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&
21st Annual General Meeting of
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PROCEEDING BOOK

Enhancing Clinical Practice Through Responsible Research

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Dr. Ilham Wan Mokhtar

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19th Annual Scientific Meeting and 21st Annual General Meeting of IADR Malaysian Section – Proceeding Book

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Footnote

Preface

The Annual Scientific Meeting and Annual General Meeting for IADR MalSec is an awaited event of the year for our members and oral sciences researchers in Malaysia. An exciting time for the field of dental, oral and craniofacial research to advance the health and well-being of the population. This yearly event has been the platform to share findings, discuss any issues and challenges in dental research, and to initiate collaborations among IADR-MalSec members and researchers from dental institutions in Malaysia.

It is a great privilege for us to present the inaugural proceeding of the IADR-MalSec to the authors and delegates of the event. We hope that you will find it useful, exciting and inspiring. We want to express our gratitude and appreciation for all the reviewers who helped us maintain the high quality of manuscripts included in the proceedings published by IADR-MalSec. We would also like to extend our thanks to the members of the organizing team for their hard work. We are now optimistic and full of hope about getting the full paper proceedings as our yearly publication to maximize the dissemination of research findings to more audience.

We hope that all participants of the 19th Annual Scientific Meeting & 21st Annual General Meeting conducted on the 10th October 2020, which was conducted online in line with the current pandemic situation in Malaysia had a wonderful and fruitful time at the conference. Special acknowledgement to our Immediate Past-President Associate Prof Dr Raja Azman for his leadership and guidance to the scientific team during the planning and execution of the scientific program.

Please enjoy the reading of our full paper proceedings, and we hope to have more in the coming years for better knowledge dissemination in our dental fraternity. These proceedings provide a written record of the research findings conducted by a various researcher from different dental institutions in Malaysia.

Associate Professor Dr Siti Mariam Ab Ghani
Scientific Chair
19th Annual Scientific Meeting & 21st Annual General Meeting
President
International Association for Dental Research Malaysian Section (IADR-MalSec)
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A retrospective study of the prevalence of C- shaped canals in mandibular second molar in Faculty of Dentistry UiTM evaluated by periapical radiograph

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Abstract. This retrospective study aims to analyse the prevalence of C-shaped canals in mandibular second molar among patients in the Faculty of Dentistry UiTM evaluated by intraoral periapical radiographs and to correlate the relationship between race and prevalence of C-shaped canals in mandibular second molar. Methods: 300 adult patients aged between 18 to 70 years old recruited. Their periapical radiographs collected using convenience sampling method via EasyDent software in determining the C-shaped root canal configurations. The occurrence of C-shaped canals and their relationship to gender, ethnicity, and age were examined and statistically analysed using chi-squared test in SPSS 25. Results: Ninety-four (31.33%) patients had a C-shaped root canal configuration. The configuration was further classified into Type I, Type II, and Type III with a prevalence of 9.57%, 81.92%, and 8.51% respectively. There were significant differences in the distribution of C-shaped canals with respect to gender, but not with respect to race or age Conclusion: There were significant variations in the root and canal morphology in mandibular second molars, which should be considered during debridement and obturation of the root canal system.

Introduction

A C-shaped root canal is generally defined as a root canal that in the transverse section, is shaped like the letter C. However, not all cases have a canal continuously C-shaped from orifice to apical foramen. Therefore, a tooth is usually defined as having a C-shaped root canal system when any arbitrary cross-section presents a C-shaped root canal configuration. It was first introduced by Cooke and Cox in 1979 and documented in their endodontic literature.

The shape and number of roots are determined by Hertwig's epithelial sheath, which bends in a horizontal plane below the cementoenamel junction and fuses in the center leaving openings for roots [1]. C‑shaped canal appears when fusions of either the buccal or lingual aspect of the mesial and distal roots occur. These fusions remain irregular, and two roots stay connected by an inter radicular ribbon [2]. Aside from that, another reason could be due to the failure of the fusion of Hertwig's epithelial sheath which is so far the most valid explanation for the formation of the C-shaped canal configuration. Failure of the Hertwig's epithelial root sheath (HERS) to fuse on the buccal side will result in the formation of a lingual groove, whereas failure to fuse on the lingual would result in a buccal groove [3]. Hence, this fusion is not uniform and a thin inter radicular ribbon connects the two roots together. However, failure of the sheath to fuse on both the buccal and lingual sides will result in the formation of a conical or prism-shaped root. The reason for fusion to occur is most likely due to the small distance between the root canals [4].

To facilitate a better understanding of the root canal anatomy of C-shaped canals, numerous classifications were proposed. The various classifications of C-shaped canals are either based on the cross-sectional shape or radiographic presentation. In 2004, Fan et al came out with a radiographic appearance of the C-shaped canals which are classified into three types [5];

Type I: Conical or square root with a vague, radiolucent longitudinal line separating the root into distal and mesial parts. There was a mesial and a distal canal that merged into one before exiting at the apical foramen (foramina).

Type II: Conical or square root with a vague, radiolucent longitudinal line separating the root into distal and mesial parts. There was a mesial and a distal canal, and the two canals appeared to continue on their own pathway to the apex.

Type III: Conical or square root with a vague, radiolucent longitudinal line separating the root into distal and mesial parts. There was a mesial and a distal canal, one canal curved to and superimposed on this radiolucent line when running toward the apex, and the other canal appeared to continue on its own pathway to the apex.

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The teeth that qualified as having a C- shaped canal system had to exhibit all the following three features: Fused roots, a longitudinal groove on the lingual or buccal surfaces of the root, and at least one cross-section of the canal belong to the C1, C2, or C3 configuration. Throughout the world, C-shaped canal has been reported most frequently in the East Asian population particularly in Koreans (32.7%) and Chinese (31.5%), and this is followed by Lebanese (19.1%), Saudi Arabians (10.6%), and Americans (2.7%-8%) [6-10]. In Malaysia, C-shaped root canals are often seen among Chinese (14.6%), compared to non-Chinese (1.04%) [11]. This canal configuration is most found in mandibular second molars (2.7-44.5%) [12]. The bilateral occurrence was over 70%-81% [13].

Methods and Materials

At the beginning of the study, a calibration process was done between two researchers as well as two specialists (endodontist). During the calibration process, 20 IOPA radiographs that were taken from previous research done by our supervisors, were used as materials for the calibration process. All 20 radiographs were observed and examined by each examiner for C- shaped canal configuration based on Fan's radiographic classification. The observation and examination of the same radiographs in the same sequence were repeated after a duration of 10 days. This is done to ensure that each examiner had a substantial correlation as measured by Cohen's Kappa. Once the examiners were trained, the study was initiated. Levels of intra-examiner agreement for day 1 and day 10 using Cohen's Kappa index were within the range of 0.6 until 1.0. The Kappa index of inter-examiner agreement among the six pairings of the four examiners ranged from 0.41 to 0.88 for day 1 and 0.58 and 1.00 for day 10 respectively.

The sample size calculation was measured using Epi-info software. The total population size of patients coming to the Faculty of Dentistry UiTM from the faculty's year of establishment which was in 2006 until 14th December 2018 was 56219. The expected frequency was 14.6% with an acceptable Margin of Error (MOE) of 5%. The design effect, clusters, and confidence level were 1.0, 1, and 95% respectively. The sample size calculated was 191, however, it was increased to 300. This was done to increase the accuracy of the result.

In this study, convenience sampling was done with both the inclusion and exclusion criteria taken into consideration. A total of 300 intraoral periapical radiographs were selected through a convenience sampling method using EasyDent Software, from the Department of Oral Radiology. The inclusion criteria for individuals selected in the study includes second mandibular molars (teeth 37 or 47), an age limit of 18-70 years old, those with records of IOPA radiographs, and radiographs taken from 5/10/2015 to 5/10/2019, whereas, records with incomplete documentation or data (no periapical radiograph) and teeth other than mandibular second molars were excluded from this research. Only records of patients who fit both the inclusion and exclusion criteria were retrieved from IDERMS using their registration number. The results from the data collected were subsequently recorded in google form and excel which includes patient's demographic data such as name, age, gender and race, registration number (RN), and IOPA radiograph. Root canal configurations were classified as C-shaped canals if they fulfilled the Fan's radiographic classification [5]. The data collected were examined and statistically analyzed using SPSS 25. Ethical approval for this study was obtained from the Research Ethics Committee dated 13th March 2019.

Results

Out of 300 periapical radiographs of mandibular second molar, 94 were C-shaped (31.33%). According to Fan's radiographic classification, the prevalence of root canal configurations of the C-shaped mandibular second molar was: Type 1: 9 (9.57%), Type 2: 77 (81.92%), and Type 3: 8 (8.51%).

Out of 94 C-shaped second mandibular molars, 84 were patients of Bumiputera status while the other 10 were not. The number of female patients who have C-shaped mandibular second molars was 62 (39.5%) while 32 (22.4%) mandibular second molars were found in male patients. There were significant differences in the distribution of C-shaped canals with respect to gender (P=0.001), but not with respect to race or age (P=0.41 and P=0.60, respectively).

In addition, C- shaped canals were found to be the highest among the 18-30 years age group with a prevalence of 30.85%, while the lowest rate was noted in the 61-70 years age group with a prevalence of 10.64%.

Discussion

A total of 300 intraoral periapical radiographs of patients from the Faculty of Dentistry UiTM were selected using convenience sampling method. This was done by reviewing all intraoral radiographs from EasyDent software; an Intraoral radiograph software used in the faculty, from 2015 until 2019 and selecting periapical radiographs of mandibular second molars that fit both the inclusion and exclusion criteria as mentioned.

Mandibular second molars teeth generally have multiple variants as compared to other molars. It was reported in a study that the incidences of C-shaped root canals are commonly seen in mandibular molars, especially in second molars [12]. There are several methods to study the shape of the roots of mandibular second molars which includes cross-sectional studies and radiographic studies. Cross-sectional studies can be evaluated based on Melton's Classification or Fan's anatomic classification, which is a modified version of Melton's method [14]. Fan's classification also includes radiographical aspects which is classified into Type 1, Type 2, and Type 3 [5]. The prevalence of mandibular second molars with type 2 C-shaped canal was 81.92% which is significantly higher compared to the other types.

The occurrence of C-shaped canals was noted to be higher among patients with non-Bumiputera status, 38.5%, as compared to patients with Bumiputera status, 30.7%. Patients with non- Bumiputera status include Chinese, Indians, and others. Hence, these results are consistent with reports depicted in a previous study by Yang et al., where the highest prevalence of C-shaped canal was found in the Chinese population in a study conducted in China [7].

The prevalence of C- shaped canals was found to be the highest among the 18-30 years age group with a prevalence of 30.85%, while the lowest rate was noted in the 61-70 years age group with a prevalence of 10.64%. This finding is consistent with the results of a study that recorded people in the 65-74 years age group had the lowest rate. However, the highest rate noted in that study was seen among the 45-54 years age group.

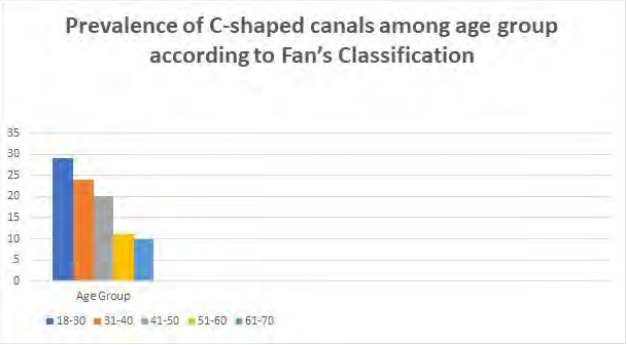
Table 1: Prevalence of C-shaped canals among Bumiputera and Non-Bumiputera

			Shape		Total
			Yes	No	
Bumiputera	Bumiputera	Count % within Gender	84 30.7%	190 69.3%	274 100.0%
	Non-bumiputera	Count % within Gender	10 38.5%	16 61.5%	26 100.0%
Total		Count % within Gender	94 31.3%	206 68.7%	300 100.0%

32 C-shaped mandibular second molars were from males (n=143) corresponding to a prevalence of 22.4% and 62 from females (n=157) corresponding to a prevalence of 39.5%. The difference between gender was considered significant at ($P<0.05$). The results correlate with a study that states males were associated with significantly lower odds of C- shaped canals [15].

Table 2: Prevalence of C-shaped canals among gender

			Shape		Total
			Yes	No	
Gender	Male	Count % within Gender	32 22.4%	111 77.6%	143 100.0%
	Female	Count % within Gender	62 39.5%	95 60.5%	157 100.0%
Total		Count % within Gender	94 31.3%	206 68.7%	300 100.0%



Graph 1: Prevalence of C-shaped canals among age group according to Fan's Classification

Conclusion

C-shaped root canals do occur among Malaysians and are not a rare finding. The diagnosis and treatment of C-shaped canals are highly challenging due to its complicated canal configurations which vary in their presentation. Thorough knowledge of the different possible alterations in the internal anatomy of teeth is important for successful endodontic therapy. The C-shaped canal system tends to vary considerably in their anatomical configuration and thus leads to difficulties in canal cleaning and shaping, debridement, obturation, and restoration. Hence, early detection of C-shaped canals preoperatively is very crucial as a precaution in order to be able to provide effective management to obtain a successful root canal treatment which subsequently leads to a good prognosis of the tooth.

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Application of artificial intelligence for bone modelling

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Abstract. Cortical bone thickness is a major factor in successful planning for miniscrew placement. It can only be viewed with 3D X-ray imaging. This study aimed to assess buccal cortical thickness and interradicular distance in the maxilla and mandible for Class I skeletal pattern and to formulate a prediction model for cortical thickness using artificial neural network (ANN). Using cone beam computed tomography (CBCT) images of 180 adult subjects with Class I skeletal pattern, cortical thickness of maxillary and mandibular alveolar processes was measured from central incisor to second molar at 8mm from cementoenamel junction. Four prediction models were developed then tested and validated using the Mean Squared Error (MSE) and the Correlation Coefficient (R). Cortical thickness in maxilla is higher than mandible anteriorly and lower than mandible posteriorly. Cortical thickness is highest between the two molars in both arches. The models' MSE for the validation set was in the range of 0.013- 0.112, while the Correlation Coefficient (R) value for the validation set was in the range of 0.87- 0.97 and for the test set in the range of 0.86-0.95. Artificial neural network prediction models can be used to estimate buccal cortical thickness without exposing patients to 3D imaging.

