Nat. Volatiles & Essent. Oils, 2021; 8(4): 8437-8460

Knowledge, Attitude And Awareness About Different Stages Of Amelogenesis Among Undergraduate Dental Students

Soorya Ganesh [1], Dr. Reshma[2], Dr. Lakshmi.T.A[3], Dr. Vishnu Priya. V[4], Dr. Reshma[5]

[1]Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, India Email id :151901099.sdc@saveetha.com

[2]Senior lecturer Department of Oral pathology Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai Email id:reshmapk.sdc@saveetha.com

[3]Senior lecturer Department of Oral pathology Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai Email id: lakshmita.sdc@saveetha.com

[4]Professor, Department of Biochemistry, Saveetha Dental College and hospitals, Saveetha Institute of medical and Technical Sciences, Saveetha University. Chennai, India E-mail: vishnupriya@saveetha.com

[5]Senior lecturer Department of Oral Pathology Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences, Saveetha University,Chennai Email id:reshmapk.sdc@saveetha.com Phone no:9445691860

ABSTRACT :

Introduction: Amelogenesis is the process of enamel formation that begins with the differentiation of the inner enamel epithelium and ends with the creation of enamel.

Aim of the study: To create awareness about different stages of amelogenesis among undergraduate dental students.

Materials and methods: A cross sectional descriptive study was conducted among undergraduate dental students.The sample size was 100 and convenience sampling was used.SPSS statistical software was used and Chi square test was used for analysis.The P value was set at less than 0.05.

Results and Discussion:14.93% of the age group between 26-30;4.98% of the age group between 17-20;9.95% of the age group between 21-25;9.45% of the age group between 31-35;10.45% of the age group more than 35 attended this survey.The present study was conducted among undergraduate students of Saveetha dental college and hospitals.All the students were aware of

different stages of amelogenesis.In our study, it was observed that interns and final year's are more aware about this topic when compared to first years.

Conclusion: From our study,we conclude that undergraduate students are aware of amelogenesis and have moderate knowledge on it.

Keywords: Amelogenesis;differentiation;enamel;innovative technique

INTRODUCTION:

Amelogenesis is the process of enamel formation that begins with the differentiation of the inner enamel epithelium and ends with the creation of enamel.(1).It is subdivided into three categories which are presecretory,secretory and post phase secretory(1,2).The pre scretory is divided into two categories which are morphogenetic and histodifferentiation(1–3).In morphogenetic stage, the shape of the crown is determined by the bell stage of the tooth development.In histodifferentiation stage,the three changes occurs which are reversal polarity,reciprocal induction and reversal of nutrition(1–4).The secretory stage divides into two categories initial and final secretory stage.Initial stage secretory phase occurs in 30% mineralization of organic matrix by amelogenin and non amelogenin;final secretory phase occurs in 90% of the mineralization in which formation of rods and interods take place,rods towards the distal extension and interods towards the proximal extension(1–5).The post phase secretory phase divides into two stages transition and maturation.In transition stage,the ameloblast cell death occurs upto 50% and in maturationstage,it is subdivided into two categories ruffle ended ameloblast and smooth ended ameloblast;the ruffed ended ameloblast introduces the inorganic material which as proximal leaky junction and distal tight junction;smooth ended ameloblast removes the organic material which as proximal tight junction and distal leaky junction(6).The modulation of ameloblast occurs in every 5 to 7 hours. Our team has extensive knowledge and research experience that has translated into high quality publications
(7),(8),(9),(10),(11),(12),(13),(14),(15),(16),(17),(18),(19),(20),(21),(22),(23),(24),(25),(26).The aim of the study is to create awareness about different stages of amelogenesis among undergraduate dental students.

MATERIALS AND METHODS:

A cross sectional descriptive study was conducted among undergraduate dental students.The sample size was 100 and convenience sampling was used.A questionnaire containing 15 questions.The survey

was then done through an online questionnaire using google forms. The data was entered in an excel sheet and exported to SPSS inorder to carry out the appropriate statistical analysis. Frequency and percentage was calculated and the result was represented as pie charts.Chi square analysis was done to compare the data between the different years of study.

Results:

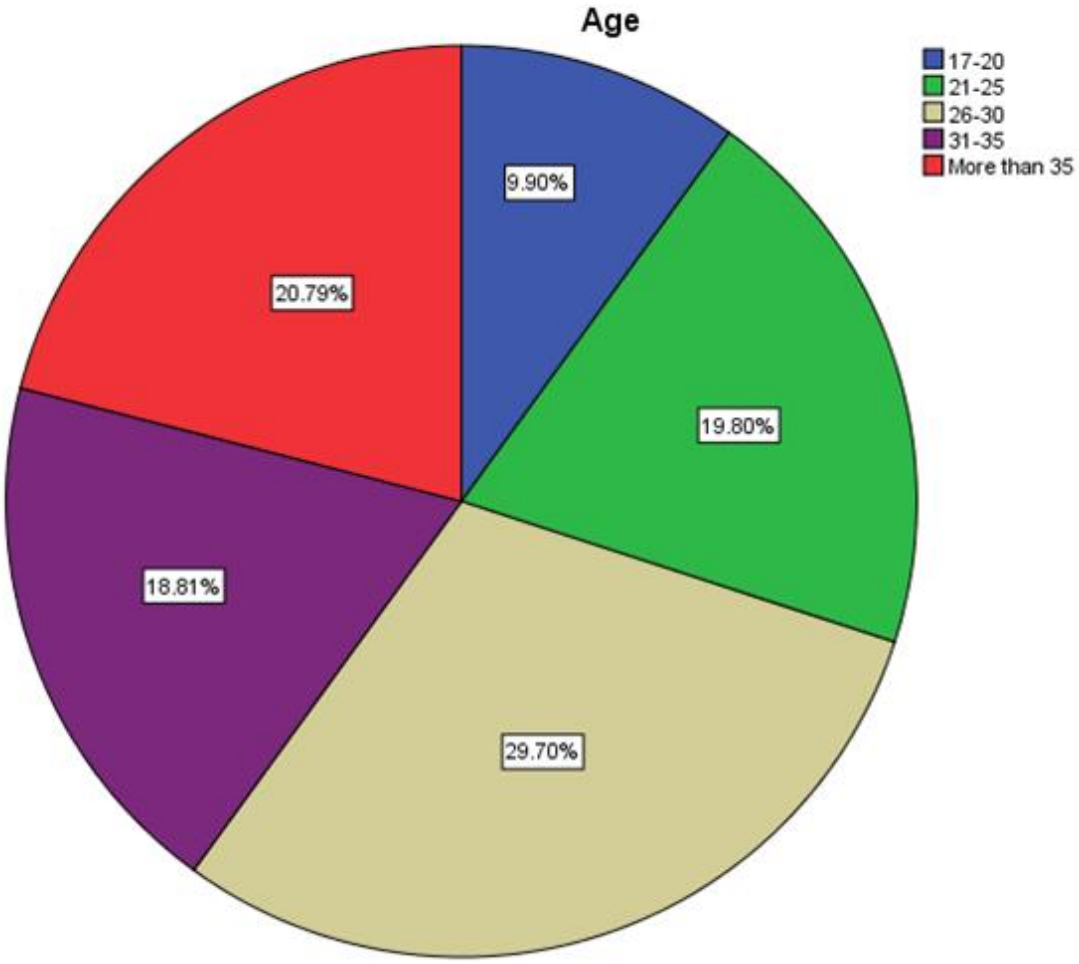

Fig 1:Shows the response of the different age group among undergraduate dental students.29.70% of the age group between 26-30(beige);9.90% of the age group between 17-20(blue);19.80% of the age group between 21-25(green);18.81% of the age group between 31-35(pink);20.79% represents age group more than 35 attended this survey(red). Majority of the participants are of the age group of 26 to 30 years.

