Original Research Article

A RADIOGRAPHIC STUDY ON DETECTION OF ANTERIOR LOOP PATTERN OF ENTRY OF MENTAL NERVE INTO MENTAL FORAMEN IN DIGITAL ORTHOPANTOMOGRAPHY AMONG SOUTH INDIAN POPULATION

Running Title: Identification of anterior loop pattern of entry of mental nerve.

ABSTRACT:

Background: The entry of the mental nerve into the mental foramen pattern is an important landmark in the mandibular premolar location. Different patterns of entry of the mental nerve are identified. As presurgical evaluation involves panoramic radiographs , the present study was taken to detect the various entry patterns of the mental nerve into the mental foramen.

Materials and Methods: Total 200 panoramic radiographs taken for diagnostic purposes were selected for this study. The radiographs were assessed and the position and the entry pattern of the mental nerve on the left and right side were recorded. The entry patterns recorded were differentiated as straight, looping, or perpendicular. The collected data is tabulated and analysed statistically using Chi-square in SPSS software.

Results: The study revealed that the most common pattern of entry of the mental nerve was a straight one accounting for a total of 79%, followed by the presence of an anterior loop of 21% and perpendicular pattern 6% of the total radiographs examined. The p value is 0.432 and p value 0.309, with respect to age and gender respectively which is statistically not significant.

Conclusion: From the results obtained within the limitations of the study,It can be concluded that the more frequent pattern of anterior loop of mental nerve observed was the straight one. For identifying the presence of anterior loop, panoramic radiograph may be a reliable imaging modality that needs to be determined for preoperative planning of surgical procedures in the mandibular premolar location.

Keywords: Anterior loop; mental nerve; panoramic radiographs; patterns of emergence;Innovative technique.

INTRODUCTION:

A branch of the mandibular nerve is the inferior alveolar nerve that enters the mandibular ramus at the lingual aspect and runs down to the mandibular canal, mandibular teeth are being supplied by this, and the associated soft tissue structures(1). One of the terminal branches is the mental nerve , that belongs to the inferior alveolar nerve, arises from the mental foramen to supply the skin and mucous membrane of the buccal vestibule from the medial border of the masseter muscle to the midline.(2)

Some authors recorded an anterior loop to the nerve before it arises from the mental foramen When inferior alveolar nerve arises from the mandibular canal and runs outward, upward, and backward to open at the mental foramen (MF) it was called as anterior loop(3).Before it was reported by Bavitz and Misch who described anterior loop as the structure "where the inferior and anterior to the mental foramen has been crossed by mental neurovascular bundle then it doubles or loops back to exit the mental foramen This can be visualized in about 11-60% of panoramic radiographs. More of this has not been described about the other paths of the mental nerve before it exits through the mental foramen. Some studies divided the pattern into loop type and non loop types,or described various patterns such as a posteriorly directed, an anteriorly directed(4). The experience from our previous studies (5) (6,7) (6)(8)(9)(10)(11)(9,11)(12)(13) (14) have led us to focus on the current topic.

The neurosensory alterations in the chin and lower lip is the most important *complication during* implant placement in the mandibular premolar region. When important vital structures such as mental foramen and anterior mental loop are not properly identified and protected these complications may occur.(15)The exact localization of the anatomical structures should be

identified prior to surgery to avoid damage to these vital structures, using appropriate radiographic techniques.(15,16) Though a number of morphometric studies have recorded the entry pattern of mental nerve into mental foramen, only a few radiographic studies have been performed in this respect. (17)Anatomic landmarks are routinely located using panoramic radiographs,for planning these surgical procedures, To determine if a panoramic radiograph is sufficient to identify the presence of anterior loop and other patterns of entry of mental nerve or is there a need for using advanced imaging techniques for the same, is the reason to take this study.Our team has extensive knowledge and research experience that has translate into high quality publications (18–25),(26),(27),(28),(29,30),(31),(32),(33–37). The aim of this study is to identify the anterior loop pattern of entry of the mental nerve into mental foramen in digital orthopantomography.

