastic conditions, systemic disorders and idiopathic, can induce resorption of the denuded tissues by allowing their colonization by multinuclear cells.

Root resorption is an asymptomatic clinical condition, detected in radiographic examinations targeted for other clinical situations, being the most important diagnostic tool for that condition. Additionally, the chances to treat and maintain the affected tooth become minimal when diagnosis occur late. As apical root resorption is one of the most common phenomenon seen in periapical pathologies, diagnosing it earlier along with the periapical pathologies will not only help in enhancing the treatment but also help in prognosis.

Hence, in this study an attempt was made to evaluate & assess the efficacy and accuracy of digital intraoral periapical radiographs in determining the apical root resorption (ARR) associated with periapical pathologies. RVG images of 190 patients with the inclusion criteria and inflammatory periapical pathologies like periapical cysts, periapical granuloma, periapical abscesses were included in the study and were evaluated for the presence or absence of resorption in the apical area of the root. Extracted teeth were examined for clinical resorption and compared to RVG images for the same.

Among 190 patients with periapical pathologies, in the 18-35 years category, there were maximum 42 (51.8%) cases with abscess, followed by 32 (39.5%) cases with apical periodontitis. Whereas, in the age group of 36-55 years category, there were 53 (52.5%) cases with abscess, while 39 (38.6%) cases with apical periodontitis

and 9 (8.9%) cases with periapical granuloma and in the > 55 years category, there were 4 (50%) cases with apical periodontitis and abscess each.(Table 1a) From the above, it was concluded that maximum periapical pathologies were in the age group of 36-55 years, which was in accordance with the study by **Ghadebo SO et al,**[28] where the patients analysed for periapical pathologies were in the age of 17 to 57 years with the mean age of 32 ± 11.7 years.

Maximum number of cases in the 18-35 years category showed moderate 35 (43.2%) to severe 34 (41.9%) type of resorption and 12 (14.8%) cases showed no resorption. Similarly, in the 36-55 years category, only 15 (14.8%) had no resorption and the rest had moderate 47 (46.5%) to severe 39 (38.6%). In the > 55 years category, there were 4 (50%) cases with moderate resorption, while 3 (37.5%) had severe resorption and 1 (12.5%) had no resorption, suggesting that there were maximum cases of severe resorption in the age category of 36-55 years followed by cases of moderate resorption in the age category of 18-35 years. Which means that, in all groups, most of the patients showed moderate to severe resorption. Literature suggests that, the periodontal membrane becomes less vascular, aplastic, and narrow and the bone more dense, avascular, and aplastic. With advancing age, these changes are reflected as higher susceptibility to root resorption in adults. Along with this, many resorbed lacunae and fewer repair zones are reported in an adult population that leads to root resorption.[44] But in the present study, since similar pattern of resorption was seen in all the groups, the probable cause could be the periapical inflammatory lesions rather than the physiological causes of ageing. Similar findings have been presented by by **Lim Xin Wei et al**[1]**,** who found that apical root resorption with

periapical pathologies was higher in young age followed by middle age followed by old age.

Similarly, study by **Fayaz Alam et al** [33], maximum radiographs with periapical pathologies examined for apical root resorption were in the age group of 18-35 years (young age), followed by 36-55 years (middle age) followed by > 55 years (old age).

In males, there were maximum 48 (48.9%) cases with abscess, followed by 39 (39.8%) cases with apical periodontitis and 11 (11.2%) with periapical granuloma. In females, there were 51 (55.4%) cases with abscess, while 36 (39.1%) cases with apical periodontitis and 5 (5.4%) cases with periapical granuloma. The association between gender and type of clinical diagnosis was statistically insignificant (Table 2a). Similarly, in a study by **Ghadebo SO et al,**[28] where the patients analysed for periapical pathologies had equal male to female ratio. Whereas, in a study by **Fayaz Alam et al** [33], maximum radiographs with periapical pathologies examined for apical root resorption were male.

The number of cases according to type of resorption in each sex, i.e., in males there were maximum 43 (43.8%) cases with moderate resorption, followed by 36 (36.7%) cases with severe and 19 (19.4%) with no resorption. Whereas, in females, there were 43 (46.7%) cases with moderate resorption, while 40 (43.5%) cases with severe and 9 (9.7%) cases with no resorption. The association between age and type of root resorption was statistically insignificant (Table 2b). Similarly, in a review by **Neeta Aryal et al**[10, 34] **along with other studies,** suggested that gender do not have

role in root resorption. Thus male and female have equal chance for the root resorption.

The signs and symptoms that were considered for diagnosis of periapical lesions were; history of pulpal pain, presence of pain at the time of examination, sensitivity to percussion, presence of intraoral or extraoral swelling, sensitivity to hot and cold fluids, grossly decayed tooth and root pieces. In the present study, there were 75 cases clinically diagnosed as apical periodontitis, out of which, 47 (62.67%) showed moderate resorption, followed by 15 (20%) with severe resorption and 13 (17.33%) with no resorption. There were 99 cases diagnosed with acute and chronic abscess and among which, 53 (53.54%) showed severe resorption, 34 (34.34%) showed moderate and 12 (12.12%) showed no resorption. There were 16 cases of periapical granuloma, out of which 8 (50%) showed severe resorption, 5 (31.25%) had moderate while 3 (18.75%) had no resorption. Overall, there were 86 (45.26%) cases with moderate resorption, followed by 76 (40%) with severe and 28 (14.74%) with no resorption. Most of the cases clinically diagnosed were abscess and also the overall proportion of severe resorption significantly higher in abscess as compared to other diagnosis categories (Table 3). This finding was in accordance with the study by **Fayaz Alam et al** [33]**,** in which, apical root resorption was also higher in periapical abscess (51.78%) followed by periapical cyst and granuloma (37.63%) and apical periodontitis (20.40%). Whereas, in a study done by **Lim Xin Wei et al**[1]**,** apical root resorption was higher in periapical granuloma and cyst (72.8%) followed by periapical abscess (35%) and apical periodontitis (18.1%) which was statistically significant.

