Sri Lanka Dental Journal

The Official Publication of Sri Lanka Dental Association

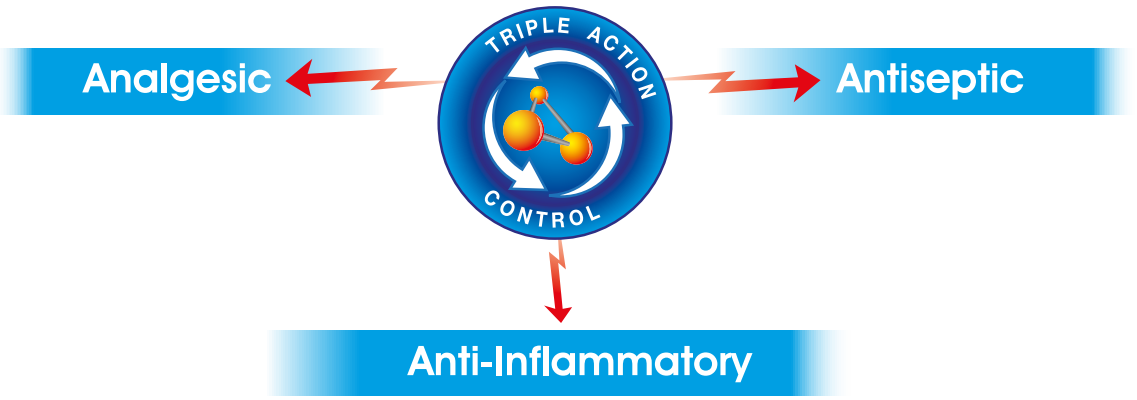
Volume : 52
Number : 01
April : 2022

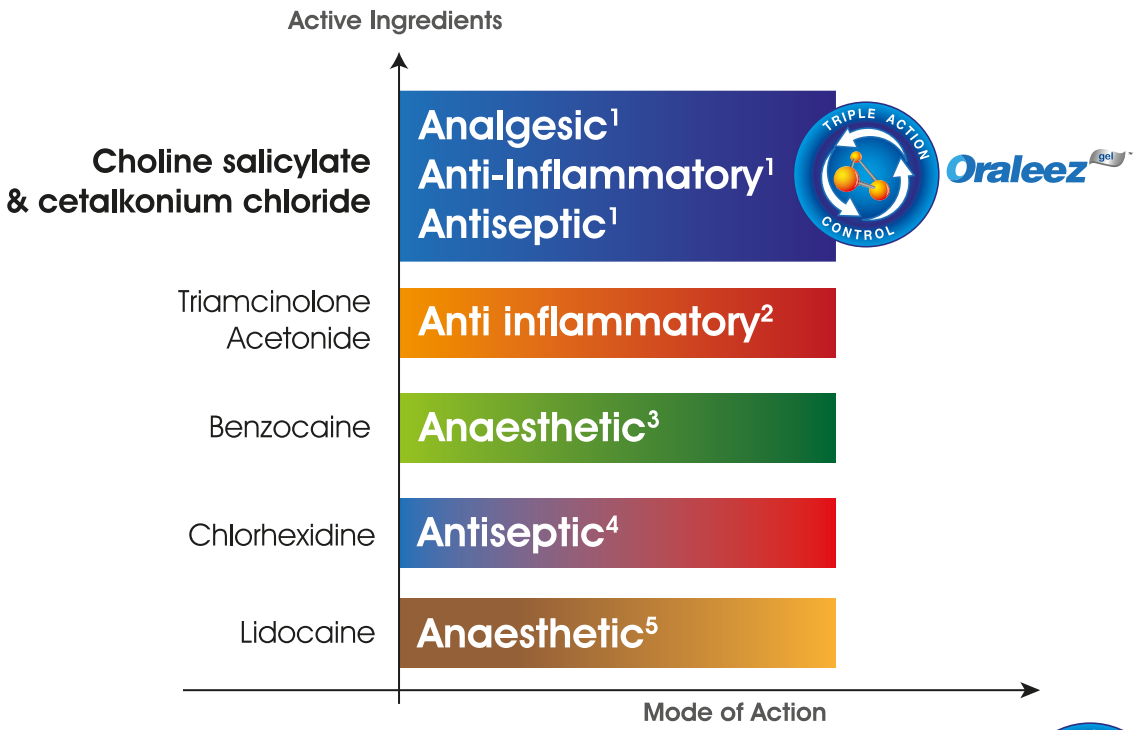
ISSN 2950-6662

SUGAR FREE

Oraleez gel™

Choline salicylate 8.714% w/w, cetalkonium chloride 0.010% w/w.





NOTHING STRONGER !!!

For Mouth Ulcers...
Pain and Inflammation

TRIPLE ACTION CONTROL

SUGAR FREE

ANISEED & MENTHOL flavour

REFERENCES:

1. https://www.medicines.org.uk/emc/product/624/smpc#gref 2. https://www.ncbi.nlm.nih.gov/books/NBK544309/ 3. https://www.ncbi.nlm.nih.gov/books/NBK541053/
4. https://www.researchgate.net/publication/337567357_The_topical_effect_of_chlorhexidine_and_povidone-iodine_in_the_repair_of_oral_wounds_A_review 5. https://www.nhs.uk/medicines/lidocaine-for-mouth-and-throat/

Sri Lanka Dental Journal

Volume 52 **Number 01** **April 2022**

The **Sri Lanka Dental Journal** is a refereed journal published three times a year by the Sri Lanka Dental Association.

Editorial Office

Office of the SLDA,
Professional Centre,
275/75, Prof. Stanley Wijesundara Mawatha,
Colombo - 7.

Correspondence regarding editorial matters, articles, reviews and news items should be addressed to the Editor, SLDJ, Prof. N.S. Soysa, Professor in Pharmacology, Department of Oral Medicine and Periodontology, Faculty of Dental Sciences, University of Peradeniya, niroshanis@dental.pdn.ac.lk, Tel: 0094 76 8818205 and Prof. B.S.M.S. Siriwardena, Professor in Oral Pathology, Department of Oral Pathology, Faculty of Dental Sciences, University of Peradeniya, samadaranis@dental.pdn.ac.lk, Tel: 0094 812397536

Correspondence regarding advertisements and financial matters should be addressed to Dr. Malcolm Stanislaus, 50, Hekitta Cross Road, Hendala, Wattala. Tele: 011 - 2930368

ISSN 2950-6662

Typeset & Layouts:

EM Creations
227/7, Uduwana Temple Road, Homagama.

C O N T E N T S

Sri Lanka Dental Journal

Volume 52 Number 01 April 2022

EDITORIAL

Practicing pandemic dentistry in the post-pandemic era

It is clear that the Coronavirus Disease-2019 (COVID-19) caused by the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) is highly likely to be a global, endemic infection akin to seasonal influenza. Hence, the dental profession has a duty of care to their patients and to the co-workers, to model their clinical practices that befit the infection control requirements necessitated by this protracted pandemic. Curbing the disease spread is especially important in dentistry as most of the dental procedures involve bio-aerosol generating procedures, the main mode of COVID-19 transmission. Moreover, it has been demonstrated that SARS-CoV-2 is present in high concentrations in saliva of both asymptomatic and symptomatic patients

Additionally, nosocomial transmission of infection to dentists and the team in clinical settings is aggravated by the close interaction of the healthcare workers with the patients. Similarly, patients are also vulnerable to contract the disease as they must temporarily get rid of their protective gear such as masks during the treatment procedure.

During the pandemic many Dental Associations, including SLDA, issued various directives on the types of treatment that should be undertaken, delivery methods of primary care, personal protective equipment (PPE), pre-operative infection control measures, and types of instruments and materials to be used during surgical procedures.

According to these guidelines only urgent, emergency treatments were provided whereas elective treatment was postponed. Dentists were also advised on the minimal use of ultrasonic and high-speed instrumentation, as well as three-way syringes. Use of rubber dam during aerosol generating procedures and high-volume saliva ejectors were recommended to reduce bio-aerosols. Furthermore, mouth rinses such as 1% Hydrogen peroxide and 0.2% Povidone-iodine were recommended as a pre-operative measure to mitigate the salivary viral load.

PPE such as various grades of N95 or surgical masks along with protective eyewear, cap, gloves, shoe covers and gown while treating patients were also highly recommended. Improving the general ventilation of the dental clinic with air filtering and periodic environmental disinfection of the clinic as well as patient waiting area should be part of the infection control protocol.

Moreover, novel teledentistry methods were introduced to screen patients from home prior to arrival at the clinic, while allocating a separate room for triage once they arrive. New point-of-care (POC) diagnostic tests such rapid antigen tests (RAT) and molecular tests were recommended to screen the patients before commencing dental treatment following the modified medical/dental/ social history taking with special emphasis on travel history and vaccinations.