MATERIALS AND METHODS:

This is a retrospective study conducted in a private dental college hospital in chennai and the study was approved by the institutional reveal board. Total 200 panoramic radiographs obtained from records maintained in the Department of Oral Medicine and Radiology were randomly selected for the study. Only high-quality radiographs with respect to geometric accuracy and contrast of image were selected for the study. Radiographs showing radiolucent or radiopaque lesions in the mental foramen region of mandible and evidence of fracture around the mental foramen and mandibular canal region, radiographs showing supernumerary or unerupted teeth in the mental foramen region and radiographs showing processing or exposure errors and artifacts obscuring visibility of structures in the mandible were excluded from the study. The radiographs were evaluated for the pattern of entry of the mental nerve into the mental foramen on either side of the mandible. The observations thus made were recorded as Anterior loop(AL), straight(S), or Perpendicular(P) and the total numbers of patterns observed on both sides were recorded. Interobserver variability was assessed using the kappa test. Tabulations for the presence of each pattern were done for both sides and the percentages calculated and analysed using the SPSS tool.

RESULTS: The study revealed that the most common pattern of entry of the mental nerve was a straight one accounting for a total of 79%, followed by the presence of an anterior loop of 21% and perpendicular pattern 6% of the total radiographs examined. The p value is 0.432 and p

value 0.309, with respect to age and gender respectively which is statistically not significant. (Figure 1,2)