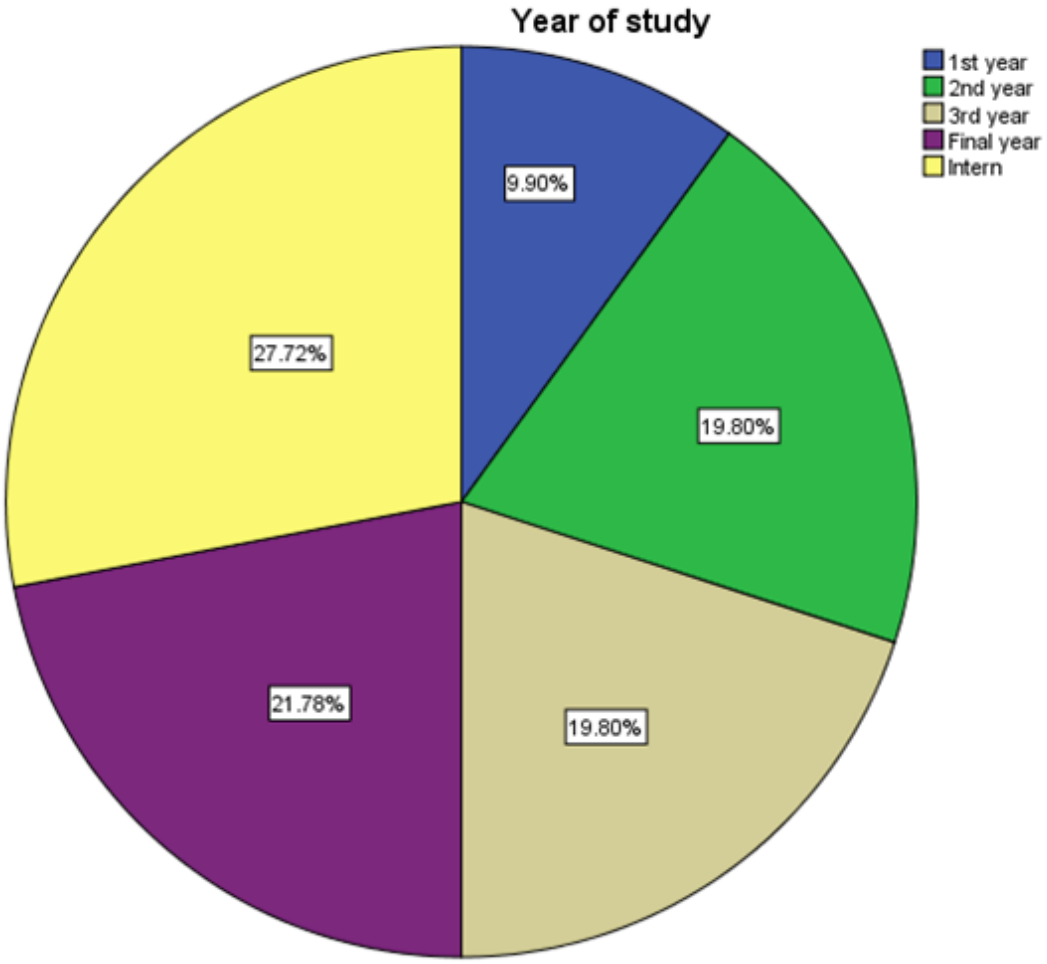

Fig 2:Shows the response of the different years of study among undergraduate dental students.9.90% of the 1st years(blue),19.80% of the 2nd years(green) and 3rd years(beige),21.78% of the final years(pink) and 27.72% of the interns(yellow) attended this survey. Majority of the participants are interns.

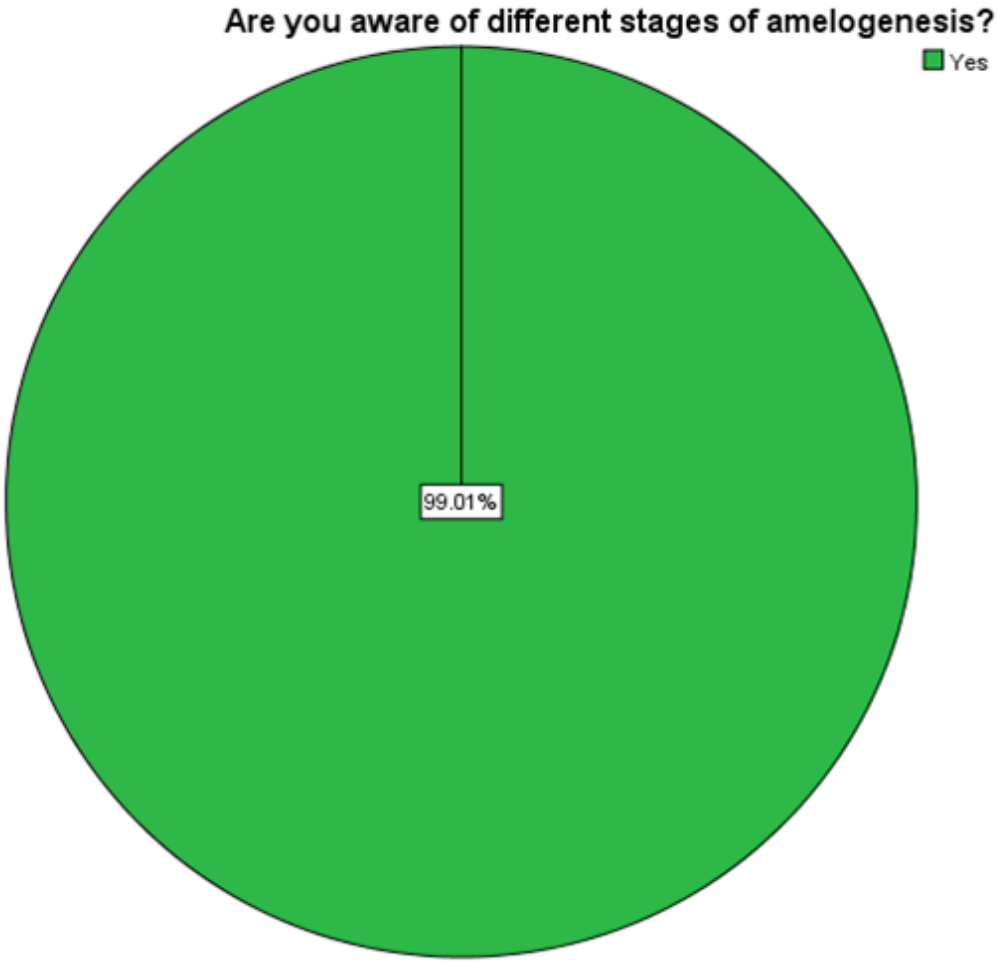

Fig 3:Shows the response of the awareness of different stages of amelogenesis among undergraduate dental students.99.01% of the all undergraduate students were aware of the different stages of amelogenesis(green).

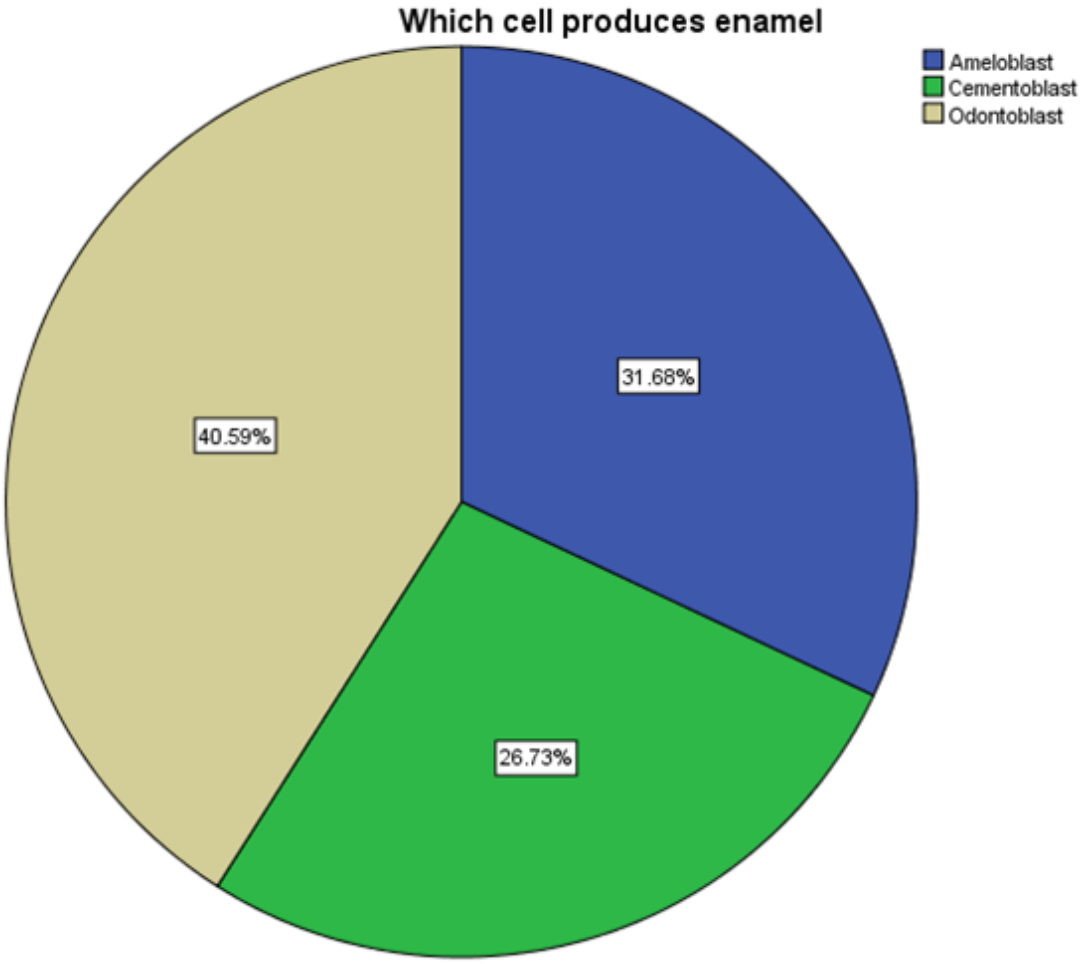

Fig 4:Shows the response of the question which cell produces enamel among undergraduate students.Blue denotes ameloblast(31.68%), 31.68% of the undergraduate students answered ameloblast correctly for the question which cell produces enamel.