As COVID-19 is an ongoing, recalcitrant infection with the possibility of novel variants emerging, it is advisable to use some, or all of these measures in the post-pandemic era. Hence, it behoves the profession to be aware of the contemporary infection control measures disseminated by the local and regional professional bodies as well the authorities such as CDC, USA, and act on these for the greater good of the patients, the dental team, as well as themselves, their family members, and the public, at large.

Selected References:

1. Samaranayake, L and KS Fakhruddin 2021 Pandemics past, present, and future: Their impact on oral health care (Invited Review) The Journal of the American Dental Association 152 (12), 972-980.

2. Jamal, M., Shah, Samaranayake, L.P. et al 2020 Overview of transnational recommendations for COVID?19 transmission control in dental care settings. Oral Diseases. doi:10.1111/odi.13431.

3. Samaranayake, L.P. 2020 COVID-19 and Dentistry: Aerosol and Droplet Transmission of SARS- CoV-2, and Its Infectivity in Clinical Settings Dental Update 228 :7:600-602.

4. Samaranayake, L Kinariwala, N Perera RM 2020 Coronavirus Disease 2019 (COVID-19) Diagnostics: A Primer Dental Update 47 (9), 761-765.

5. Samaranayake, L.P.; Chang JWW, Panduwawala C 2021 COVID-19 vaccine: Vagaries and vacillations Dental Update; 48(4):323-326.

Prof. N.S. Soysa
Prof. B.S.M.S. Siriwardena
Editors - Sri Lanka Dental Journal

Research Article

Sri Lanka Dental Journal 2022; 52(01) 01-09
Received: 28.01.2022 | Revised: 15.03.2022 | Accepted: 29.03.2022

Orthodontic retention practices among consultant Orthodontists in Sri Lanka

WBMCRD Weerasekera, DMNS Seneviratne

Abstract

Objective: Orthodontic retention phase is mandatory following active treatment. The developments in the orthodontic retention strategies have created a wide variation. Hence, a personal preference exists among orthodontists. This survey is aimed to study the perspective of the retention practices among orthodontists in Sri Lanka.

Method: Orthodontists (n=34) who met the inclusion criteria were included in this study. A validated self-administered questionnaire was modified according to the Sri Lankan context based on the results of the pilot study. The pilot study was conducted via an online Google form. The questionnaire comprised of four parts, (1) Socio-demographic information of orthodontist, (2) preference on different retainer types, wearing duration and the number of retention check-ups, (3) information regarding the type and size of the wires used for permanent bonded retainers and (4) information on the retainers which become unintentionally active. The collected data was analyzed using SPSS 21 software.

Results: A total of 29 (85.29%) orthodontists responded (M/F:27:73). Most of the orthodontists (44.7%) were in the age range of 46-55 and 69% of them were attached to government hospitals. Findings showed that the most preferred appliance as Hawley retainer (62%) for the upper arch and bonded retainer (41.3%) for the lower arch. 96% of the Hawley retainers were fabricated by the technicians and 96% of bonded retainers by orthodontists themselves without technical support. Further, the functional appliance (51.7%) was the most common adjunctive retention appliance recommended by the study participants. Initially, full time wearing was prescribed by all orthodontists for upper arch and 86.2% for lower arch. Retainer check-ups were performed every 2-4 months for removable retainers by 83% orthodontists. Stainless steel triple strand round wire (41%) was the most used wire type for bonded retainers.

Conclusion: Hawley retainers and bonded retainers were the most prescribed retention appliances for maxillary and mandibular arches, respectively among orthodontists in Sri Lanka and the retention practices were in accordance with those of developed countries.

Key Words: orthodontic retention, retainers, orthodontists, Sri Lanka.

Introduction

Orthodontic treatment outcome is potentially unstable and therefore, treatment is not over until the ultimate clinical result is stabilized to last lifelong[1]. Therefore, a second stage of retention is essential, and this stage is coined as the 'stepchild' of orthodontic treatment. The

WBMCRD Weerasekera (Correspondence) — Department of Community Dental Health, Faculty of Dental Sciences, University of Peradeniya, Sri Lanka. E-mail: c.weerasekera@yahoo.com ORCID: 0000 0002 3754 7945

DMNS Seneviratne — Department of Community Dental Health, Faculty of Dental Sciences, University of Peradeniya, Peradeniya, 20400, Sri Lanka.

importance of retention phase was identified as early as 1860 by Emerson C. Angell [2] who is known as the father of rapid palatal expansion in orthodontic treatment. Subsequent developments in the field contributed to improve the retention strategies. Fulfilment of patients' expectations is one of the most important objectives of the health care delivery systems [3]. One of the expectations of the patients is to maintain the achieved occlusion for a lifetime [4]. Therefore, it is mandatory to carry out a well-planned retention phase which is the responsibility of the patient as well. Attitudes to the strategies of retention have been changed over the years, but there is a shortage of reliable evidence on which to base clinical practice on retention [5]. A study by Wong and Freer concluded that retention procedures have a personal preference [6]. Therefore, it is accepted that the orthodontic retention procedures have a variation from clinician to clinician and country to country. However, it is understood that the choice of retainer type is mainly based on experience [7].

Orthodontic practice in Sri Lanka is based on four different professional settings. They practice in hospitals in various parts of the country administrated by the Ministry of Health, the University Dental Hospital, Military hospitals of the tri-forces and in full-time private practices. Most of them have dual practices as orthodontists indulge in part-time private practice apart from their primary clinical settings.

It is of utmost importance for the dental profession to explore the common retention practices employed by the orthodontists in Sri Lanka. Therefore, the aim of this study was to survey the retention protocols that are followed by orthodontists in Sri Lanka. According to the best of the knowledge of the researchers', this aspect has not been explored among the Sri Lankan orthodontists so far.

Materials and methods

The survey questionnaire designed by Renkema *et al*.[8] was used with a few modifications to relate to the Sri Lankan context, in accordance with the studies conducted in other countries. The questionnaire was pilot tested with two orthodontic post graduate students who succeeded at the final examination for the master's degree in orthodontics and were awaiting overseas training prior to the board certification as a consultant orthodontist in Sri Lanka. Based on their responses, the first draft of the questionnaire was revised, and the final questionnaire was generated ensuring the face validity and content validity of the questionnaire. Ethical Approval was obtained from the Ethics review committee at the Faculty of Dental Sciences, University of Peradeniya. (ERC/FDS/UOP/I/2019/19).

The final questionnaire consisted of a mixture of multiple-choice questions, closed ended and open-ended questions. The questionnaire elicited the following information which consisted of 4 sections and 17 questions. 'Section A' the demographics and background information of the consultant orthodontist. 'Section B' and 'C' addressed the use of different retainer types, orthodontists' prescription on duration of removable and bonded retainer wear, number of retention check-ups and information regarding the type and size of the wires used for permanent bonded retainers while 'Section D' collected information on the unintentionally active bonded retainers along with additional comments and remarks.

Board certified Consultant orthodontists from Sri Lanka were included while the Consultants orthodontists who did not practice due to medical conditions were excluded from the study. The questionnaire was sent online as a Google form accompanying with an invitation and the informed consent form to all the 34 Board certified Consultant Orthodontists who satisfied the inclusion criteria by March 2020. The participants were reminded of the Google form one month later by a text message and an email. The survey was closed for response after one month from the date of the reminder.

Responses from the survey were entered into an excel sheet in the Google drive and the data were exported to SPSS (Version 21). Demographic information of the orthodontists, different appliance types, wire types, retention period and other information in the questionnaire were described in percentages. The comparison of the prescription of adjunctive procedures across different age categories of the orthodontists was done using Kruskal-Wallis Test at a significance of $p<0.5$.

Data were analyzed using Statistical Package of Social Sciences, version 21 for Windows (SPSS, Chicago, IL, USA)

Results

A total of 29 orthodontists responded with an overall response rate of 85%. Only a few participants responded to the final three open-ended questions. Most of the participants (72.4%) consisted of female practitioners while 69% of the participants worked at Government Hospitals. 6.8% responses were from full time private practitioners, 13.8% from military hospitals and 10.3% from university hospital respectively. Many of the orthodontists belonged to the 46–50-year age group and 41.6% of the participants were above 51 years of age. Out of the respondents, 65.2 % of the orthodontists reported to have more than 11years of experience in orthodontic clinical practice and only 13.7% of less than 5 years.

The most preferred retainer type for the maxilla was Hawley retainer (HR) (62%) and canine to canine bonded retainer (BR) for the mandible (55%). None of the orthodontists opted for canine-to-canine BR for the maxilla alone. However, they used BRs in combination with HRs or Vacuum Formed Retainers (VFR) for both arches. Any form of BR used singly or in combination was the choice of 85.3% of orthodontists for the mandibular arch. Bonded retainer for the upper arch was less popular as only 34.3% used it separately or in combination (Figure 1). It was identified that 86.2% of the BRs were constructed by the orthodontists themselves. A 13.8% of BR and 69% of VFR fabrications were done by orthodontic technicians at laboratories.

