Type of manuscript: *Original study*

Prevalence and Assessment of Periapical Lesions in Subjects Reporting to a Private Teaching Hospital, Chennai,India : A Retrospective Study

Chris Noel Timothy[1], Pratibha Ramani[2]

[1]*Research Associate, Dental Research Cell,* [2]*Professor & Head of department, Department of oral pathology,* [3]*Reader, Department of prosthodontics, Saveetha Dental College & Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, India*

Abstract

Apical or periapical lesions are inflammatory processes which are generally caused by microorganisms or their by-products and manifest due to defense response of the host to the stimulus in the root canal system. The aim of this study was to assess prevalence of periapical lesions among the south indian population. This was a descriptive study, where the data of the patients who reported to the dental clinics in saveetha dental college, SIMATS, Chennai, India, was obtained from the department of conservative dentistry and endodontics. Data was further analyzed, recorded in microsoft excel software and was subjected to statistical analysis. n = 15 for periapical lesions. From the data analysed through SPSS, it is observed that the prevalence of periapical lesions among non - vital teeth among the outpatients in the department of oral pathology is 1.1%. The age group of 60 - 70 years was the most commonly observed (60%). Male predilection was noted (67%). Radiographic examination was performed for 40% and histopathological examination was performed for 6.7% of the teeth with periapical lesions. 100% of the teeth observed in the current study were non - vital. Periapical abscess was the most common finding (53.3%). Occurring mostly in anterior maxillary, anterior mandibular and posterior mandibular regions (26.7%) each. The most commonly observed treatment modality was extraction (73.7%). Within the limitations of the current study , there exists increased prevalence of periapical pathology above 60 years, predominantly in the age group of 60 - 70 years, primarily reported in the undergraduate clinics. Routine dental checkup with both radiographic and histopathological examination of the periapical lesions is essential for the survival of the tooth and is beneficial for the community.

Keywords: *periapical lesions, histopathology, radiograph, extraction, dental caries, periapical abscess, periapical cyst.*

Introduction

Periapical or apical lesions are a set of chronic inflammatory processes where the causative factor is the presence of microorganisms or their by- products which are present in the periapical tissue .[1,2] The reason for the formation of the lesion is due to the reaction of the host tissue as a defense mechanism against noxious stimulus .[3,4] The formation of the periapical lesions occur frequently with dental caries as a predecessor .[5,6] Preceding the formation of periapical lesions, there commonly occurs the inflammation of the pulp which is known as pulpitis .[7] This pulpitis is of 2 types namely, acute and chronic pulpitis .[8] The common sites at which lesions occur are the apex and surrounding the apex .[9] For radiographic examination, a physician usually

Corresponding author:
Pratibha Ramani
Professor & Head of Department
Department of oral pathology
Saveetha Dental College & Hospitals,
Saveetha Institute of Medical and Technical Sciences,
Saveetha University, Chennai, India
Email Id - pratibaramani@saveetha.com

observes the size of the lesion, location of the lesion, periodontal ligament space widening, lamina dura and bone loss .[10] For the histopathological examination, the most commonly observed features included the cell predominance , type of epithelium present, presence of wall, cavity and blood vessels .[11–13]

Previous literature showed that periapical lesions were the most common inflammatory processes that are chronic in nature which are present in the jaws .[14] It was also found that this process most predominantly affects people in the third to fourth decade of life .[15] In a study conducted by N.A. Luna et al, 2009, it was observed that 79% of the root canal treated teeth presented with a lesion of some kind .[16] Due to lack of proper diagnosis and a wrong treatment decision, the end result is an unresolved condition that persists even after treatment .[17,18] There is presence of a widely held view that most of the periapical lesions, to be exact, almost half of all periapical lesions were thought to be cysts.in a study conducted by Ramachandran. N et al ,1996, found that out of the entire study population, cysts were found to be the least , making up merely 15% of all periapical lesions with radicular cysts being the lowest incidence among cysts thereby proving the previous thought invalid .[19] The major difficulty that was faced by researchers in previous studies was the presence of undefined radiographic characteristics which further affected the clinical validity of the diagnosis .[20]

The requirement of the current study was that there was a presence of a major inconsistency between the clinical findings, radiographic findings and histopathological findings of periapical lesions .[21,22] There was also the absence of certain clinical markers which affected the final diagnosis and treatment adversely .[23–25] This showed that clinical and radiographic findings alone were insufficient for diagnosis and that histopathological examination was of absolute necessity .[26,27] The type of radiograph will also determine the diagnosis. Newer imaging modalities such as cone beam computed tomography (CBCT) and orthopantomogram (OPG) aid in better analysis of the lesion to provide a precise diagnosis .[28] A prompt follow up is also required in order to study the disease progression post treatment .[29] The study will aid dental professionals in understanding the need for histopathology as an essential tool in achieving precise diagnosis which will cause the condition to resolve .[30,31] Thus the aim of the current study was to assess prevalence of periapical lesions among elderly subjects reporting to a private dental college and hospital.