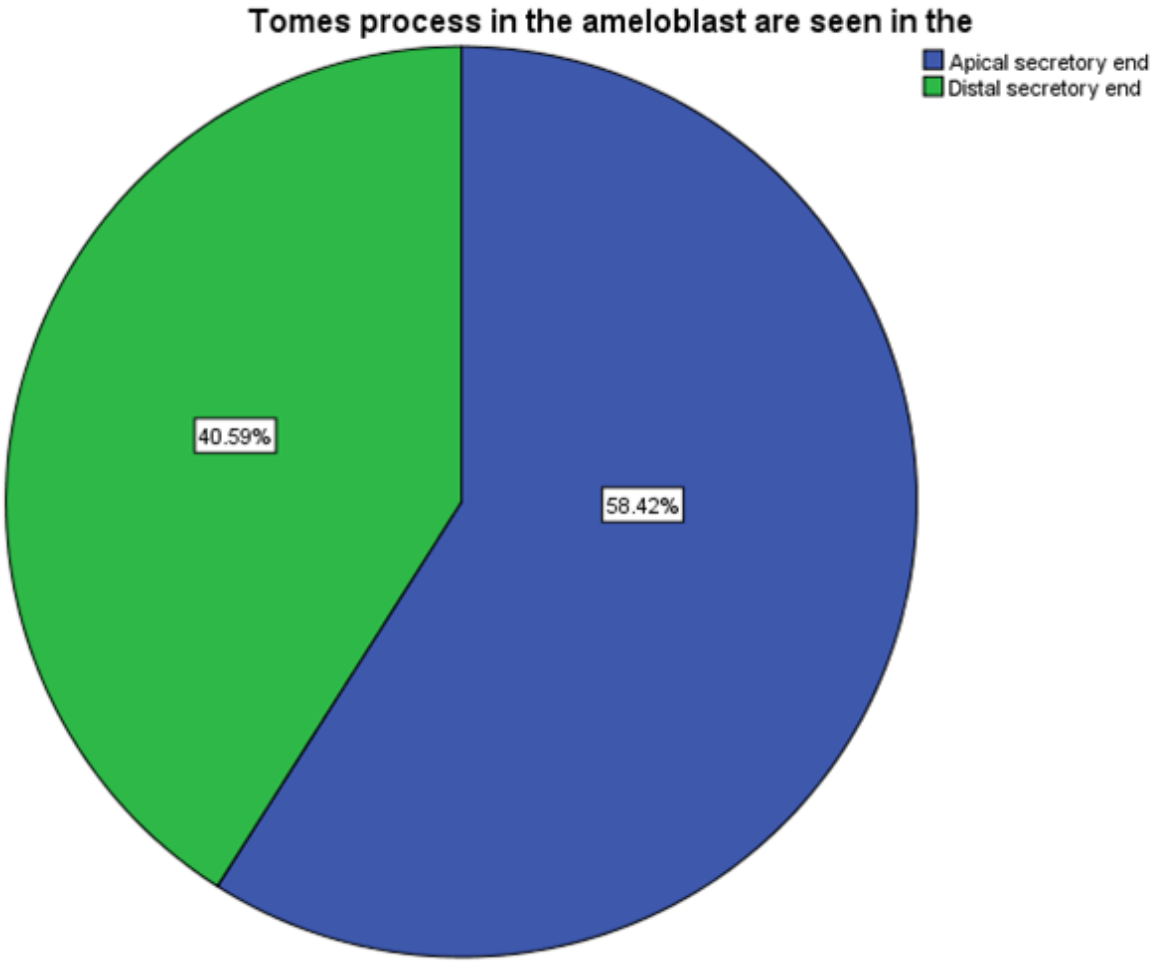

Fig 5:Shows the response of the question where the tomes process is seen , 58.42% answered that ameloblast is seen in apical secretory end(blue) and the rest 40.59% respond distal secretory end(green)

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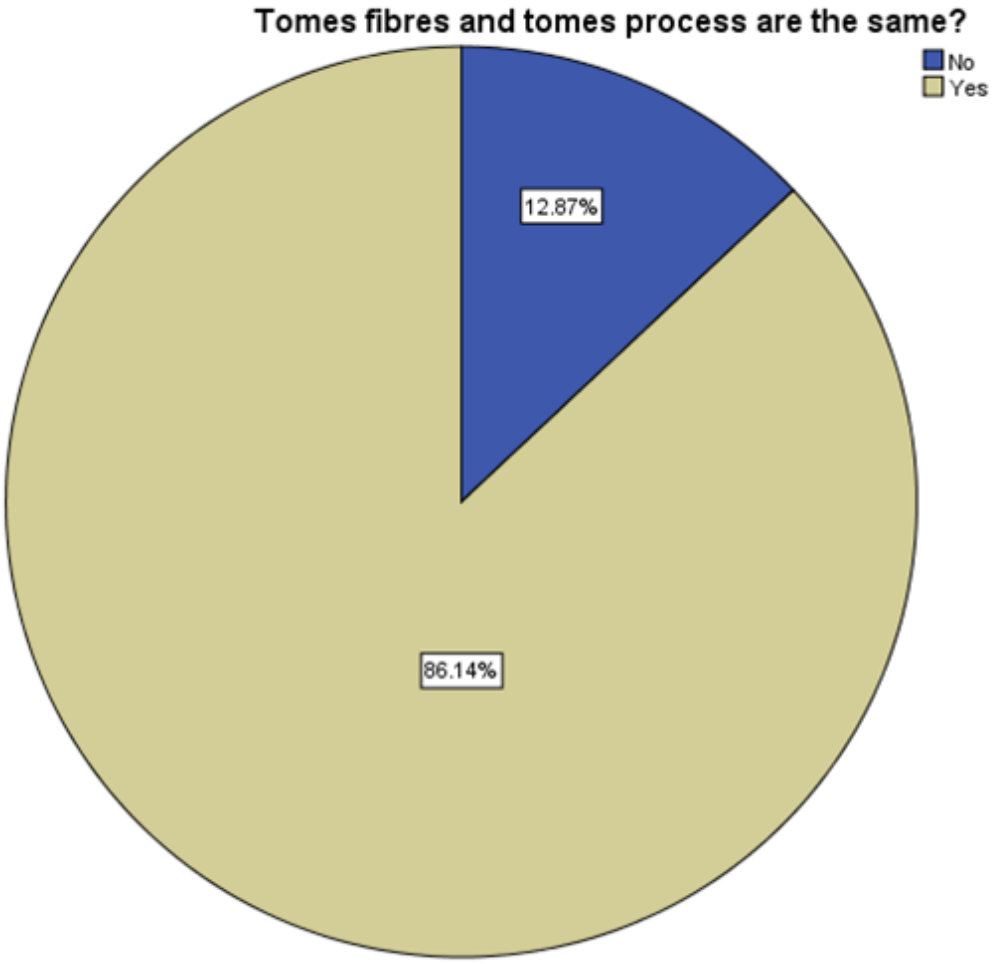

Fig 6:Shows the response of the question where the tomes process and tomes fibres are the same. 86.14% answered yes(beige) and 12.87% answered no(blue).

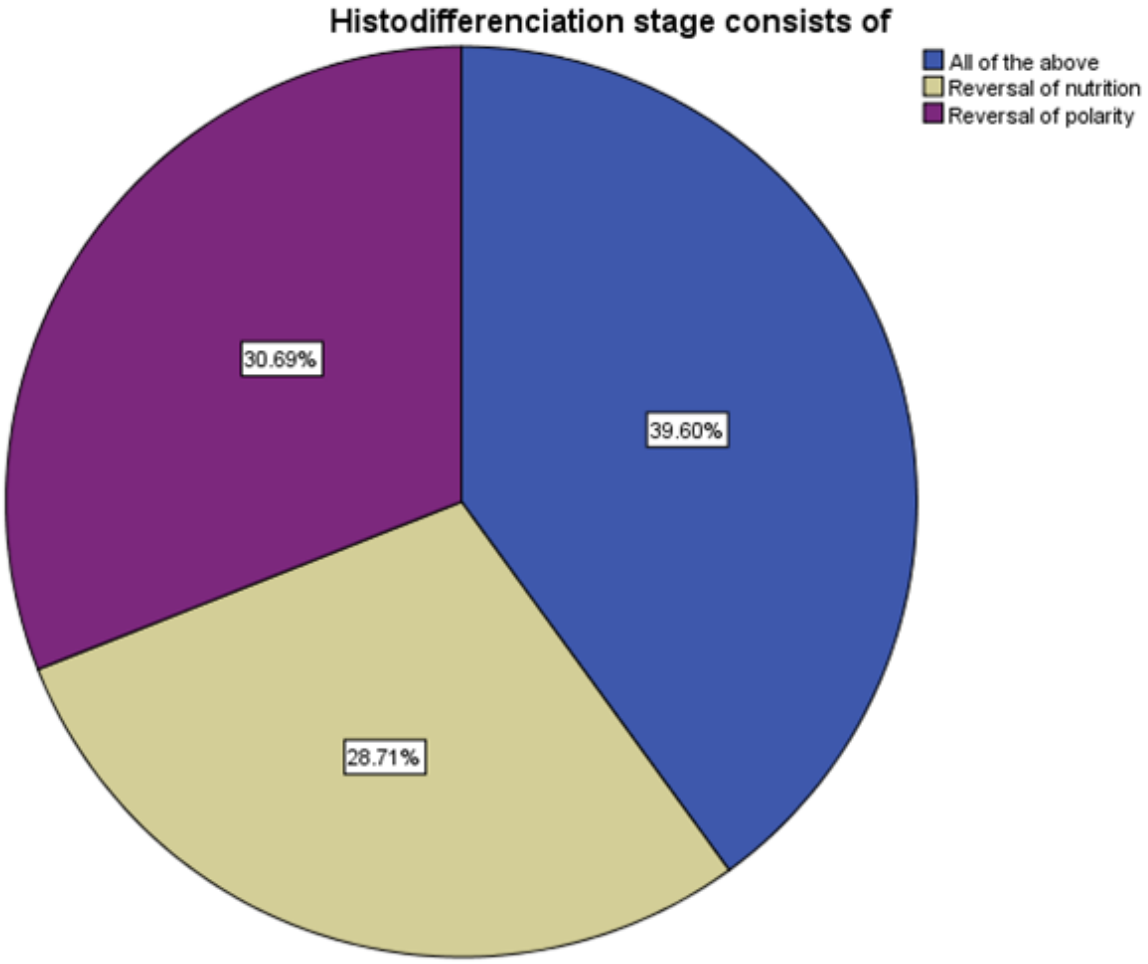

Fig 7:Shows the response of the question on various histodifferentiation stages. 28.71% answered reversal of nutrition(beige),30.69% responded reversal of polarity(pink) and 39.60% answered all of the above(blue).