The frequency of the use of eight different strategies, supplementary to the retention was questioned in a Likert scale. The response 'sometimes' given by the orthodontists was taken into consideration. It was revealed that the response 'sometimes' was given by 51% of orthodontists for functional appliances, 44% for habit breakers, and 41% for inclined planes

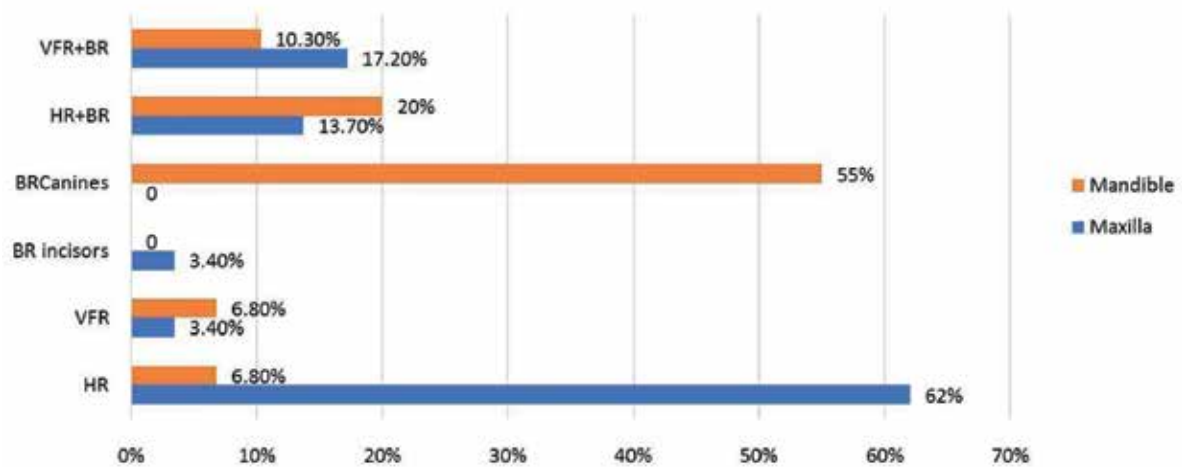


Figure 1. Preference of the retainer type

along with or without the traditional retention appliances. A significant difference ($p<0.5$) was revealed in the use of supplementary retention strategies such as functional appliances and prophylactic removal of third molars across the different age groups of the participants (Kruskal-Wallis Test). The total group of orthodontists, irrespective of experience or gender, prescribed the wearing of the removable maxillary retainers for full time, i.e., more than 22 hours, during the initial 3 months period while only 86.2% prescribed for full time wearing of the mandibular retainer (Table 1).

The predominant choice for the total duration of the bonded retainer in-situ for both adults and children were determined by the orthodontists according to the individual patient's clinical scenario such as the type of original malocclusion, age of the patient and the compliance. Interestingly, the total duration of the BR for children was between 0-1 years in 13.7% of orthodontists. Same percentage of orthodontists (13.7%) kept the BRs until the end of growth or permanently (Figure 2).

The HRs and VFRs were considered as removable retainers and 48.2% of orthodontists carried out checkups for removable retainers every 2-4 months. However, 17.2% of removable retainer and 51.7% of BR checkups were done only upon a complaint by the patient, irrespective of their age (Figure 3). For BRs, Stainless Steel (SS) twisted 3-strand round wire was the choice of 41% of the orthodontists for both the maxillary and mandibular arches. Furthermore, another 41% preferred dead soft wires for the maxilla as well (Figure 4).

The experience of the orthodontists on the unexpectedly active BR was questioned and 51.7% (n=15) of the orthodontists responded as 'rarely', 31% (n=9) as 'sometimes', 17 % (n=5)

Table 1. Prescribed duration of the wearing of the removable retainers

Duration	*Maxillary Arch*	*Mandibular Arch*
Day and Night	100%(n=29)	86.2%(n=25)
Evening and night	0	3.4% (n=1)
Night only	0	10.3%(n=3)