Materials and Methods

The study was designed as a comparative and a descriptive study .[32] where the data of all the patients reporting to saveetha dental college , SIMATS, chennai , India with periapical lesions were obtained from the department of conservative dentistry and endodontics where 86000 patient records were reviewed and analysed between june 2019 and march 2020. This was a university setting and the study was conducted in the dental clinics of saveetha dental college. This setting came with various pros and cons. The pros included the presence of a versatile population and an abundant availability of data.Some of the cons included the study taking place in an unicentred setting and possessing a very limited demographic. The dependent variables in this study included the radiographic markers and histological markers. The independent variables include the age of subject, gender of the subject and the frequency. This was a correlation and association type of analysis. The selection of the study population was performed at random . This population was selected from the patients who visited the undergraduate and postgraduate dental clinics in saveetha dental college. The approval to undertake this research study had been approved by the ethical board of saveetha university (applied). n = 15 cases were reviewed and cross verification was performed by an additional reviewer. The minimisation of sample bias was performed by an additional reviewer, acquiring all the data from within the university and as an additional measure, simple random sampling was performed .[33] There was a presence of high internal and external validity. The data was then arranged in a methodical manner using microsoft excel software and was tabulated on the basis of 8 parameters namely, age , gender, radiograph, histopathology, tooth vitality, clinical diagnosis, site and treatment performed. Data pertaining to presence of non - vital teeth among patients were also assessed to determine the incidence of periapical lesions among these non vital teeth. For the non - vital teeth the age groups of the patients and the site of occurrence were noted. The data was validated by an additional reviewer. Any incomplete or censored

data that was present in the collected data was excluded from the study. Statistical analysis of the compiled data was performed using IBM SPSS statistical analyzer. Chi square test was done for statistical analysis .[10,34,35] The inclusion criteria for this study was outpatients with presence of periapical lesions irrespective of their age or gender. The exclusion criteria included outpatients who did not have the presence of periapical lesions.

Results and Discussion

The total sample size was n = 15 for patients who had periapical lesions. For patients who had non - vital teeth, n = 1310. The prevalence of periapical lesions in the dental clinics was found to be 1.1 %, meaning out of 1310 non vital teeth only 1.1 % of them had the presence of periapical lesions. The mean age group of the study for periapical lesions was found to be 70.5 years with the age group of 60 - 70 years being the most prevalent. Among non vital teeth, the most commonly observed age group was 28 to 48 years.male predilection (67 %) was observed in the case of periapical lesions. Radiographic examination was performed for 40 % and histopathological examination was performed for 6.7 % of the study population. As mentioned previously 100 % of the teeth showing periapical lesions were observed to be non vital. Periapical abscess was the most commonly observed (53.3 %). Occurring most commonly in anterior maxillary, anterior mandibular and posterior mandibular regions with (26.7%) of the population each. Most common site for non vital teeth was found to be the posterior mandible (44.2 %). The most commonly observed treatment modality was extraction which was done for 73.3 % of the cases with periapical lesions whereas in the case of non - vital teeth 100% of the affected teeth underwent root canal treatment.

The treatment choice for periapical lesions may be influenced by a variety of reasons such as the size of lesion, extent of lesion, association to surrounding structures and patient cooperation. There is no set protocol for management of periapical lesions and there is still ongoing debate regarding an ideal protocol which also addresses conservative management of the lesion .[36] Periapical changes occur in concordance to the changes that occur in the pulp over a period of time almost in every case. This does not mean that periapical pathology cannot occur without pulpal pathology, so assessment of the disease process is of absolute necessity .[37] If the disease process is found to be of origin from the pulpal tissues, the microbial infection and cell death could occur not only at the apex but also periapically. This is what dental professionals observe as a radiolucency in the periapical region .[38] Assessment of the patient's history is also essential to rule out the presence of congenital or hereditary factors that may be pertaining to the formation of periapical lesions .[39]

Among all the non - vital teeth the most predominant age group was 28 to 48 years (44.6 %) followed by 8 to 28 years (38.8 %), 48 to 68 years (15.6 %) and 68 to 88 years (0.8 %) . in a recent study by G. Kandemir et al, 2019 it was seen that similarly a younger age group was seen with presence of non vital teeth, with the majority of the vitality loss occurring in the age group of 18 to 40 years .[30] The primary reason for the loss of tooth vitality at a young age is dental caries which could be influenced by a variety of factors such as diet, poor oral hygiene, lack of professional dental treatment .[31,32] When we observed periapical lesions, contrasting results in relation to non vital teeth were observed as the most common age group with presence of periapical lesions was 60 - 70 years (60 %) followed by 70 - 80 years (27 %) and 80 - 90 years (13 %). Periapical were seen in an older study population unlike non vital teeth. In a previous study conducted by Akinyamoju AO et al, 2014, contradicting results were observed, the peak age of incidence was found to be 20 - 30 years .[18] Also in the study conducted by Gbadebo SO et al, 2014 , the peak age of incidence was found to be 32 years .[21] The primary reason for these literature findings could be due to the primary cause of periapical lesions being an endodontic pathology. immune response is increased in a younger age which could induce proinflammatory cytokines which is followed by periapical pathology .[33] The reason for the findings of our study is again dental caries but due to the reduced healing capacity of the body as it ages and its inability to fight infection could be the cause of periapical pathology in older individuals .[34] Thereby the findings of our study were not in concordance with that of literature. -

Among periapical lesions a male predilection was observed constituting 67 % and females constituting 33%. In a study conducted by Enriquez FJ et al, 2015, a female predilection was observed with females

constituting 65 % and males constituting 35 % .[35] Similarly the study conducted by Akinyamoju AO et al, 2014,observed a female predilection with females making up with 51.9 % .[18] Another study by Silva BSF et al, 2017, showed the presence of a male predilection similar to the one observed in the current study .[7] The study conducted by Gbadebo SO et al, 2014 also showed a male predilection with 53 % .[21] The results obtained from literature were varied and this could be due to the difference in study setting, population, clinical condition. Male patients were also found to a greater incidence of periapical abscesses.