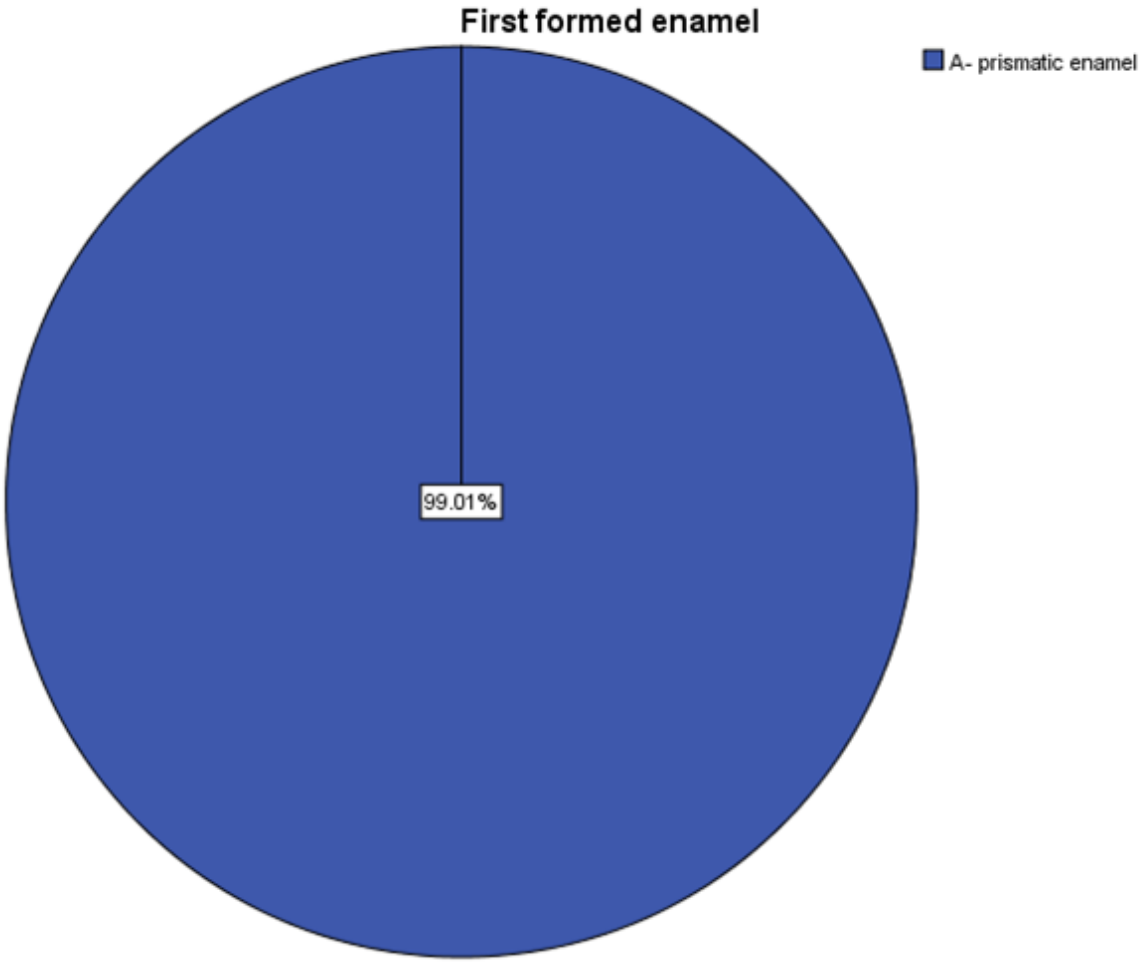

Fig 8: Shows the response of the question on the first formed enamel.99.01% answered a prismatic enamel (blue).

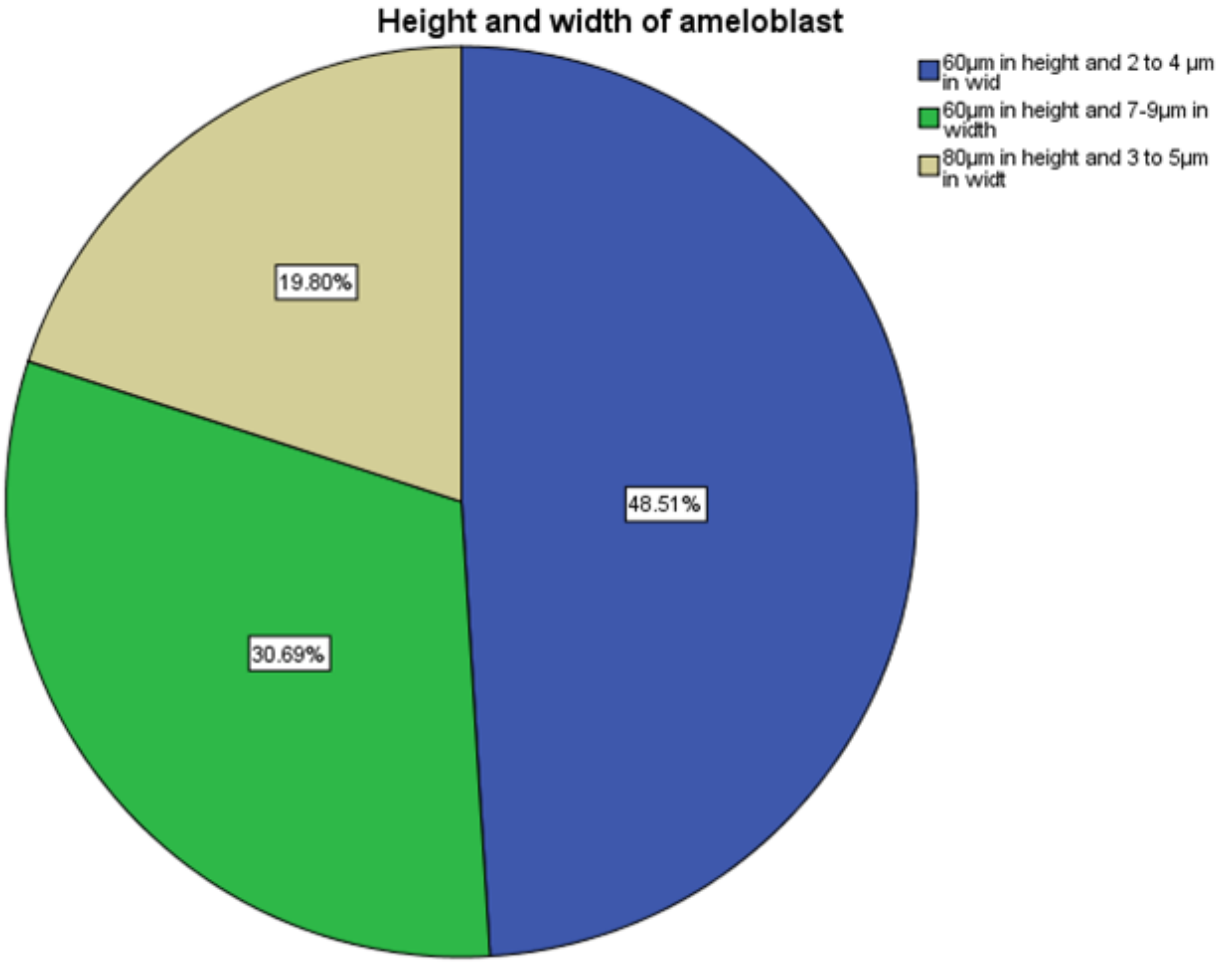

Fig 9:Shows the response of the question on the height and width of the enamel . 30.69% answered 60mu m in height &7-9 mu m in width(green) , 48.51% 60mu m in height &2-4 mu m in width(blue) and 19.80 % 80mu m in height & 3-5 mu m in width(beige).