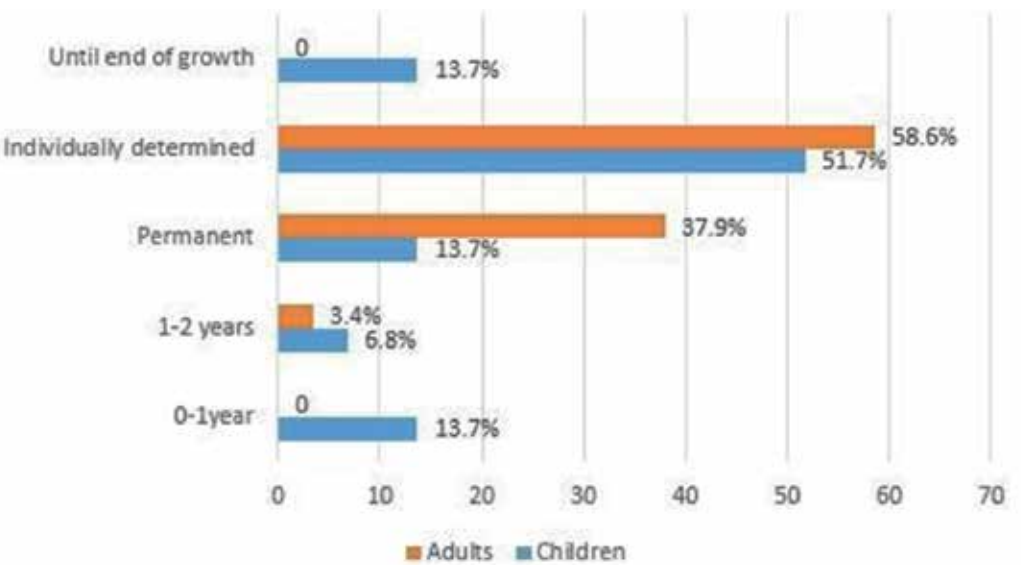


Figure 2. Total duration of Bonded Retainer in-situ

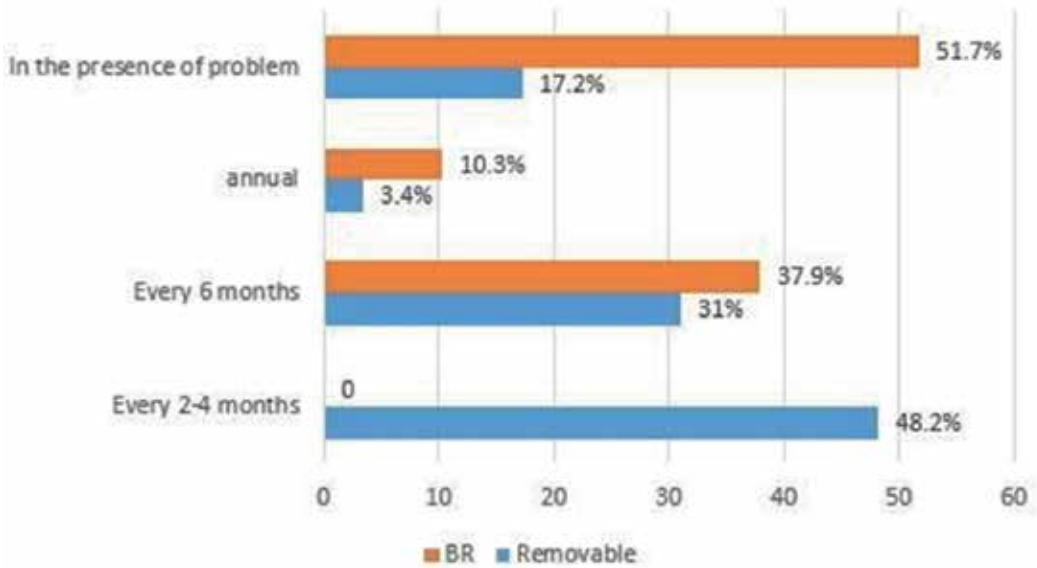


Figure 3. Frequency of checkups for removable retainers

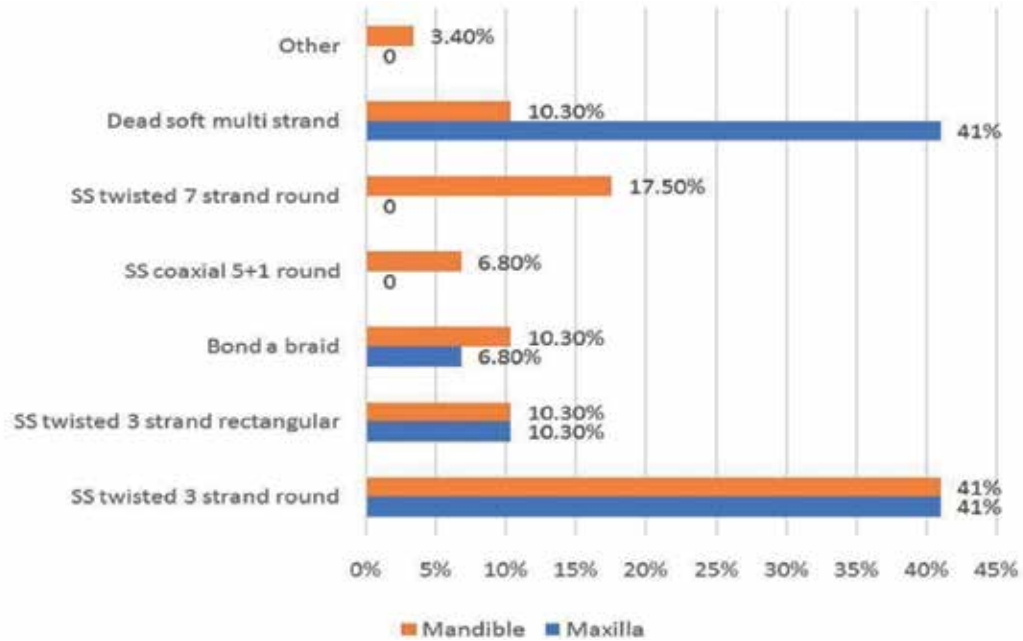


Figure 4. Wire materials used for bonded retainer

'never' and none as 'often' to this phenomenon. In the final section, three open-ended questions were asked on the clinical observations of unintentionally active BRs and only 79% (n=24) responded. The observations made by the orthodontists were malalignment of several teeth or a single tooth in the bonded section, rotation of teeth, extrusion or intrusion of teeth, tooth mobility and proclination of teeth. It was observed that 50% of the respondents preferred the removal of the BRs and observe for settling and only 29% preferred retreatment of the relapsed section (Table 2).

Finally, as 'other comments', out of the 17% (n=4) who responded, the orthodontists highlighted

Table 1. Remedies for unintentionally active Bonded Retainers

Remedial action	%
Retreatment	29% (n=7)
Remove and observe for settling	50%(n=12)
New type of retainer	8.3%(n=2)
Other suggestions-reinforce oral hygiene, remove, and do enamel reduction to create space, retreat and fix a dead soft wire	12.5%(n=3)

three important aspects: 1. the importance of correct diagnosis and treatment planning with realistic treatment goals to avoid readily reversible end results 2. construction of the BRs on the study casts instead of fabrication on the patient's teeth at chairside and 3. the necessity to refer the patients to the general dental practitioner for follow-ups at least once a year in order to maintain oral hygiene.

Discussion

The present study investigated the demographic patterns and the retention strategies employed by the consultant orthodontists in Sri Lanka using a questionnaire circulated via a Google form. The respond rate for the survey was 85%. It is a higher rate compared to the survey responses of other countries such as Australia[6], New Zealand [6] and India[9] ~~surveys~~ but less than that of British[10] and Iraq[11] surveys which had an 87% respond rate.

Regarding the type of appliance, according to our results, HRs proved to be the first choice for the maxilla among 62% of orthodontists, whereas canine to canine BR was the first choice (55%) for the mandible showing a similarity to the findings in India[9], the US[12] and Saudi Arabia[13]. VFR combined with BR (17.2%) for maxilla and HR combined with BR (20%) for mandible were the second most popular retainer choices in Sri Lanka while the second most common choice for both arches were VFRs in India[9], US[12] and Saudi Arabia[13].

About construction of retainers, 86% of the BRs are constructed by the orthodontists themselves and this is in line with the findings of Iraq[11] and Australia[8] in which many orthodontists fabricated the BR directly over the teeth or on the study cast and only a 34.2% got the commercial laboratory to fabricate it on the study cast. However, only 24% of the Sri Lankan orthodontists constructed VFRs by themselves.

More than half of the orthodontists in Iraq chose over-correction as an adjunctive method to enhance retention, and 19.3% preferred interproximal stripping (IPR)[11]. However, no adjunctive procedure was reported by 12.7% of the orthodontists who tend to recommend lifetime retention. Al-Jewair *et al*., reported that IPR was more common among Saudi orthodontists and only 26.8% did not perform any adjunctive procedure[13]. In our study it was revealed that a multitude of adjuvant retention strategies were used in the frequency of 51% in functional appliances, 20.7% in supracrestal fiberotomy and 2.9% performing prophylactic removal of third molars.

In the Netherlands [8] patients were advised to wear the removable retainers for an average of 18 h per day, 7 days a week, after which part-time wear was advised for 9-16 h a day. In another study two-thirds of the orthodontists in their first retention phase, prescribed full-time maxillary retainer wear, for more than 20 h per day, for at least 3-9 months[14]. In our study, it was approximately more than 22 hours during the initial 3 months for the maxillary arch and only 86% prescribed full time wearing for the mandibular arch.

Most Iraqi orthodontists recommended lifetime wearing of a fixed retainer, corroborates with

most previous studies[6,15,19]. In this study, the total duration of the BR in situ for the adults and children was determined individually as such selections are case specific by most orthodontists. Interestingly, the total duration of the BR for children was less than 1 year among 13.7% of orthodontists and another 13.7% placed the BR until the end of growth.

Valiathan and Hughes reported that the timing of the scheduled retention appointments varied among clinicians and depended on their number of years in practice[12]. Most of the orthodontists in Malaysia scheduled the first retention appointment at 1-3 months after debonding and followed their patients closely for a maximum of 2-4 years. In agreement with the above findings, our study showed removable retainer checkups every 2-4 months up to 2 years and BR checkups only in the presence of a complaint by the patient irrespective of their age.

Stainless Steel twisted 3-strand round wire was the choice of 41% of the orthodontists for both maxillary and mandibular arches and this contrasts with the orthodontists in Australia[7] whose material of choice was SS single strand wire while a majority opted for 'other' in the material selection. Most orthodontists in New Zealand[6] selected SS twisted 3-strand round wire for the maxillary arch and the SS single strand rectangular for the mandibular arch. These findings are in par with the results from the studies done in Netherlands[8] and the USA[12]. Many of the orthodontists fabricate and adapt the retainer inside the patient's mouth using the multistrand dead soft wire and flowable composite. Similarly, most Dutch orthodontists selected the multistrand dead soft wire for bonded retainers[8].

The experience of BR wires becoming unexpectedly active during the retention period. Padmos *et al*.,[15] reported that most of the Dutch orthodontists were familiar with the phenomenon of unintentionally active retainers and only nine orthodontists (3.0%) had never observed this phenomenon. In our study, 51% of the orthodontists experienced 'rarely' and 13.7% orthodontists declared that they never encountered this phenomenon. The observations made by the Sri Lankan orthodontists were malalignment of a segment of teeth or a single tooth in the bonded section, rotation of teeth, extrusion or intrusion, proclination and tooth mobility. The most preferred remedial action taken was the removal of the BRs and wait for self-correction. In the same study by Padmos *et al*.,[15], strategies to manage unintentionally active retainers were to make the patient aware about the situation and removal of the retainer and moving from a round multistrand to a rectangular multistrand wire.

Three major responsibilities of an orthodontist in the retention practices had been pointed out by the Sri Lankan orthodontists in the survey which include accurate diagnoses and treatment planning, the importance of the precision in the BR construction and the importance of persuading the patients to make regular visits to the general dental practitioner? to stabilize the result. This study focused on routine practices and generalized opinions in retention practices, and it might have been a limitation for the orthodontists to express their case specific opinions. Moreover, it was not explored whether the orthodontists' hand over the retention responsibility to the general dental practitioner at some point of the retention management regime. Though the sample size of the study could be a limitation, however, there was only 34 eligible consultant orthodontists in Sri Lanka at the time of recruitment of participants for the study.

Conclusion

The study findings depict that the retention practices of the Consultant Orthodontists in Sri Lanka are in par with those of the developed countries.

Acknowledgements

We would like to extend our gratitude to all the consultant orthodontists in Sri Lanka who

provided us with their invaluable inputs.

References

1. Reitan, K. (1967). Clinical and histologic observations on tooth movement during and after orthodontic treatment. Am J Orthod Dentofacial Orthop.*53*(10), 721–745. https://doi.10.1016/0002-9416(67)90118-2.

2. Wikimedia Foundation. (1868). Emerson C. Angell. Wikipedia. Retrieved from https://en.wikipedia.org/wiki/Emerson_C._Angell.

3. Bondemark, L., Holm, A.-K., Hansen, K., Axelsson, S., Mohlin, B., Brattstrom, et al. (2007). Long-term stability of orthodontic treatment and patient satisfaction. The Angle Orthodontist, 77(1), 181–191.https://doi.10.2319/011006-16R.1.

4. Yao, J., Li, DD., Yang, YQ. et al. (2016). What are patients' expectations of orthodontic treatment: a systematic review. BMC Oral Health 16, 19. https://doi.org/10.1186/s12903-016-0182-3.

5. Melrose C, Millett DT. (1998). Toward a perspective on orthodontic retention? Am J Orthod Dentofacial Orthop. 113(5):507-14. doi: 10.1016/s0889-5406(98)70261-6.

6. Wong PM, Freer TJ. (2004). A comprehensive survey of retention procedures in Australia and New Zealand. Aust Orthod J. 20(2):99-106. PMID: 16429880.