The diagnosis of apical root resorption is usually based on some measurement of radiographic difference. Radiographically, apical root resorption appears as radiolucency on the external surface of the dentin with or without shortening of the root depending upon the severity of resorption. In the present study, the teeth with periapical radiolucencies were examined for the presence or absence of resorption in the apical area of the root using the RVG tools, according to following criteria[1]:

- If there is intact outline of root surface with uniform density in root contour then there is **no resorption.**
- If there is presence of blurred irregularities on the apical root contour with less radio dense areas then there is **moderate resorption.**
- If there is presence of distinct radiolucent indentations or shortening of root tip then there is **severe resorption**.

Anuj Bhattacharya et al [7]**,** evaluated the accuracy of diagnosing periapical lesions through conventional radiography and digital radiography technique and found that digital images had a slight advantage in diagnostic value according to the sensitivity and specificity when compared to conventional radiography. Whereas, **Patel et al**[23]**,** compared the accuracy of digital intraoral radiography and cone beam computed tomography to detect simulated external inflammatory root resorption lesions, from which they concluded that, CBCT provides a reliable and valid method of detecting artificially created external inflammatory root resorption defects. However, they also concluded that the intraoral digital radiography resulted in acceptable level of accuracy in diagnosis of resorption. Therefore, in the present study intraoral digital radiography was selected.

Association of clinical and radiological diagnosis showed that, there were 99 cases clinically diagnosed as abscess, out of which, 90 cases were also diagnosed as periapical abscess radiologically. Similarly, out of 75 cases of apical periodontitis diagnosed clinically, 50 cases had same diagnosis on radiographs and 16 cases of clinically diagnosed periapical granuloma, had 10 cases with the same radiologic diagnosis. This points to the fact that digital intraoral periapical radiograph's were accurate in determining the periapical apical pathologies. Among radiologically diagnosed cases of abscess, 49 (54.4%) showed severe resorption, 75 cases of apical periodontitis, 32 (64%) showed moderate resorption and 10 cases of periapical granuloma, 7 (70%) showed severe resorption, suggesting that most of the cases diagnosed as abscess and granuloma, clinically and radiographically had severe resorption while cases diagnosed as apical periodontitis had moderate resorption. (Table 10). Similar to the present study, **Fayaz Alam et al** [33]**,** also found apical root resorption higher in periapical abscess (51.78%) followed by periapical cyst and granuloma (37.63%) and apical periodontitis (20.40%) which was statistically significant. Contrary to this, study by **Lim Xin Wei et al**[1]**,** in their study found that apical root resorption was higher in periapical granuloma and cyst (72.8%) followed by periapical abscess (35%) and apical periodontitis (18.1%). It also, suggested that results of previous studies cannot be compared with the present study because the authors[6 13 14 16] reported high prevalence of apical root resorptions developing after orthodontic treatment or after tooth replantations.

In the present study, periapical tissues of the teeth with periapical pathologies were examined histologically, to determine and correlate the periapical pathology

associated with the extracted tooth specimen. The periapical lesions were classified as[8]:

- Periapical granuloma: Lesions predominantly infiltrated by lymphocytes, plasma cells and macrophages, with or without epithelial remnants and covered by a capsule of collagen fibres. In these lesions, neutrophils were sparse forming no abscess microcavities or concentrated infiltrates.
- Periapical abscess: Lesions with a distinct collection of neutrophils in the interior of a previously existent granuloma.
- Periapical cyst: Lesions with a layer of stratified squamous epithelium along a surface of sufficient quantity of conjunctive tissue to indicate a delineated cavity and surrounded by a capsule.
- Chronic inflammation: Presence of inflammatory cells only.

Histologically, out of 190 cases, there were 99 cases clinically diagnosed abscess. Out of which, 29 cases were histologically diagnosed as chronic abscess, 56 cases as chronic inflammation, 6 as periapical granuloma and 8 as radicular cyst. Also, there were 75 cases of apical periodontitis diagnosed clinically. Among these, on histology, 10 cases showed clinical abscess, 62 cases of chronic inflammation, one case of periapical granuloma and 2 cases of radicular cyst. 16 cases, which was clinically diagnosed as of periapical granuloma showed 3 cases of chronic abscess, 4 cases of chronic inflammation, 7 periapical granuloma and 2 radicular cyst. (Table 11 & 12).