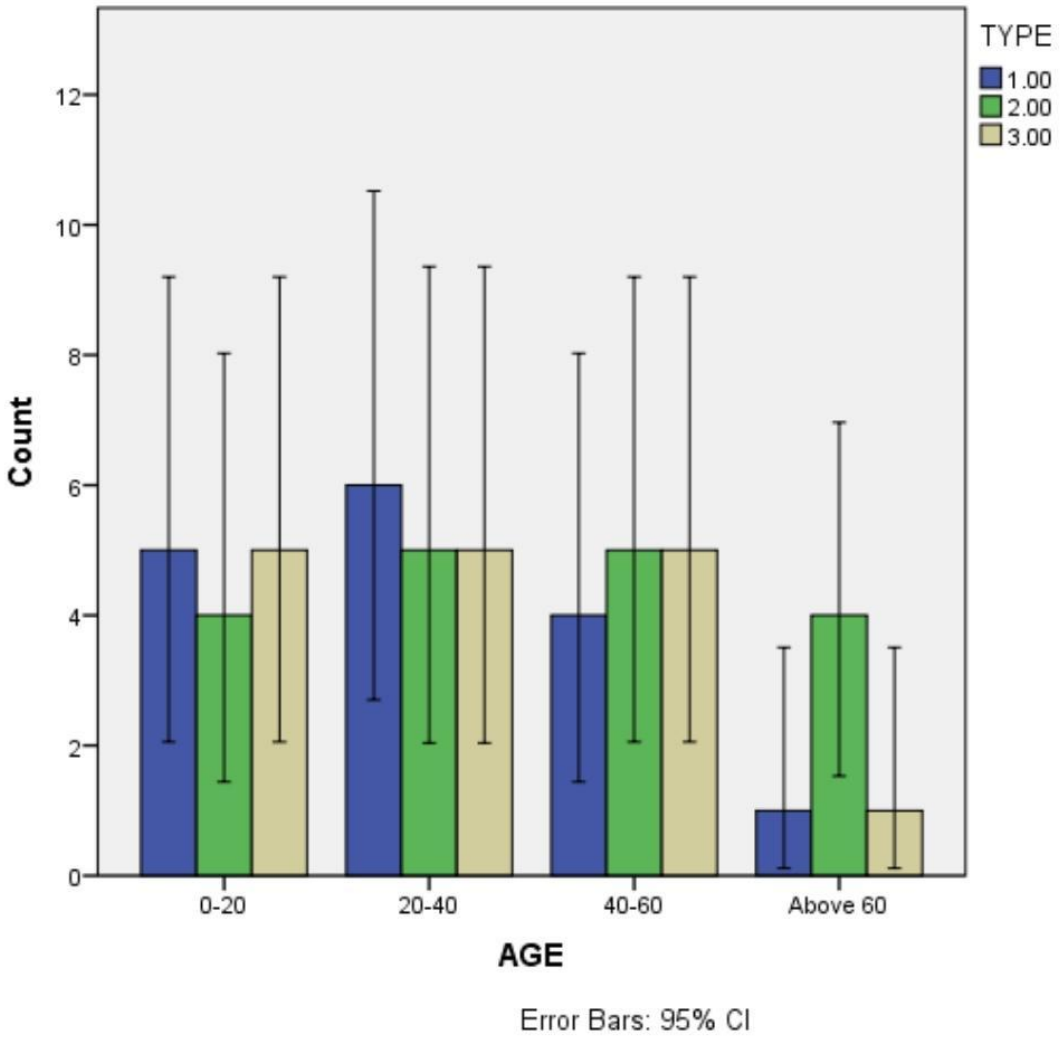

Fig 1- The bar graph represents the frequency distribution with respect to age. The X axis represents the age and the y axis represents the number of samples. Type I is anterior loop (blue), type ll is straight (green), type lll is perpendicular (yellow). Anterior loop pattern is observed in more frequency among age group 20-40 yrs. The Chi square test was observed with p value 0.432, which is statistically not significant.