7. Meade, M.J., Dreyer, C.W. (2019). A survey of retention and retainer practices of orthodontists in Australia. Australasian Orthodontic Journal, *35*(2), 174-183. doi:10.21307/ aoj-2020-047.

8. Renkema, A.M., Helene Sips, E.T., Bronkhorst, E., Kuijpers-Jagtman, A. M. (2009). A survey on orthodontic retention procedures in the Netherlands. The Eur J of Orthodontics, 31(4), 432–437 https://doi.10.1093/ejo/cjn131.

9. Sandhya, V., Arun, A. V., Mahendra, S., Chandrashekar, B. S., Shetty, B., Mahesh, C. M., et al (2019). Retention protocols and use of vacuum-formed retainers among specialist orthodontists in India. Journal of the World Federation of Orthodontists, 8 (2), 64–67. https://doi.10.4103/jpbs.JPBS_615_20.

10. Singh, P., Grammati, S., Kirschen, R. (2009). Orthodontic retention patterns in the United Kingdom. Journal of Orthodontics, 36 (2), 115–121 https://doi.10.1179/14653120723040.

11. Mushriq F. Abid, Ali M. Al-Attar, Akram F. Alhuwaizi, (2020). Retention Protocols and Factors Affecting Retainer Choice among Iraqi Orthodontists, International Journal of Dentistry, Article ID 8810641, https://doi.org/10.1155/2020/8810641.

12. Valiathan, M., Hughes, E. (2010). Results of a survey-based study to identify common retention practices in the United States. Am J Orthod Dentofacial Orthop. 137 (2), 170–177. https://doi10.1016/j.ajodo.2008.03.023.

13. Al-Jewair, T.S., Hamidaddin, M. A., Alotaibi, H. M., Alqahtani, N. D., Albarakati, S. F., Alkofide, E. A., et al (2016). Retention practices and factors affecting retainer choice among orthodontists in Saudi Arabia. Saudi medical journal, 37(8), 895–901.https://doi10.15537/smj.2016.8.14570.

14. Ab Rahman N, Low TF, Idris NS (2016). A survey on retention practice among orthodontists in Malaysia. Korean J Orthod.;46(1):36-41. doi:10.4041/kjod.2016.46.1.36.

15. Padmos JAD, Fudalej PS, Renkema AM (2018) Epidemiologic study of orthodontic

retention procedures. Am J Orthod Dentofacial Orthop. ;153(4):496-504. doi: 1016/j.ajodo.2017.08.013. PMID: 2960234 https://doi10.1016/j.ajodo.2017.08.013.

16. Lai CS, Grossen JM, Renkema AM, Bronkhorst E, Fudalej PS, Katsaros C (2014). Orthodontic retention procedures in Switzerland. Swiss Dent J.;124(6):655-61.

17. Wouters, C, Lamberts, AA, Kuijpers-Jagtman, AM, Renkema, AM, (2019). Development of a clinical practice guideline for orthodontic retention. Orthod Craniofac Res.;22: 69– 80. https://doi10.1111/ocr.12302.

18. Padmos, J., Mei, L., Wouters, C., Renkema, A. M. (2019). Orthodontic retention procedures in New Zealand: A survey to benefit clinical practice guideline development. Journal of the World Federation of Orthodontists,8(1), 24–30. https://doi.org/10.1016/j.ejwf.2018.12.003.

19. Paşaoğlu A, Aras I, Mert A, Aras A. Survey on Retention Protocols Among Turkish Orthodontists. Turk J Orthod. 2016;29(3):51-58. https://doi.10.5152/TurkJOrthod.2016.06.

Research Article

Sri Lanka Dental Journal 2022; 52(01) 10-19
Received: 08.03.2022 | Revised: 25.03.2022 | Accepted: 29.03.2022

Quality indicators for oral health care provision in tertiary health care institutions in Sri Lanka

PU Gamalathge, TBA Jayalal, BMOV Basnayake, LS Perera, HML Kariyawasam

Abstract

Objective: To develop quality indicators related to provision of oral health care in tertiary health care institutions in Sri Lanka.

Materials and Methods: Firstly, an extensive literature review identified existing international quality indicators and relevant themes to measure quality in oral health care. Secondly, a steering group initiated by the principal author led the discussions to formulate quality indicators for oral health care to suit the local context. Qualitative methods such as brainstorming sessions and repeated discussions were held among the expert panel until a saturation point was met to draft the primary quality indicators. In-depth interviews with experts in the relevant fields of Dentistry were carried out to further refine the formulated quality indicators.

Results: Eight important key clinical indicators to suit the local context were generated considering the feasibility, achievability and relevance to improve service quality in oral health care in Sri Lanka.

Conclusion: Once established, quality indicators for oral health care in Sri Lanka can be utilized to monitor and improve oral health care in the country. Furthermore, regular indicators for specialized dental hospitals need to be developed to maximize the effectiveness in service provision carried out by them.

Keywords: Quality indicators, oral health care, service quality

Introduction

Quality has been defined in many ways in different contexts around the world. According to the definition expressed by the International Organization for Standardization, quality refers to the ability of a product or service to satisfy the stated or implied needs of the clients.[1] Improving the quality of health services has been a key priority of successive governments in Sri Lanka as manifested in their political statements and policy documents.[2] According to Sipkoff, quality is in the eye of beholder.[3] It is an abstract entity, which cannot be easily defined or measured. Quality in healthcare is defined in different perspectives by health plan leaders, providers, patients, and payers.[3]

Moreover, the report by Donabedian [4] identified quality as a multidimensional factor. As far back as 1966, he described quality as the product of the science and technology of healthcare, and the application of that science and delivery of care. He has defined care of high quality as care,

PU Gamalathge Director (Dental Services), Ministry of Health, Sri Lanka. E-mail: pushpagamalathge@gmail.com ORCID: 0000-0002-3299-9774

TBA Jayalal Ministry of Health, Sri Lanka.

BMOV Basnayake Ministry of Health, Sri Lanka.

LS Perera Ministry of Health, Sri Lanka.

HML Kariyawasam Ministry of Health, Sri Lanka.

which maximizes patient welfare, in terms of the advantages and disadvantages.[4] In par with the aforementioned work by Donabedian [4], Maxwell further developed this view by suggesting six dimensions of quality assessment in health.[5] According to him access to services, relevance to need, effectiveness, equity, social acceptability, efficiency and economy are the six dimensions of health care qualities.[5] World Health Organization has identified that it is imperative to carefully consider the quality of care and health services to achieve Health for All. They have highlighted the need for health services to be effective, safe, people-centered, timely, equitable, integrated and efficient, irrespective of how quality is defined.[6]

An indicator is an element that is used to measure and show changes or progress in practice performance. Quality indicators are used to assess the quality and the change in the quality of care provided.[7] Quality indicators can be related to the structure, process, or outcome of health care delivery system. Each of these indicators have their own uses and limitations. Structure relates to the setting or system in which care is provided. This would include the facilities, equipment, staffing, and the organization. Process relates to the delivery of care and the implementation of treatment. An outcome is a measure of the results of the care or treatment that was carried out. Measures of processes and outcomes are predominantly favored as indicators as they offer a more reliable approach to quality assessment rather than indicators related to the structure.[8]

In the Sri Lankan context, the Directorate of Healthcare Quality and Safety (DHQC) was established in September 2012 under the Ministry of Health to ensure quality and safety in the delivery of healthcare, especially in curative sector. National Policy on Healthcare Quality and Safety was published in 2015 [9] to identify the roles and responsibilities of the government and private institutions to provide better curative and preventive care through specific programs island wide [9]. They have also prepared clinical indicators for all four major specialties of health service of the country, namely Medicine, Surgery, Paediatrics and Obstetrics & Gynaecology in collaboration with the relevant colleges. Each college has selected five clinical indicators on their specialties to be implemented in all healthcare institutions. A follow-up plan was developed to present the measured indicators at the quarterly performance review meetings held at the Directorate of Healthcare Quality & Safety.[10]

Quality indicators for oral health care in Sri Lanka have not yet been developed and stated explicitly, leading to a serious gap in improvement of quality of oral health care in the country. Thus, it is evident that the profession must embrace and adopt quality indicators related to the practice of Dentistry if they wish to deliver safe, effective and patient centered care. There are several research methods for the development of quality indicators. They can be categorized as non-systematic methods, systematic evidence-based methods and systematic evidence-based methods combined with consensus. Systematic methods include scientific evidence / evidence in combination with expert opinion, or clinical guidelines. Non-systematic methods include case studies. Scientific evidence such as trial based empirical studies provide strong evidence for development of quality indicators.[11]

Consensus techniques explore the level of consensus among a group of experts where individual opinions from the individuals in the expert group are combined into a refined aggregated opinion. Professional opinion based on expert group judgements are preferable to individual judgements since they are more consistent and less prone to personal bias. Methods such as Delphi technique (a process used to arrive at a group opinion by surveying a panel of experts) [12] and RAND / UCLA appropriateness method (a technique where a panel of experts classify procedures or items relating

to practice and policies on 'appropriateness')[13] are internationally accepted techniques used for systematic evidence-based methods combined with consensus.