Association of clinical, radiological and histological diagnosis along with radiological resorption showed that, there were 99 cases of abscess diagnosed clinically, out of which, 90 cases were diagnosed as periapical abscess radiographically. Among these, 27 were diagnosed with chronic abscess histologically, 52 were diagnosed with chronic inflammation, 4 with periapical granuloma and 7 with radicular cyst. Out of 27, 18 (66.7%) cases showed sever resorption, while 7 (25.9%) showed moderate and 2 (7.4%) showed absence of resorption. Out of 52 cases of chronic inflammation, 22 (42.3%) showed severe resorption, 21 (40.4%) showed moderate, while 9 (17.3%) showed no resorption. Similarly, there were 75 cases of apical periodontitis diagnosed clinically, among which, on radiology, 50 cases had same diagnosis. On histology, 5 showed chronic abscess while 45 showed chronic inflammation. Out of 45 cases of inflammation, 29 (64.4%) showed moderate resorption, while 8 (17.8%) each showed severe and no resorption. There were 16 cases of periapical granuloma on clinical diagnosis, out of which only 10 radiographically came out to be granuloma. From the 10 cases of periapical granuloma diagnosed radiologically, 2 showed chronic abscess, 6 cases of periapical granuloma and 2 radicular cyst histologically. (Table 7&8). Association of clinical, histological diagnosis showed that there were 99 cases of abscess diagnosed clinically and radiologically also 90 cases were diagnosed as abscess, but histologically most of the cases (52) came out to be of chronic inflammation. Similarly, out of 75 cases of apical periodontitis diagnosed clinically and radiographically maximum cases (50) came out to be with the same diagnosis, but 62 cases came out to be chronic inflammation histologically. Variation in the diagnosis may be because histological classification of periapical pathologies varies

according to the different authors but all of them share same phenomenon i.e., inflammation and most of the cases were histologically diagnosed as chronic inflammation on the basis of presence of inflammatory cells only, which is not suggestive of proper a histological diagnosis. So, as most of the cases in the present study had same clinical and radiological diagnosis but histologically, it showed inflammation only, it is concluded that digital intraoral periapical radiograph's is accurate in determining and confirming the periapical pathologies, even without doing the histological examination of periapical tissue. (Table 11 & 12)

Literature suggested that, digital intraoral periapical radiography is preferred as diagnostic tool for evaluation apical root resorption.[1,10,23,50] In the present study also, there were 71 cases showing presence of resorption by clinical method, out of which maximum i.e. 44 (61.97%) showed severe radiological resorption, 24 (33.8%) with moderate resorption and 3 (4.23%) with no resorption. i.e, most of the cases (71) showed resorption clinically also came out with severe resorption radiographically. (Table 6). Whereas, **Vânia Portela Ditzel Westphalen et al[20] in their study concluded that** regardless of the size of the simulated external root resorption cavities, the digital radiographic imaging method detected a higher number of cavities compared to the conventional method**. Ahmed M.F. El-Angbawi et al[15]**, in their study concluded that digital radiographs were more accurate method for measuring apical root shortening.

In the present study, the findings of the three researchers were also compared regarding the evaluation of apical root resorption on digital radiographs. And it was judged to be statistically in fair agreement. (Table 15)

From the above findings, it can be concluded that digital intraoral periapical radiograph's is reliable in determining the periapical apical pathologies and apical root resorption, as most of the cases in the present study had same clinical and radiological diagnosis, also on evaluating apical root resorption radiographically, cases which was clinically diagnosed as resorption came out to be moderate and severe resorption.

CONCLUSION

This cross-sectional observational study was carried out on 190 RVG images with periapical pathologies. The study was undertaken with the objectives to assess the efficacy & accuracy of digital intraoral periapical radiograph for the detection of apical root resorption in periapical pathologies and to compare the apical root resorption in different types of periapical pathologies.

The conclusions which can be drawn from our study are,

- The maximum patients affected with periapical pathologies were middle age i.e; in the age range of 36-55 years.

- The association between gender and type of clinical diagnosis was statistically insignificant suggesting that both males and females were equally affected with periapical pathologies.
- Patients clinically diagnosed as periapical abscess, periapical granuloma and apical periodontitis, were also diagnosed similarly on radiographic evaluation suggesting that clinical diagnosis of periapical lesions is comparable to the radiographic diagnosis.
- Most of the cases in the present study had same clinical and radiographical diagnosis but histologically, it showed chronic inflammation on the basis of presence of inflammatory cells only, which is not suggestive of proper a histological diagnosis. Hence, it can concluded that digital intraoral periapical radiograph's is accurate in determining and confirming the periapical pathologies, even without doing the histological examination of periapical tissue
- Maximum patients clinically showing apical root resorption also showed moderate and severe root resorption on radiographic evaluation.
- Hence, on radiographic examination, digital intraoral periapical radiograph were found to be accurate in determining the periapical apical pathologies and apical root resorption, as most of the cases in the present study had same clinical and radiological diagnosis along with presence apical root resorption clinically and radiographically.
- Also, there was fair agreement among the three observers in evaluating apical root resorption radiographically in periapical pathologies.

LIMITATIONS

- The sample in the study is limited to 190 patients. Larger sample size would be desirable so as to substantiate the results.

- Also, digital radiographs have limitations for the accurate diagnosis of external root resorption, especially when manifested as small defects located on the buccal or lingual surfaces.

FUTURE PROSPECTIVE

- Future research should be carried out in large sample size.
- In the present study, apical root resorption was determined in periapical pathologies by using digital intraoral radiography. However, various studies reported high accuracy level in determining the apical root resorption in periapical pathologies by using newer technologies like CBCT and scanning electron microscope. Thus, in future these newer technologies can be taken into consideration so as to detect apical root resorption in various periapical pathologies.

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ANNEXURE I
CASE HISTORY PROFORMA

ASSESSMENT OF DIGITAL INTRAORAL PERIAPICAL RADIOGRAPH FOR THE DETECTION OF APICAL ROOT RESORPTION IN INFLAMMATORY PERIAPICAL PATHOLOGIES: A RADIOVISIOGRAPHY STUDY.