Introduction

The objectives of orthodontic treatment are not limited to the achievement of well aligned even teeth and normal occlusion between the maxillary and mandibular dental arches. Orthodontic treatment also aims to provide a beautiful smile line that harmonizes with the face and improves smile esthetics. Treatment with orthodontic fixed appliances may have side effects, including anchorage loss.

Orthodontists are in continuous search of treatment modalities that requires minimal patient compliance while at the same time providing maximal anchorage This has led orthodontists to use Temporary Anchorage Devices (TADS) such as mini-plates, dental implants and miniscrews. Miniscrews feature several advantages such as their small size, low cost, relatively straightforward insertion and removal procedures and the ability to provide adequate anchorage to enable orthodontic movements especially in cases where anchorage requirement is critical [1]. The desired type of orthodontic tooth movement should be determined before site choice of miniscrew placement because insertion at an unsuitable site may contribute to complication of treatment planning and restraining tooth movement [2].

Miniscrews can be placed in maxillary and mandibular alveolar interradicular spaces, they can be also inserted in the palate and retromolar area. In planning the placement of orthodontic miniscrews, hard and soft tissue anatomy, root proximity, sinus and nerve locations should all be carefully considered. Cortical bone thickness plays a critical role in primary stability of the miniscrews. Sites with higher cortical thickness reduces the possibility of premature loosening and loss of miniscrews [3]. Guidelines were suggested, and favorable positions were recommended to have 1mm cortical thickness to increase possibility of success of miniscrews. Muscle activities, bite force and masticatory efficiencies differ in subjects with different skeletal relationships [4]. In Class II subjects less occlusal contacts and a large overjet appears to be related to poor masticatory performance.

Variations in attached muscles activity can influence size and shape of bones [5]. In recent years, advances in Cone Beam Computerized Tomography (CBCT) technology have enabled increased three-dimensional analyses of the maxilla and mandible, with the result of data accumulation on the morphology and thickness of the cortical bone. Few studies considered the effect of skeletal vertical relationship on the alveolar cortical thickness and concluded that vertical facial morphology is related to cortical bone thickness at sites of miniscrew placement.

Moreover, a previous study concluded that cortical bone thickness differs significantly in subjects with different skeletal relationship [6]. Cortical thickness can only be viewed with three dimentional imaging by computed tomography (CT) or CBCT. Although CBCT radiation dose is less than CT, it is still higher than the conventional 2D images. With recent advances in AI (Artificial Intelligence) and the advances in

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computational technology, more precise and reliable tools are available for modelling of biological systems. Artificial Neural Networks (ANNs) are capable of modelling of biological systems since they can recognize complex nonlinear patterns [7]. To date, there is no deterministic cortical thickness model, thus the aim of this study was to assess maxillary and mandibular cortical thickness and interradicular distance in Class I subjects and utilize the data to create an ANN model for cortical thickness prediction to avoid the use of 3D imaging that exposes patients to high doses of radiation

Materials and Methods

The study was conducted retrospectively using CBCT images from records of 180 adult subjects (90 males, 90 females) with Class I skeletal pattern. Data were collected after ethical approval was obtained from Faculty of Dentistry, UiTM. The following general inclusion criteria were used: age between 20-45 years, Malay ethnic group, normal vertical relationship with SN/GoMe angle 27º- 37º, healthy alveolar bone level with no vertical or horizontal periodontal bone loss, no periapical or periradicular pathologies or radiolucency, no facial asymmetries, no cleft lip or palate or any craniofacial anomaly, no impacted or missing teeth in the measured quadrant, no history of orthognathic surgery or orthodontic treatment. All images were taken using i-CAT unit (Imaging Sciences International, Hatfield, PA). All selected scans were taken with the following settings: 120 KVp, 5mA, 4 seconds exposure time and 0.3 mm voxel size. The i-CAT Vision software was used to view and reconstruct the three- dimensional views. Cortical thickness and interradicular distance of maxillary and mandibular alveolar processes was measured from central incisor to second molar at 8mm from cementoenamel junction (Figures 1, 2)

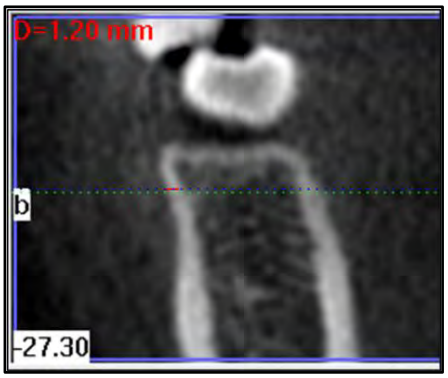

Fig 1. Cortical thickness measurement


Fig 2. Interradicular distance measurement

2.1 Statistical analysis

Intra-examiner and inter-examiner reliability were measured. Ten images from each group were remeasured two weeks apart. Data were analyzed using SPSS software version 20.0 (SPSS, Chicago, IL). The intra-examiner and inter-examiner measurement reliability were tested using Intraclass Correlation Coefficient (ICC). Descriptive statistics (mean and standard deviation) were performed for all variables. Independent t-test was used to evaluate differences between genders

2.2 Model Development

Mean and standard deviation of all the variables were generated. Statistical analysis showed no significant difference between male and female mean values for all variables. Consequently, in this study, it was decided to pool the data for male and female subjects. To create the model, a specific type of ANN was used which is the Nonlinear Autoregressive Network with Exogenous Inputs (NARX). The training program that was chosen in this study, for the ANN, was MATLAB R2014a, which is a software package developed by MathWorks, Inc. (Natick, Massachusetts, USA) and is recommended to train this type of ANN. Interradicular distance was

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chosen as the predictor in model development. Since input data plays crucial role in model development, the Goodness of Fit (R^2) data were used for choice of input data and number of models needed. R^2 value deteriorated when a single model was developed for the whole arch. Conversely, separate models for the anterior and posterior segment showed high R^2 values and low Mean Squared Error (MSE), thus it was decided to develop separate models for anterior and posterior segment. The final step was using the Neural Network Toolbox to develop and validate the models. The model development process was repeated 4 times to create the 4 models. In MATLAB, NARX network was accessed, data were then selected and uploaded to the network. The data were then divided randomly, by the network, into training, validation, and testing sets. The percentage chosen by the ANN were as follows: 70% of the data for training, 15% for testing and 15% for validation. The Levenberg–Marquardt algorithm was used as the optimization training algorithm to train the ANN model [7]. After training of the network, the mean squared error (MSR) and the correlation coefficient (R) regression values were obtained for each data set.

Results

The data were analyzed for intra-examiner and inter-examiner reliability using Intraclass Correlation Coefficient (ICC), and the reported ICC results ranged from 0.903-0.966 with 95% confident interval. Based on the ICC results, it can be concluded that, the test-retest reliability was "excellent". In the maxilla the highest mean value for interradicular distance anteriorly was available between the centrals (1-1), while posteriorly it was highest between second premolar and fist molar (5-6). In the mandible the highest interradicular distance was between lateral and canine anteriorly (1-2) and the two molars posteriorly (6-7). Cortical thickness in both arches was highest between lateral and canine anteriorly 2-3) and the two molars posteriorly (6-7) as shown in Table 1.

Table 1. Cortical thickness and interradicular distance mean values

Site	Maxilla		Mandible	
	BCT Mean ± SD (mm)	**Root distance Mean ± SD mm**	**BCT Mean ± SD mm**	**Root distance Mean ± SD mm**
1-1	0.65± 0.26	2.53± 0.66	0.27± 0.15	1.20± 0.28
1- 2	0.73 ± 0.21	2.31 ± 0.61	0.27 ± 0.15	1.52 ± 0.40
2-3	1.01± 0.18	2.52± 0.53	1.74± 0.36	2.52± 0.63
3-4	1.17± 0.27	2.31± 0.61	1.22± 0.27	2.17± 0.62
4-5	1.23±0.27	2.59±0.52	1.52±0.40	2.51±0.58
5-6	1.38±0.46	2.68±0.46	2.20±0.65	3.14±0.41
6-7	1.61±0.36	2.31±0.60	2.81±0.53	3.54±0.53

BCT (Buccal Cortical Thickness)

3.1 Model testing and validation

Four ANN prediction models were developed. Mean Squared Error **(**MSE) was in the range of 0.013- 0.112 for the validation set, and 0.104-0.116 for the test set. The Correlation Coefficient (R) value for the validation set was in the range of 0.87- 0.97 and for the test set in the range of 0.86-0.95 (Table 2).

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Table 2. Mean Squared Error (MSE) and Regression (R) Value for the Developed Models

	MSE		R	
Model	**Validation set**	**Testing set**	**Validation set**	**Testing set**
Upper Anterior	1.12245e-1	1.13782e-1	8.83595e-1	8.64158e-1
Upper Posterior	1.32455e-2	1.0473e-1	8.80213e-1	8.80146e-1
Lower Anterior	1.12527e-1	1.31731e-1	8.70110e-1	8.59585e-1
Lower Posterior	1.02538e-1	1.16762e-1	9.70647e-1	9.52209e-1

Discussion

In this study buccal cortical thickness and interradicular distance of the maxilla and mandible were evaluated in areas of possible placement of orthodontic miniscrews. Ethnicity was reported as a factor that could influence cortical thickness [8]. In this study only Malaysian Malay subjects were included. The cementoenamel junction (CEJ) was used instead of the alveolar crest as the reference point to measure the vertical heights at 8 mm. The alveolar crest could be affected by periodontitis and, unlike CEJ, cannot serve as a constant and reliable reference point. Since previous studies reported that buccal cortical thickness could be influenced by the differences in vertical skeletal relation, in this study, only records with normal vertical relation were included [9].

A previous study reported that buccal cortical thickness differs significantly between subjects with different sagittal skeletal pattern [6]. Thus, only subjects with Class I skeletal relationship were included in this study. The assessment of cortical thickness and interradicular distances was intended to be used for modelling. The accuracy of models is greatly influenced by the input data; hence, it was crucial to use data of one skeletal class since different skeletal relationship demonstrated different patterns which requires different model for each skeletal pattern. Understanding the characteristics of the cortical bone thickness of the maxilla and mandible not only has descriptive benefits, but clinical implications as well. The use of miniscrews helps clinicians to achieve absolute anchorage.

Miniscrews are being increasingly used by orthodontists as a tool to avoid loss of anchorage and to gain more control on tooth movement. Miniscrews are relatively easy to insert and remove, they are also independent of patient's cooperation. These attractive features made miniscrews a principle part of the treatment plan in many difficult cases. Hence the quest by clinicians to eliminate possible causes of failure.

Anchorage is one of the most critical concerns in orthodontic treatment planning. Traditional anchorage appliances like head gears, lingual and palatal arches, have many limitations. Reports indicated that these appliances enhance anchorage, but they are not able to eliminate tooth movement in the direction of the reactive force applied to the teeth. Miniscrews provide a compliance independent means of absolute skeletal anchorage and can prevent undesirable tooth movement [10]. Although more than one factor affects the success of miniscrew placement, cortical bone thickness appears to be the most important factor [11]. Orthodontic miniscrews are placed in the maxilla and mandible and do not osseointegrate like traditional endosseous implants. Miniscrews retention and stability are dependent upon the mechanical interdigitation between the cortical bone and miniscrew surface [5]. Similarly, other researchers concluded that the success of miniscrew retention is dependent upon the thickness of the cortical bone. In a meta –analysis for risk factors and failure rate of miniscrews, it was found that cortical bone thickness of more than 1 mm was associated with higher success rate [12], the same conclusion was reached by an earlier study [13]. The mean value, in this study, for labial cortical thickness in the anterior segment was 1 mm or higher in both arches at one site only, which is site 2-3. The results of this study showed that in Class I, the cortical thickness increases posteriorly in both arches, this agrees with results from previous studies [14, 15]. This pattern might be explained by the higher functional demands placed on the posterior teeth. Cortical thickness can only be assessed using 3D imaging which is associated with increased radiation doses to patients compared with conventional dental radiographic techniques. In a previous study, the researchers reported that a relationship was found between intracranial meningiomas and dental radiographic procedures [16]. Unfortunately, guidelines on the clinical usage of 3D imaging in dentistry are frequently poorly presented and not always adhered to [17]. The models developed in this study could offer an alternative for measuring cortical thickness without exposing patients to high radiation doses.

In this study ANN was chosen as the tool to develop the model due to its ability to capture nonlinear relationship which makes them proper tools for modeling biological systems [18]. The developed models in this study are the first deterministic ANN models for bone thickness. The validity of the model was tested on a different set of data to ensure accuracy of prediction. In this study the R value of the test set of developed models was in the range of 0.86-0.95. It is reported that 0.8 R value and above is considered very strong [19]. Thus, it is safe to say that the developed models showed a high level of accuracy and could be used to predict buccal cortical thickness for orthodontic treatment planning.

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Conclusions

A subarea of Artificial Intelligence (AI), which is the nonlinear autoregressive neural network with exogenous inputs (NARX), was employed to create the first ANN deterministic model for cortical thickness which can be used to predict buccal cortical thickness and plan miniscrew placement safely without exposing the patient to the high radiation doses of 3D imaging.

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Attitudes towards a new teaching aid of local anaesthetic simulator kit (LASK) in performing inferior alveolar nerve block (IANB): a preliminary investigation - part I

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Abstract. The inferior alveolar nerve block (IANB) is one of the most frequent regional anaesthesia used in dental procedures. Thus, it is imperative for dental undergraduates to have proper training in order to reduce mistakes and ensure that they master local anaesthesia administration skills prior to treating patients. In response to this issue, an innovative local anaesthesia simulator kit (LASK) as a new andragogy in pre-clinical training in performing an IANB was developed. This study is mainly to describe students' attitudes towards LASK. A cross-sectional survey design was employed with the study population comprising of first-year dental undergraduates. A survey question using 5-point Likert scale statements was used. Descriptive statistics were carried out to report students' perceived attitudes of behaviour intention towards LASK. Majority of the students strongly agreed or agreed to the intention to continue using LASK because it offered (n= 80; 96.3%), ease of use of LASK (n=74; 89.2%) and help to manage better time (n=71; 85.5%). For all survey items, only 6% of students have disagreement, namely strongly disagreed or disagreed to continue using LASK in future. Having an effective and efficient technique in performing IANB in dental procedures, particularly at undergraduate level, is crucial.