Hence, the objective of this present study is to develop quality indicators related to provision of oral health care in tertiary health care institutions in Sri Lanka.

Material and Methods

This study has used qualitative methods such as expert opinion by means of in-depth interviews and expert group discussions as well as scientific evidence by means of literature search when developing the indicators. We used the following methods to strengthen the comprehensiveness of the formulated quality indicators (Figure 1). First, the authors carried out a thorough literature search using international databases such as PubMed, Hinari and Google Scholar to identify the existing quality indicators in Dentistry.

Next, the principal author through the Directorate of Dental Services of Ministry of health formulated a steering group to lead the discussions. The respective colleges of clinical specialties in Sri Lanka collaborated as requested by the Deputy Director General (Dental Services). The resource personnel participated in the preliminary discussions include Deputy Director General (Dental Services) of Ministry of Health, Director (Dental Services) of Ministry of Health, Consultant representing the Association of Specialists of Restorative Dentistry, Consultant representing the Sri Lankan Association of Oral and Maxillofacial Surgeons, Consultant representing the Sri Lanka Orthodontic Society, Head of the Research and Surveillance Unit, Institute of Oral Health, Maharagama, Senior Registrar in Medical Administration, Senior Hospital Dental Officer of National Dental Hospital, Dental Surgeon of Mobile Dental Unit of Ministry of Health and the House Officer in

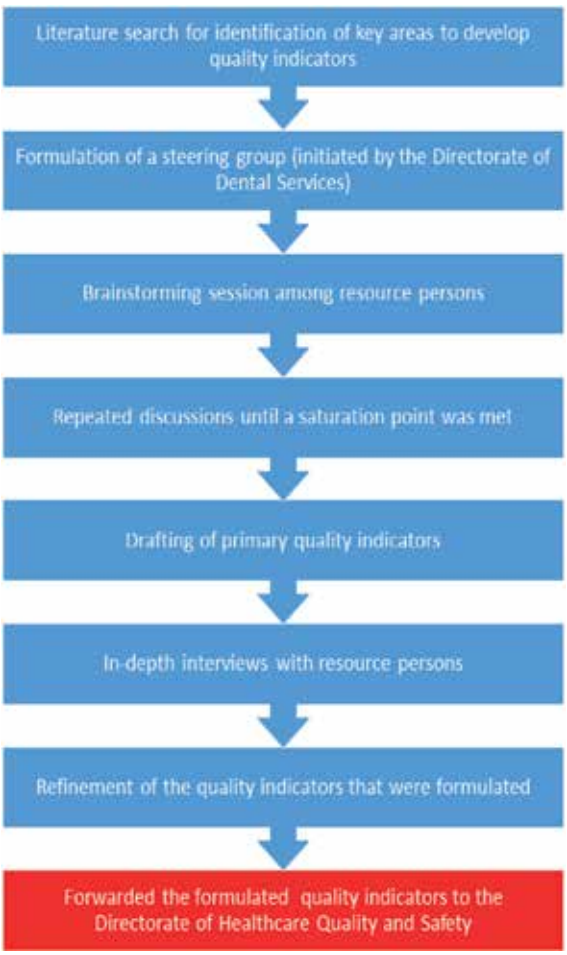


Figure 1. Flowchart of the methods used in this study.

OMF Surgery at the National Dental Hospital. As shown in the Figure 1, the first meeting included a brainstorming session among the resource persons to generate ideas to find out key areas to develop quality indicators. Further discussions led to the identification of domains to develop indicators, relevant to the local context. Members from each of the colleges and the working committee had several consultative meetings. List of capital equipment required for out-patient dental clinics (OPD) based on Sri Lanka Essential Service Package [14] and the Specialized Dental Clinics with the help of the College of Dentistry and Stomatology of Sri Lanka (Supplementary material Appendix 1) were also developed. Repeated discussions were held with the experts

of the relevant fields and under the purview of the Deputy Director General (Dental Services), Ministry of Health, Sri Lanka. Primary indicators were drafted once a saturation point for the discussions on the quality indicators was met.

In-depth interviews with resource persons were carried out to further refine the drafted primary indicators. Finally, eight important key clinical indicators to suit the local context were formulated considering the feasibility, achievability and relevance to improve oral health care in Sri Lanka. All the indicators developed included the following parameters: Performance area, Indicator definition, Rationale, Standard and Data collection methods required, if any. A data collection system (Supplementary material Appendix 2) and follow-up plan was developed to present the measured indicators at the quarterly performance review meetings held at the Directorate of Dental Services. The prepared indicators were forwarded to the Directorate of Healthcare Quality and Safety for implementation by incorporating to the National health care Quality reviews in 2022. Once the Directorate of Healthcare Quality and Safety implements the formulated quality indicators, they will apply these indicators to patients attending the tertiary health care institutions in Sri Lanka. Once they are applied, the feedback from those patients will be taken and depending on the feedback the indicators will be further refined.

Results

We identified seven domains in the initial literature search and brainstorming sessions on quality indicators for oral health care. As there is no internationally accepted definition for quality of oral healthcare at present, the working definition for quality of oral healthcare developed by the International Association for Dental Research in 2018 was adopted for our study.[15] The domains selected to develop the quality indicators in this study are included in Table 1. Nine primary quality indicators were drafted upon the initial brainstorming sessions and expert group discussions (Supplementary material Appendix 3). Finalized quality performance indicators for oral health care in Sri Lanka are given in Table 2. Eight quality performance indicators were formulated. Three separate quality performance indicators were resulted for Dental OPDs. This included one output indicator and two process indicators. A single input indicator namely, 'percentage of functional capital equipment available in dental clinics' was resulted for both dental OPDs and Specialized dental clinics. Process indicators for the three specialties (Restorative Dentistry, Orthodontics and OMFS) were formulated separately. An input indicator for human resource availability, a process indicator for infection control and an indicator for patient satisfaction were also formulated.

Discussion

We developed quality indicators in dentistry to be implemented in tertiary health care providing institutions for optimum oral health care in Sri Lanka. A thorough literature search indicated that

Table 1. Selected domains for the quality of provision of oral health care

	Domain
1.	Equitability in oral health care
2.	Patient safety
3.	Patient-centeredness
4.	Timeliness to avoid unnecessary delays in access and utilization of care
5.	Effectiveness
6.	Efficiency
7.	Accessibility

Table 2. Quality performance indicators for oral health care in tertiary care institutions in Sri Lanka

	Performance area	Indicator	Definition	Rationale	Standard	Data collection
1.	OPD (Output)	Percentage of pregnant mothers screened for a given month / quarter / year	Percentage of pregnant mothers screened is defined as the number screened from the estimated number of pregnant mothers in the drained area of the clinic as decided by MOMCH Percentage of Pregnant mothers screened = Number of pregnant mothers screened ×100 *Estimated to be screened *(this should be decided with the assistance of MOMCH)	Screening of pregnant mothers for oral health diseases is important due to the scientific evidence of links between poor oral health and low birth weight and other adverse medical conditions. Therefore, encouraging good oral health during pregnancy and emphasizing the importance of oral health from infancy will encourage the lifecycle approach of the national MCH policy. Quality dimension assessed- accessibility	100%	Pregnant mothers return
2.	OPD/ Specialized clinic (Input)	Percentage of functional capital equipment available in dental clinics	Percentage of capital and other functional equipment available in dental clinic against the guideline checklist Percentage of functional Equipment available in the dental clinic = Number of functional Equipment ×100 Number of items in the check list	Equipment availability is essential to ensure quality of services. Therefore, availability of capital equipment needs to be monitored as an input indicator to ensure service provision. Quality dimensions assessed- accessibility, availability	100%	Draft check list annexed **(Supple-mentary material Appendix 1)**
3.	OPD (process)	Lag time for patients to receive a scaling from time of registration	OPD- Lag time for patients to receive a scaling from time of registration is defined as the average time duration taken from the patients' initial visit to receive a scaling treatment to the time taken to receive the teeth scaling treatment.	OPD- Teeth scaling is an important treatment for periodontal disease prevention and management. Therefore a patient indicated for scaling needs to receive it as a primary treatment within a reasonable time duration from indicated.	To be decided	Patient records, Patients register
4.	OPD (process)	Ratio of Root Canal(RC) treated teeth	Ratio of RC treated teeth to the number of teeth extracted a month could be defined as the ratio between the number of teeth (from 1st	As dentistry has evolved over the years it is important to focus on restoring teeth rather than extractions	To be decided	Patients register/ Monthly