Registration No: Date:

Name: Age/Sex:

Address:

Religion: Contact No:

Education: Illiterate / Literate

Marital status: Occupation:

Economic status: low/ moderate / high

Chief complaint:

History of present illness:

Medical history:

H/O major illness

H/O allergy

Current medical treatment if any -

Past dental history:

Family history:

Addiction habits:

Intraoral examination

Hard tissue examination

Teeth present

Occlusion

Attrition

Erosion

Abrasion

Caries

Tenderness

Root pieces

Fracture

Restored teeth

Stains/ calculus

Prosthesis

Soft tissue examination

Buccal mucosa

Labial mucosa

Palate (hard/ soft)

Retromolar area

Vestibule

Gingiva

Provisional diagnosis:

Investigations:

Radiographic examination:

	1st observer	**2nd observer**	**3rd observer**
No resorption:			
Moderate resorption:			
Severe resorption:			

Clinical examination of tooth specimen after extraction:

Apical root resorption: Present / Absent

Histopathological examination:

No pathologic features/ Periapical cysts/ Periapical granuloma/ Abscesses/ Others**.**

ANNEXURE II

INFORMED CONSENT FORM

ASSESSMENT OF DIGITAL INTRAORAL PERIAPICAL RADIOGRAPH FOR THE DETECTION OF APICAL ROOT RESORPTION IN INFLAMMATORY PERIAPICAL PATHOLOGIES- A RADIOVISIOGRAPHY STUDY.

Patients I.D:

I, Mr./Master/Mrs./Miss.______________________________ Resident of: ______________________________ aged _____ years, exercising my free will/choice, without any pressure/lure of incentive in any form, hereby give my consent/consent on behalf of patient named Mr./Master/Mrs./Miss. ______________________________ Resident of: ______________________aged _____ years, as his/her ____________________.

I acknowledge that doctor has informed me about this research project suitably and sufficiently to my satisfaction. I agree to let my X-rays, photographs, impressions and other investigations to be taken as required. I agree to take part in this project and will not mix any other projects during the period of this trial. I shall report to the dental hospital or other place where called on given appointment dates and time. I shall inform the doctor on any adverse effects or unusual symptoms noticed by me. I shall co-operate with the doctors and paramedical staff, in all respects. I permit to publishing the results of my participation in this study. I shall not be given any reimbursement or compensation. I have been informed of my right to opt out of this research project at any time without giving any reason for doing so.

I hereby record my consent for participation in the said trial.

1.	______________________	______________________	________	______
	Patient's Name	Signature/Thumb Print	Date	Time
OR	______________________	______________________	________	______
	Name of the person Providing consent	Signature/Thumb Print	Date	Time
2.	______________________	______________________	________	______
	Witness' Name	Signature/Thumb Print	Date	Time
3.	______________________	______________________	________	______
	Investigators Name	Signature/Thumb Print	Date	Time

वैयक्तिक जाणकारी

ASSESSMENT OF DIGITAL INTRAORAL PERIAPICAL RADIOGRAPH FOR THE DETECTION OF APICAL ROOT RESORPTION IN INFLAMMATORY PERIAPICAL PATHOLOGIES- A RADIOVISIOGRAPHY STUDY.

मरीज का नाम :

उमर / लिंग :

पत्ता :

मोबाईल नंबर :

मैं मानता हू कि चिकित्सक ने मुझे इस शोध परियोजना के बरे मी उपयुक्त और पर्याप्त रूप से मेरी संतुष्टी के बारे में बताया है. मै अपने एक्स रे, फोटो, इंप्रेशन और अन्य जांचो को जरुरी रूप में लेणे के लिये सहमत हू. मै इस परियोजना में भाग लेणे के लिये सहमत हूं और इस परीक्षण कि अवधिके दौरान किसी भी अन्य परियोजनाओ को मिला नही करेगा. मैं सभी मामलो में डॉक्टर और पेरामेडिकल स्टाफ के साथ मिलकर काम करुंगा. मैं इस अध्ययन में अपनी भागीदारी के परिणामोको प्रकाशित करणे कि अनुमती देता हूं. मुझे कोई प्रतीपूर्ती या क्षतीपूर्ती नही दि जायेगी. मुझे ऐसा करणे के लिये किसी भी कारण के बिना किसी भी समय इस शोधपरीयोजनासे ऑप्टआऊट करणे का मेरे अधिकार के बरे में सूचित किया गया है. मैं एतद्वारा परीक्षण में भाग लेणे के लिये मेरी सहमती रिकॉर्ड करता हूं.

मरीज का नाम	सही	तारीख	समय
साक्षीदार	सही	तारीख	समय
डॉक्टर का नाम	सही	तारीख	समय

ASSESSMENT OF DIGITAL INTRAORAL PERIAPICAL RADIOGRAPH FOR THE DETECTION OF APICAL ROOT RESORPTION IN INFLAMMATORY PERIAPICAL PATHOLOGIES- A RADIOVISIOGRAPHY STUDY.

वैयक्तीक माहिती

रूग्णाचे नाव : दिनांक :
वय/लिंग :
पत्ता :

मोबाईल नंबर :

मी कबूल करतो की डॉक्टरांनी मला या संशोधन प्रकल्पाबद्दल समाधानकारक माहिती दिली आहे. मी माझ्या एक्स-रे, छायाचित्रे, इंप्रेशन आणि आवश्यकतेनुसार अन्य तपासण्या करण्यास सहमत आहे. मी या प्रकल्पात भाग घेण्यास सहमती देतो आणि या चाचणीच्या कालावधीत कोणतेही अन्य प्रकल्प एकत्रित करणार नाही. मला डेन्टल हॉस्पिटल किंवा इतर ठिकाणी दिलेल्या भेटीची तारीख आणि वेळ सांगितली आहे. मी डॉक्टर आणि पॅरामेडिकल कर्मचा-यांना सर्व बाबतीत सहकार्य करेल. या अभ्यासात मी माझ्या सहभागाचे निकाल प्रकाशित करण्यास परवानगी देतो. मला कोणतीही नुकसान भरपाई दिली जाणार नाही. असे करण्यासाठी कोणतेही कारण न देता मला कोणत्याही वेळी या संशोधन प्रकल्पातून बाहेर पडण्याचा अधिकार मिळालेला आहे. मी या अन्वये केलेल्या चाचणीत सहभागासाठी माझी संमती नोंदवित आहे.