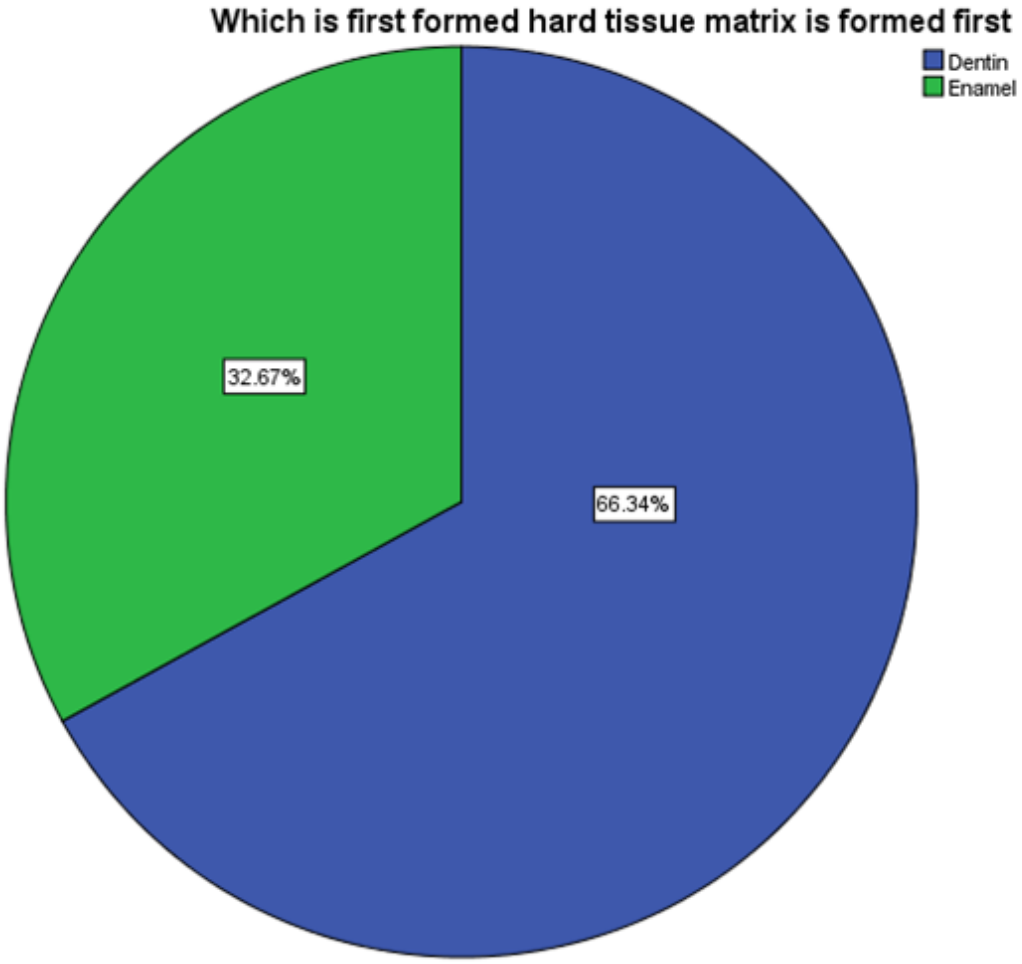

Fig 10 :Shows the response of the question on first formed hard structurel . 66.34% answered dentin(blue), 32.67% answered enamel(green).

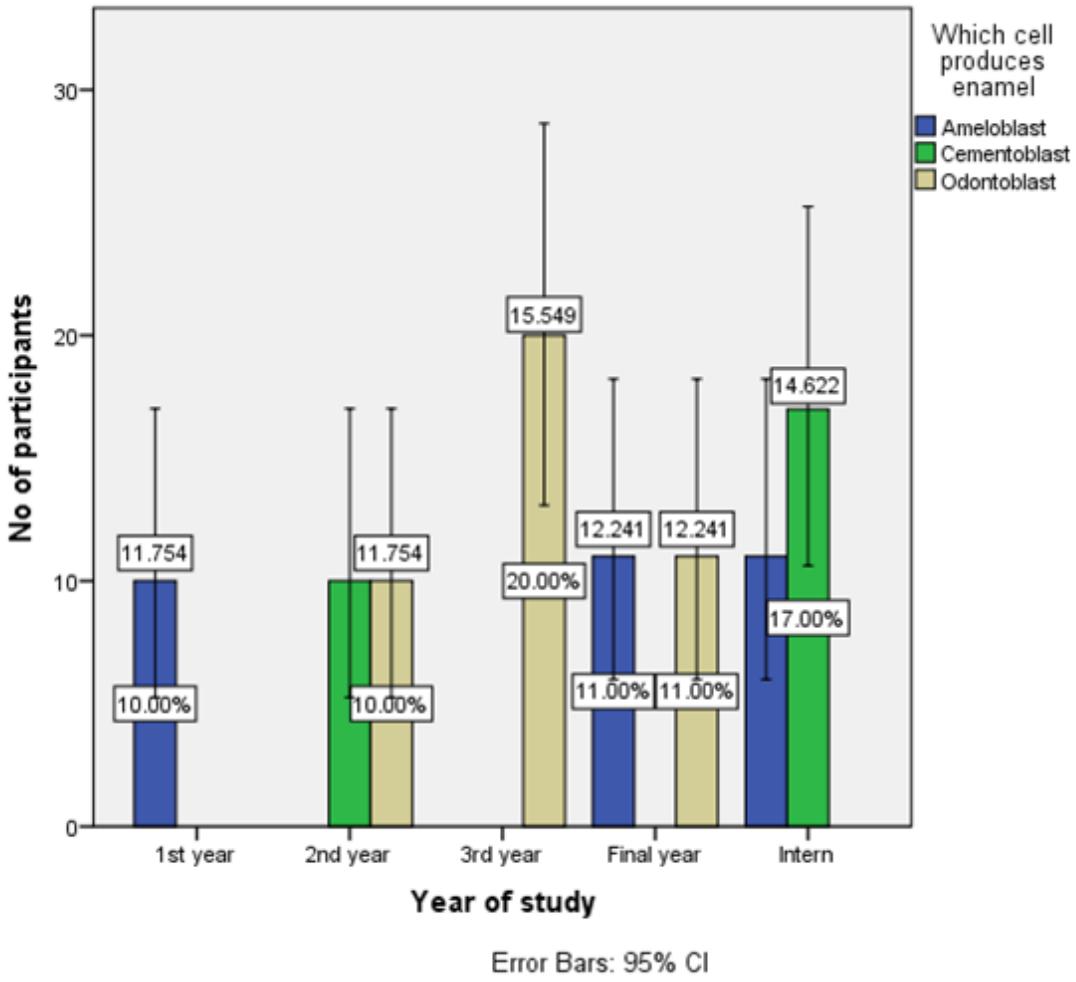

Figure 11:-Bar graph representing the association between year of study and cells producing enamel. X-axis represents the year and the Y-axis represents the no of participants, of which green indicates cementoblast,blue indicates ameloblast and beige indicates odontoblast.From this question we can associate the inference that 10-11% students of 1st year,final year and internship answered rightly for this questions and they were well knowledgeable about this topic.The difference was statistically significant{Pearson's Chi square value :195.009[a], P value - 0.01 ($p<0.05$)}.

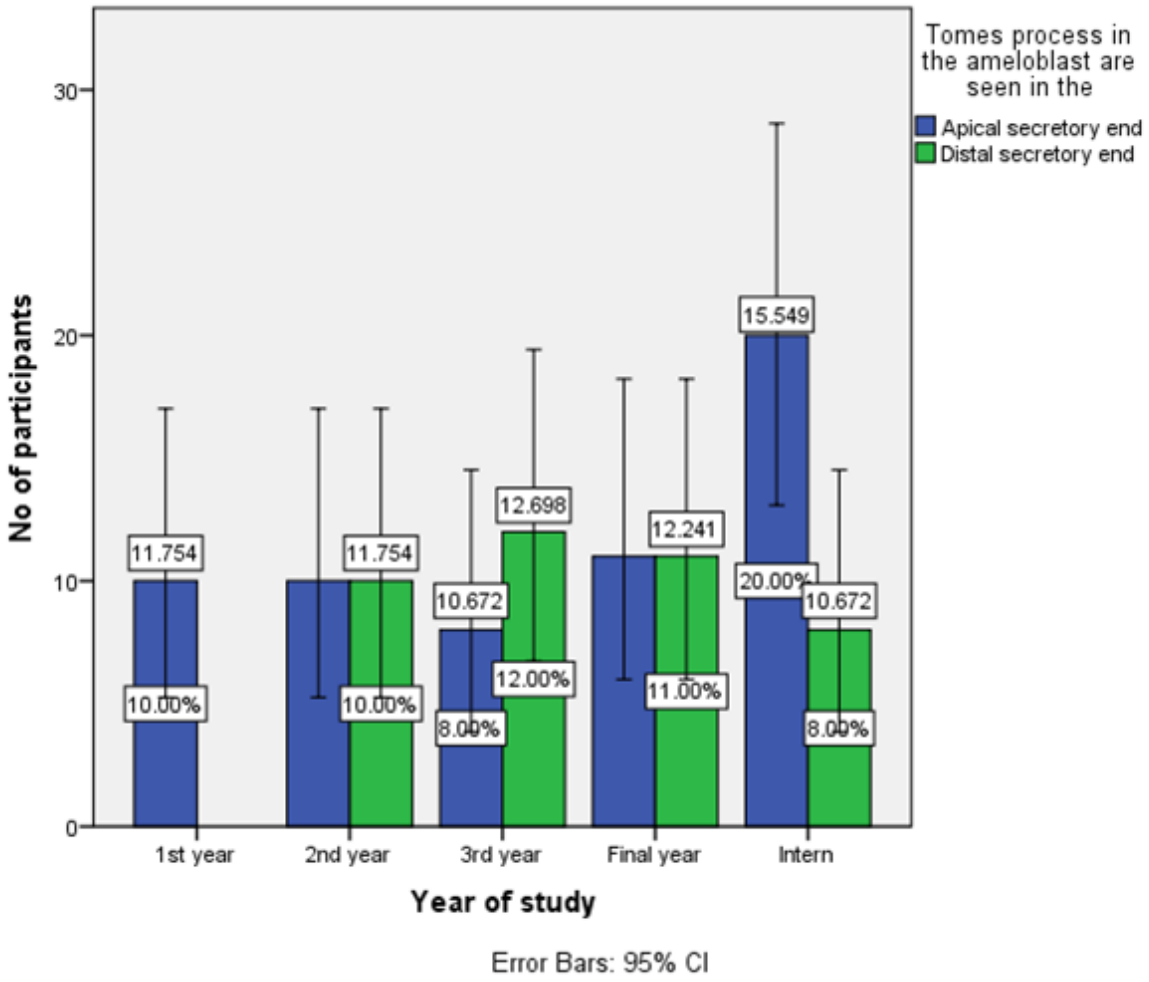

Figure 12- Bar graph representing the association between year of study and the presence of the tomes process in ameloblast . The X- axis represents the year and the Y-axis represents the no of participants, of which blue indicates apical secretory end and green indicates distal secretory end. From this question we can associate the inference that 8-11% students of each year answered rightly for this question and they were well knowledgeable about this topic.The difference was statistically significant{Pearson's Chi square value :114.259[a], p value - 0.01 ($p<0.05$)}.