Introduction

Local anaesthesia is an essential part in dental treatment and is formally taught in worldwide dental curriculum. The inferior alveolar nerve block (IANB) is one of the most frequent regional anaesthesia techniques used in dental procedures. However, this technique is reported to have the highest failure rates among dental undergraduates, interns and even, dental professionals. Thus, it is imperative for dental undergraduates to have proper practical training in order to reduce mistakes and ensure that they master local anaesthesia administration skills prior to treating patients in their clinical years. In response to this issue, this research focuses on development of an innovative local anaesthesia simulator kit (LASK) as a new andragogy in pre-clinical training in performing an IANB, and will be further introduced at regional dental schools. Conventional and widely-used pre-clinical teaching methods at worldwide dental schools is via skull mannequins (bone) or dental models. However, even though going through this simulation training, most students feel ill-confident and insufficiently prepared for their first injection on a human-being. Thus, this preliminary study is mainly to describe the student's attitudes towards a Novel Local Anaesthesia Simulator Kit (LASK) in performing Inferior Alveolar Nerve Block (IANB).

Material and method

This study has obtained the ethics approval from UiTM Research Ethics Committee (REC/182/19). In this preliminary study, a nine-item survey was used to assess the attitudes of non-clinical students towards a new teaching aid in administering inferior alveolar nerve block (IANB); namely Local Anaesthetic Simulator Kit (LASK). The study method is described in the following section.

2.1 Study design and participants

A cross-sectional survey design was employed. This study was carried out at Faculty of Dentistry, Universiti Teknologi MARA (UiTM), Cawangan Selangor, Sungai Buloh Campus; with the study population comprising all the first-year students registered in Semester 2/2019.

2.2 Instrument and data analysis

A survey question was used as method of data collection. Three items investigating demographic characteristics of participants and nine 5-point Likert scale statements examined attitudes of behaviour intention towards LASK among participants. In or order to confirm the internal consistency of items, Cronbach's alpha coefficient was used. Internal consistency is an assessment of how reliably survey or test items that are designed to measure the same construct do so. Moreover, descriptive statistics (frequency and percentage) were carried out to report student's perceived attitudes of behaviour intention towards LASK.

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Results

Descriptive analysis is presented in this section. Demographic background of respondents will be described. Data results relating to internal consistency of the instrument and descriptive analysis of variables were also reported.

3.1 Demographic background

All 83 participants were undergraduate dental students from Year 1; involving 69.9% female and 30.1% male. Majority of students were between ages of 18 to 20 years (n=71; 85.5%), and less than 15% (n=12) were between ages of 21 to 22.

3.2 Descriptive analysis

In testing internal consistency, the 9-item Likert's scale obtained good reliability scores (Cronbach's alpha = .885). In analysing descriptive data, there was no attempt to add all the results into a composite score and the neutral responses were deleted; thus the N-value differs from item to item. A positive attitude will be resulted from obtaining high percentage of positive items and negative items responses. Details of survey findings are shown in Table 1 and Table 2. Majority of the students strongly agreed or agreed to the intention to continue using this novel teaching aid because benefits of LASK offered (n= 80; 96.3%), ease of use of LASK (n=74; 89.2%) and help to manage better time (n=71; 85.5%). Most of the students strongly agreed and agreed to continue using LASK in the future as it is perceived to be appropriate for their profession (n=78; 93.9%) and working style (n=72; 86.7%); and having opportunities to LASK in their profession (n=79; 95.1%). The students also strongly agreed and agreed that after seeing classmates used the LASK (n=63; 75.9%) and examining the use of LASK in study plan had made the participants continue using LASK in the future (n=71; 85.5%). However, 55.5% of respondents disagree and strongly disagree will not continue LASK when there was difficulty in learning to use the LASK (n=63).

For all survey items, only 6% of students have disagreement, namely strongly disagreed or disagreed to continue using LASK in future (item C4, C6, C7 and C8).

Table 1. Frequency and percentage of students' attitudes of behaviour intention towards LASK (N=83)

Item	Statement	SD	D	A	SA
C1	The benefits of the LASK will make me continue to use them in the future.	-	-	51 (61.4%)	29 (34.9%)
C2	I intend to continue to use the LASK because they help manage my time better.	-	-	49 (59%)	22 (26.5%)
C3	Because the LASK IS appropriate to my profession, I will use it in future.	-	-	47 (56.6%)	31 (37.3%)
C4	The LASK usage is appropriate for my working style and I will continue using it.	-	2 (2.4%)	48 (57.8%)	24 (28.9%)
C5	The ease of use of the LASK will make me continue to use it.	-	-	45 (54.2%)	29 (35%)
C6	The difficulty in learning to use the LASK will make me not use it in future.	10 (12%)	36 (43.4%)	9 (10.8%)	5 (6%)
C7	Seeing my colleagues use the LASK will make me continue to use it.	-	1 (1.2%)	41 (49.4%)	22 (26.5%)
C8	What I have observed about the use of the LASK in my studies will make me keep using it.	-	1 (1.2%)	50 (60.2%)	21 (25.3%)
C9	Trying out the opportunities of using the LASK in my profession will make me continue using it in future.	-	-	51 (61.4%)	28 (33.7%)

Note: Percentages do not equal 100% because neutral responses were excluded. Abbrev: SD – Strongly Disagree, D – Disagree, A – Agree and SA – Strongly agree.

Discussion

Overall, most students can be considered having positive attitudes towards the new teaching aid of LASK. The findings in this study is consistent with previous studies that found that user's positive attitudes can lead to a positive and direct influence towards intention to use new technology (Boulton,2017; Mirzajani et al.,2016).

Conclusion

Having an effective and efficient technique in performing the inferior alveolar nerve block (IANB) in dental procedures, particularly at undergraduate level, is crucial. LASK is currently designed and developed is in response to this issue. This preliminary study findings provide positive responses from the pre-clinical dental undergraduates.

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Table 2. Mean and standard deviation of students' attitudes of behaviour intention towards LASK (N=83)

Item	Statement	M	SD	DECISION
C1	The benefits of the LASK will make me continue to use them in the future.	4.31	0.54	Positive
C2	I intend to continue to use the LASK because they help manage my time better.	4.12	0.63	Positive
C3	Because the LASK IS appropriate to my profession, I will use it in future.	4.31	0.58	Positive
C4	The LASK usage is appropriate for my working style and I will continue using it.	4.13	0.69	Positive
C5	The ease of use of the LASK will make me continue to use it.	4.24	0.64	Positive
C6	The difficulty in learning to use the LASK will make me not use it in future.	2.55	1.04	Positive
C7	Seeing my colleagues use the LASK will make me continue to use it.	4.01	0.74	Positive
C8	What I have observed about the use of the LASK in my studies will make me keep using it.	4.10	0.66	Positive
C9	Trying out the opportunities of using the LASK in my profession will make me continue using it in future.	4.29	0.55	Positive

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Oral leukoplakia: where are we in 2020?

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Abstract Oral leukoplakia is the most common oral disorder with the potential for malignant transformation. The definition of oral leukoplakia is often being confusing and so much controversial that some clinicians now avoid using this term in their lexicon. Despite the intensive research regarding cellular and molecular predictors for malignant transformation, no parameter has yet to be integrated for routine clinical use

Introduction

A wide range of oral mucosal disorders have been described as persistent white or red, or mixed white and red patches in the literature. These disorders are termed as oral potentially malignant disorders (OPMDs) and include Oral Leukoplakia, Erythroleukoplakia, Erythroplakia, Oral submucous fibrosis, Oral lichen planus, Palatal lesions in reverse smokers, Oral lupus erythematosus, Graft-versus-host disease, Oral lichenoid reactions and few more conditions. Among these, Oral Leukoplakia and Erythroplakia are the two conditions which require special consideration as they have increased risk of malignancy [1,2] and these OPMDs are relatively common conditions that general practitioners of head and neck, and oral medicine specialists, observe in their everyday practice. [3]

Discussion

A white lesion on the tongue, which was probably represented syphilitic glossitis was termed as Leukoplakia by Schwimmer a Hungarian dermatologist in 1877. [4]

Oral leukoplakia is the most common oral disorder with the potential for malignant transformation. With the overall global prevalence of 4.11%, the use of tobacco (smoked or smokeless) is considered as the main etiological factor. Males are more commonly affected usually over 5 decades and this predilection varies according to geographical parameters and habits. [5]

According to the International Association of Cancer Registries (IACR), a component of the WHO via their GLOBOCAN project revealed the greatest burden of oral cancer in the world is in South Asian countries, like India, Pakistan, Bangladesh, and Sri Lanka. Among these South Asian countries, Sri Lanka had the highest incidence of oral cancer which was followed by Pakistan. [6-8]

In recent years, a number of oral white patches have been identified which appeared after the use of toothpaste/mouth rinses which contains the herbal extract known as sanguinaria. Histologically, these lesions usually show hyperkeratosis and epithelial atrophy, sometimes may be associated with true dysplasia, but their potential for the development of cancer is not certain. [9-11]

Many studies have reported that the rate of malignant transformation (MT) of Oral leukoplakia ranges from 0.7% - 17%. [12] Oral leukoplakia is the most frequent precursor lesion of oral squamous cell carcinoma (OSCCs) with a prevalence rate of 1–3%. Tobacco and alcohol use are considered as a risk factors. Other risk factors include immunocompromised patients, chewing of areca nut and previous history of malignancy. [13,14]

Many attempts have been made in the past to provide a definition of oral leukoplakia and the is often being confusing and so much controversial that some clinicians now avoid using this term. [4] In 1968 Pindborg defined “oral leukoplakia as a white patch or plaque, not less than 5 mm in diameter, which could not be removed by rubbing and which could not be classified as any other diagnosable disease.”[15] In 1978, World Health Organization (WHO) redefined oral leukoplakia “as a white patch or plaque that cannot be characterized clinically or pathologically as any other disease.” [16] Whereas in 1983, WHO modified the 1978 definition as “Leukoplakia is not associated with any physical or chemical causative agent except the use of tobacco.”[17] In 1994, International Collaborative Group on Oral White Lesions defined it as

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"definitive diagnosis of leukoplakia should be based on the result of elimination of suspected etiologic factors, if any/and, in case of a persistent or an idiopathic lesion, as revealed on histopathologic examination.[18]

In 2005, WHO amended the 1978 definition as 'white plaques of questionable risk having excluded (other) known diseases or disorders that carry no increased risk for cancer.'[19] For a long time, the term precancerous lesion and precancerous condition were used to designate an increased risk of malignant transformation of leukoplakia's and which were defined as 'A precancerous lesion is a morphologically altered tissue in which cancer is more likely to occur compared with its apparently normal counterpart, whereas a precancerous condition is a generalized state associated with a significantly increased risk of cancer'.[15,16]

Later the preference was given to the term 'potentially malignant" rather than to premalignant or precancerous as one favours using of term 'disorder' instead of the lesion by recognizing the fact that malignant transformation does not always take place. [20]

In 2007, WHO suggested the distinction between potentially malignant lesions and conditions to be abandoned in favour of a common term oral potentially malignant disorders. [21] In the same year, WHO redefined oral leukoplakia as "clinical presentations that carry a risk of cancer development in the oral cavity, whether in a clinically definable precursor lesion or in clinically normal mucosa. [22]

In 2018 a new term proposed to introduce potentially preneoplastic oral epithelial lesions or as "potentially premalignant oral epithelial lesions [PPOELs]" for Oral potentially malignant disorders. [16,23]

Many studies have been done on cancer stem cells (CSC) as of now, but there is no single marker or set of markers that predict which oral leukoplakia has a potential for MT in an individual patient, and also there is no evidence that lifelong follow-up in treated or untreated patients with oral leukoplakia is effective in preventing the MT. The geographic differences in the malignant transformation rate are more likely related to the differences in habits and perhaps genetic differences in various parts of the world. In the United States populations, a majority of oral leukoplakia probably never become malignant. [20,24-27]

The term lesion, instead of disease/disorder, is probably better understood by clinicians.[15] clinicians should know that absence of dysplasia does not preclude potential pre-malignant that pathologists report on the tissue they receive, and those histopathologic findings which are highly dependent on a correct and representative sampling of the lesion provide by them.[15,28] For clinicians, it's also a disturbing finding that leucoplakia's in non-smokers are more likely to undergo malignant transformation than smokers but this should not be interpreted to diminish the well-established role of tobacco in oral carcinogenesis. It may also indicate that the non-smokers have other more potent carcinogenic factors. [29]

Oral manifestations with recurrent herpes simplex, candidiasis, and geographic tongue have been reported in patients with COVID-19 but, the question is about whether these lesions are due to COVID-19 or due to secondary manifestations that might be resulting from the patient's systemic condition. [30]

2.1 Leukoplakia: Where are we in 2020?!

1.Since 1968-2017, we have received more than half a dozen of definition for oral leukoplakia.

2. Technology & Terminology: Leukoplakia is only a clinical term. New terminologies have been introduced in recent years as lesion or condition or a disorder. The definition and terminology related to this is of a great importance for both clinical as well as research purposes. However, renaming frequently causes confusion and controversy for an oral physician to an extent that, some clinicians now avoid using this term in their lexicon. Regrettably, no technology or biomarker that are suitable for use in a routine diagnostic setting or no reliable and validated in vivo chairside adjuncts which have a sufficient sensitivity and specificity to predict MT. The existing diagnostic adjuncts which are providing the immediate report or response have diagnostic limitation. Although, the method discovered recently based on the change in expression of certain glycan remnant on the surface of specific fluorescent conjugated lectin to target this abnormal glycosylation cells showed a promising initial results.

3.Cure rate remained constant over 30 years. Leukoplakia may progress to malignancy, but assessment of an individual patient's risk is difficult and time to MT is unpredictable as it varies from months to years. Is it due to geographic, habit, and genetic differences.? the management of these premalignant lesions is still complex, and the contemporary literature regarding the ideal treatment modality is conflicting. Clinicians must perform a biopsy of the lesion or refer to a specialist immediately for a patient with a clinically suspected OPMD lesion.