Radiographic analysis was performed for 40 % of the study population and was not done for the remaining 60%. Likewise histopathological examination was performed for a mere 6.7 % of the population which further increases the need for the current study to increase awareness regarding the use of histopathology for a spot on diagnosis. In a study performed by Kruse C et al, 2017, radiographic diagnosis was performed for 100 % of the study population and histopathological examination was done for 42% of the population. Reasons for this could be improved methods and techniques for diagnosis, age of the patient, existing condition of the tooth, awareness of the dental professional and patient compliance some of which may have been lacking in the setting of the current study .[48,49]

As mentioned previously all the teeth in the current study were non - vital (100 %). In a study conducted by Kuc et al, 2000, it was found that 93.8 % of the teeth were non vital which is in concordance with the results of the current study .[50] From this we can infer that the vitality of the tooth plays a role in the majority of cases for the formation of periapical lesions .[51]

The most commonly observed lesions were periapical abscesses with 53.3 % followed by periapical cyst with 33.3 % and finally radicular cyst with 13.3 %. Chi square test revealed the distribution to be insignificant. In the studies such as the ones conducted by Akinyamoju AO et al, 2014 and Gbadebo SO et al, 2014 .[18, 21] where the most commonly observed lesions were periapical granulomas and periapical cysts respectively. In another study conducted by Çalışkan MK et al, 2016, the most commonly observed lesions were periradicular granulomas constituting 72 % of the study population .[39] Reason for this inconcordance may have been due to variation in the population and setting but further research is required to correlate race with the type of periapical lesions. More probable reasons may include lack of awareness of the lesion and misdiagnosis.

We also observed the common sites of incidence of both non vital teeth and periapical lesions. In the case of non vital teeth the most common site was the posterior mandible with 44.2 % followed by anterior maxilla (26.8 %), posterior maxilla (22.3 %) and anterior mandible (6.4 %). The reason for this could be due to the increased incidence of dental caries in the posterior region such as that observed in the study conducted by AH Wyne et al, 2008 .[53] Similarly in periapical lesions most common sites were anterior maxillary, anterior mandibular and posterior mandibular regions (26.7%) each the reasons for which could be similar to that of non vital teeth.

The most common treatment modality chosen for periapical lesions in the current study were extraction being done for 73.3 % of the population followed by no treatment for 20 % of the lesions and finally periradicular surgery for 7 % of the population. In a study conducted by Gbadebo SO et al, 2014 [21], it was found that the entire study population had undergone periradicular surgery. The reason for this inconcordance could be due to availability of infrastructure, patient compliance, experience of the dental professional and awareness regarding the treatment of the lesion.

In this study geographic limitation was present where the population was predominantly south indian. Some of the collected data was unclear, incomplete or the reporting parameters were not considered. Another limitation was that the study was a unicentred study taking place only within saveetha dental college, SIMATS, Chennai, India .[54,55] The study could pave the way for new research which will focus on the prevention of periapical lesions and also provide methods for the improved assessment of lesions which will lead to better treatment prognosis. A greater sample size combined with a variety in ethnicity which will yield a better result.

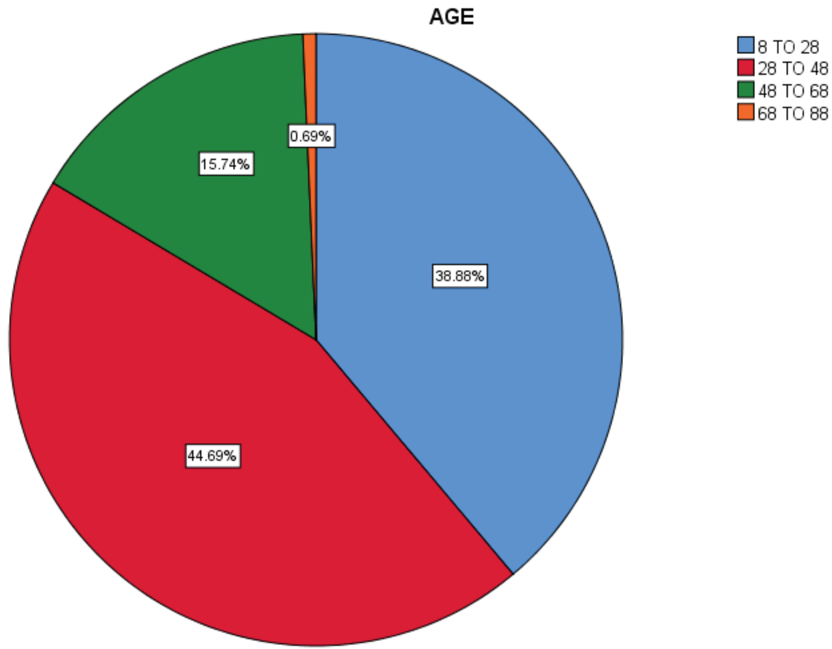

Figure 1 : This pie chart represents the distribution of non-vital teeth among different age groups on a scale of 1 – 100 % where blue colour denotes age group of 8 to 28 years, pink colour denotes age group of 28 to 48 years, green colour denotes age group of 48 to 68 years and orange colour denotes age group of 68 to 88. Most commonly observed age group was 28 to 48 years followed by 8 to 28 years, 48 to 68 years and finally the least commonly observed age group was 68 to 88 years .