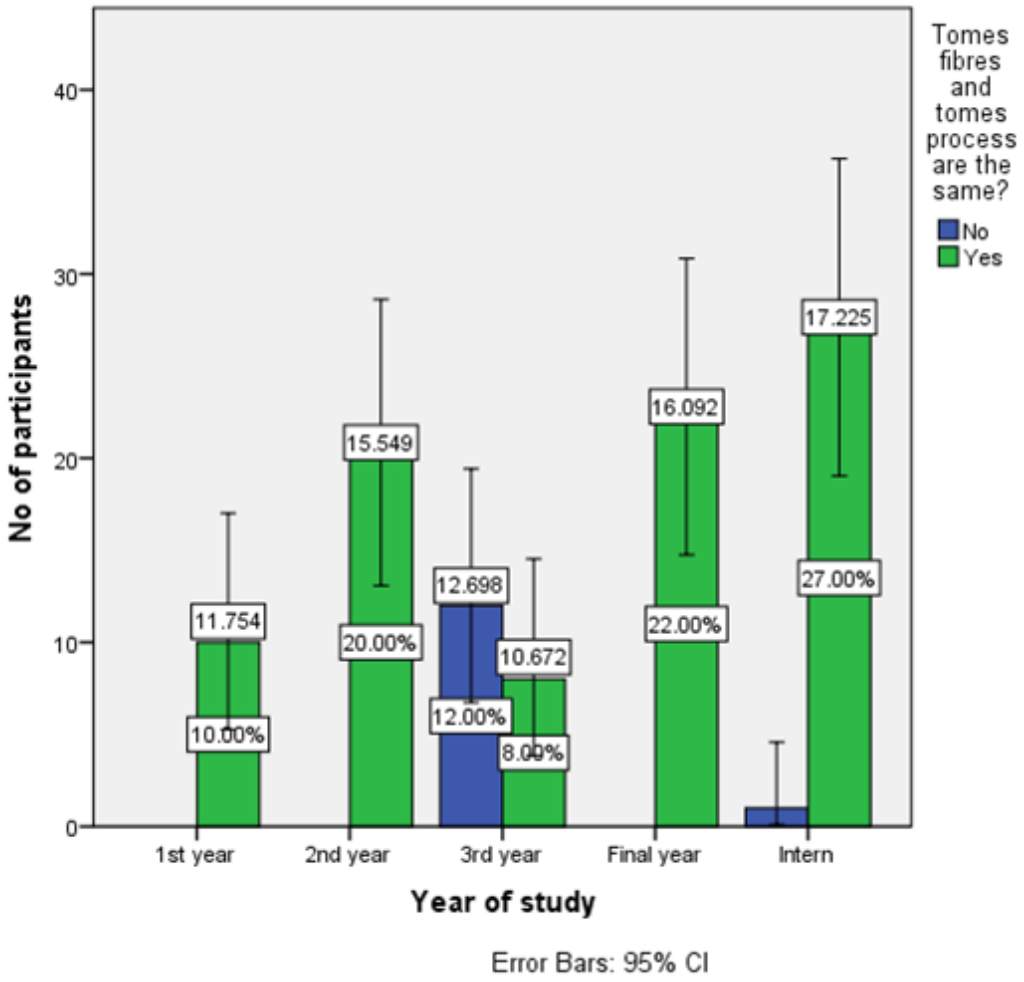

Figure 13- Bar graph representing the association between year of study and Tomes process. X- axis represents the year and the Y-axis represents the no of participants, of which green indicates yes,blue indicates no.From this question we can associate the inference that majority of 12% students of 3rd year answered rightly for this questions and they were well knowledgeable about this topic.The difference was statistically significant{Pearson's Chi square value :150.524[a], p value - 0.01 ($p<0.05$)}.

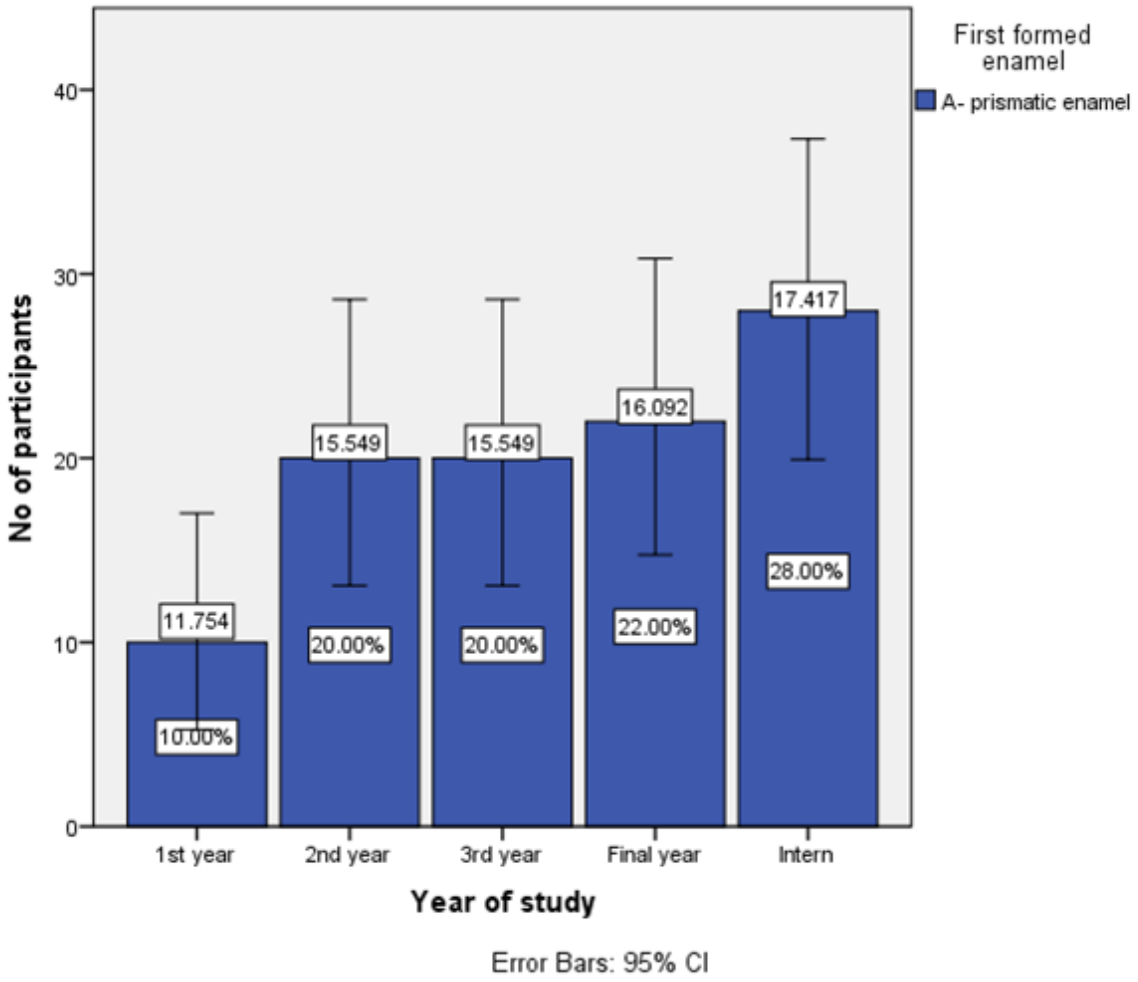

Figure 14- Bar graph representing the association between year of study and cells' aprismatic enamel. X-axis represents the year and the Y-axis represents the no of participants, of which blue indicates aprismaticenamel.From this question we can associate the inference that 10-28% students of each year answered rightly for this questions and they were well knowledgeable about this topic.The difference was statistically significant.{Pearson's Chi square value :101.000[a], p value - 0.01 ($p<0.05$)}.