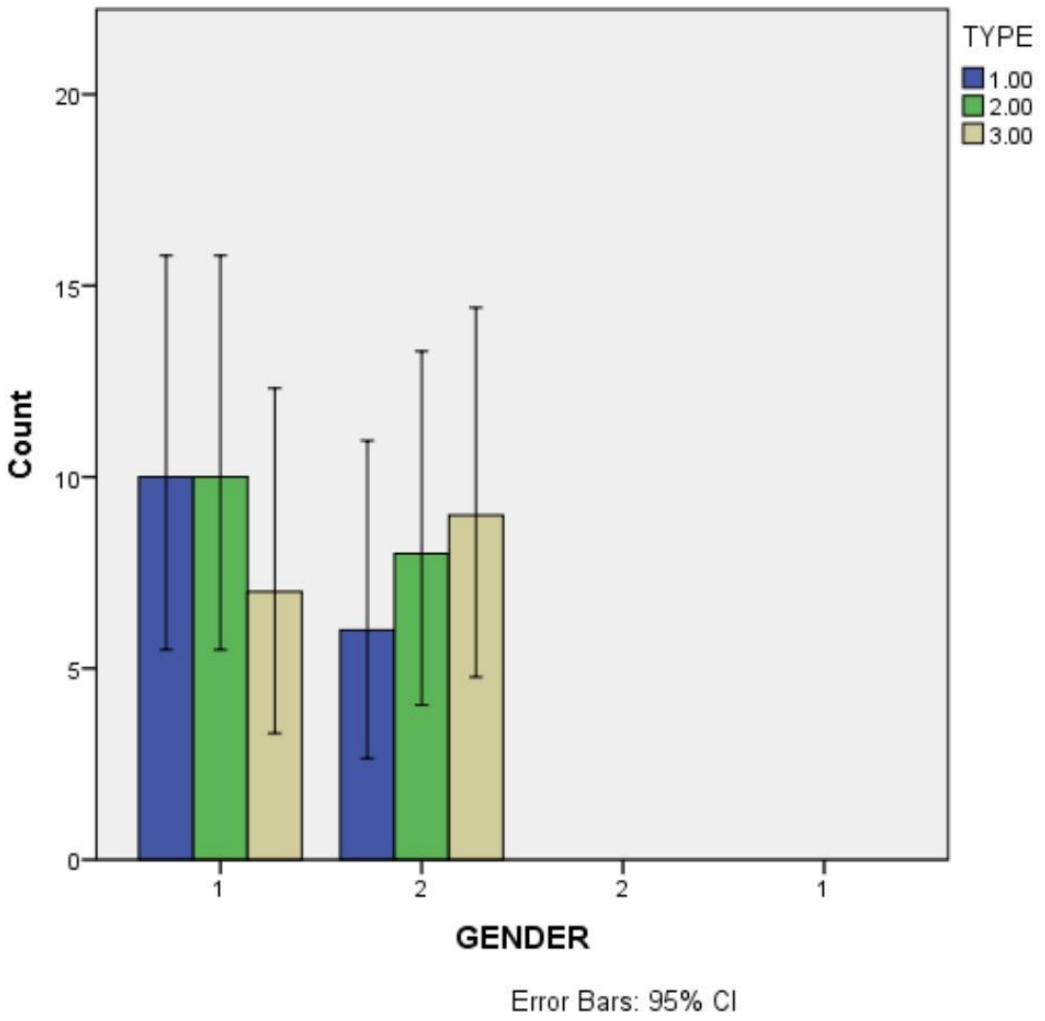

Figure 2: The bar graph represents the frequency distribution with respect to gender. In the X axis, 1 represents male and 2 represents female. In the y axis the numbers represent the number of samples. Type I is anterior (blue), type ll is straight (green), type lll is perpendicular (yellow), among which anterior loop and straight pattern are more in males when compared to females.Chi square test was done with p value 0.309, which is statistically not significant.

DISCUSSION:

The result of this study is that maximum samples account for the straight pattern of entry of mental nerves into mental foramen. The transitional part of the inferior alveolar nerve has been addressed in few studies between the mandibular canal and the mental foramen in cadaveric

mandibles. Solar, et al.,divided their cases simply into loop and non loop types. (38) *The author* studied the actual path of arising of the mental nerve and divided it into posterior, anterior, right angled, or multiple. Investigation on the path of emergence of the mental nerve in a number of human population groups. Slight curve of the mental canal opening directly into the mental foramen was observed as a straight pattern. When the mental canal bent perpendicularly into the foramen the vertical pattern was seen.(39)

To determine if such patterns are visible as such on the radiographs, no radiographic studies have been done so far. Although radiographic studies have not addressed the various patterns of entry of the mental nerve into the mental foramen, the presence of anterior loop has been a subject of interest in studies comparing cadaveric and radiographic findings. The fact that the tomographic layer may not capture the entire area appropriately is the only reason for the unreliability of mental foramen region assessment based on panoramic imaging. By accounting for the different criteria used to define the anterior loop,the variability in the radiographic assessment of the anterior loop may be explained by dissimilar diagnostic techniques, equipment and poor radiographic quality. The inability to distinguish it from normal trabecular patterns is the most probable explanation.(40)

Since, panoramic radiographs give only a 2-dimensional view of the area examined, there are advantages of using CT images in identifying the mandibular canal and anterior loop of the mental nerve, although contradictory results have also been found.Studies conducted to determine the visibility of anterior loop on 3-dimensional cone beam CT have revealed considerably better results (41)

An important point noted in the present study was that in the radiographs where an anterior loop was seen, the mental foramen was located closer to the alveolar crest as compared to the radiographs where no loop was observed. Thus, based on this finding, it may be assumed that in cases where the position of the mental foramen is higher up in the vertical plane, the mental nerve has to loop back to enter the foramen. Further studies involving cadaveric and radiographic comparisons of this observation may be required to prove the same.

Lastly, the anatomy of the mandibular premolar region has clinical significance in pretreatment planning of surgical procedures due to the presence of the anterior loop. Damage to this nerve bundle may cause neurosensory alterations in the chin and lower lip. Of particular interest has been the placement of endosseous implants in the anterior interforaminal region. To maximize the distance between implants, the most posterior implant should be placed as close as possible to the mental foramen(42). The greater the distance between the interforaminal implants, the better the anterior implants can counteract the forces generated on the distal

cantilevers of the fixed prosthesis. According to Bavitz, et al., an implant in the mental region is best positioned, so that its distal aspect is 1mm anterior to anterior border of mental foramen(43). However, some authors have recommended a minimum distance of 6 mm between the mental foramen and the most posterior implant. The reason behind this large safety margin is to prevent damage to the anterior loop of the mental nerve that has been documented to extend anteriorly upto 5 mm.The results are inconclusive due to limited sample size to make the context evident the study can be proceeded in large scale studies in future.

CONCLUSION:

From the results obtained within the limitations of the study,It can be concluded that the more frequent pattern of anterior loop of mental nerve observed was the straight one. For identifying the presence of anterior loop, panoramic radiograph may be a reliable imaging modality that needs to be determined for preoperative planning of surgical procedures in the mandibular premolar location. Studies taking into account various ethnic groups may be required to actually determine how predictive the conventional as well as advanced imaging modalities prove useful in assessment of exact anatomy of the mandibular premolar region, which holds immense importance for planning any surgical procedures in this region.