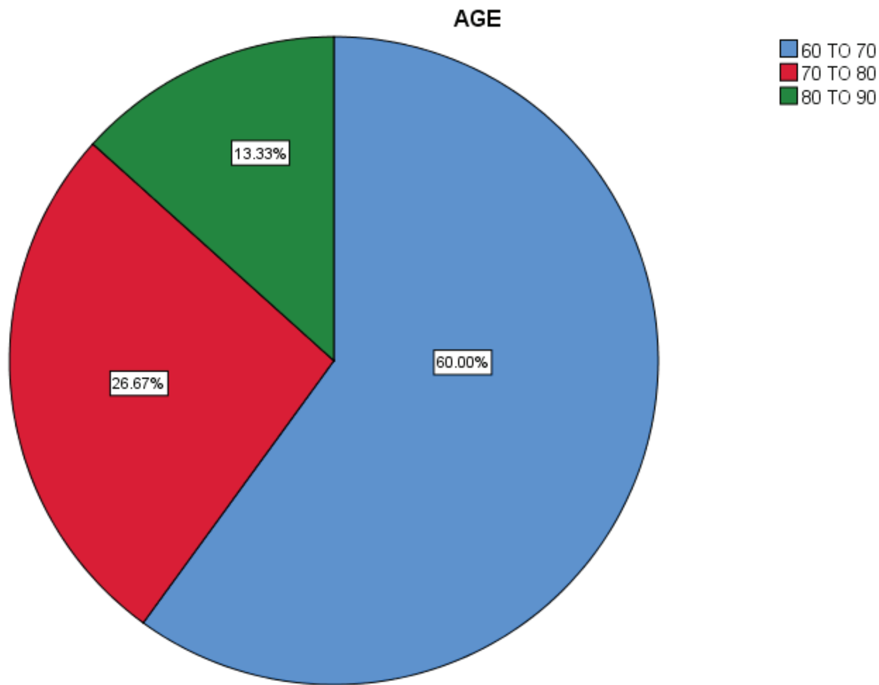

Figure 2 : This pie chart represents the distribution of periapical lesions among different age groups on a scale of 1 – 100 % where blue colour denotes age group of 60 to 70 years, pink colour denotes 70 to 80 years and green colour denotes 80 to 90 years. Most commonly observed age group was 60 to 70 years followed by 70 to 80 years and finally the least commonly observed age group was 80 to 90 years .

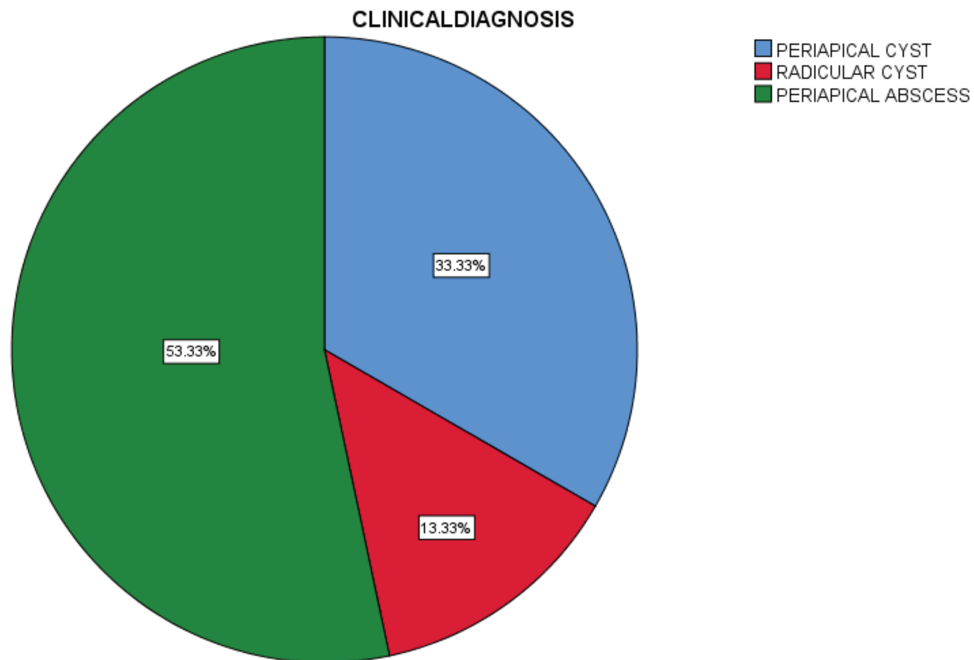

Figure 3 : This pie chart represents the distribution of clinical diagnosis of periapical lesions on a scale of 1 – 100 % where blue colour denotes periapical cyst, red colour denotes radicular cyst and green colour denotes periapical abscess. Most of the lesions were found to be periapical abscesses which is the most common followed by periapical cyst and radicular cyst.