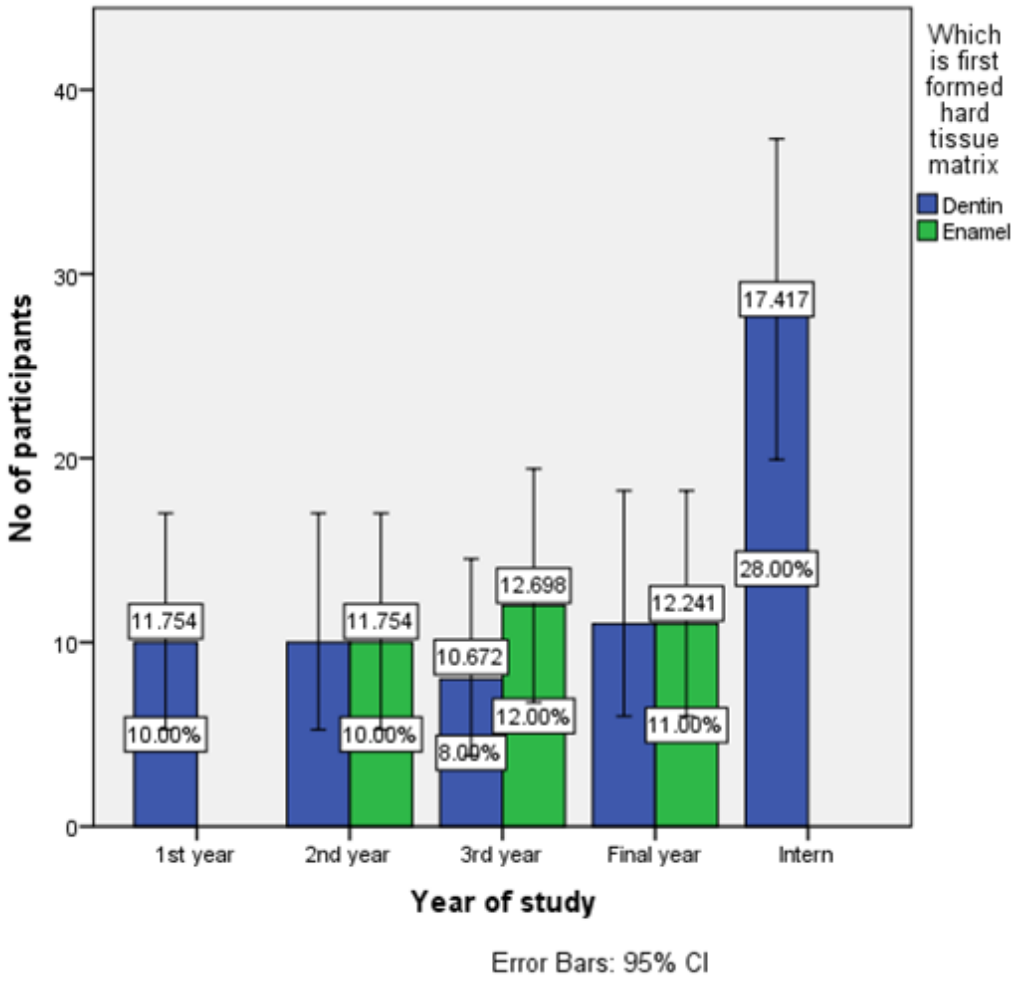

Figure 15- Bar graph representing the association between year of study and first formed hard tissue. X-axis represents the year and the Y-axis represents the no of participants, of which green indicates enamel and blue indicates dentin.From this question we can associate the inference that 10-12% students of 2nd year,3rd year and final year answered rightly for this questions and they were well knowledgeable about this topic.The difference was statistically significant

{Pearson's Chi square value :132.109[a], p value - 0.01 ($p<0.05$)}.

Results:

29.70% of the age group between 26-30(beige);9.90% of the age group between 17-20(blue);19.80% of the age group between 21-25(green);18.81% of the age group between 31-35(pink);20.79% of the age group more than 35 attended this survey(red)(fig 1)s.9.90% of the 1st years(blue),19.80% of the 2nd years(green) and 3rd years(beige),21.78% of the final years(pink) and 27.72% of the interns(yellow) attended this survey (fig 2).This questionnaire survey consisted of 15 questions which were based on

knowledge, attitude and awareness.99.01% of the all undergraduate students were aware of the different stages of amelogenesis(green) from this question (fig 3).58.42% answered that ameloblast is seen in apical secretory end(blue) and the rest 40.59% respond distal secretory end(green) (fig 5).86.14% answered yes(beige) and 12.87% answered no(blue) (fig 6).28.71% answered reversal of nutrition(beige),30.69% responded reversal of polarity(pink) and 39.60% answered all of the above(blue) (fig 7).99.01% answered a prismatic enamel (blue) (fig 8).30.69% answered 60mu m in height &7-9 mu m in width(green) , 48.51% 60mu m in height &2-4 mu m in width(blue) and 19.80 % 80mu m in height & 3-5 mu m in width(beige) (fig 9). 66.34% answered dentin(blue), 32.67% answered enamel(green) (fig10).Bar graph representing the association between year of study and cells producing enamel. X- axis represents the year and the Y-axis represents the population distribution, of which green indicates cementoblast,blue indicates ameloblast and beige indicates odontoblast.From this question we can associate the inference that 10-11% students of 1st year,final year and internship answered rightly for this questions and they were well knowledgeable about this topic(fig 11);Bar graph representing the association between year of study and the presence of the tomes process in ameloblast . The X- axis represents the year and the Y-axis represents the population distribution, of which blue indicates apical secretory end and green indicates distal secretory end. From this question we can associate the inference that 8-11% students of each year answered correctly for these questions and they were well knowledgeable about this topic(fig 12);Bar graph representing the association between year of study and Tomes process. X- axis represents the year and the Y-axis represents the population distribution, of which green indicates yes,blue indicates no.From this question we can associate the inference that majority of 12% students of 3rd year answered rightly for this questions and they were well knowledgeable about this topic(fig 13);Bar graph representing the association between year of study and cells' aprismatic enamel. X- axis represents the year and the Y-axis represents the population distribution, of which blue indicates aprismaticenamel.From this question we can associate the inference that 10-28% students of each year answered rightly for this questions and they were well knowledgeable about this topic(fig 14);Bar graph representing the association between year of study and first formed hard tissue. X- axis represents the year and the Y-axis represents the population distribution, of which green indicates enamel and blue indicates dentin.From this question we can associate the inference that 10-12% students of 2nd year,3rd year and final year answered rightly for this questions and they were well knowledgeable about this topic(fig 15).From the results we can assume that the majority of the undergraduate students are well aware and have an excellent platform about this topic.

Discussion:

Enamel, the hardest human tissue, provides the outer protective covering for teeth. it's composed primarily of carbonate substituted hydroxyapatite crystallites. The method of enamel development is termed amelogenesis and therefore the cells that make enamel, the ameloblasts, are derived from oral ectoderm. The ameloblasts are liable for controlling the complex processes necessary to make this tissue. Ameloblasts express thousands of genes during enamel development thereby orchestrating and controlling amelogenesis during a highly regulated manner. Ameloblasts secrete an extracellular matrix that's organized round the developing enamel crystallites. This matrix is processed in an orderly manner helping control the expansion and directionality of the enamel crystals.A comprehensive review on enamel development is out there providing readers with information on the cellular functions, extracellular matrix and mineralization of enamel.Enamel is one among the foremost important structures of the tooth, both from a functional and esthetic point of view. Primary enamel carries registered information regarding metabolic and physiological events that occurred during the period around birth and also the first year of life. Detailed knowledge of normal development and therefore the structure of enamel is vital for the assessment of mineralization defects.

The present study was conducted among undergraduate students of Saveetha dental college and hospitals.All the students were aware of different stages of amelogenesis.In our study, it was observed that interns and final year's are more aware about this topic when compare to first years(27).This may be due to years of experience and academic reinforcement on the topic. Genetic and environmental factors have marked influence on these processes; consequently, may result in developmental enamel defects (DED) from any event disturbing these phases(27,28).To diagnose developmental defects like amelogenesis imperfecta the knowledge of amelogenesis is important(29). More teaching and Didactic lectures should be incorporated in the undergraduate curriculum to have more knowledge about amelogenesis(29,30).As we discussed with previous study,our study explains the knowledge about different stages of amelogenesis among undergraduate where as previous study describes about the stages of amelogenesis in molar teeth of young rats(31) same way other previous study explains about the effects of chronic fluoride exposure on morphometric parameters defining the stages of amelogenesis and ameloblast modulation in rat incisors(32,33).In our study, create an awareness among undergraduate students but the previous are tested with animals,no study create knowledge and awareness among undergraduate students.

Conclusion:

From our study,we can understand that this study helps to create awareness among undergraduate students and more knowledge about amelogenesis which helps the undergraduate students in forthcoming examinations like NEET exam and so on.One of the important clinical disorder about amelogenesis is amelogenesis imperfecta.Amelogenesis imperfecta (AI) is that the name given to a heterogeneous group of conditions characterized by inherited developmental enamel defects.So from this survey we can conclude that undergraduate students are aware of amelogenesis and have moderate knowledge on it.

Limitations:

Limitations of the study was that it was conducted among undergraduates of one particular college.

Future scope:

It can be conducted in bigger populations including undergraduate students of other dental colleges too to assess their awareness levels.