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2.2 What next?

1. Biopsy should be recommending for lesions in patients who do not discontinue their tobacco habit (smoke or smokeless). [29]

2.The American Cancer Society recommends a cancer-related check-up once a year for all individuals over 40 and above, and once in three years for those of 20 to 39 years. [30]

3. Continuing educational campaigns (CDE) to be made at local, state, even national level to educate the public about the risk factors and early signs and symptoms of this disease. [31]

4. Public should be encouraged to seek a regular professional oral examination by a dentist or by physician. [32]

Conclusion

The oral potentially malignant disorders (OPMDs) are a broader umbrella with common/uncommon oral lesions, as not all OPMDs will transform into malignancy. [33] Despite the intensive research regarding cellular and molecular predictors for malignant transformation, no parameter has yet to be integrated for routine clinical use. [34] It is also important to raise public health awareness on the MT rates of these disorders. Communication with the patient is of the utmost importance and also strict follow-up measures/optimal treatment strategies can help in reducing the transformation of these oral conditions into invasive cancer. [35]

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A systematic review of caries preventive interventions in the elderly

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Abstract. As the human lifespan increases, the elders are known to retain their teeth for longer. The need to uncover effective ways of preventing caries among this age group is, therefore, crucial. This systematic review was conducted in the Cochrane, MEDLINE, EMBASE and Web of Science databases using search terms. The titles and abstracts were initially screened for the use of caries prevention interventions. Studies were excluded based on the predetermined criteria. Of 7942 articles identified from the search, 59 full texts were evaluated and 11 analysed. One study found lower coronal caries increment by rinsing with 0.05% of sodium fluoride (NaF) twice daily. Another study reported a lower percentage of coronal and root caries with the use of 1,100 ppm of NaF dentifrice twice daily. A reduction of root caries was observed from using 5,000 ppm fluoridated dentifrice twice daily, annual professional 38% silver diamine fluoride (SDF) solution application, six-monthly acidulated phosphate fluoride (APF) gel application. The use of 0.12% chlorhexidine (CHX) rinse and xylitol chewing gum did not show reduction of caries incidence. Therefore, toothbrushing with 5,000 ppm NaF dentifrice, rinsing with 0.05% NaF, application of 38% SDF solution or application of APF gel can effectively prevent caries among the elders.

Introduction

Dental caries among the elders is becoming increasingly common and the rate of new caries development is said to be at least as great as that experienced by adolescents (1). Possible explanations for this include the increased life expectancy (2) and the emerging trend that old people are retaining their teeth for longer (3). Multiple risk factors are believed to be associated with caries development among the older population including loss of periodontal attachment, past caries experience, high cariogenic bacterial load, lack of awareness, diet or nutrition, existing medical condition and polypharmacy (2, 4).

Loss of periodontal attachment leaves the root surfaces of the teeth unprotected against the hostile oral environment (5). The root surface is composed of dentine covered by a cementum layer. This layer is often removed, either by erosion, abrasion or iatrogenic causes (6), which leaves the collagenous dentine exposed and susceptible to demineralisation. Furthermore, the pH required to cause dentin demineralisation is higher than that of enamel, resulting in much faster caries progression on the exposed dentinal surface (7).

A study of caries incidence at nursing homes in Adelaide saw 64% of coronal caries and 48% of root caries increment after one year (8). Another study in Iowa found the annualised attack rates of coronal and root caries to be 2.13 and 0.80 surfaces respectively in older Iowans (9). In their study, approximately 93% of individuals developed new coronal caries and 43% new root caries at a two-year follow-up. These figures show that both coronal and root caries incidence is high among the elders, regardless of their level of dependency, demanding caries preventive strategies. The rate of new caries development is much higher than those seen in children (9) and yet the focus on caries prevention for older people is relatively limited (10).

Therefore, this review aimed to specify the clinical efficacy of available interventions in caries prevention among community-based elderly.

Materials and Methods

The reporting of this review followed the PRISMA statement for reporting systematic review and meta-analysis of studies (11).

Inclusion criteria were randomised controlled trials (RCTs), controlled clinical trials (CCTs), longitudinal, case-control and cross-sectional studies, studies involving preventive trials which measured coronal and/or root caries incidence and increment.

Exclusion criteria were reviews, case reports, in-vitro, in-situ studies and non-English articles. Studies conducted on institutionalised elders, subjects who were medically compromised, subjects with advanced periodontal disease and aged 59 years and younger or had no clear age distinction, studies on remineralising and arresting effect and studies with surrogate endpoints (plaque index, gingival index, salivary flow rate, or/and microbiological findings).

2.1 Search strategy

A systematic search of the literature was conducted on four databases: Cochrane Central Register of Controlled Trials (The Cochrane Library 2020, Issue 9), MEDLINE via Ovid (1946 to 2020), EMBASE via Ovid (1980 to 2020) and Web of Science Core Collection (1900 to 2020)

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by two investigators (E.M.Y.) and (M.L.M), independently. The key words used were 'caries', 'demineralisation', 'prevention', 'adult' and 'aged'.

The titles and abstracts were initially screened for the use of various interventions at preventing caries. Studies were also excluded based on the inclusion and exclusion criteria. The full texts of the remaining studies were then obtained and evaluated. Finally, studies that met the inclusion criteria were considered in this review and

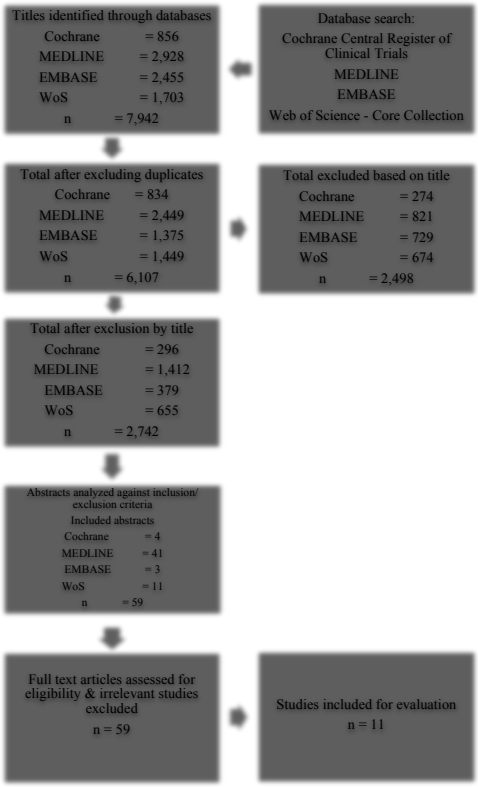

Fig 1 Flow chart of literature search

analysed. After screening, the two investigators discussed the selected potential studies to be included. Any uncertainties were deliberated with a third investigator (A.W.) before they were considered to be evaluated.

The risk of bias of the included studies was assessed using the method suggested by the Cochrane Handbook for Systematic Review of Interventions (12).

Results

The initial search conducted on the four databases identified 7,942 articles, out of which 856 articles were from Cochrane Library, 2,928 from MEDLINE, 2,455 from EMBASE and 1,703 from Web of Science Core Collection (Fig. 1). After removal of duplicates, the titles were screened and irrelevant ones excluded, leaving the number to 2,742. The abstracts were scrutinised and selectively removed according to the exclusion criteria.

The full texts of 59 articles were then evaluated. Forty-eight articles were excluded for reasons such as subjects were institutionalised elders, not solely subjects aged 60 years and above, no clear distinction of age of subjects, children and adolescents' subjects, in vitro studies and studies with surrogate outcomes. Ultimately, a total of 11 studies were included in this review (13-23).

3.1 Characteristics of the included studies

Of the 11 included studies, 6 were RCTs, 2 were CCTs, 2 were retrospective cohort studies and one was a prospective cohort study. The outcome measurement of the 11 studies was found to be either root surface caries only or both coronal and root caries. Hence, the studies outcomes were categorised into two groups, coronal caries and root caries, to clearly visualise the efficiency of the interventions on the two different surfaces.

3.2 Outcome of caries preventive interventions on coronal caries

One study reported the use of 0.05% of NaF rinse twice daily to be associated with a lower mean coronal caries increment compared to NaF tablet, slurry toothpaste and control groups (13) (Table 1). All the groups were given 1,500 ppm NaF fluoridated toothpaste throughout the study. Another study reported the use of 1,100 ppm of NaF dentifrice twice daily resulted in a lower percentage of coronal caries compared to placebo dentifrice use which contained less than 1 ppm of fluoride (14). Interestingly, 2 of the retrospective studies that assessed patients attending the practices of dentist-members of Northwest PRECEDENT (Practice-based Research Collaborative in Evident-based Dentistry) reported that fluoride placement among the 65+ group was associated with greater number of new caries lesion (15, 16).

Two RCTs found the use of daily or weekly 0.12% CHX rinsing produced a lower rate of coronal caries compared to their control groups, however, these differences were found to be not statistically significant (17, 18). Only one CCT studied the effect of xylitol chewing gum among the elders. The study found no statistical significance of this intervention at reducing coronal caries (19).

3.3 Outcome of caries preventive interventions on root caries

The result of an RCT on frail elders found that monthly professional tooth cleaning coupled with Duraphat varnish application on active root caries yielded fewer new active root caries compared to the use of 1,450 ppm fluoridated toothpaste twice daily (20) (Table 2). This study also found the use of 5,000 ppm of fluoridated toothpaste twice daily resulted in fewer new root caries lesions compared with 1,450 ppm toothpaste (21), which was similar to the findings of an RCT done on community-dwelling elders. Another study found the use of 1,100 ppm NaF dentifrice twice daily to be associated with a lower percentage of root caries increment compared with a placebo dentifrice (14).

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The semi-annual professional application of topical acidulated phosphate fluoride (APF) gel in one study found the number of new root caries lesion to be less than the control group which used daily placebo mouth rinse. Meanwhile, the usage of daily 0.05% NaF rinse had no significant effect on the number of new root caries lesion compared to the control group (22). Annual professionally applied 38% SDF solution on the root surface showed a significant reduction in the mean number of new root surface caries, when compared with water as placebo (23).

Two studies found no significant effect of using 0.12% CHX rinse daily or weekly at preventing root caries when compared with their control groups (17, 18). Similar to coronal caries outcome, only one study found no significant reduction of root caries with xylitol chewing gum (19). The risk of bias of the included studies is shown in Table 3.

Discussion

The results in this review showed that toothbrushing with a commercially available fluoridated toothpaste twice daily was sufficient in preventing coronal caries. However, in preventing root caries, a higher concentration of fluoridated toothpaste was needed, and occasional professionally applied fluoride proved useful. No significant effect was observed by using 0.12% CHX or xylitol chewing gum. In this review, the interventions and outcome measurement varied between the included studies, making comparison difficult. For this reason, a meta-analysis was not performed.

Table 1. Summary of caries preventive studies with coronal caries outcome.

Article	Study type	Age (mean)	Grouping/ preventive treatment	Follow-up period	Results	
					No. of subjects	**Outcome**
Al-Haboubi et al (2012) [19]	RCT	60+ (70.2)	*Gp1*: xylitol chewing gum 2x/day for 15 minutes *Gp2*: control (no chewing gum)	6 months	146	Mean decayed coronal surfaces *Gp1=Gp2* (p=0.522)
Wyatt et al (2007) [24]	RCT	60-76 (67.5)	Daily rinsing for 1 month & weekly rinsing for 5 months *Gp1*: 0.12% CHX rinse *Gp2*: placebo rinse	5 years	828	% of coronal surfaces remained sound *Gp1=Gp2* (p=0.21)
Powell et al (1999) [17]	RCT	60+	*Gp1*: control *Gp2*: OHE *Gp3*: OHE + weekly 0.12% CHX rinse *Gp4*: as *Gp3* + fluoride varnish *Gp5*: as *Gp4* + six-monthly Sc & RP	3 years	201	Average rate of coronal caries, fillings and extractions (*Gp1+Gp2*)=(*Gp3+Gp4+Gp5*) p=0.09
Jensen and Kohout (1988) [14]	CCT	*Gp1*: 54-93 (68.5) *Gp2*: 58-90 (68.6)	Twice daily use: *Gp1*: placebo dentifrice (<1ppm F) *Gp2*: 1,100ppm NaF dentifrice	12 months	810	% increment of coronal caries (p=0.006) *Gp1>Gp2*
Fure et al (1998) [13]	PC	60+ (71.5)	1,500ppm NaF toothpaste and: *Gp1*: 0.05% NaF rinse (2x/day) *Gp2*: 1.66mg NaF tablet (2x/day) *Gp3*: brush with *slurry* toothpaste rinsing technique (3x/day) *Gp4*: control (brush as usual)	2 years	164	Mean total caries increment *Gp1<Gp4* (p<0.002)
Rothen et al (2014) [16]	RC	9-65+	Fluoride toothbrushing, water rinse after brushing, interproximal cleaning, other fluoride products	Past 24 months	1400	Mean caries rate Fluoride toothbrushing frequency (No or <1x/day)>2x/day
Ferracane et al (2011) [15]	RC	3-92	Prophylaxis, fluoride (varnish and APF, SnF, NaF), sealant	Past 12 months	1877	Prophylaxis – no significant association with new carious lesion Fluoride – significant greater odd at having new lesion

RCT randomized controlled trial *CCT* controlled clinical trial *PC* prospective cohort *RC* retrospective cohort *Gp* group *ppm* parts per million, *OHI* oral hygiene instructions, OHE oral hygiene education, *Sc* scaling, *RP* root planning, NaF sodium fluoride, *SnF* stannous fluoride, *CHX* chlorhexidine, *APF* acidulated phosphate fluoride

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Table 2. Summary of caries preventive studies with root caries outcome.