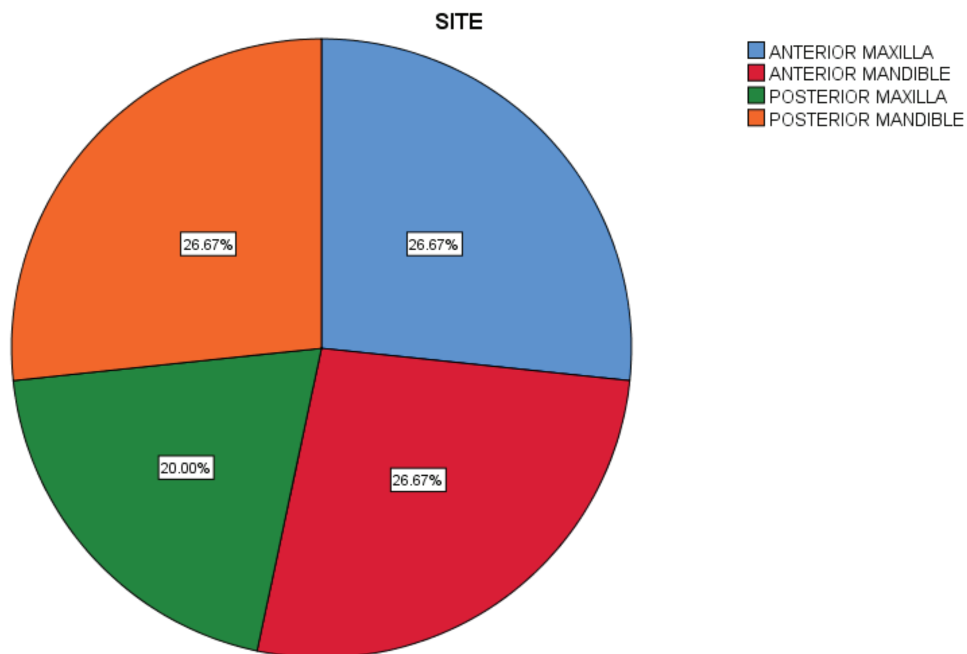

Figure 4 : This pie chart represents the distribution of sites associated with periapical lesions on a scale of 1 – 100 % where blue colour denotes anterior maxilla, red colour denotes anterior mandible, green colour denotes posterior maxilla and orange colour denotes posterior mandible. The most common sites where periapical lesions were observed were the anterior maxilla, anterior mandible and posterior mandible followed by posterior maxilla.

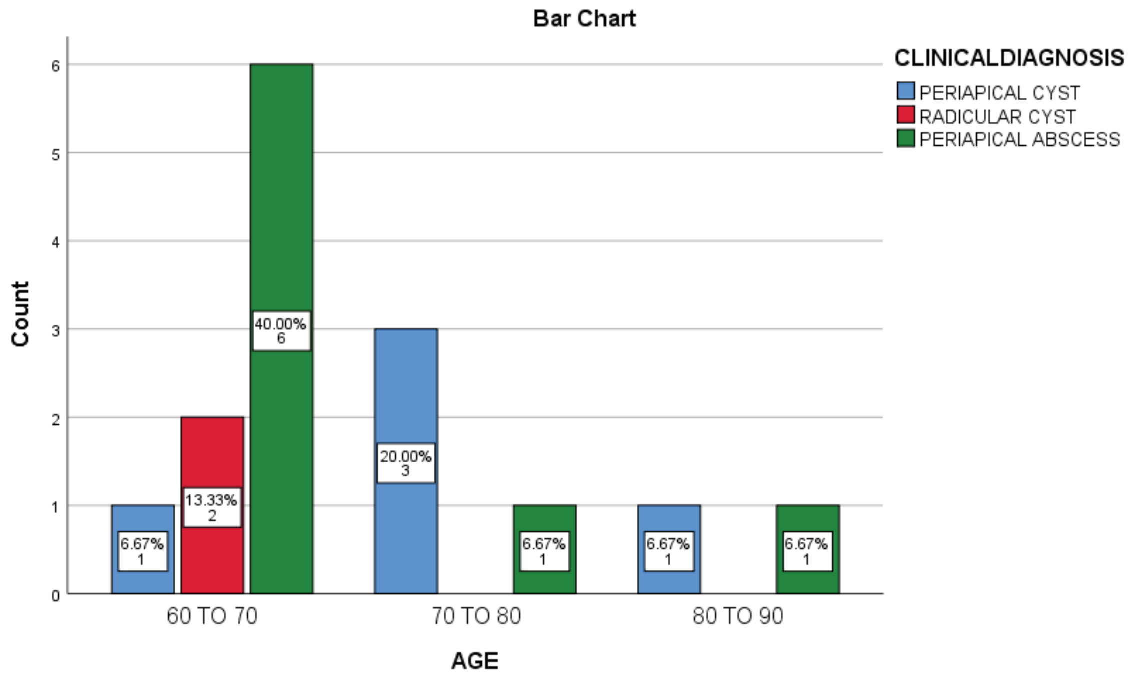

Figure 5.1 : Bar graph showing association of age of the population with the clinical diagnosis of the periapical lesions. X axis represents the age of the population and y axis represents the count and percentage of clinical diagnosis. Periapical abscess was common among 60 to 70 yr old subjects. Chi square test was done and the association was found to be statistically not significant. Pearson's Chi square value: 5.823, DF: 4, p value: 0.213 (>0.05) statistically not significant. Hence there is no age predilection for any particular type of periapical lesion.