		to the number of teeth extracted a month	incisor to 2nd PreMolar) treated with a root canal treatment(RCT) to the number of teeth that were extracted a month RCT: Extractions	especially to achieve the 20 by 80 goal. Therefore, this indicator reflects the direction that the interventions are driven in a given institution. Since the OPD of a hospital carries out RCT of incisors, pre molars and canines the number of teeth considered as extracted are from the 1st incisor to the 2nd Premolar		return
5.	Specialized clinics (process)	**Restorative Dentistry** Time taken from initial registration to completion of RCT among 12 years and above **Orthodontics** Time taken from registration to commencement of treatment **OMFS** Time taken from registration to performance of major surgery	**Restorative Dentistry** Percentage of those whose RCT was completed within a month out of those registered for RCT among patients who are 12 years and above **Orthodontics** Percentage of those whose orthodontic treatment commenced within a year out of those registered for orthodontics within the same year **OMFS** Percentage of those whose major surgery was completed within 3 months out of those registered for major surgery within a given year. Generally major surgery includes those which require general anesthesia and given respiratory assistance and usually carries some degree of risk to the patient's life, or the potential for severe disability	**Restorative Dentistry** The time duration for a RCT to be completed should be an acceptable timeframe in order to improve prognosis of the RC treated tooth. **Orthodontics** Time duration for commencement of orthodontic treatment depends on the diagnosis of malocclusion and the treatment to be carried out. It is important to commence treatment at least within a stipulated timeframe in order to ensure patient satisfaction and ensure better prognosis of treatment carried out. **OMFS** Commencement of major surgeries within a stipulated timeframe from diagnosis in order to ensure patient satisfaction and ensure better prognosis of treatment carried out is important. (Quality dimension of acceptability)	To be decided	Patient records, Patients register Randomly selecting the prescription chits and calculating the time duration

			patient's life, or the potential for severe disability if something goes wrong during the surgery and mesenchymal barrier is opened.[1-2]	(Quality dimension of acceptability)		
6.	Human resource availability (Input)	Ratio of Dental surgery assistants to dental chairs in a clinic	Ratio of Dental surgery assistants to dental chairs in a specialized clinic is defined as the ratio between the dental surgery assistants to the dental chairs in a clinic	To ensure optimum services it is important that at least one assistant is available for a dental chair to ensure cleanliness and efficient assistance to ensure satisfaction of dental surgeons and improve quality of services. (Quality dimension of accessibility)	1:1	Duty rosters
7.	Infection control (Process)	Percentage score of cleanliness in dental clinics	Percentage Score of cleanliness is defined as the cleanliness of the clinic out of the total cleanliness expected expressed as a percentage Percentage score of cleanliness = cleanliness score / cleanliness expected × 100	Cleanliness of the dental clinic is important in order to prevent complications due to infections and improve patient satisfaction. (Quality dimension safety) Observation al check list	100%	A cleanliness check list
8.	Patient satisfaction	Percentage of patients satisfied with the services provided by the clinic	Percentage of patients satisfied with the services provided by the clinic could be defined as the number of patients responding as satisfied with the services provided both technically and functionally to a self administered questionnaire periodically	Patient satisfaction is important to understand the quality of services that are provided. By a self-administered questionnaire carried out at least once a year patients could freely express their views and an assessment of the quality dimension acceptability	100%	Self administered questionnaire

while quality indicators for oral health care have been extensively developed for developed countries (particularly USA, England and Nordic countries); they have not been developed as such for developing countries.[16-18] Even though, quality indicators developed specifically for oral health care could not be found for South East Asian countries, quality of care policies had been developed to varying extents.[18]

This is the first effort in developing clinical indicators for oral health care in Sri Lanka. A method similar to that used by the Directorate of Healthcare Quality and Safety in preparing quality indicators for the major specialties (Medicine, Surgery, Paediatrics and Obstetrics & Gynaecology) was used in this study. A limitation in our study was that inputs from external stakeholders were not considered when preparing the quality indicators. Perception of the patients would have been an added benefit if it had been included when developing the indicators. The American Dental Association (ADA) have adopted a transparent approach to receive feedback and forward the proposed specific measure concepts to the dental community for further improvements when developing quality indicators for Dentistry.[16] This approach is unique in design since it adds more validity to the study. In our study, the patients' perspectives will be considered when applying the indicators once the Directorate of Healthcare Quality and Safety implemented them.

The Nordic Council of Ministers when establishing quality indicators for oral health care, selected in

accordance with recommendations from the ECHI (European Community Health Indicators) and EGOHID (European Global Oral Health Indicators Development -Project) used a method similar to our study which is applicable to Nordic conditions[17]. The indicators developed by us were also refined to suit the local context after several meetings with the resource personnel and representatives of the colleges representing the clinical dental specialties in the country.

The similarities and differences that were found when comparing the indicators presented in this study with the indicators developed by the Directorate of Healthcare Quality and Safety for medical specialties (Medicine, Surgery, Paediatrics and Obstetrics & Gynaecology) are illustrated in Table 3. Even though, the quality indicators for different specialties are not comparable in terms of what they measure, we have used an analogous indicator to suit the local context similar to the indicators prepared by the Directorate of Healthcare Quality and Safety.

In conclusion, we were able to formulate quality indicators for oral health care for the first time in Sri Lanka with the objective of improving the quality of oral health service provision in the country. Once established, quality indicators for oral health care can be utilized to monitor and improve oral health care in the country. However, an error free quality measurement might never be a possibility. Furthermore, quality indicators will not be effective and successful in introducing strategies for quality improvement without understanding the factors that are required to underpin their development and to facilitate their transference between clinical settings in hospitals in Sri Lanka. Therefore, further research is recommended to identify the limitations of the proposed quality indicators and to formulate regular indicators for specialized dental hospitals to maximize the effectiveness in service provision carried out by them.

Table 3. Comparison of quality indicators developed by the Directorate of Healthcare Quality and Safety for medical specialties with the quality indicators developed for oral health care in the present study

Quality Indicators developed by the Directorate of Healthcare Quality and Safety for medical specialties	Comparable quality indicators developed in the present study
Percentage of Surgical facilities using the 'Surgical Safety Checklist'	Percentage of functional capital equipment available in dental clinics.
Waiting time duration in indexed operations. Divided into cancer and non-cancer	*Restorative Dentistry* Time taken from initial registration to completion of RCT among 12 years and above. *Orthodontics* Time taken from registration to commencement of treatment. *OMFS* Time taken from registration to performance of major surgery. *OPD* Lag time for patients to receive a scaling from time of registration.

Acknowledgments
The authors would like to thank Dr. A. H. T. S. Karunathilake (Consultant in Oral and Maxillo-Facial Surgery, Colombo South Teaching Hospital Kalubowila), Dr. W. M. Senadheera (Consultant in Orthodontics, National Dental Hospital, Colombo), Dr. R.M.S.D.K. Ranathunga (Consultant in Restorative Dentistry, Institute of Oral Health, Maharagama), Dr. Prasanna Jayasekara (Consultant in Community Dentistry, Head – Research and Surveillance Unit, Institute of Oral Health, Maharagama), Dr. Pubudu Liyanage (Senior Hospital Dental Officer, National Dental Hospital, Colombo), Dr. Pushpika Abeysekara (Dental Surgeon, Mobile Dental Unit, Ministry of Health) and Dr. W. M. H. L. B. Wijethunga (House Office, Oral and Maxillo-Facial Surgery Unit, National Dental Hospital, Colombo) for their valuable contribution as resource personnel in the meetings held to develop Quality Indicators for oral health care in Sri Lanka.

References

1. ISO 8402:1994 Quality management and quality assurance Vocabulary, withdrawn and revised by ISO 9000:2000 Quality management systems - Fundamentals and vocabulary, 2004. https://www.iso.org/standard/20115.html

2. National Health Policy of Sri Lanka 2016 - 2025. Sri Lanka: Ministry of Health, 2016.

3. Sipkoff M. The new consensus favoring IOM's definition of quality. Managed care (Langhorne, Pa). 2004; 13(6):18-27.

4. Donabedian A. Evaluating the quality of medical care. The Milbank quarterly. 2005; 83(4):691–729. https://doi.org/10.1111/j.1468-0009.2005.00397.x

5. Maxwell R. Quality assessment in health. British medical journal (Clinical research ed). 2022; 288 (6428): 1470–1472. https://doi.org/10.1136/bmj.288.6428.1470.

6. World Health Organization. 2022. https://www.who.int/ management /quality/assurance/ QualityCare_B.Def.pdf.

7. Lawrence M, Olesen F. Indicators of Quality in Health Care. The European Journal of General Practice. 1997; 3(3):103-108.

8. Mills I, Batchelor P. Quality indicators: the rationale behind their use in NHS dentistry. British dental journal. 2011; 211(1):11-15. https://doi.org/10.1038/sj.bdj.2011.52.

9. National Policy on Healthcare Quality and Safety. 2015. https://www.quality.health.gov.lk/images/pdf/resources/policy/national_policy_quality_and_safety.pdf.

10. Implementation of clinical indicators in all four major specialties. 2017. https://www.quality.health.gov.lk/images/news/2020/12-SD-9-Implementation-of-clinical-indicators-in-all-four-major-specialties-.pdf.