Article	Study type	Age (mean)	Grouping	Follow-up period	Results **No. of subjects**	**Outcome**
Leon et al (2019) [21]	RCT	60-88 (69.6)	*Gp1*: 1,450 ppm fluoridated toothpaste 2x/day *Gp2*: 5,000 ppm fluoridated toothpaste 2x/day	2 years	280	% of new root caries *Gp1>Gp2* (p<0.001)
Zhang et al (2013) [23]	RCT	60-89 (72.5)	*Gp1*: annual OHI + placebo (water) *Gp2*: annual OHI + 38% SDF solution *Gp3*: annual OHI + 38% SDF solution + 6-monthly OHE All professionally applied.	24 months	266	Mean number of new root caries surfaces *Gp1>Gp2>Gp3* (p<0.05)
Al-Haboubi et al (2012) [19]	RCT	60+ (70.2)	*Gp1*: xylitol chewing gum 2x/day for 15 minutes *Gp2*: control (not given chewing gum)	6 months	146	Mean decayed root surfaces *Gp1=Gp2* (p=0.154)
Ekstrand et al (2008) [20]	RCT	75+ (81.6)	*Gp1*: professional cleaning + Duraphat varnish monthly *Gp2*: 5,000 ppm fluoridated toothpaste 2x/day + OHI *Gp3*: 1,450 ppm fluoridated toothpaste 2x/day + OHI	8 months	189	Number of new active root caries *Gp1=Gp2*<Gp3(p<0.02)
Wyatt et al (2007) [24]	RCT	60-75 (67.5)	Daily rinsing for 1 month & weekly rinsing for 5 months: *Gp1*: 0.12% CHX rinse *Gp2*: placebo rinse	5 years	828	% of root surfaces remained sound *Gp1=Gp2* (p=0.42)
Powell et al (1999) [17]	RCT	60+	*Gp1*: control *Gp2*: OHE *Gp3*: OHE + weekly 0.12% CHX rinse *Gp4*: as *Gp3* + fluoride varnish *Gp5*: as *Gp4* + six-monthly Sc & RP	3 years	201	Average rate of root caries, fillings and extractions (*Gp1+Gp2*)= (*Gp3+Gp4+Gp5*) p=0.15
Wallace et al (1993) [22]	CCT	60+	*Gp1*: daily placebo mouthrinse *Gp2*: semi-annual application of topical APF gel *Gp3*: daily 0.05% NaF rinse	48 months	466	Number of new root caries lesion *Gp1>Gp2* (p<0.05) *Gp1=Gp3* (p=0.19)
Jensen and Kohout (1988) [14]	CCT	*Gp1*: 54-93 (68.5) *Gp2*: 58-90 (68.6)	Twice daily use: *Gp1*: placebo dentifrice (<1ppm F) *Gp2*: 1,100ppm NaF dentifrice	12 months	810	% increment of root caries (p=0.014) *Gp1>Gp2*
Fure et al (1998) [13]	PC	60+ (71.5)	1,500ppm NaF toothpaste and: *Gp1*: 0.05% NaF rinse (2x/day) *Gp2*: 1.66mg NaF tablet (2x/day) *Gp3*: brush with *slurry* toothpaste rinsing technique (3x/day) *Gp4*: control (brush as usual)	2 years	164	Mean total caries increment *Gp1<Gp4* (p<0.002)
Rothen et al (2014) [16]	RC	9-65+	Fluoride toothbrushing, water rinse after brushing, interproximal cleaning, other fluoride products	Past 24 months	1400	65+ population: Mean caries rate Fluoride toothbrushing frequency (No or <1x/day)>2x/day
Ferracane et al (2011) [15]	RC	3-92	Preventive treatments in the past 12 months: Prophylaxis, fluoride (varnish and APF, SnF, NaF), sealant.	Past 12 months	1877	Prophylaxis – no significant association with new carious lesion Fluoride – significant greater odd at having new lesion

RCT randomized controlled trial *CCT* controlled clinical trial *PC* prospective cohort *RC* retrospective cohort *ppm* parts per million, *OHI* oral hygiene instructions, OHE oral hygiene education, *Sc* scaling, *RP* root planning, NaF sodium fluoride, *SnF* stannous fluoride, *CHX* chlorhexidine, *APF* acidulated phosphate fluoride, *SDF* silver diamine fluoride

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A study conducted on frail elders was included in this review as it fitted the criteria of home-based elders living independently. Regarding the nature of the included retrospective cohort studies, it was difficult to factor out the subjects' medical condition due to a large sample size. Therefore, the outcome from these studies might be influenced by the subjects' general health. Nonetheless, the extracted data may be of value as it described the older population living independently.

Studies that were conducted on institutionalised elders were excluded from this review as the oral hygiene of this group of old people is often very poor with the likelihood of having rampant dental caries (24). Furthermore, the results from these studies might influence the effect of oral health promotion (OHP) on community-based elders. Studies that included older people in a wider population sample but did not measure separately the outcome of older participants to the younger ones were also excluded as the efficacy of the interventions used could not be specifically determined for older participants.

The findings of this review suggest that 5,000 ppm fluoridated dentifrice use twice daily is valuable at reducing root caries incidence among the elders. Gotjamanos, as cited by Zhang et al., stated that the use of high concentration of fluoride (40% silver fluoride) is acceptable in the older population and will not cause dental fluorosis (23). Alternatively, brushing with fluoridated toothpaste together with rinsing using 0.05% NaF solution twice daily or annual professional application of 38% silver diamine fluoride (SDF) solution is beneficial where high fluoride concentration toothpaste is not available (13, 22, 23). Apart from that, professional cleaning or application of APF gel six-monthly proved useful in reducing root caries compared to toothbrushing using a low concentration of fluoridated toothpaste alone (22).

Two of the retrospective studies in this review found any kind of fluoride placement to be related to increased caries incidence in elders. This is probably due to additional confounding factors for dental caries, such as the presence of any medical condition that offers greater vulnerability of the tooth surface to caries.

There is conflicting evidence about the value of CHX in caries prevention among adults. A study that used 0.012% CHX rinse as part of a comprehensive caries reduction algorithm saw it to be beneficial when used alongside other preventative strategies (26). Papas et al. evaluated a 10%weight/volume CHX varnish for caries prevention. They showed little efficacy in low-risk populations but when high-risk populations were analysed separately, the result showed a substantial caries reduction (27). These studies, however, did not focus on the elderly group per se and this review found limited evidence to support CHX rinse use among this age group at reducing new caries lesion. Likewise, a randomised controlled trial on institutionalised elders found daily rinsing with 0.2% NaF solution produced a better result than rinsing with 0.12% CHX solution (24).

This review failed to see any significant reduction in coronal or root caries incidence in the use of xylitol chewing gum twice daily among the elders (19). The study evaluated, nevertheless, was not conducted sufficiently long enough to show any caries preventive effects. A study design of xylitol for adult caries trial (X-ACT) also showed no statistically significant result of daily xylitol use in reducing caries incidence in caries-active adults (28). Lynch and Milgrom (2003) suggested using sugar alcohol, giving Xylitol as an example, as a sugar substitute as it is useful for its anti-cariogenic effect and for the reason that it is not readily metabolised by bacteria (29).

Table 3. Risk of bias of the included studies.

Legend: ⊕ Low risk ∅ Unclear risk ⊗ High risk	Random sequence generation	Allocation concealment	Blinding of participants and researchers	Blinding of outcome assessment	Incomplete outcome data	Selective reporting	Other bias
Al-Haboubi et al (2012)	⊕	⊕	⊕	∅	⊕	⊕	⊕
Ekstrand et al (2008)	⊗	∅	⊕	⊗	⊕	∅	∅
Ferracane et al (2011)	⊗	⊕	∅	∅	⊗	⊗	∅
Fure et al (1998)	⊗	∅	⊗	⊕	⊕	⊕	∅
Jensen&Kohout (1988)	⊗	⊕	⊕	∅	⊕	⊕	⊕
Leon et al (2019)	⊕	⊕	⊕	⊗	∅	⊕	⊕
Powell et al (1999)	⊗	∅	⊗	∅	⊕	∅	∅
Rothen et al (2014)	⊕	∅	∅	⊕	∅	∅	∅
Wallace et al (1993)	⊕	∅	∅	⊗	⊕	∅	∅
Wyatt et al (2007)	⊕	⊕	⊕	⊕	⊕	∅	⊕
Zhang et al (2013)	⊕	⊕	⊕	⊕	⊕	∅	⊕

This review assessed the risk of bias of each study with six legends as described by Cochrane Handbook of Systematic Review of Intervention. It also had two independent investigators performing the search in effort to minimise selection bias. The limitations of this review include the absence of reference to "grey literature" and the exclusion of non-English articles. From the findings of this review, more studies on caries preventive interventions in community-based older adults are needed due to a constricted number of well-designed studies observed.

Conclusion

Toothbrushing using 5,000 ppm fluoridated toothpaste is useful at reducing root caries incidence. However, the water fluoride level of the population should be considered before recommending such toothpastes containing high concentration of fluoride. Semi-annual professional cleaning and application of APF gel is also beneficial in preventing root caries. Toothbrushing twice daily with widely available fluoridated toothpaste and

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having professionally applied 38% SDF solution as an adjunct are also practical at preventing both coronal and root caries. The use of 0.12% CHX rinse and xylitol chewing gum failed to show any preventive effect.

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Antimicrobial activity of berries against *Lactobacillus spp.* isolated from clinically excavated dental caries

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Abstract. Berries are one of the best dietary sources of health benefits with high phenolic compounds that have demonstrated antimicrobial properties. *Lactobacillus spp.* is the second most cariogenic bacteria of oral flora. Studies have shown antimicrobial effects of berries against oral pathogens. Aim of study is to evaluate the antimicrobial effect of blackberry, blueberry and raspberry extracts on the growth and viability of *Lactobacillus spp.* pure juice extracts were obtained from fresh blueberry, blackberry and raspberry and stored separately. *Lactobacillus spp.* were isolated from the excavation of infected dentinal caries of twelve paediatric patients. The antibacterial activities of extracts against *Lactobacillus spp.* were determined using Agar Well Diffusion Method. The zone of inhibition was measured in mm & data were subjected for statistical analysis.Tukey Post Hoc test revealed that the Raspberry group showed a statistically significant difference in the zone of inhibition (11.79 ± 2.06 mm) compared with control group (9.17 ± 0.26 mm), Blueberry group (9.58 ± 0.69 mm) and Blackberry group (9.73 ± 0.66 mm) with p value =0.000.The study demonstrated that raspberry extract may be effective as they showed larger inhibition zones. Hence, this study highlights the potential of raspberry for caries control.

Introduction

Dental caries, a multifactorial disease is a major oral health problem affecting 60–90% of school children and a majority of adults around the world [1]. The main key factors in the etiology of this disease are cariogenic bacteria, fermentable carbohydrates, a susceptible tooth, the host, and the time. Previous studies suggested that the main cariogenic bacteria are Streptococcus mutans which plays an important role in the initiation of dental caries whereas; Lactobacillus is not the caries initiator but helps in the caries progression [2].

A wide variety of natural products are traditionally used for caries control. Berries are good sources of flavanols while the predominating group of flavonoids, especially in red berries, is anthocyanins. The flavonoids are potent antioxidants, free radical scavengers and metal chelators; they inhibit lipid peroxidation and exhibit various physiological activities including anti-inflammatory, antiallergic, anticarcinogenic, antihypertensive, antiarthritic and antimicrobial activities [3]

Berries also are one of the best dietary sources of health benefits with high phenolic compounds that have demonstrated antimicrobial properties. They contain high level of antioxidants especially vitamin C which can help prevent the risk of cancer. The darker the color pigment of the berry, the more nutritious it is [4]. Berries are also good food for brain. In a recent research, these fruits have been shown to support cognitive functioning in humans [5]. Raw berries are pure source of vitamins and minerals, raw enzymes and vital antioxidants that are essential for proper growth of the body cells. Berries are important for growing up children due to its ability to strengthen their immune system [6]. Children nowadays are more susceptible to many bacteria and viruses. Incorporating berries in your child's berries will promote a healthy immune system [7].

Several studies have shown that berries have antimicrobial effect against oral microorganisms including cariogenic pathogen and periodontopathogens [3,8,9]. However, no studies have been reported about the antimicrobial effects of three different types of berries (cranberry, blueberry and blackberry). Hence, our present study is undertaken to evaluate antimicrobial effects of different types of berries against cariogenic pathogens, *Lactobacillus spp.*

Materials and Methods

2.1 Material

2.1.1 Extraction of Pure Juice from Blueberries, Blackberries, Cranberries

The pure juice extraction started with washing and grinding the berries to get the pulpy fruit sludge which were then strained to get only the liquid concentrate.

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Blueberry, blackberry and cranberry liquid concentrate were stored separately.

2.1.2 Microorganisms

The human cariogenic pathogens were isolated from caries infected children patients of SEGi Oral Health Centre, Kota Damansara.

Fig. 1. Pure juice extracts were obtained from fresh blueberry, blackberry and raspberry and stored separately.

2.2 Sampling

The study was carried out in SEGI Oral Health Centre, Kota Damansara. Infected dentinal caries excavated from twelve paediatric patients aged 3-12 years. The study inclusion criteria were: Healthy patients with no systemic disease, with at least 1 or more deeply carious primary molars having either ICDAS score of 5 and 6 & the patients aged 3-12 years old. Exclusion criteria were: Patients that are not within age range required, low to moderate caries risk patients, teeth with developmental anomalies & defects, carious teeth limited to ICDAS score of 1,2,3, carious permanent molars, those on antibiotic therapy medication due to systemic illness & medically compromised patients.

Fig. 2. *Lactobacillus spp.* were isolated from the excavation of infected dentinal caries.

2.3 Methodology

Pure juice extracts were obtained from fresh blueberry, blackberry, raspberry and stored separately. (Fig.1) *Lactobacillus spp.* were isolated from the excavation of infected dentinal caries (ICDAS 5/6) of twelve paediatric patients aged 3-12 years. (Fig.2) The samples were cultured in nutrient agar and then in MRS Lactobacilli agar. (Fig. 3) The antibacterial activities of extracts against *Lactobacillus spp.* were determined using Agar Well Diffusion Method. Wells were prepared on Mueller-Hinton agar with 9 mm diameter. Each well was filled with 220 µl of 3 different extracts of berries & saline as a control group. (Fig. 4) The zone of inhibition was measured in mm by using digital pen & data were subjected for statistical analysis.