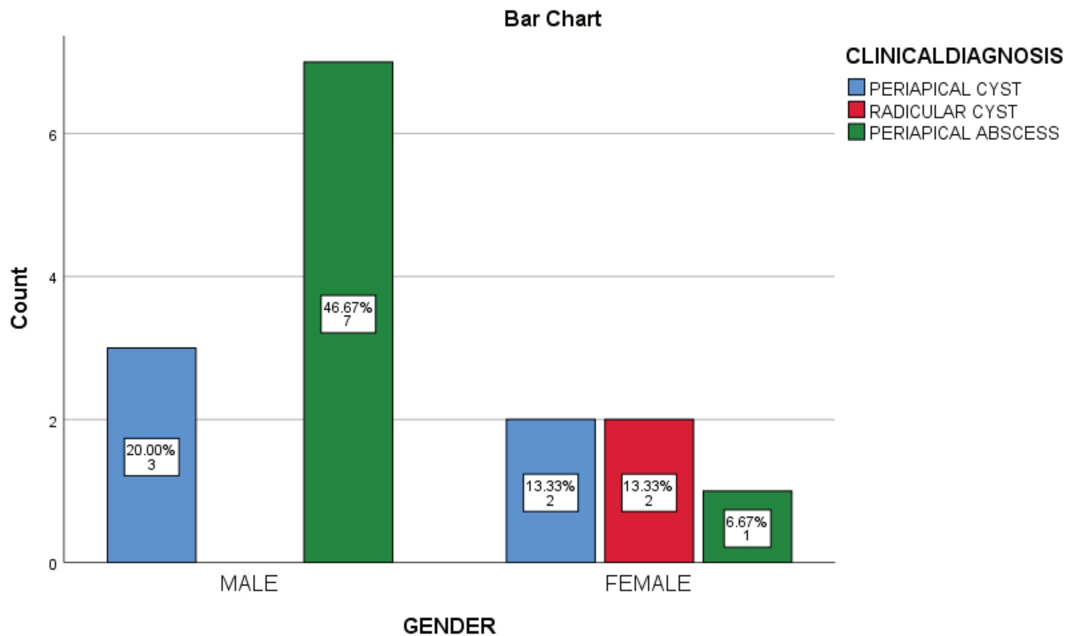

Figure 5.2 : Bar graph showing association of the gender of the population with the clinical diagnosis of the periapical lesions. X axis represents the gender of the population and y axis represents the count and percentage of clinical diagnosis. Chi square test was done and the association was found to be statistically significant. Pearson's Chi square value: 5.663, DF: 2, p value: 0.05 (=0.05). Hence statistically significant showing males have a higher incidence of periapical abscess compared to females.

Conclusion

Within the limitations of the current study, there exists increased prevalence of periapical lesions in the age group of 60 - 70 years and males had a higher prevalence of periapical abscess compared to females. Routine dental checkup with both radiographic and histopathological examination of the periapical lesions is essential for the survival of the tooth and is beneficial for the community.

Acknowledgements: The authors would like to acknowledge the help and support rendered by the Department of Conservative Dentistry and endodontics and information technology of Saveetha Dental College and Hospitals and management for their constant assistance with the research.

Conflict of Interest: None declared.

Source of Funding: Self.

Ethical Clearance: It is taken from "Saveetha Institute Human Ethical Committee" (Ethical Approval Number- SDC/SIHEC/2020/DIASDATA/0619-0320)

References

1. Čolić M, Gazivoda D, Vučević D, Vasilijić S, Rudolf R, Lukić A. Proinflammatory and immunoregulatory mechanisms in periapical lesions [Internet]. Vol. 47, Molecular Immunology. 2009. p. 101–13. Available from: http://dx.doi.org/10.1016/j.molimm.2009.01.011
2. Jayaraj G, Sherlin HJ, Ramani P, Premkumar P, Anuja N. Cytomegalovirus and Mucoepidermoid carcinoma: A possible causal relationship? A pilot study. J Oral Maxillofac Pathol. 2015;19(3):319.
3. Nair PNR. Pathogenesis ofApicalPeriodontitis and theCauses ofEndodonticFailures [Internet]. Vol. 15, Critical Reviews in Oral Biology & Medicine. 2004. p. 348–81. Available from: http://dx.doi.org/10.1177/154411130401500604
4. Viveka TS, Shyamsundar V, Krishnamurthy A, Ramani P, Ramshankar V. p53 Expression Helps Identify High Risk Oral Tongue Premalignant Lesions and Correlates with Patterns of Invasive Tumour Front and Tumour Depth in Oral Tongue Squamous Cell Carcinoma Cases [Internet]. Vol. 17, Asian Pacific Journal of Cancer Prevention. 2016. p. 189–95. Available from: http://dx.doi.org/10.7314/apjcp.2016.17.1.189
5. Holt R, Roberts G, Scully C. Dental damage, sequelae, and prevention. West J Med. 2001;174(4):288.
6. Ahad M, Gheena S. Awareness of tooth brushing techniques and proper oral hygiene among school children. Res J Pharm Biol Chem Sci. 2015;7(6):367.
7. Kovačević M, Tamarut T, Jonjić N, Braut A, Kovačević M. The transition from pulpitis to periapical periodontitis in dogs' teeth [Internet]. Vol. 34, Australian Endodontic Journal. 2008. p. 12–8. Available from: http://dx.doi.org/10.1111/j.1747-4477.2008.00120.x
8. Adegbulugbe IC, Shaba OP. Diagnosis of Pulpal Pain by Dentists in Nigeria. Nigerian Journal of Health and Biomedical Sciences. 2005 May 5;4(1):53–6.
9. Silva BSF, Bueno MR, Yamamoto-Silva FP, Gomez RS, Peters OA, Estrela C. Differential diagnosis and clinical management of periapical radiopaque/hyperdense jaw lesions [Internet]. Vol. 31, Brazilian Oral Research. 2017. Available from: http://dx.doi.org/10.1590/1807-3107bor-2017.vol31.0052
10. Correa CP, García LB, Río EP del, Caballero AD. Correlation of clinical, radiographic and histological diagnoses of apical dental lesions. Revista Odontológica Mexicana. 2017 Jan 1;21(1):e21–8.
11. Walton RE. Routine histopathologic examination of endodontic periradicular surgical specimens--is it warranted? Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 1998;86(5):505.
12. Regezi JA. Periapical diseases: spectrum and differentiating features. J Calif Dent Assoc. 1999;27(4):285–9.
13. Peters E, Lau M. Histopathologic examination to confirm diagnosis of periapical lesions: a review. Journal-Canadian Dental Association. 2003;69(9):598–600.
14. Mirkovic S, Tadic A, Djurdjevic-Mirkovic T, Levakov A. Comparative analysis of accuracy of diagnosis of chronic periapical lesions made by clinical and histopathological examination [Internet]. Vol. 65, Medical review. 2012. p. 277–80. Available from: http://dx.doi.org/10.2298/mpns1208277m

15. Osorio-Cabarcas G, Quintero-Ricardo E, Covo-Morales E, Díaz-Caballero AJ, Simancas-Pallares MÁ. Análisis radiográfico de las lesiones periapicales en pacientes sometidos a tratamiento de conducto [Internet]. Vol. 10, Revista Nacional de Odontología. 2014. p. 41–8. Available from: http://dx.doi.org/10.16925/od.v10i18.720