REFERENCES:

1. Kieser J, Kuzmanovic D, Payne A, Dennison J, Herbison P. Patterns of emergence of the human mental nerve [Internet]. Vol. 47, Archives of Oral Biology. 2002. p. 743–7. Available from: http://dx.doi.org/10.1016/s0003-9969(02)00067-5

2. Arzouman MJ, Otis L, Kipnis V, Levine D. Observations of the anterior loop of the inferior alveolar canal. Int J Oral Maxillofac Implants. 1993;8(3):295–300.

3. Bavitz JB, Harn SD, Hansen CA, Lang M. An anatomical study of mental neurovascular bundle-implant relationships. Int J Oral Maxillofac Implants. 1993;8(5):563–7.

4. Ngeow WC, Dionysius DD, Ishak H, Nambiar P. Effect of ageing towards location and visibility of mental foramen on panoramic radiographs. Singapore Dent J. 2010 Jun;31(1):15–9.

5. Shruthi M, Preetha S. Effect of Simple Tongue Exercises in Habitual Snorers [Internet]. Vol. 11, Research Journal of Pharmacy and Technology. 2018. p. 3614. Available from: http://dx.doi.org/10.5958/0974-360x.2018.00665.0

6. Preetha S, Packyanathan J. Comparison of the effect of Yoga, Zumba and Aerobics in controlling blood pressure in the Indian population [Internet]. Vol. 9, Journal of Family Medicine and Primary Care. 2020. p. 547. Available from: http://dx.doi.org/10.4103/jfmpc.jfmpc_607_19

7. J SK, Saveetha Dental College and Hospitals, Road PH, Chennai, Tamilnadu, Preetha S, et al. Effect of aerobics exercise and yoga on blood pressure in hypertensives [Internet]. Vol. 6, International Journal of Current Advanced Research. 2017. p. 3124–6. Available from: http://dx.doi.org/10.24327/ijcar.2017.3126.0200

8. Prathap L, Suganthirababu P, Ganesan D. Fluctuating Asymmetry of Dermatoglyphics and DNA Polymorphism in Breast Cancer Population [Internet]. Vol. 10, Indian Journal of Public Health Research & Development. 2019. p. 3574. Available from: http://dx.doi.org/10.5958/0976-5506.2019.04141.x

9. Lavanya J, Prathap S, Alagesan J. Digital and palmar dermal ridge patterns in population with breast carcinoma. Biomedicine. 2014 Jul 1;34(3):315–21.

10. Prathap L, Jagadeesan V. Association of quantitative and qualitative dermatoglyphic variable and DNA polymorphism in female breast cancer population. Online J Health [Internet]. 2017; Available from: https://www.researchgate.net/profile/Prathap_Suganthirababu/publication/321606278_Association_of_Quantitative_and_Qualitative_Dermatoglyphic_Variable_and_DNA_Polymorphism_in_Female_Breast_Cancer_Population/links/5a28c8f1a6fdcc8e8671c0cd/Association-of-Quantitative-and-Qualitative-Dermatoglyphic-Variable-and-DNA-Polymorphism-in-Female-Breast-Cancer-Population.pdf

11. Lavanya J, Kumar VJ, Sudhakar N, Prathap S. Analysis of DNA repair genetic polymorphism in breast cancer population. Int J Pharma Bio Sci [Internet]. 2015; Available from: https://scholar.google.ca/scholar?cluster=8949053652564257518&hl=en&as_sdt=0,5&sciodt=0,5

12. Prathap L, Suganthirababu P. Estrogen Exposure and its Influence in DNA Repair Genetic Variants in Breast Cancer Population [Internet]. Vol. 13, Biomedical and Pharmacology Journal. 2020. p. 1321–7. Available from: http://dx.doi.org/10.13005/bpj/2001

13. Ravikumar H, Prathap L, Preetha S. ANALYSIS OF PALMAR ATD ANGLE IN POPULATION WITH MALOCCLUSION. 2020 Jan 1;1174–82.

14. Prathap L. INTERPLAY OF OXIDATIVE STRESS AND LIPOPROTEINS IN BREAST CARCINOMA INITIATION, PROMOTION AND PROGRESSION -A SYSTEMATIC REVIEW. PalArch's Journal of Archaeology of Egypt/ Egyptology [Internet]. 2021 Jan 7 [cited 2021 Mar 9];17(7). Available from: http://dx.doi.org/