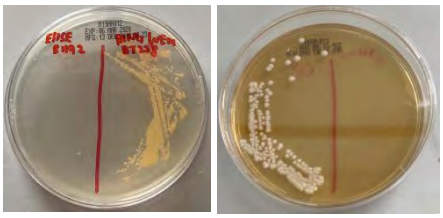


Fig. 3. The samples were cultured in nutrient agar and then in MRS Lactobacilli agar.

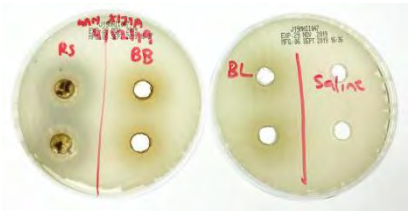


Fig. 4. The antibacterial activities of extracts against *Lactobacillus spp.* were determined using Agar Well Diffusion Method.

2.4 Statistical Analysis

Statistical analysis was performed using the statistical software SPSS for Windows, version 22.. *Zone of inhibition* between berries against Lactobacillus spp. isolated from clinically excavated dental caries were determined using *One-way ANOVA & Turkey Post Hoc test*. The level of significance for all tests was chosen as $P < 0.05$.

Result

There was a statistically significant difference between groups as determined by One-way ANOVA $F(3, 44) = 12.597$ $p<0.001$. Tukey Post Hoc test revealed that ***Raspberry group showed statistically significant larger zone of inhibition*** 11.79 ± 2.06 mm compared with $p=0.000$. However, there was no significant difference

among the saline group 9.17 ± 0.26 mm, Blueberry group 9.58 ± 0.69 mm and Blackberry group 9.73 ± 0.66 mm with p>0.05. (Table: 1 & 2)

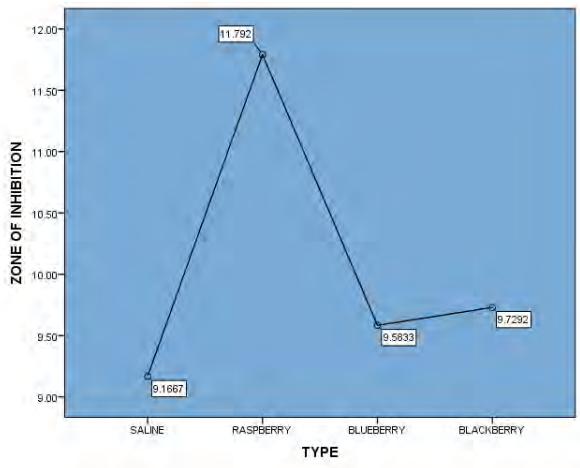
Table 1: One-way ANOVA test Zone of inhibition

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	49.598	3	16.533	12.597	.000
Within Groups	57.745	44	1.312		
Total	107.342	47			

Table 2: Descriptive Statistics

Sample	N	Min	Max	Mean	Std. Deviation
Saline Control	12	9.0	9.8	9.167	.268
Raspberry	12	9.0	16.0	11.792	2.064
Blueberry	12	9.0	11.0	9.583	.694
Blackberry	12	9.0	11.0	9.729	.661

Graph 1. Line graph showing the mean zone of inhibition



Discussion

Present study showed that, the extracts have all been found to inhibit certain dental caries and periodontal pathogens thus solidify the claims that natural remedies are important and will play a bigger role in caries prevention in the future. The study was similar to a study done by Chandra Shekar et al (2015) that review the current evidence on the antimicrobial efficacy of 10 plant extracts on dental caries and plaque microorganisms [10].

Out of all the natural remedies, we have chosen to study the effect of berries against periodontal pathogens. Berries are distinct from other foods because of their unique compounds with bioprotective effects and antimicrobial/prebiotic properties. Phillip N et al (2018) in a study claims that dark-colored fruit berries are a rich source of polyphenols that could provide innovative bioactive molecules as natural weapons against dental caries. The bioactive compounds in berries contain mainly phenolic compounds (phenolic acids, flavonoids, such asanthocyanins and flavonols, and tannins) and ascorbic acid [11]. These compounds, either individually or combined, are responsible for various health benefits of berries. This has been studied by Beattie et al (2005) in which they assess the current scientific evidences for claims that berries may have additional health benefits [12].

However, it is not possible to study the antimicrobial effects of berries in all cariogenic pathogens thus this study has chosen *Lactobacillus spp*. as microorganisms of choice. Lactobacilli are Gram-positive, non-spore-forming, aciduric or acidophilic and catalase-negative rods or coccobacilli inhabiting various environments. Lactobacillus is said to play an important role in caries progression and can mostly be found in deep caries as supported by Ahirwar et al (2019) [13]. Another study by Švec et al (2009) also proved that different strains of lactobacillus were presented in dental caries [14].

Hence, we have chosen to compare the antimicrobial effect of different types of berries (raspberry, blueberry and blackberry) against the cariogenic pathogen *Lactobacillus spp.* All data collected on mean zone of inhibition was compared and subjected to statistical analysis.

In our study, it was revealed that Raspberry group showed statistically significant larger zone of inhibition 11.79 ± 2.06 mm compared with p=0.000. This is in agreement with previous studies by Bobinaitė et al (2013) stating that Raspberry has a high concentration of total phenolics and ellagitannins which has shown high inhibitory effect against tested Gram-positive bacteria [15]. However, there was no significant difference among

the saline group 9.17 ± 0.26 mm, Blueberry group 9.58 ± 0.69 mm and Blackberry group 9.73 ± 0.66 mm with $p>0.05$. This is in contrary with a research by Nebu Philip at al (2018) stating that Blueberry extract produced significant reductions in metabolic activity and acidogenicity only at the highest concentration tested on *Streptococcus mutans* [11]. The differences in methodology may be the cause of discrepancies in results when compared to the present study.

Overall, the results could not be compared fully to other studies as this is the first of its kind research comparing between Raspberry, Blueberry and Blackberry. Clearly, this research is not free of limitations where better standardization, accuracy of data collection and the usage of a larger sample size should be further improve in future studies.

Conclusion

The present study demonstrated that raspberry extract shows the largest zone of inhibition compared to the blueberries and blackberries. Hence, this study highlights the potential of raspberry extracts in caries control. However, a more precise and detailed research should be conducted to further support this statement.

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Throughout this research, we've learnt a lot about the pathogens in dental caries and the antimicrobial effect of different berries on these pathogens. We hope that this research paper will help contribute to the never ending sea of knowledge.

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Considerations and beliefs in tooth donation to research in Malaysia

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Abstract. An increase in the number of dental undergraduates throughout the years might be causing an escalating demand for extracted human teeth. However, due to the rapid interest in dental pulp stem cells (DPSCs) research, the acquisition of extracted human teeth for the use of research and preclinical training could be challenging. The purpose of this study was to evaluate whether dental students were facing difficulties in obtaining extracted human teeth for preclinical training purposes and their beliefs and attitudes towards tooth donation to research. Methods: A total of 155 dental students from selected public dental universities in Kuala Lumpur and Selangor who were undergoing preclinical training participated in this research. A questionnaire that used a multiple-choice grid was developed using Google Forms and was distributed to students accordingly. The quantitative data were analysed using SPSS (Cramer's V correlation analysis, $p<0.05$). Conclusions: Most dental students were willing to donate their tooth to research. Promoting tooth donation to the public to meet the demand for preclinical training and research in Malaysia through educational programs could be considered. In future, the establishment of a tooth bank would be beneficial in systematically storing teeth.

Introduction

Malaysia is a developing country, and its performance in the education sector is improving steadily, with a total of 20 public and 47 private universities nationwide [1]. Out of these universities, 20 universities made it to the top 1000 based on the QS World University Rankings 2020 [2]. The rise of public and private universities offering dentistry is also significant, from only one public university in the 1970s to 13 universities to date [3]. Hence, the multiplication of dental schools and an increase in the number of dental undergraduates is logically causing an escalating demand for extracted human teeth for training purposes. However, due to the rapid interest in dental pulp stem cells (DPSCs) research, the acquisition of extracted human teeth for the use of both research and preclinical training could be challenging.

Bachelor of Dental Surgery (BDS) course in Malaysia is a five-year course with a two-year preclinical level. Dental students are obliged to complete a preclinical training that will run for a year or more before they can treat patients in clinical years. The preclinical training is vital for students to develop clinical skills without the fear of harm to patients, retain didactic information and repetition of critical skills, and motivate themselves [4]. The application of preclinical training in the dental curriculum is still highly significant as it ensures that students achieve an adequate level of clinical competence to treat patients in clinical years [5]. Besides, preclinical training in phantom heads has been considered the 'gold standard' for restorative dental education to date [6].

In Malaysia, some dental schools require the use of extracted human teeth for operative dentistry and endodontic preclinical training. As an example, for endodontic preclinical training, it demands the use of uncomplicated anterior and posterior teeth, whereby students should be able to locate the canal orifices, clean and shape the root canals with minimal procedural errors and obturate these teeth to an acceptable manner. Operative dentistry simulation requires mainly sound natural human teeth for students to achieve ideal cavity preparations on teeth. It is a known fact that training on natural teeth allows students to experience the anatomy of the root canal system as well as the natural hardness of enamel and dentin [7]. This form of requirement might contribute to the imbalance between the supply and demand (undergraduates and researchers) of extracted human teeth. Promoting tooth donation in Malaysia could be a way to move forward to improve the supply of human extracted teeth for dental education and research purposes.

In most European countries, a tooth extracted in the context of treatment plan corresponds to clinical waste, whereas if used for research, it is considered a biological sample [8]. A study in France and Jordan reported that the

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participants preferred donating their teeth after extraction for research purposes, 95% (n=22), and 62.8% (n=500), respectively [8, 9]. Nonetheless, more than half of the participants in Jordan had a sense of ownership towards their extracted tooth despite donating it to research [10] similar to the findings in France [8]. In terms of sociodemographic background, those of higher educational background is associated with the likelihood of accepting teeth donation. Other demographic variables such as gender, age, place of living, and income were insignificant [10]. There are no known studies to date in relation to ethnicity and religion to tooth donation. Educational programs could be beneficial to enhance the awareness and attitudes of patients on the ownership of extracted teeth, donation of teeth, and the consent process [10].

This study was to establish whether the preclinical dental students in the public universities in Kuala Lumpur and Selangor were facing difficulties in obtaining extracted human teeth and their beliefs and attitudes and towards tooth donation for research purposes.

Methods and Materials

A total of 155 Year 2 preclinical students from three selected public universities offering dentistry participated in this research. To provide anonymity of the universities that participated, the three universities were labelled as University A, B and C. Convenient sampling was used to include all Year 2 students from the respective universities in Kuala Lumpur and Selangor. A response rate of 91.2% out of 170 students was achieved.

A well-structured survey was administered and prepared using Google forms and distributed to students' smartphones via WhatsApp Messenger which is a freeware, cross-platform messaging and voice IP service owned by Facebook, Inc. Participation in this research was voluntary. They had an option to withdraw at any time without being penalised

The online questionnaire consisted of 21 closed-ended questions, including demographic characteristics and questions related to the study objectives. Part of the survey aimed to explore the students' difficulty in finding extracted human teeth for the use of preclinical studies and attitudes and beliefs toward tooth donation for research. The demographic characteristics included the place of study, gender, hometown, ethnicity and religion. The questionnaire was developed based on an existing validated survey instrument by Le Breton et al. (2015) and Mortadi et al. (2018) and modified to suit the local conditions. It was revalidated by pilot testing with ten dental students to ensure that the questions could be clearly understood and correctly interpreted by them and the intended respondents.

The data were analysed using the Statistical Package for Social Sciences software program (SPSS) version 25.0 (IBM Corporation, Armonk, NY, USA). The data were summarized using frequency tables. Further analysis was undertaken using a Chi-square test, with the significance value taken as $p<0.05$ to analyse the association between willingness to donate their teeth to research and various demographic variables of the respondents. Ethics approval by research ethics committee (REC/01/2020:UG/MR/33)

Results and Statistical Analysis

Participants (n=155), Year 2 undergraduate dental students from University A, B and C, were administered the study's questionnaire. The total number of preclinical students from University A, B and C were 83, 52 and 35, respectively. In general, the majority of the respondents were from University A (49%), then University B (31%) and University C (20%) which contributed to the total response rate of 91.2% (n=155) for this study. Refer Table 1. Out of the 155 participants, 73.5% were females and 26.5% were males. As for hometown, the highest percentage of students was from Selangor (26.5%), then Johor (14.8%) and Kedah (9.7%). Approximately two-thirds of the participants' ethnicity were Malay (87.7%), followed by Chinese (11%), Indian (0.6%) and others (0.6%). As for the religion, the majority were Muslim (87.7%), followed by Buddhist (10.3%), Christian (1.3%) and Hindu (0.6%).

Table 1: Total number of respondents from each university

University	Number of students	Number of respondents (%)
University A	83	91.5 (n=76)
University B	49	94.2 (n=49)
University C	35	85.7 (n=30)

Most of the participants (92.9%) had difficulty in finding extracted human teeth needed for their preclinical projects mainly extracted molar teeth (71%). More than half the students (54.8%) agreed that the extracted premolar teeth were the easiest to acquire, followed by canines (43.2%) and incisors (38.1%). The majority of the participants were required to use extracted human teeth for operative dentistry (64.5%) and endodontic preclinical training (79.4%).

97.4% of participants believed that their teeth are part of them. More than half of the participants (53.5%) were willing to donate their tooth to the researcher after being extracted, 36.8% of them preferred to keep it, and 9.7% of the participants preferred to leave it or throw away their extracted tooth. When tooth donation for research was considered, 60% of the participants thought that their tooth belongs to the researcher, whereas 17.4% thought that their tooth would forever be theirs despite donating it to research. 22.6% of the students were uncertain about the belonging of their tooth after donating it to research. (Refer Table 2)

96.8% agreed to use their extracted tooth in research and preferred to know the type of research conducted on their

extracted tooth (85.8%). Moreover, 63.2% were willing to sign consent forms before donating their teeth to research with 62.2% preferring to sign the consent form during the consultation visit before the extraction of their tooth.

Table 2: Student's belief and attitude towards tooth donation to research.