Acknowledgment:

Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University

Conflict of interest:

Nil

Source of funding:

The present study was supported by the following agencies

- Saveetha Institute of Medical and Technical Sciences
- Saveetha Dental College and Hospitals
- Saveetha University
- Shanthi Ram Dental Clinic

References:

1. Aoba T. Enamel Formation During Porcine Amelogenesis [Internet]. Hard Tissue Mineralization and Demineralization. 1992. p. 63–80. Available from: http://dx.doi.org/10.1007/978-4-431-68183-0_5

2. Moreno EC, Aoba T. Calcium Binding in Enamel Fluid and Driving Force for Enamel Mineralization in

the Secretory Stage of Amelogenesis [Internet]. Vol. 1, Advances in Dental Research. 1987. p. 245–51. Available from: http://dx.doi.org/10.1177/08959374870010021301

3. Guo F, Feng J, Wang F, Li W, Gao Q, Chen Z, et al. Bmp2 Deletion Causes an Amelogenesis Imperfecta Phenotype Via Regulating Enamel Gene Expression [Internet]. Vol. 230, Journal of Cellular Physiology. 2015. p. 1871–82. Available from: http://dx.doi.org/10.1002/jcp.24915

4. Weiss MP, Voegel JC, Frank RM. Enamel crystallite growth: Width and thickness study related to the possible presence of octocalcium phosphate during amelogenesis [Internet]. Vol. 76, Journal of Ultrastructure Research. 1981. p. 286–92. Available from: http://dx.doi.org/10.1016/s0022-5320(81)80059-7

5. Costacurta L. A Study of Cell Height and Nuclear Volume in the Enamel Organ during Amelogenesis in the Upper Incisor of the Rat [Internet]. Vol. 44, Journal of Dental Research. 1965. p. 1247–53. Available from: http://dx.doi.org/10.1177/00220345650440062301

6. Imhof T, Rosenblatt K, Pryymachuk G, Weiland D, Noetzel N, Deschner J, et al. Epithelial loss of mitochondrial oxidative phosphorylation leads to disturbed enamel and impaired dentin matrix formation in postnatal developed mouse incisor. Sci Rep. 2020 Dec 16;10(1):22037.

7. 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.

8. Mathew MG, Samuel SR, Soni AJ, Roopa KB. Evaluation of adhesion of Streptococcus mutans, plaque accumulation on zirconia and stainless steel crowns, and surrounding gingival inflammation in primary molars: randomized controlled trial. Clin Oral Investig. 2020 Sep;24(9):3275–80.

9. 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;48(4):299–306.

10. R H, Hannah R, Ramani P, Ramanathan A, Jancy MR, Gheena S, et al. CYP2 C9 polymorphism among patients with oral squamous cell carcinoma and its role in altering the metabolism of benzo[a]pyrene [Internet]. Vol. 130, Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology. 2020. p. 306–12. Available from: http://dx.doi.org/10.1016/j.oooo.2020.06.021

11. Antony JVM, Ramani P, Ramasubramanian A, Sukumaran G. Particle size penetration rate and effects of smoke and smokeless tobacco products - An invitro analysis. Heliyon. 2021 Mar 1;7(3):e06455.

12. Sarode SC, Gondivkar S, Sarode GS, Gadbail A, Yuwanati M. Hybrid oral potentially malignant disorder: A neglected fact in oral submucous fibrosis. Oral Oncol. 2021 Jun 16;105390.

13. Hannah R, Ramani P, WM Tilakaratne, Sukumaran G, Ramasubramanian A, Krishnan RP. Author response for "Critical appraisal of different triggering pathways for the pathobiology of pemphigus vulgaris—A review" [Internet]. Wiley; 2021. Available from: https://publons.com/publon/47643844

14. Chandrasekar R, Chandrasekhar S, Sundari KKS, Ravi P. Development and validation of a formula for objective assessment of cervical vertebral bone age. Prog Orthod. 2020 Oct 12;21(1):38.

15. Subramanyam D, Gurunathan D, Gaayathri R, Vishnu Priya V. Comparative evaluation of salivary malondialdehyde levels as a marker of lipid peroxidation in early childhood caries. Eur J Dent. 2018 Jan;12(1):67–70.

16. Jeevanandan G, Thomas E. Volumetric analysis of hand, reciprocating and rotary instrumentation techniques in primary molars using spiral computed tomography: An in vitro comparative study. Eur J Dent. 2018 Jan;12(1):21–6.

17. Ponnulakshmi R, Shyamaladevi B, Vijayalakshmi P, Selvaraj J. In silico and in vivo analysis to identify the antidiabetic activity of beta sitosterol in adipose tissue of high fat diet and sucrose induced type-2 diabetic experimental rats. Toxicol Mech Methods. 2019 May;29(4):276–90.

18. Sundaram R, Nandhakumar E, Haseena Banu H. Hesperidin, a citrus flavonoid ameliorates hyperglycemia by regulating key enzymes of carbohydrate metabolism in streptozotocin-induced diabetic rats. Toxicol Mech Methods. 2019 Nov;29(9):644–53.

19. Alsawalha M, Rao CV, Al-Subaie AM, Haque SKM, Veeraraghavan VP, Surapaneni KM. Novel mathematical modelling of Saudi Arabian natural diatomite clay. Mater Res Express. 2019 Sep 4;6(10):105531.

20. Yu J, Li M, Zhan D, Shi C, Fang L, Ban C, et al. Inhibitory effects of triterpenoid betulin on

inflammatory mediators inducible nitric oxide synthase, cyclooxygenase-2, tumor necrosis factor-alpha, interleukin-6, and proliferating cell nuclear antigen in 1, 2-dimethylhydrazine-induced rat colon carcinogenesis. Pharmacogn Mag. 2020;16(72):836.

21. Shree KH, Hema Shree K, Ramani P, Herald Sherlin, Sukumaran G, Jeyaraj G, et al. Saliva as a Diagnostic Tool in Oral Squamous Cell Carcinoma – a Systematic Review with Meta Analysis [Internet]. Vol. 25, Pathology & Oncology Research. 2019. p. 447–53. Available from: http://dx.doi.org/10.1007/s12253-019-00588-2

22. Zafar A, Sherlin HJ, Jayaraj G, Ramani P, Don KR, Santhanam A. Diagnostic utility of touch imprint cytology for intraoperative assessment of surgical margins and sentinel lymph nodes in oral squamous cell carcinoma patients using four different cytological stains. Diagn Cytopathol. 2020 Feb;48(2):101–10.

23. Karunagaran M, Murali P, Palaniappan V, Sivapathasundharam B. Expression and distribution pattern of podoplanin in oral submucous fibrosis with varying degrees of dysplasia – an immunohistochemical study [Internet]. Vol. 42, Journal of Histotechnology. 2019. p. 80–6. Available from:http://dx.doi.org/10.1080/01478885.2019.1594543

24. Sarode SC, Gondivkar S, Gadbail A, Sarode GS, Yuwanati M. Oral submucous fibrosis and heterogeneity in outcome measures: a critical viewpoint. Future Oncol. 2021 Jun;17(17):2123–6.

25. Raj Preeth D, Saravanan S, Shairam M, Selvakumar N, Selestin Raja I, Dhanasekaran A, et al. Bioactive Zinc(II) complex incorporated PCL/gelatin electrospun nanofiber enhanced bone tissue regeneration. Eur J Pharm Sci. 2021 May 1;160:105768.

26. Prithiviraj N, Yang GE, Thangavelu L, Yan J. Anticancer Compounds From Starfish Regenerating Tissues and Their Antioxidant Properties on Human Oral Epidermoid Carcinoma KB Cells. In: PANCREAS. LIPPINCOTT WILLIAMS & WILKINS TWO COMMERCE SQ, 2001 MARKET ST, PHILADELPHIA …; 2020. p. 155–6.

27. Ruspita I, Das P, Xia Y, Kelangi S, Miyoshi K, Noma T, et al. An - Pathway Operates During Late Stages of Tooth Development to Control Amelogenesis. Front Physiol. 2020 Oct 26;11:582610.

28. Lagerström-fermér M, Landegren U. Understanding Enamel Formation from Mutations Causing X-

Linked Amelogenesis Imperfecta [Internet]. Vol. 32, Connective Tissue Research. 1995. p. 241–6. Available from: http://dx.doi.org/10.3109/03008209509013729

29. Kim YJ, Lee Y, Zhang H, Song J-S, Hu JC-C, Simmer JP, et al. A Novel de Novo sp6 Mutation Causes Severe Hypoplastic Ame-Logenesis Imperfecta. Genes [Internet]. 2021 Feb 26;12(3). Available from: http://dx.doi.org/10.3390/genes12030346

30. Nikolopoulos G, Smith CEL, Poulter JA, Murillo G, Silva S, Lamb T, et al. Spectrum of pathogenic variants and founder effects in amelogenesis imperfecta associated with MMP20. Hum Mutat [Internet]. 2021 Feb 18; Available from: http://dx.doi.org/10.1002/humu.24187

31. Reith EJ. The stages of amelogenesis as observed in molar teeth of young rats. J Ultrastruct Res. 1970 Jan;30(1):111–51.

32. Morphogenesis of Gap Junctions in Rat Amelogenesis [Internet]. Journal of Electron Microscopy. 1981. Available from: http://dx.doi.org/10.1093/oxfordjournals.jmicro.a050305

33. Smid JR, Young WG, Monsour PA. Dipeptidyl-peptidase II and cathepsin B activities in amelogenesis of the rat incisor [Internet]. Vol. 109, European Journal of Oral Sciences. 2001. p. 260–6. Available from: http://dx.doi.org/10.1034/j.1600-0722.2001.00025.x