16. Luna Jaramillo NA, Santacruz Insuasty AX, Palacios Córdoba BD, Mafla Chamorro AC.Prevalence of chronic apical periodontitis in endodontically treated teeth in the academic community at Universidad Cooperativa de Colombia, Pasto, 2008. Rev Fac Odontol Univ Antioq [Internet]. 2009;21(1). Available from: http://search.ebscohost.com/login.aspx? direct=true& profile=ehost& scope=site& authtype=crawler &jrnl=0121246X&asa= Y&AN=58657241&h=e1dkxPh7osY13h8H7M1Qn5VjWarb52L9ik8z0ZQaNwrTrXP4wax XF8Jh RWzcyyUE0Us%2B%2F82b0cyh HmBUBMy%2Bww%3D%3D&crl=c.

17. Ramamoorthi S, Nivedhitha MS, Divyanand MJ. Comparative evaluation of postoperative pain after using endodontic needle and EndoActivator during root canal irrigation: a randomised controlled trial. Aust Endod J. 2015;41(2):78–87.

18. Siqueira JF, Rôças IN, Alves FRF, Campos LC. Periradicular status related to the quality of coronal restorations and root canal fillings in a Brazilian population. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology. 2005 Sep 1;100(3):369–74.

19. Ramachandran Nair PN, Pajarola G, Schroeder HE. Types and incidence of human periapical lesions obtained with extracted teeth. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 1996 Jan 1;81(1):93–102.

20. Akinyamoju AO, Gbadebo SO, Adeyemi BF. Periapical lesions of the jaws: A review of 104 cases in Ibadan. Annals of Ibadan Postgraduate Medicine. 2014;12(2):115–9.

21. Alt KW, Türp JC, Wächter R. Periapical lesions—clinical and anthropological aspects. In: Dental anthropology. Springer; 1998. p. 247–76.

22. Shree KH, Ramani P, Sherlin H, Sukumaran G, Jeyaraj G, Don KR, et al. Saliva as a diagnostic tool in oral squamous cell carcinoma--a systematic review with Meta analysis. Pathol Oncol Res. 2019;25(2):447–53.

23. Jain S, Ismail PS, Apoorva K, Manasa N, Rama Krishna R, Bhowmick S. Clinical, radiographic, and histological findings of chronic inflammatory periapical lesions – A clinical study [Internet]. Vol. 9, Journal of Family Medicine and Primary Care. 2020. p. 235. Available from: http://dx.doi.org/10.4103/jfmpc.jfmpc_715_19

24. Sridharan G, Ramani P, Patankar S. Serum metabolomics in oral leukoplakia and oral squamous cell carcinoma. J Cancer Res Ther. 2017 Jul 1;13(3):556.

25. Sherlin H, Ramani P, Premkumar P, Kumar A, Natesan A. Expression of CD 68, CD 45 and human leukocyte antigen-DR in central and peripheral giant cell granuloma, giant cell tumor of long bones, and tuberculous granuloma: An immunohistochemical study [Internet]. Vol. 26, Indian Journal of Dental Research. 2015. p. 295. Available from: http://dx.doi.org/10.4103/0970-9290.162872

26. Gbadebo SO, Akinyamoju AO, Sulaiman AO. Periapical pathology: comparison of clinical diagnosis and histopathological findings. Journal of the West African College of Surgeons. 2014;4(3):74.

27. Gupta V, Ramani P. Histologic and immunohistochemical evaluation of mirror image biopsies in oral squamous cell carcinoma. Journal of Oral Biology and Craniofacial Research. 2016 Sep 1;6(3):194–7.

28. Sivaramakrishnan SM, Ramani P. Study on the Prevalence of Eruption Status of Third Molars in South Indian Population. Early Pregnancy. 2015;7(4):1.

29. Jayaraj G, Sherlin HJ, Ramani P, Premkumar P, Natesan A. Stromal myofibroblasts in oral squamous cell carcinoma and potentially malignant disorders. Indian J Cancer. 2015 Jan 1;52(1):87.

30. Kumar R, Khambete N. Ultrasound in differential diagnosis of periapical radiolucencies: A radiohistopathological study [Internet]. Vol. 18, Journal of Conservative Dentistry. 2015. p. 39. Available from: http://dx.doi.org/10.4103/0972-0707.148889

31. Jayaraj G, Ramani P, Herald J. Sherlin, Premkumar P, Anuja N. Inter-observer agreement in grading oral epithelial dysplasia – A systematic review [Internet]. Vol. 27, Journal of Oral and Maxillofacial Surgery, Medicine, and Pathology. 2015. p. 112–6. Available from: http://dx.doi.org/10.1016/j.ajoms.2014.01.006

32. Swathy S, Gheena S, Varsha SL. Prevalence of pulp stones in patients with history of cardiac diseases. Research Journal of Pharmacy and Technology. 2015;8(12):1625–8.

33. Odesjo B, Hellden L, Salonen L, Langeland K. Prevalence of previous endodontic treatment, technical standard and occurrence of periapical lesions in a randomly selected adult, general population [Internet]. Vol. 6, Dental Traumatology. 1990. p. 265–72. Available from: http://dx.doi.org/10.1111/j.1600-9657.1990.tb00430.x

34. Rosalem CGC, Mattos CM de A, Guerra SMG. Association between intra-radicular posts and periapical lesions in endodontically treated teeth. J Appl Oral Sci. 2007;15(3):225–9.

35. Thangaraj SV, Shyamsundar V, Krishnamurthy A, Ramani P, Ganesan K, Muthuswami M, et al. Molecular Portrait of Oral Tongue Squamous Cell Carcinoma Shown by Integrative Meta-Analysis of Expression Profiles with Validations. PLoS One. 2016 Jun 9;11(6):e0156582.