Factors	Choices	n (%)
What does your teeth mean to you?	It is part of me It has no meaning	151 (97.4) 4 (2.6)
What do you wish to do with your tooth after being extracted?	I prefer to keep it with me I prefer to leave it or throw it away I prefer to donate to the researcher	57 (36.8) 15 (9.7) 83 (53.5)
If you give your tooth to research, would you think it belongs to you or to the researcher?	I think it belongs to me always I think it belongs to the researcher Not sure	27 (17.4) 93 (60) 35 (22.6)
Do you agree to use your extracted tooth in research?	Yes No	150 (96.8) 5 (3.2)
How do you evaluate your knowledge on stem cells?	Excellent Poor None	33 (21.3) 110 (71) 12 (7.7)
Would you like to know the research type that will be done on your extracted tooth?	Yes No Not sure	133 (85.8) 8 (5.2) 14 (9)
Do you think you need to sign a consent form before the donation of tooth to research?	Yes No Not sure	98 (63.2) 38 (24.5) 19 (12.3)
If YES, when would you like to sign the consent?	At consultation visit, before extraction At surgery appointment, before extraction At surgery appointment, after extraction	61 (62.2) 21 (21.4) 16 (16.3)
Would you like to know the result of research on your tooth?	Yes No Not sure	133 (85.8) 12 (7.7) 10 (6.5)
If YES, how do you prefer to be informed?	Phone call Email Letter mail	12 (9) 111 (71.6) 10 (7.5)
Are you worried about extracting your tooth for research purposes rather than medical purposes?	Yes No Not sure	59 (38.1) 66 (42.6) 30 (19.4)
Who do you think should ask you to donate your tooth research?	A surgeon or dentist Other member of the health care team A member of the research team	111 (71.6) 6 (3.9) 38 (24.5)

21.4% preferred to sign the consent form at surgery appointment before the extraction and 16.3% preferred to sign the consent form at surgery appointment after the extraction has been performed. 85.8% were interested in knowing the results of the research conducted on their tooth, and the preferred mode of communication was via email (71.6%).

Furthermore, 42.6% of the participants had no fear or worries about the extraction of their tooth for research purposes rather than medical purposes. 71.6% of students agreed that a surgeon or dentist should be the person responsible for asking them to donate their tooth to research, followed by the member of the research team (24.5%) or other members of the health care team (3.9%) (Refer Table 2)

When the association of willingness to donate their extracted tooth to research and demographic characteristics were examined, the various demographic variables including gender, hometown, religion and ethnicity were insignificant ($P>0.05$).

Discussion

This study was designed to explore the difficulties of dental students in obtaining extracted human teeth for preclinical training and their beliefs and attitudes toward tooth donation.

Some may argue that gender roles, your upbringing and surroundings, varieties of cultures and beliefs do affect a person when it comes to decision-making. According to Sharon Glazer, culture is an essential facet of the decision-making process [11]. However, based on this survey, the differences in gender, place of origin, ethnicity, and religion did not affect their decision making whereby there was no significant association between these demographic characteristics with the willingness to donate their teeth to research ($P>0.05$). A similar finding was reported by Mortadi et al. (2018) in terms of gender [10]. A study on medical students in Malaysia concluded that Indians were more likely to register for organ donation (78%), followed by Chinese (77%), Malays (64%) and other ethnicities (45%) [12]. As for religion, the main reason of Malaysian Muslims not pledging to organ donation was due to their lack of confidence of the government's ability to properly administer organ donation procedures and their lack of information on organ donation [13]. In contrast, all ethnicities and religion were willing to donate their tooth to research with the majority being Malays (43.2%) and Muslim (43.2%). It is worth to mention that the majority of students who participated in this research were Malay (87.7%) and Muslims (87.7%). To date, there are no known studies relating ethic and religion to tooth donation. Further information is needed as the findings of our study might not represent the actual situation amongst dental students or population in Malaysia as there were insufficient samples for each demographic variable evaluated.

A large portion of the students (92.9%) agreed that it was hard for them to find extracted human teeth, especially molar teeth, followed by incisors, canines and premolars. Over the years, there has been a steady increase in the number of universities in Malaysia offering the dentistry course. No doubt, the Malaysian Dental Council (MDC) highlighted a threefold rise in the number of dental graduates, from 186 in 2009 to 660 in 2017 [14] hence making the acquisition of sound or caries-free extracted human teeth feels almost like a competition among students or even researchers. Carious-free teeth are the preferred option for the preclinical training in operative dentistry and endodontics. However, a report produced in 2019 by the International Islamic University Malaysia stated that caries was the main reason for tooth extraction [15]. Hence, this further justifies that tooth donation awareness campaigns could be considered to increase the supply of extracted human teeth to meet the demands of dental schools and researchers. If the usage of extracted human teeth is still highly relevant, perhaps the government should develop a tooth bank to organise teeth systematically for preclinical and research usages.

When it comes to the beliefs and attitudes of dental students towards teeth donation to research, a majority of students agreed to donate their extracted tooth for research purposes (96.8%) despite having poor knowledge in dental pulp stem cells (DPSCs) research (71%). Their limited understanding of stem cell research might be because all students were in Year 2 preclinical years and might not have had any experience in conducting research or being exposed to the current research in dentistry. Thus, the Ministry of Health (MOH), dental institutions, professional health care members and local mass media play a vital role in creating awareness among the public on the importance of tooth donation for preclinical training and research purposes.

Although 97.4% of dental students claimed ownership of their tooth, 53.5% of them preferred to donate it to the researcher after extraction whereas the rest of the students preferred to keep it or throw it away, 36.8% and 9.7% respectively. Ethical and legal bodies in Europe pronounced the status of extracted teeth as clinical waste but shall not dismiss the importance of gaining consent from the source of the tooth; the person itself and the possibility of repatriation to the donor. Post donation, the samples retrieved shall be treated with respect and dignity whenever it is being processed [8].

In terms of consent, 63.2% were willing to sign the consent form for donating their tooth to research before extraction and preferably during the consultation visit (62.2%). A high percentage of students (85.8%) were keen on knowing the results of the research, and the mode of communication favoured was via email (71.6%). Similar findings were reported Mortadi et al. on patients in Jordan in regards to results of research; however, their patients opted for phone calls rather than email and letter mail [10]. From these situations alone, we could conclude that the students or patients felt they held a certain extent of authority towards their donated teeth even after the donation process. A report produced in 2006 by de Montgolfier et al. stated, 'once items or products have been taken from the body, they become "special things"' [16]. 71.6% of students thought that a surgeon or a dentist should request the consent. It makes sense as dentist or surgeons are experienced medical personnel and are perceived to be knowledgeable in the field of stem cell research. These findings are paralleled to the respondents' educational background that allows them to become aware of the importance of researches towards scientific development and progression. Higher education level was more likely to accept donating teeth towards research [10].

In conclusion, most dental students were willing to donate their tooth to research. Promoting tooth donation to meet the demand for preclinical training and research in Malaysia through educational programs and local mass media could be considered. In future, the establishment of a bio-bank would be beneficial in systematically storing teeth for the usage of preclinical studies and research. However, future study is recommended to overcome the imbalance in the demographic variables in this research to capture the actual influences of these characteristics (gender, ethnicity, religion and others) to tooth donation.

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Depth of needle penetration for an effective inferior alveolar nerve block: A cross-sectional study

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Abstract. The inferior alveolar nerve block is a common procedure in dentistry. Considering there is many techniques to do the injection, there is also a number of difficulties encountered while doing this procedure. One of the problems related is the absence of consistent landmarks. This makes the depth of penetration of injection difficult to gauge. This study was conducted to determine the depth of penetration in relation to the inferior alveolar nerve block. Statistical analysis done using one-way ANOVA determined that the mean time for anesthesia was lower at 4.27±2.0 in group A (10-18mm) when compared to group B (19-26mm) 4.60 ± 2.38, and group C (27mm-34mm) 5.53±2.85. However, the difference in time taken was not statistically significant with p>0.05 (p=0.347). Pearson correlation to determine the relationship between depth of needle penetration and time taken to anesthesia found there was no correlation (Pearson's correlation =0.183 p=0.229).

Introduction

The inferior alveolar nerve block, a common procedure in dentistry, involves the insertion of a needle near the mandibular foramen in order to deposit a solution of local anesthetic near to the nerve before it enters the foramen, a region where the inferior alveolar vein and artery are also present. [1] The pterygoid plexus is located posterior and superior to this area. Failure of inferior alveolar nerve block has been reported to be mainly due to technical errors by dental operators and not because of the anatomical variations that may present in some patients. Some operators may fail to identify the anatomical landmarks useful in applying the inferior alveolar nerve block and rely instead on assumptions as to where the needle should be positioned. The failure rate of inferior alveolar nerve block has been reported to be 20-25%.[2] In this basic introductory review, simplified basic information related to the inferior alveolar nerve anatomy and its different available blocking techniques was collected from the available literature with an overview of some of the techniques related complications.

A second difficulty with the traditional Halsted approach to the inferior alveolar nerve (IAN) (i.e., "mandibular block," or IANB) is the absence of consistent landmarks. Multiple authors have described techniques to achieve anesthesia when the conventional IANB method fails. Indeed, reported failure rates for the IANB are commonly high, ranging from 31% and 41% in mandibular second and first molars to 42%, 38%, and 46% in second and first premolars and canines, respectively, [3] and 81% in lateral incisors. [4]

The depth of penetration at the narrowest anteroposterior width of the ramus and pterygotemporal depression was determined to be half the narrowest anteroposterior width of the ramus plus or minus 1 mm. This depth was within the limits of a short needle. It was easier to estimate the depth of penetration with a short needle than with a long needle. A short needle also was less likely to go too deep and deviate from its course than was a long needle. [10]

Taking all information into consideration, it is determined that a long needle must always be used when conducting an IANB to get the proper depth of 20-25mm between the soft tissue entry point to the mandibular foramen. [1] However, this depth has a wide variation and in certain cases, the depth of the penetration may not even reach 20mm, therefore, making a short needle suitable to used. [11] In this research we would like to determine the depth of penetration in relation to the inferior alveolar nerve block and observe the various variation, as well as considering the time taken for complete anesthesia of area of interest.

1.1 Aims and Objectives

1.1.1 Aims

To correlate the depth of needle insertion and failed anesthesia in the local anesthetic (LA) techniques commonly used in the extraction of lower mandibular molar teeth

1.1.2 Objectives

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Toevaluate the association between the penetration depth in inferior alveolar nerve block and failed inferior alveolar nerve block

Methodology

Study was conducted on patients (n=45) that requires extraction of mandibular posterior teeth including the third molars, in Faculty of Dentistry, SEGi University Kota Damansara. Informed consent was taken prior to the procedure and ethics approval was obtained prior to the commencement of this research.

1.2 Inclusion criteria

The study inclusion criteria were: Patients aged from 17 to 40 years old, that require extraction of mandibular posterior teeth and should be healthy of systemic diseases

1.3 Exclusion criteria

The study exclusion criteria were: Patients 16 years and below, pregnant, with hemolytic disorder and allergic to local anesthesia (Lignocaine and Adrenaline)

1.4 Materials

• Aspirating syringes (Sterilife®, Anthogyr SAS, 2 237 avenue, André-Lasquin, 74700 Sallanches France) are used for the delivery of the LA solution.
• 27G and 30G needles.
• Endodontic silicone stop.
• Endodontic block.
• Local anesthesia (2% Lignocaine + 1:100,000 Adrenaline).

1.5 Procedure

1. Written consent was taken from the patients
2. Endodontic silicone stop was inserted through the needle (1.5 cm, from the tip of the needle)
3. The patient was asked to rinse their mouth with antiseptic mouthwash.
4. Examination of site of injection intraorally
5. Injection of IAN block followed by Lingual nerve block and Long Buccal nerve block is given by an aspirating syringe with 2% lignocaine + 1:100,000 adrenaline
6. Time for complete anesthesia is taken from the start of injection until patient feel numbness through objective and subjective symptoms of IANB. This is assessed by probing along the sulcus of the tooth of interest with a probe, asking the patient of tingling sensation felt on the lower lip and tip of the tongue to the posterior of the tongue.)
7. The needle length of penetration (from needle tip to rubber stopper) was measured using endo block and the measurement is recorded.
8. The time for complete anesthesia and the depth of needle penetration was recorded.
9. Patients were grouped according to the depth of needle insertion (Group A:10-18mm, Group B:19-26 mm and Group C: 27- 34mm).
10. One-way ANOVA and Pearson Correlation was done and $p<0.05$ was considered significant.

Fig. 1. Silicone stop inserted 1.5cm through the needle

Fig. 2. Injection of IAN block

Fig. 3. The depth of needle penetration was measured with endodontic block

2 Statistical analysis and Results

Statistical analysis

All statistical analysis was performed using the statistical software SPSS for Windows, version 22. Differences between the mean time of the 3 groups, Group A (10- 18mm), Group B (19-26mm) and Group C (27-34mm) were determined using one-way ANOVA. The level of significance for the test was chosen as $P < 0.05$. The relationship between depth of needle penetration and time taken to anesthesia was determined using Pearson's correlation, where Pearson's correlation = 0.183.

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2.1 Results

The mean time for anesthesia was found to be lower 4.27±2.0 in the group A (10-18mm) when compared to group B (19-26mm) 4.60 ± 2.38, and group C (27mm-34mm) 5.53±2.85. However, the difference in time taken was not statistically significant with p>0.05 (p=0.347). Pearson correlation to determine the relationship between depth of needle penetration and time taken to anesthesia found there was no correlation (Pearson's correlation =0.183 p=0.229)

Table 1. One-way ANOVA test

	Sum of Squares	df	Mean Square	F	Sig.
Between groups	12.933	2	6.467	1.085	.347
Within groups	250.267	42	5.959		
Total	262.200	44			

Table 2. Pearson's correlations

		Depth	Time
Depth	Pearson Correlation	1	.183
	Sig. (2-tailed)		.229
	N	45	45
Time	Pearson Correlation	.183	1
	Sig. (2-tailed)	.229	
	N	45	45

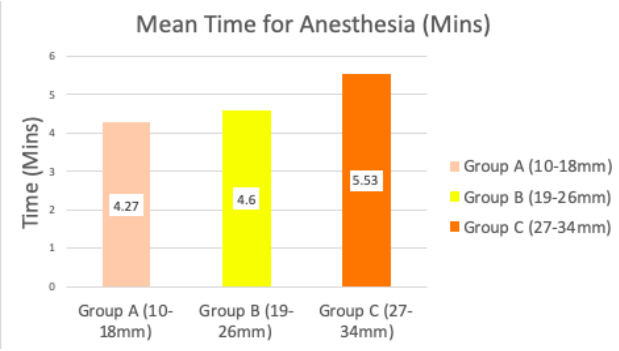

Chart 1. Bar chart showing the mean time for anesthesia between the three group

Discussion

The current study is to correlate the onset of local anesthetic effect and the depth of needle insertion when performing inferior alveolar nerve block. However, there was no statistical significance found between the depth of needle insertion and the onset of anesthesia when performing IAN block as we could not rule out the diffusion of anesthesia agent in the area. There were too many variables that were not considered such as anatomical variations and age of the patient.