15. Ulm CW, Solar P, Blahout R, Matejka M, Watzek G, Watzek G, et al. Location of the mandibular canal within the atrophic mandible [Internet]. Vol. 31, British Journal of Oral and Maxillofacial Surgery. 1993. p. 370–5. Available from: http://dx.doi.org/10.1016/0266-4356(93)90193-z

16. Hu K-S, Yun H-S, Hur M-S, Kwon H-J, Abe S, Kim H-J. Branching patterns and intraosseous course of the mental nerve. J Oral Maxillofac Surg. 2007 Nov;65(11):2288–

94.

17. Juodzbalys G, Wang H-L, Sabalys G. Anatomy of mandibular vital structures. Part I: mandibular canal and inferior alveolar neurovascular bundle in relation with dental implantology. J Oral Maxillofac Res. 2010 Apr 1;1(1):e2.

18. Sekar D, Lakshmanan G, Mani P, Biruntha M. Methylation-dependent circulating microRNA 510 in preeclampsia patients. Hypertens Res. 2019 Oct;42(10):1647–8.

19. Princeton B, Santhakumar P, Prathap L. Awareness on Preventive Measures taken by Health Care Professionals Attending COVID-19 Patients among Dental Students. Eur J Dent. 2020 Dec;14(S 01):S105–9.

20. Logeshwari R, Rama Parvathy L. Generating logistic chaotic sequence using geometric pattern to decompose and recombine the pixel values. Multimed Tools Appl. 2020 Aug;79(31-32):22375–88.

21. Johnson J, Lakshmanan G, M B, R M V, Kalimuthu K, Sekar D. Computational identification of MiRNA-7110 from pulmonary arterial hypertension (PAH) ESTs: a new microRNA that links diabetes and PAH. Hypertens Res. 2020 Apr;43(4):360–2.

22. Paramasivam A, Priyadharsini JV, Raghunandhakumar S, Elumalai P. A novel COVID-19 and its effects on cardiovascular disease. Hypertens Res. 2020 Jul;43(7):729–30.

23. Pujari GRS, Subramanian V, Rao SR. Effects of Celastrus paniculatus Willd. and Sida cordifolia Linn. in Kainic Acid Induced Hippocampus Damage in Rats. Ind J Pharm Educ. 2019 Jul 3;53(3):537–44.

24. Rajkumar KV, Lakshmanan G, Sekar D. Identification of miR-802-5p and its involvement in type 2 diabetes mellitus. World J Diabetes. 2020 Dec 15;11(12):567–71.

25. Ravisankar R, Jayaprakash P, Eswaran P, Mohanraj K, Vinitha G, Pichumani M. Synthesis, growth, optical and third-order nonlinear optical properties of glycine sodium nitrate single crystal for photonic device applications. J Mater Sci: Mater Electron. 2020 Oct;31(20):17320–31.

26. Wu S, Rajeshkumar S, Madasamy M, Mahendran V. Green synthesis of copper nanoparticles using Cissus vitiginea and its antioxidant and antibacterial activity against urinary tract infection pathogens. Artif Cells Nanomed Biotechnol. 2020 Dec;48(1):1153–8.

27. Vikneshan M, Saravanakumar R, Mangaiyarkarasi R, Rajeshkumar S, Samuel SR, Suganya M, et al. Algal biomass as a source for novel oral nano-antimicrobial agent. Saudi J Biol Sci. 2020 Dec;27(12):3753–8.

28. Alharbi KS, Fuloria NK, Fuloria S, Rahman SB, Al-Malki WH, Javed Shaikh MA, et al. Nuclear factor-kappa B and its role in inflammatory lung disease. Chem Biol Interact. 2021 Aug 25;345:109568.