__________	__________	__________	__________
१) रूग्णाचे नाव	स्वाक्षरी	तारीख	वेळ
__________	__________	__________	__________
२) साक्षीदाराचे नाव	स्वाक्षरी	तारीख	वेळ
__________	__________	__________	__________
३) डॉक्टरचे नाव	स्वाक्षरी	तारीख	वेळ

ANNEXURE III
LIST OF ABBREVIATIONS

ARR	:	Apical root resorption
AIRR	:	Apical inflammatory root resorption
CR	:	Conventional radiographs
DDR	:	Direct Digital Radiography
RVG	:	Radiovisiography
cm	:	Centimetre
mm	:	Millimetre
kV	:	Kilovolts
mA	:	Miliamperes
P Value	:	Probability value
SD	:	Standard deviation
RANK	:	Receptor activator of nuclear factor kappa.
RANKL	:	Receptor activator of nuclear factor kappa l ligand.
OPG	:	Osteoprotegerin
CCD	:	Charge-coupled device
PSP	:	Photo-stimulable phosphor
SEM	:	Scanning electron microscopy
IRR	:	Internal root resorption
IIR	:	Internal inflammatory resorption
ERR	:	External root resorption
EIR	:	External inflammatory resorption lesions (EIR) lesions
OPG	:	Orthopantomogram

CBCT	:	Cone beam computed tomography
2D	:	Two dimensional
3D	:	Three dimensional
CT	:	Computed tomography
ROC	:	Receiver operating characteristic
NPVs	:	Negative predictive value
PPVs	:	Positive predictive value
DDI	:	Direct digital imaging
CBCTPAI	:	Cone-beam computed tomography periapical Index.
PA	:	Periapical Radiograph
IOPA	:	Intra-oral periapical radiograph

MASTER CHART

S.no.	Age	Sex	Clinical diagnosis	Clinical diagnosis	Radiographic	No resorption_obs1	Moderate resorption_obs1	Severe resorption_obs1	Obs1	No resorption_obs2	Moderate resorption_obs2	Severe resorption_obs2	Obs2	No resorption_obs3	Moderate resorption_obs3	Severe resorption_obs3	Obs3	RESORPTION	Apical root absorption	Histologic diagnosis
1	34	Male	Acute periapical abscess	Abscess	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
2	44	Male	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Periapical granuloma
3	38	Female	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	1	0	Moderate	0	1	0	Moderate	1	0	0	No	Moderate	Absent	Chronic inflammation
4	29	Female	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
5	42	Male	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Chronic abscess
6	32	Female	Acute periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	0	0	No	Severe	Absent	Chronic inflammation
7	28	Female	Acute periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Absent	Chronic inflammation
8	44	Female	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	1	0	Moderate	Severe	Absent	Chronic inflammation
9	52	Female	Chronic apical periodontitis	Periapical granuloma	Periapical granuloma	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Periapical granuloma
10	29	Male	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	1	0	Moderate	Severe	Absent	Chronic inflammation
11	37	Male	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	0	1	Severe	0	0	1	Severe	0	1	0	Moderate	Severe	Absent	Chronic inflammation
12	32	Female	Acute periapical abscess	Abscess	Periapical abscess	1	0	0	No	1	0	0	No	0	0	1	Severe	No	Present	Chronic abscess
13	39	Female	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Radicular cyst
14	29	Female	Acute apical periodontitis	Apical peridontitis	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
15	44	Female	Acute apical periodontitis	Apical peridontitis	Periapical abscess	1	0	0	No	1	0	0	No	0	1	0	Moderate	No	Absent	Chronic inflammation
16	32	Male	Chronic apical periodontitis	Periapical granuloma	Periapical granuloma	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Periapical granuloma
17	42	Male	Acute periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Chronic abscess
18	52	Male	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Radicular cyst
19	41	Male	Acute periapical abscess	Abscess	Periapical abscess	1	0	0	No	1	0	0	No	0	1	0	Moderate	No	Absent	Chronic inflammation
20	27	Male	Chronic periapical abscess	Abscess	Periapical abscess	1	0	0	No	1	0	0	No	0	1	0	Moderate	No	Absent	Chronic inflammation
21	44	Male	Chronic apical periodontitis	Periapical granuloma	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
22	52	Female	Chronic periapical abscess	Abscess	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
23	32	Male	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Chronic abscess
24	38	Male	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
25	28	Male	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
26	42	Male	Acute apical periodontitis	Apical peridontitis	Periapical abscess	1	0	0	No	1	0	0	No	0	1	0	Moderate	No	Absent	Chronic inflammation
27	36	Male	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	1	0	Moderate	Severe	Absent	Chronic inflammation
28	42	Female	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Chronic abscess