36. Kumar MS, Kumar MH, Vishalakshi K, Sabitha H. Radiographic assessment of bone formation using RHBMP2 at maxillary periapical surgical defects: a case series. J Clin Diagn Res. 2016;10(4):ZR01.

37. NOVAK, MJ. Classification of diseases and conditions affecting periodontium. Clinical periodontology. 2002;64–73.

38. Mobeen N. Incidence of Common Periapical Lesions-An Intra Oral Periapical Radiographic Study. Res J Pharm Biol Chem Sci. 2015;7(8):590.

39. Jangid K, Alexander AJ, Jayakumar ND, Varghese S, Ramani P. Ankyloglossia with cleft lip: A rare case report. J Indian Soc Periodontol. 2015;19(6):690.

40. Kandemir Demirci G, Kaval ME, Güneri P, Çalışkan MK. Treatment of immature teeth with non vital pulps in adults: a prospective comparative clinical study comparing MTA with Ca (OH) 2. Int Endod J. 2020;53(1):5–18.

41. Dharsini S, Ramakrishnan M, Ganapathy D. The effect of severe caries on the quality of life in young children: A cross-sectional study. Drug Invention Today [Internet]. 2020;14(3). Available from: http://search.ebscohost.com/ login.aspx?direct= true &profile=ehost& scope= site& authtype= crawler &jrnl=09757619 & AN=142952435&h= 9iFFlqf2hZIzj PnpBVqz E6VR5hc RimlH1Oy2A 7YJPRx GObR4sIG%2 Ffmde5AFiP%2 FNcCej1v 05SFAlbawr XBsvLwQ%3 D%3D&crl=c

42. Çolak H, Dülgergil ÇT, Dalli M, Hamidi MM. Early childhood caries update: A review of causes, diagnoses, and treatments. J Nat Sci Biol Med. 2013;4(1):29.

43. Sasaki H, Hirai K, M. Martins C, Furusho H, Battaglino R, Hashimoto K. Interrelationship Between Periapical Lesion and Systemic Metabolic Disorders. Curr Pharm Des. 2016;22(15):2204–15.

44. Sridharan G, Ramani P, Patankar S, Vijayaraghavan R. Evaluation of salivary metabolomics in oral leukoplakia and oral squamous cell carcinoma. J Oral Pathol Med. 2019 Apr 18;48(4):299–306.

45. Gould LJ, Fulton AT. Wound healing in older adults. R I Med J. 2016;99(2):34.

46. Gheena S, Ezhilarasan D. Syringic acid triggers reactive oxygen species–mediated cytotoxicity in HepG2 cells. Hum Exp Toxicol. 2019 Jun 1;38(6):694–702.

47. Enriquez FJJ. Relationship between Clinical and Histopathologic Findings of 40 Periapical Lesions [Internet]. Vol. 05, Dentistry. 2015. Available from: http://dx.doi.org/10.4172/2161-1122.1000277

48. Kruse C, Spin-Neto R, Reibel J, Wenzel A, Kirkevang L-L. Diagnostic validity of periapical radiography and CBCT for assessing periapical lesions that persist after endodontic surgery. Dentomaxillofacial Radiology. 2017 Oct 1;46(7):20170210.

49. Hannah R, Ramani P, Herald. J. Sherlin, Ranjith G, Ramasubramanian A, Jayaraj G, et al. Awareness about the use, Ethics and Scope of Dental Photography among Undergraduate Dental

Students Dentist Behind the lens [Internet]. Vol. 11, Research Journal of Pharmacy and Technology. 2018. p. 1012. Available from: http://dx.doi.org/10.5958/0974-360x.2018.00189.0

50. Kuc I, Peters E, Pan J. Comparison of clinical and histologic diagnoses in periapical lesions. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology. 2000 Mar 1;89(3):333–7.

51. Valderhaug J, Jokstad A, Ambjørnsen E, Norheim PW. Assessment of the periapical and clinical status of crowned teeth over 25 years. J Dent. 1997 Mar 1;25(2):97–105.

52. Çalışkan MK, Kaval ME, Tekin U, Ünal T. Radiographic and histological evaluation of persistent periapical lesions associated with endodontic failures after apical microsurgery [Internet]. Vol. 49, International Endodontic Journal. 2016. p. 1011–9. Available from: http://dx.doi.org/10.1111/iej.12554

53. Wyne AH, Chohan AN, Jastaniyah N. Bilateral occurrence of dental caries and oral hygiene in preschool children of Riyadh, Saudi Arabia. Tropical Dental [Internet]. 2008; Available from: https://www.researchgate.net/profile/Amjad_Wyne/publication/24426370_Bilateral_occurrence_of_dental_caries_and_oral_hygiene_in_preschool_children_of_Riyadh_Saudi_Arabia/links/09e41507184c806cd0000000.pdf

54. Sureshbabu NM, Selvarasu K, V JK, Nandakumar M, Selvam D. Concentrated Growth Factors as an Ingenious Biomaterial in Regeneration of Bony Defects after Periapical Surgery: A Report of Two Cases [Internet]. Vol. 2019, Case Reports in Dentistry. 2019. p. 1–6. Available from: http://dx.doi.org/10.1155/2019/7046203

55. Nandakumar M, Nivedhitha MS. Concentrated Growth Factor as an Ingenious Biomaterial in Regeneration of Bony Defects after Periapical Surgery: A Case Report. iacde.in [Internet]. Available from: https://www.iacde.in/images/case-of-month/2019/case-of-month-february-2019.pdf