29. Rao SK, Kalai Priya A, Manjunath Kamath S, Karthick P, Renganathan B, Anuraj S, et al. Unequivocal evidence of enhanced room temperature sensing properties of clad modified Nd doped mullite Bi2Fe4O9 in fiber optic gas sensor [Internet]. Vol. 838, Journal of Alloys and Compounds. 2020. p. 155603. Available from:

http://dx.doi.org/10.1016/j.jallcom.2020.155603

30. Bhavikatti SK, Karobari MI, Zainuddin SLA, Marya A, Nadaf SJ, Sawant VJ, et al. Investigating the Antioxidant and Cytocompatibility of Mimusops elengi Linn Extract over Human Gingival Fibroblast Cells. Int J Environ Res Public Health [Internet]. 2021 Jul 4;18(13). Available from: http://dx.doi.org/10.3390/ijerph18137162

31. Marya A, Karobari MI, Selvaraj S, Adil AH, Assiry AA, Rabaan AA, et al. Risk Perception of SARS-CoV-2 Infection and Implementation of Various Protective Measures by Dentists Across Various Countries. Int J Environ Res Public Health [Internet]. 2021 May 29;18(11). Available from: http://dx.doi.org/10.3390/ijerph18115848

32. Barma MD, Muthupandiyan I, Samuel SR, Amaechi BT. Inhibition of Streptococcus mutans, antioxidant property and cytotoxicity of novel nano-zinc oxide varnish. Arch Oral Biol. 2021 Jun;126:105132.

33. Vijayashree Priyadharsini J. In silico validation of the non-antibiotic drugs acetaminophen and ibuprofen as antibacterial agents against red complex pathogens. J Periodontol. 2019 Dec;90(12):1441–8.

34. Priyadharsini JV, Vijayashree Priyadharsini J, Smiline Girija AS, Paramasivam A. In silico analysis of virulence genes in an emerging dental pathogen A. baumannii and related species [Internet]. Vol. 94, Archives of Oral Biology. 2018. p. 93–8. Available from: http://dx.doi.org/10.1016/j.archoralbio.2018.07.001

35. Uma Maheswari TN, Nivedhitha MS, Ramani P. Expression profile of salivary micro RNA-21 and 31 in oral potentially malignant disorders. Braz Oral Res. 2020 Feb 10;34:e002.

36. Gudipaneni RK, Alam MK, Patil SR, Karobari MI. Measurement of the Maximum Occlusal Bite Force and its Relation to the Caries Spectrum of First Permanent Molars in Early Permanent Dentition. J Clin Pediatr Dent. 2020 Dec 1;44(6):423–8.

37. Chaturvedula BB, Muthukrishnan A, Bhuvaraghan A, Sandler J, Thiruvenkatachari B. Dens invaginatus: a review and orthodontic implications. Br Dent J. 2021 Mar;230(6):345–50.

38. Rosenquist B. Fixture placement posterior to the mental foramen with transpositioning of the inferior alveolar nerve. Int J Oral Maxillofac Implants. 1992 Spring;7(1):45–50.

39. Mardinger O, Chaushu G, Arensburg B, Taicher S, Kaffe I. Anterior loop of the mental canal: an anatomical-radiologic study. Implant Dent. 2000;9(2):120–5.

40. Yosue T, Brooks SL. The appearance of mental foramina on panoramic radiographs. I. Evaluation of patients [Internet]. Vol. 68, Oral Surgery, Oral Medicine, Oral Pathology. 1989. p. 360–4. Available from: http://dx.doi.org/10.1016/0030-4220(89)90224-7

41. Chau A. Comparison between the use of magnetic resonance imaging and conebeam computed tomography for mandibular nerve identification [Internet]. Vol. 23, Clinical Oral Implants Research. 2012. p. 253–6. Available from: http://dx.doi.org/10.1111/j.1600-0501.2011.02188.x

42. von Arx T, Lozanoff S. Clinical Oral Anatomy: A Comprehensive Review for Dental Practitioners and Researchers. Springer; 2016. 561 p.

43. Jacobs R, Mraiwa N, vanSteenberghe D, Gijbels F, Quirynen M. Appearance, location, course, and morphology of the mandibular incisive canal: an assessment on spiral CT scan [Internet]. Vol. 31, Dentomaxillofacial Radiology. 2002. p. 322–7. Available from: http://dx.doi.org/10.1038/sj.dmfr.4600719