29	37	Female	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Chronic abscess
30	34	Female	Acute apical periodontitis	Apical peridontitis	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	0	0	1	Severe	Moderate	Present	Radicular cyst
31	29	Male	Chronic periapical abscess	Abscess	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
32	44	Female	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
33	49	Male	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	1	0	0	No	1	0	0	No	1	0	0	No	No	Absent	Chronic inflammation
34	32	Male	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	1	0	Moderate	Severe	Absent	Chronic inflammation
35	39	Female	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	1	0	0	No	1	0	0	No	0	1	0	Moderate	No	Absent	Chronic inflammation
36	29	Female	Acute apical periodontitis	Apical peridontitis	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Chronic abscess
37	22	Female	Chronic periapical abscess	Abscess	Periapical granuloma	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Periapical granuloma
38	32	Male	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Chronic abscess
39	37	Female	Acute apical periodontitis	Apical peridontitis	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
40	42	Male	Acute apical periodontitis	Apical peridontitis	Periapical abscess	1	0	0	No	1	0	0	No	0	1	0	Moderate	No	Absent	Chronic inflammation
41	53	Female	Chronic periapical abscess	Abscess	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
42	29	Female	Acute apical periodontitis	Apical peridontitis	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Chronic abscess
43	32	Male	Chronic periapical abscess	Abscess	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	0	0	1	Severe	Moderate	Absent	Chronic inflammation
44	38	Female	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Chronic abscess
45	43	Male	Chronic periapical abscess	Abscess	Periapical granuloma	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Radicular cyst
46	33	Male	Acute periapical abscess	Abscess	Periapical granuloma	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
47	37	Male	Chronic periapical abscess	Abscess	Periapical abscess	1	0	0	No	1	0	0	No	0	1	0	Moderate	No	Absent	Chronic inflammation
48	43	Female	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
49	48	Male	Chronic apical periodontitis	Periapical granuloma	Periapical abscess	1	0	0	No	1	0	0	No	1	0	0	No	No	Absent	Chronic inflammation
50	34	Male	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Chronic abscess
51	39	Female	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	1	0	Moderate	0	1	0	Moderate	1	0	0	No	Moderate	Absent	Chronic inflammation
52	29	Male	Chronic periapical abscess	Abscess	Periapical abscess	1	0	0	No	1	0	0	No	0	1	0	Moderate	No	Absent	Chronic inflammation
53	44	Male	Chronic periapical abscess	Abscess	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
54	40	Male	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	1	0	Moderate	Severe	Absent	Chronic inflammation
55	38	Male	Chronic periapical abscess	Abscess	Periapical granuloma	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
56	34	Male	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	1	0	0	No	1	0	0	No	0	1	0	Moderate	No	Absent	Chronic inflammation
57	33	Male	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Chronic abscess
58	47	Male	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
59	42	Female	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Chronic abscess
60	34	Male	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Radicular cyst
61	29	Male	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	1	0	Moderate	0	1	0	Moderate	1	0	0	No	Moderate	Absent	Chronic inflammation
62	35	Male	Chronic periapical abscess	Abscess	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
63	39	Female	Chronic periapical abscess	Abscess	Periapical abscess	1	0	0	No	1	0	0	No	0	1	0	Moderate	Moderate	Absent	Chronic inflammation

64	44	Male	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	1	0	Moderate	0	1	0	Moderate	1	0	0	No	No	Absent	Chronic inflammation
65	33	Female	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Chronic abscess
66	28	Male	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Chronic abscess
67	34	Female	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Chronic abscess
68	45	Male	Chronic periapical abscess	Abscess	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	1	0	0	No	Moderate	Absent	Chronic inflammation
69	52	Male	Chronic periapical abscess	Abscess	Periapical abscess	1	0	0	No	1	0	0	No	0	1	0	Moderate	No	Absent	Chronic inflammation
70	34	Female	Chronic periapical abscess	Abscess	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
71	27	Male	Chronic periapical abscess	Abscess	Periapical abscess	1	0	0	No	1	0	0	No	0	1	0	Moderate	No	Absent	Chronic inflammation
72	53	Female	Chronic periapical abscess	Abscess	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	0	0	1	Severe	Moderate	Present	Chronic abscess
73	44	Male	Chronic periapical abscess	Abscess	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	0	0	1	Severe	Moderate	Present	Chronic abscess
74	49	Male	Chronic periapical abscess	Abscess	Periapical abscess	1	0	0	No	1	0	0	No	0	1	0	Moderate	No	Absent	Chronic inflammation
75	35	Male	Chronic periapical abscess	Abscess	Periapical abscess	1	0	0	No	1	0	0	No	0	1	0	Moderate	No	Absent	Chronic inflammation
76	29	Female	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	0	1	Severe	0	0	1	Severe	1	0	0	No	Severe	Absent	Chronic inflammation
77	37	Male	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	1	0	0	No	Severe	Absent	Chronic inflammation
78	62	Male	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	1	0	Moderate	Severe	Absent	Chronic inflammation
79	35	Male	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Chronic abscess
80	52	Male	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	1	0	Moderate	0	1	0	Moderate	0	0	0		Moderate	Present	Chronic abscess
81	44	Male	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	0	1	Severe	0	0	1	Severe	0	1	0	Moderate	Severe	Absent	Chronic inflammation
82	29	Female	Chronic periapical abscess	Abscess	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	0	0	1	Severe	Moderate	Present	Chronic abscess
83	38	Female	Chronic periapical abscess	Abscess	Periapical granuloma	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Chronic abscess
84	66	Female	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Chronic abscess
85	29	Female	Chronic periapical abscess	Abscess	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
86	43	Male	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	1	0	Moderate	0	1	0	Moderate	1	0	0	No	Moderate	Absent	Chronic inflammation
87	30	Male	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	1	0	Moderate	Severe	Absent	Chronic inflammation
88	48	Female	Chronic periapical abscess	Abscess	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	0	0	1	Severe	Moderate	Present	Chronic abscess
89	33	Female	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	1	0	0	No	1	0	0	No	0	1	0	Moderate	No	Absent	Chronic inflammation
90	62	Female	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	1	0	0	No	1	0	0	No	0	1	0	Moderate	No	Absent	Chronic inflammation
91	28	Male	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Absent	Chronic inflammation
92	35	Male	Chronic apical periodontitis	Periapical granuloma	Periapical granuloma	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Periapical granuloma
93	54	Female	Acute apical periodontitis	Apical peridontitis	Periapical granuloma	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Radicular cyst
94	44	Male	Chronic periapical abscess	Abscess	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	0	0	1	Severe	Moderate	Present	Chronic abscess
95	34	Female	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	1	0	Moderate	0	1	0	Moderate	1	0	0	No	Moderate	Absent	Chronic inflammation
96	39	Female	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
97	32	Female	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
98	38	Female	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation

99	43	Male	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
100	28	Female	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	1	0	Moderate	0	1	0	Moderate	1	0	0	No	Moderate	Absent	Chronic inflammation
101	43	Female	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	1	0	Moderate	0	1	0	Moderate	1	0	0	No	Moderate	Absent	Chronic inflammation
102	51	Male	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
103	22	Female	Acute apical periodontitis	Apical peridontitis	Periapical abscess	1	0	0	No	1	0	0	No	0	1	0	Moderate	No	Absent	Chronic inflammation
104	43	Female	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	0	1	Severe	0	0	1	Severe	0	1	0	Moderate	Severe	Absent	Chronic inflammation
105	45	Female	Chronic apical periodontitis	Periapical granuloma	Periapical granuloma	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Chronic abscess
106	37	Female	Chronic apical periodontitis	Periapical granuloma	Periapical granuloma	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Periapical granuloma
107	45	Female	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	1	0	Moderate	0	1	0	Moderate	0	0	1	Severe	Moderate	Absent	Chronic abscess
108	48	Male	Acute apical periodontitis	Apical peridontitis	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	1	0	Moderate	Severe	Absent	Chronic inflammation
109	33	Female	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Chronic abscess
110	34	Female	Chronic periapical abscess	Abscess	Apical periodontitis	0	1	0	Moderate	0	1	0	Moderate	0	0	1	Severe	Moderate	Present	Chronic abscess
111	29	Male	Acute apical periodontitis	Apical peridontitis	Periapical abscess	1	0	0	No	1	0	0	No	0	1	0	Moderate	No	Absent	Chronic inflammation
112	26	Male	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
113	54	Male	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	1	0	Moderate	Severe	Absent	Chronic inflammation
114	44	Female	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	1	0	Moderate	Severe	Absent	Chronic inflammation
115	34	Female	Acute apical periodontitis	Apical peridontitis	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	0	0	1	Severe	Moderate	Present	Chronic abscess
116	32	Male	Chronic periapical abscess	Abscess	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	0	0	1	Severe	Moderate	Present	Radicular cyst
117	36	Female	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	1	0	Moderate	Severe	Absent	Chronic inflammation
118	38	Female	Acute apical periodontitis	Apical peridontitis	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
119	43	Male	Chronic apical periodontitis	Periapical granuloma	Periapical granuloma	0	1	0	Moderate	0	1	0	Moderate	0	0	1	Severe	Moderate	Present	Radicular cyst
120	38	Male	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	1	0	Moderate	0	1	0	Moderate	0	0	0		Moderate	Absent	Chronic inflammation
121	33	Male	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	0	1	Severe	0	0	1	Severe	0	1	0	Moderate	Severe	Absent	Chronic inflammation
122	28	Male	Chronic apical periodontitis	Periapical granuloma	Periapical granuloma	0	1	0	Moderate	0	1	0	Moderate	0	0	1	Severe	Moderate	Present	Periapical granuloma
123	65	Female	Chronic periapical abscess	Abscess	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	1	0	0	No	Moderate	Absent	Chronic inflammation
124	24	Female	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	1	0	0	No	Severe	Absent	Chronic inflammation
125	37	Female	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Periapical granuloma
126	44	Female	Chronic periapical abscess	Abscess	Periapical granuloma	0	1	0	Moderate	0	1	0	Moderate	0	0	1	Severe	Moderate	Present	Periapical granuloma
127	48	Male	Chronic apical periodontitis	Periapical granuloma	Periapical abscess	1	0	0	No	1	0	0	No	1	0	0	No	No	Absent	Chronic inflammation
128	37	Male	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
129	34	Male	Acute periapical abscess	Abscess	Periapical abscess	0	0	0		0	0	0		0	1	0	Moderate	Moderate	Absent	Chronic inflammation
130	29	Male	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	1	0	0	No	1	0	0	No	1	0	0	No	No	Absent	Chronic inflammation
131	54	Female	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	1	0	Moderate	0	1	0	Moderate	1	0	0	No	Moderate	Absent	Chronic inflammation
132	34	Male	Acute apical periodontitis	Apical peridontitis	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
133	27	Female	Acute apical periodontitis	Apical peridontitis	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation

134	44	Female	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Chronic abscess
135	54	Male	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Chronic abscess
136	25	Female	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	1	0	Moderate	0	1	0	Moderate	0	0	0		Moderate	Absent	Chronic inflammation
137	34	Male	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	1	0	Moderate	Severe	Absent	Chronic inflammation
138	27	Female	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	1	0	Moderate	Severe	Absent	Chronic inflammation
139	45	Female	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Chronic abscess
140	29	Female	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	1	0	Moderate	0	1	0	Moderate	0	0	1	Severe	Moderate	Present	Chronic abscess
141	34	Male	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	1	0	Moderate	Severe	Absent	Chronic inflammation
142	44	Male	Acute periapical abscess	Abscess	Periapical abscess	1	0	0	No	1	0	0	No	0	1	0	Moderate	No	Absent	Chronic inflammation
143	38	Female	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Present	Chronic inflammation
144	49	Female	Acute periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Periapical granuloma
145	35	Male	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	1	0	Moderate	0	1	0	Moderate	1	0	0	No	Moderate	Absent	Chronic inflammation
146	29	Female	Chronic apical periodontitis	Periapical granuloma	Periapical granuloma	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Chronic abscess
147	48	Female	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	1	0	Moderate	Severe	Absent	Chronic inflammation
148	45	Female	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	1	0	Moderate	0	1	0	Moderate	1	0	0	No	Moderate	Absent	Chronic inflammation
149	38	Female	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	1	0	0	No	1	0	0	No	0	1	0	Moderate	No	Absent	Chronic inflammation
150	37	Male	Chronic apical periodontitis	Periapical granuloma	Periapical granuloma	0	1	0	Moderate	0	1	0	Moderate	0	0	1	Severe	Moderate	Present	Periapical granuloma
151	33	Male	Chronic apical periodontitis	Periapical granuloma	Periapical granuloma	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Radicular cyst
152	45	Female	Acute periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	1	0	Moderate	Severe	Present	Chronic abscess
153	56	Female	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
154	46	Male	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
155	34	Female	Chronic periapical abscess	Abscess	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
156	45	Male	Acute periapical abscess	Abscess	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
157	37	Female	Chronic periapical abscess	Abscess	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	0	0	1	Severe	Moderate	Present	Periapical granuloma
158	30	Male	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	0	1	Severe	0	0	1	Severe	0	1	0	Moderate	Severe	Absent	Chronic inflammation
159	45	Male	Acute apical periodontitis	Apical peridontitis	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
160	54	Male	Chronic periapical abscess	Abscess	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	0	0	1	Severe	Moderate	Present	Chronic abscess
161	34	Female	Acute periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	1	0	Moderate	Severe	Absent	Chronic inflammation
162	45	Female	Acute periapical abscess	Abscess	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	1	0	0	No	Moderate	Absent	Chronic inflammation
163	30	Female	Chronic periapical abscess	Abscess	Periapical granuloma	1	0	0	No	1	0	0	No	1	0	0	No	No	Absent	Chronic inflammation
164	33	Male	Chronic apical periodontitis	Periapical granuloma	Periapical abscess	1	0	0	No	1	0	0	No	0	0	1	Severe	No	Present	Periapical granuloma
165	45	Female	Chronic periapical abscess	Abscess	Apical periodontitis	0	0	1	Severe	0	0	1	Severe	0	1	0	Moderate	Severe	Absent	Chronic inflammation
166	28	Female	Acute apical periodontitis	Apical peridontitis	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	0	0	1	Severe	Moderate	Present	Chronic abscess
167	34	Female	Acute periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Radicular cyst
168	36	Female	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	1	0	Moderate	Severe	Absent	Chronic inflammation

169	56	Male	Acute apical periodontitis	Apical peridontitis	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
170	45	Male	Acute apical periodontitis	Apical peridontitis	Periapical granuloma	0	1	0	Moderate	0	1	0	Moderate	0	0	1	Severe	Moderate	Present	Periapical granuloma
171	34	Female	Chronic apical periodontitis	Periapical granuloma	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Chronic abscess
172	49	Female	Acute periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Radicular cyst
173	45	Male	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	1	0	Moderate	Severe	Absent	Chronic inflammation
174	34	Male	Acute periapical abscess	Abscess	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
175	38	Male	Acute apical periodontitis	Apical peridontitis	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
176	29	Female	Chronic periapical abscess	Abscess	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
177	56	Male	Chronic periapical abscess	Abscess	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	0	0	1	Severe	Moderate	Present	Chronic abscess
178	57	Male	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	0	1	Severe	0	0	1	Severe	0	1	0	Moderate	Severe	Absent	Chronic inflammation
179	45	Male	Acute apical periodontitis	Apical peridontitis	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Present	Chronic inflammation
180	39	Male	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Present	Chronic inflammation
181	39	Female	Chronic periapical abscess	Abscess	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	1	0	0	No	Moderate	Present	Chronic inflammation
182	45	Female	Chronic periapical abscess	Abscess	Periapical abscess	1	0	0	No	1	0	0	No	0	0	1	Severe	No	Present	Chronic abscess
183	45	Male	Acute apical periodontitis	Apical peridontitis	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Chronic abscess
184	33	Female	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	0	1	Severe	Severe	Present	Radicular cyst
185	39	Male	Chronic periapical abscess	Abscess	Periapical abscess	0	0	1	Severe	0	0	1	Severe	0	1	0	Moderate	Severe	Absent	Chronic inflammation
186	32	Male	Acute apical periodontitis	Apical peridontitis	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
187	34	Female	Chronic periapical abscess	Abscess	Periapical abscess	0	1	0	Moderate	0	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
188	32	Male	Acute apical periodontitis	Apical peridontitis	Apical periodontitis	0	1	0	Moderate	0	1	0	Moderate	1	1	0	Moderate	Moderate	Absent	Chronic inflammation
189	34	Female	Acute apical periodontitis	Apical peridontitis	Periapical abscess	1	0	0	No	1	1	0	Moderate	0	1	0	Moderate	Moderate	Absent	Chronic inflammation
190	39	Male	Chronic apical periodontitis	Periapical granuloma	Apical periodontitis	0	1	0	Moderate	0	1	0	Moderate	0	0	0		Moderate	Absent	Chronic inflammation