A study by Richard A. Menke, Joseph M. Gowgiel (1979) with the use of short-needle block anesthesia at the mandibular foramen concluded that average depth was 16mm which is in line with our result which have the lowest mean time for the depth of 10-18mm.

Furthermore, a thorough knowledge of the anatomy of the pterygomandibular area is essential for us to administer the inferior alveolar nerve block successfully. In addition to the inferior alveolar and lingual nerves, other structures in this area are of significance for local anesthesia, including the inferior alveolar vessels, the sphenomandibular ligament and the interpterygoid fascia according to JN Khoury et. al. (2011) as they could potentially impede diffusion of local anesthetic solution to the IAN.

Concerning the anatomical variations of the accessory mylohyoid nerve, bifid mandibular nerve, presence of retromolar foramen and contralateral innervation of anterior teeth (Fan S et. al.,2009), the successful rate in the anesthesia of the inferior alveolar nerve should be increased using the supplementary anesthetic techniques (Meechan JG et. al. 2006). With regard to the anatomical variation of the mandibular foramen, the literature reports that the position of this foramen changes with skeletal growth both in craniocaudal and anteroposterior directions (Nicholson ML, 1985) which is a challenge to us. Thus, with such correct anatomical landmarks and adequate local anesthesia given, group A tends to have a lower mean time compare to other 2 groups.

The current study is not free of limitation. Age and anatomical variations are the biggest challenge for us. The accuracy of the data can be further improved with future studies by limiting the age group down to 35 and with a larger group of samples.

Conclusion

This study found no statistically significant correlation between the depth of needle insertion and the onset of anesthesia when performing IAN block. The average depth of needle insertion was found to be 21.96 mm which was adequate to produce effective anesthesia in 4.8 minutes.

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Periodontitis patients' knowledge on diabetes and relationship between their periodontal health and glycemic status

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Abstract. This study aimed to determine the periodontitis patients' knowledge on diabetes mellitus and the association between their periodontal health with glycemic status. Methods: 88 periodontitis patients were recruited in two university dental clinics in Kuala Lumpur. After the full study information was given and inform consent was obtained, a short questionnaire on the patients' socio-demographic data and knowledge on diabetes mellitus was given to patients to complete. A full periodontal charting was carried out to diagnose the periodontal status while glycemic levels of patients were determined using glycated hemoglobin (HbA1c) test on patients' venous blood. Results: Most of the patients were found to have currently unstable periodontitis (96.6%), severe periodontitis (67%) and CPITN-4 (79.5%), with equally high percentage falling in prediabetic and diabetic patient groups in all the three categories. Glycemic status was found to be significantly associated with the percentage of knowledge on diabetes (p=0.026) in which more diabetic and prediabetic patients had poor and moderate knowledge only (56.8%). Both patients who had lower-income and who received primary education and below were found to have poor knowledge of diabetes (p=0.020 and p=0.033 respectively). Conclusion: In this study cohort, more than two thirds of the periodontitis patients have moderate to poor knowledge on diabetes and have diabetes or pre-diabetes. Our study suggests screening for diabetes is vital in dental clinic to ensure holistic management of periodontal health.

Introduction

Diabetes mellitus is characterized by hyperglycemic, absolute or relative insulin deficiency or insulin resistance, and a propensity to develop certain long-term complications [1]. According to the International Diabetes Federation, there are about 415 million people worldwide who have diabetes, and that number is expected to grow to 642 million by 2040 [2]. Diabetes is well known to be linked to periodontitis, and often referred to as the sixth complication of diabetes [3], while more pronounced periodontal tissue destruction is seen in people with diabetes [4-5,1]. Diabetes-related morbidities such as diabetic retinopathy, neuropathy and cardiovascular disease have also placed a heavy financial burden on the community [6]. When both diabetes and periodontitis are present, the quality of life of the individuals are frequently affected and this could have become a significant health burden for the nation's economy as higher utilization of healthcare services needed for medical and dental interventions when instead it could have been largely preventable by modifications that target lifestyle behaviors.

Diabetes often goes undetected; approximately one-third of people with diabetes are not aware of their condition due to the absence of symptoms and/or disease-related knowledge [7]. Hence, a preliminary cross-sectional study was carried out to evaluate the knowledge on diabetes mellitus among the patients with periodontitis from different sociodemographic status in a small area of Kuala Lumpur city. This study also aimed to determine the association between glycemic status and periodontitis status of these patients.

Material and Methods

A cross-sectional study was carried out among patients with periodontitis in two university dental clinics in Kuala Lumpur. Patients diagnosed with periodontitis with age more than 16 years old were included in the study while pregnant or those having any renal diseases were excluded from the study. Details including age, occupation, ethnicity, gender, education level, smoking history, known diabetes, medication and family medical history were recorded.

2.1 Periodontal health assessment

The periodontal health of all patients was evaluated based on routine oral examination for new and recall patients. Classification of periodontitis was evaluated using the measurements of full mouth bleeding on probing (BOP) and probing pocket depth (PPD) of each patients based on diagnosis categories of either 'Currently stable'

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(BOP <10%, PPD <4mm and no BOP at 4mm sites), 'Currently in remission' (BOP >10%, PPD <4mm and no BOP at 4mm sites) or 'Currently unstable' (PPD ≥5mm or PPD ≥4mm and BOP) [8]. The severity of periodontitis was then classified according to Case definition of Periodontitis [9] for either 'Mild' (>3 and <5mm), 'Moderate' (≥5 and <7mm) or 'Severe' (≥7mm) periodontitis.

2.2 Glycaemic assessment

For this part, measurement of glycated hemoglobin (HbA1c) from 3ml venous blood taken from patients was made. Subsequently, patients were classified into 3 groups i.e. 'No diabetes' (<5.6% or 38mmol/mmol), 'prediabetes' (5.6-6.2% or 38-44mmol/mol) and 'diabetes' (≥6.3 % or 45mmol/mol) [10].

2.3 Knowledge on diabetes mellitus

Patients' knowledge on diabetes mellitus was assessed using a twelve-item self-administered questionnaire on general awareness, symptoms, complications, prevention and control of diabetes mellitus, and relationship between diabetes and periodontitis (adapted from [11-12]. A score of '1' was given to each correct answer and '0' was to every wrong answer including "don't know". Total score of 75% and above were considered as having "Good knowledge", 50% or less as "Poor knowledge" while score between 51-74% were considered as "Moderately adequate knowledge" [13].

2.4 Statistical analysis

All analyses were conducted using statistical software package IBM SPSS Statistic Version 20 (IBM, Armonk, USA). Descriptive analysis using frequency, means and standard deviation (SD) were used to describe the socio-demographic data. After the patients were categorized according to the glycemic status, Pearson chi-square was used to analyze sociodemographic variables and Kruskal-Wallis test for the relationship of knowledge and education level.

Results

3.1 Study participants

The study involved 88 periodontitis patients (mean age 51.76, SD 12.42), with majority (45, 51.1%) were between 40-59 years old (Table 1). Most patients were Malays (61.4%) and males (62.5%). Highest education level received mostly from secondary school (46.6%) and only few from primary or no formal education (7.9%). More than half of the patients have higher monthly income which is more than RM2500 (54.5%).

There were 19 patients who smoked (21.6%) and 27 (30.7%) reported that they knew they had diabetes. Majority of the patients also reported that they have a family history of hypertension (61.4%), diabetes mellitus (56.8%), hypercholesterolemia (30.7%) and some reported family history of cardiovascular disease (15.9%).

Table 1. Sociodemographic dan medical details of the participants, n=88

Characteristics	Total, n (%)
Age (years)	
20 – 39	15 (17.0)
40 – 59	45 (51.1)
60 and more	28 (31.8)
Ethnicity	
Malay	54 (61.4)
Chinese	22 (25.0)
Indian	11 (12.5)
Others	1 (1.1)
Gender	
Male	55 (62.5)
Female	33 (37.5)
Highest education level	
Primary / no formal education	7 (8.0)
Secondary	41 (46.6)
Tertiary	40 (45.5)
House whole monthly income	
< RM2500	40 (45.5)
> RM2500	48 (54.5)
Smoking status	
Yes	19 (21.6)
No	69 (78.4)
Known diabetes	
Yes	27 (30.7)
No / Don't know	61 (69.3)
Medical history of family	
Diabetes mellitus	50 (56.8)
Hypertension	54 (61.4)
Hypercholesterolemia	27 (30.7)
Cardiovascular diseases	14 (15.9)

3.2 Periodontitis and Glycemic status of patients

Table 2 shows that most of the patients were diagnosed as "Periodontitis currently unstable" (n=85, 96.6%), with severe periodontitis (59, 67%) and CPITN-4 (79.5%), with almost equal high percentages within the groups of prediabetic and diabetic patients for all the three categories. Of the diabetic groups, 15.6% of patients were newly diagnosed with diabetes while another 39.8% of periodontitis patients were under the prediabetes category after glycemic assessment. There is no statistically significant difference between periodontitis and diabetic status among diabetic and prediabetic patients (p=0.066).

Table 2. Sociodemographic dan medical details of the participants, n=88

Periodontitis status	Glycemic status (HbA1C level), n (%)		
	Non-diabetes (<5.6%)	Pre-diabetes (5.5-6.2%)	Diabetes (>6.3%)
Diagnosis Currently: stable	0 (0)	1 (1.1)	0 (0)

in remission	0 (0)	1 (1.1)	1 (1.1)
unstable	21 (23.9)	33 (37.5)	31 (35.2)
Severity			
Mild	0 (0)	3 (3.4)	1 (1.1)
Moderate	5 (5.7)	7 (8.0)	13 (14.8)
Severe	16 (18.2)	25 (28.4)	18 (20.5)

3.3 Patients knowledge on diabetes

Many of the patients showed moderate knowledge (40, 45.5%) and almost equal percentage had poor and good knowledge (27, 30.7% and 21, 23.9% respectively) with no significance difference was found between groups (Table 3).

Analysis using Chi-square on income shows statistically significance difference between the glycemic status groups (p=0.020) compared to non-diabetics, while Kruskal Wallis analysis on education level show statistical significance between the three groups of patients (p=0.033). Patients with lower income were seen to be more likely to have poor knowledge on diabetes, while those with only primary education and below had poor knowledge. However, there was no significant difference between the groups in aspects of age, gender or ethnicity (p=0.535, p=0.584 or p=0.286 respectively). Majority of patients (52.3%) were not aware of the relationship between periodontitis and diabetes.

Table 3. Knowledge on diabetes mellitus among periodontitis patients with or without diabetes

Knowledge level	n (%)			p-value
	NDM	Pre-DM	DM	
Poor	6 (6.8)	12 (13.6)	9 (10.2)	0.082
Moderate	11 (12.5)	14 (15.9)	15 (17.0)	0.772
Good	4 (4.5)	9 (10.2)	8 (9.1)	0.055

NDM = Non-diabetic, Pre-DM = Pre-diabetic, DM = Diabetic

Discussion

Our study's findings on the high detection of diabetes and pre-diabetes status among periodontitis patients (76.1% DM and Pre-DM compared to 23.8% NDM) has raised instantaneous concern among the dental professionals. Although there is no statistical significance difference between glycemic groups, the detection of high numbers of diabetes and pre-diabetes patients among the currently unstable cases demands immediate and drastic action to control both the progression of periodontitis as well as glycemic status.

The study also detected 15.6% new cases of diabetes and 39.8% pre-diabetes cases among periodontitis patients treated in both university dental clinics. As it has been established that many individuals do not know they have diabetes before [14], this result can indicate that periodontitis can be an early sign of undiagnosed diabetes [7]. Our finding hence supports the recommendation made on precondition diabetes screening among periodontitis patients in dental clinics [15]. Glycemic status screening among periodontitis patients is crucial to identify patients at risk and to ensure appropriate referral to the health clinic in order to improve their periodontal health as well as diabetic wellness.

In this study, we found that there was a significant difference in the knowledge on diabetes mellitus among the periodontitis patients with different education levels and monthly income, whereas gender, age group and ethnicity do not have any significant differences with their level of knowledge. Similar finding was found in a previous study where participants with lower level of education were found to have poorer knowledge, attitude and practice on diabetes compared to those who had higher education trainings [13]. These studies support other studies which indicated that educational level as a predominant predictive factor for knowledge of diabetes [16-18, 12]. It was also shown that diabetic patients who had lower level of education were more likely to be diagnosed with periodontal disease [19], while higher scores for knowledge on diabetes was seen among patients with higher education level [20]. Parallel to our finding, increased knowledge on diabetes was found to be associated with lower glycaemic status [6].

Knowledge on diabetes was also found to be associated with patients' household income; lower income groups showed lesser knowledge when compared to those with higher income. However, our finding contradicts with other study where there is no association between income and diabetes knowledge [21].

Findings from this study could highlight the clinical significance of emphasizing a more holistic periodontitis-diabetes mellitus management especially in the general dental practice, inclusive of diabetes screening and implementing better literacy of periodontitis-diabetes knowledge to help reduce the impact of systemic risk as well as enhance treatment outcomes for periodontitis patients.

Conclusion

In this study cohort, more than two thirds of the periodontitis patients have moderate to poor knowledge on diabetes and have diabetes or pre-diabetes. Our study suggests screening for diabetes is vital in dental clinic to ensure holistic management of periodontal health.

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