11. Campbell SM, Braspenning J, Hutchinson A, Marshall M. Research methods used in developing and applying quality indicators in primary care. Qual Saf Health Care 2002; 11:358–364. doi: 10.1136/qhc.11.4.358.

12. Barrett D, Heale R. What are Delphi studies? Evidence-Based Nursing 2020; 23:68-69. https://doi.org/10.1136/ebnurs-2020-103303.

13. Campbell JL, Fletcher E, Abel G. Policies and strategies to retain and support the return of experienced GPs in direct patient care: the ReGROUP mixed-methods study. Southampton (UK): NIHR Journals Library, 2019. doi:10.3310/hsdr07140.

14. Sri Lanka Essential Service Package. Management Development and Planning

Unit Ministry of Health, Nutrition and Indigenous Medicine, 2019.

15. Righolt AJ, Walji MF, Feine JS, Williams, DM, Kalenderian E, Listl S. An International Working Definition for Quality of Oral Healthcare. JDR clinical and translational research 2020; 5:102–106. https://doi:10.1177/2380084419875442.

16. Quality Measurement in Dentistry A Guidebook. 2019 American Dental Association on behalf of the Dental Quality Alliance (DQA), 2019.

17. Ekornrud T, Wilberg M, Arge S, Ágústsdóttir H, Appelquist M, Cederlund A, Nordblad A, Vilstrup L. Quality indicators in oral health care: A Nordic project. Oslo: Norwegian Directorate of Health (Helsedirektoratet), 2013.

18. Evaluating Quality Strategies in Asia-Pacific Countries: Survey Results. Geneva: World Health Organization Western Pacific Region, 2015.

Research Article

Sri Lanka Dental Journal 2022; 52(01) 20-30
Received: 06.02.2022 | Revised: 25.03.2022 | Accepted: 29.03.2022

Microbial etiology and associated factors of pericoronitis in a group of Sri Lankans

MC Nissanka, HP Somarathna, S Karunatilleke, S Wickrama, S Withanage, Mahitharan, GK Wijesinghe, C Gunasekara, MM Weerasekera, A Dilhari

Abstract

Objectives: This study is aimed to assess the microbial etiology and the associated factors of pericoronitis, in a group of Sri Lankans.

Materials and Method: Thirty-five clinically diagnosed patients with pericoronitis were included in the study. Patients were recruited from Oral and Maxillofacial (OMF) clinic at the Colombo South Teaching Hospital (CSTH) after obtaining informed written consent. A pus specimen which was aspirated from the lesion was used for microbiological identification. A swab specimen was collected from the same anatomical region on the contralateral side and used as the control. If both sides were affected, swab specimens were collected from one specific region (first molar) and used as the control. Specimens were inoculated on Blood, Chocolate, MacConkey culture media, incubated aerobically at 37°C and subjected to a series of biochemical tests for etiological identification. Antibiotic sensitivity testing was performed according to the Clinical and Laboratory Standards Institute (CLSI) guidelines.

Results: Pericoronitis was found to be relatively common among young adults in the study population (34.3%). The majority (62.9%) of the patients were females. Sixty percent of the patients had chronic pericoronitis. Soft tissues adjacent to vertically impacted (19/35; 54.3%) and partially erupted mandibular third molars (34/35; 91.7%) were the commonly affected sites. Association of pericoronitis with age, gender, state of eruption, type of impaction and acute/chronic form was not statistically significant. Aerobic/facultative anaerobic bacteria were predominantly isolated in pericoronitis patients. Among aerobes/facultative-anaerobes, Viridians group (26/35;74.3%) were predominant. Cefepime, chloramphenicol, ciprofloxacin were found to be the most sensitive antibiotics for aerobic/facultative anaerobic bacteria.

Conclusions: Aerobes/facultative anaerobes

MC Nissanka	Department of Medical Laboratory Sciences, Faculty of Allied Health Sciences, University of Sri Jayewardenepura. ORCID ID: 0000-0002-3636-9067
HP Somarathna	Department of Medical Laboratory Sciences, Faculty of Allied Health Sciences, University of Sri Jayewardenepura.
S Karunatilleke	Oral and Maxillofacial clinic, Colombo South Teaching Hospital, Kalubowila.
S Wickrama	Department of Microbiology, Faculty of Medical Sciences, University of Sri Jayewardenepura.
S Withanage	Oral and Maxillofacial clinic, Colombo South Teaching Hospital, Kalubowila.
Mahitharan	Oral and Maxillofacial clinic, Colombo South Teaching Hospital, Kalubowila.
GK Wijesinghe	Department of Medical Laboratory Sciences, Faculty of Allied Health Sciences, University of Sri Jayewardenepura.
C Gunasekara	Department of Microbiology, Faculty of Medical Sciences, University of Sri Jayewardenepura.
MM Weerasekera	Department of Microbiology, Faculty of Medical Sciences, University of Sri Jayewardenepura.
A Dilhari	Department of Basic Sciences, Faculty of Allied Health Sciences, University of Sri Jayewardenepura.

were predominantly associated with pericoronitis and cefepime, chloramphenicol, ciprofloxacin were the most sensitive antibiotics. Lesions were significantly colonized by bacteria compared to that of un-affected control sites.

Keywords: pericoronitis, mandibular third Molar, tooth Eruption, microbial etiology, antimicrobial agents

Introduction

Pericoronitis is a common periodontal emergency all over the world with a prevalence rate of 59.5%[1]. Pericoronitis (operculitis) is defined as inflammation of the soft tissues surrounding the crown of an erupted or partially erupted tooth including dental follicle and gingiva[2,3]. Accumulation of debris and bacteria beneath the operculum is considered to be the main cause of pericoronitis[4,5]. Due to its favored topography, the mandibular third molar has been found as the most frequently affected site [6].Clinically, pericoronitis is classified as acute and chronic[7]. The acute form is characterized by severe pain, swelling of the pericoronal tissues and discharge of pus while chronic pericoronitis is characterized by dull pain lasting a day or two, may be with remission lasting many months[6,7]. The presence of unerupted or partially erupted teeth, poor oral hygiene, respiratory tract infections, tonsillitis and physical fatigue are identified as common predisposing factors for pericoronitis[8].

Pericoronitis is a painful condition and if left untreated it may lead to more serious problems and can even progress to facial cellulitis[7,9,10]. Therefore, therapeutic management is important[11]. The management of pericoronitis involves a local surgical procedure followed by antimicrobial therapy. Metronidazole alone or in combination is also used in treating pericoronitis [11,12]. However, removal of the third molar is the most effective way of managing pericoronitis[13-15]. Pericoronitis is mainly due to the anaerobic and facultative anaerobic bacteria[11,16] such as *Streptococcus milleri* group, *Stomatococcus mucilaginosus*, *Rotbiadentocariosa*, *Streptococcus sanguis* and *Streptococcus oralis*[11]. Although pericoronitis patients are commonly seen in dental clinics less attention was paid to investigate the microbial etiology of the condition. It is important to identify the microbial etiology of pericoronitis which finally will lead to better patient management. The present study is aimed to identify the microbial etiology, antimicrobial sensitivity pattern and risk factors for pericoronitis.

Material and methods

Study population: This study was a descriptive cross-sectional study. The study was carried out for a period of six months starting from August 2018 to January 2019. Thirty-five clinically suspected pericoronitis patients who attended the Oral and Maxillofacial (OMF) clinic at the Colombo South Teaching Hospital (CSTH) were included in the study. Patients were selected by a qualified dental officer in-charge, after the clinical and radiological examination.

Definition for acute pericoronitis: Acute pericoronitis is defined as 'varying degrees of inflammatory involvement of the pericoronal flap and adjacent structures as well as systemic complications' like malaise, cervical lymphadenopathy or fever which are short-lived with sudden onset[7].

Definition for chronic pericoronitis: Chronic pericoronitis is defined as 'repeated episodes of acute pericoronitis that occur periodically' and is characterized by dull aching low-grade pain, bad taste and loss of appetite that lasts for a short duration which interspersed with remission lasting many months[6,7].

Inclusion criteria: Medically competent patients who were more than 18 years old were included in the study after obtaining their informed written consents.

Exclusion criteria: Mentally unstable patients and patients who suffered from systemic diseases like diabetes mellitus, congestive cardiac failure and hemorrhagic disorders were excluded. Pregnant and lactating women were also excluded.

Ethical clearance: The study was independently reviewed and approved by the Ethics Review Committee of University of Sri Jayewardenepura (Ref. No: MLS/06/18) and Colombo South Teaching Hospital (Ref. No: PLEC/29/2018).

Data collection: A duly signed written informed consent form was obtained from each patient and a pre-tested interviewer-administered questionnaire was used to collect the data regarding oral/dental habits, past dental/medical history, clinical presentation and treatments.

Specimen collection and transportation: Once the patients were enrolled in the study, the patients were provided with sterile normal saline and instructed to rinse the mouth prior to the specimen collection. A pus sample from the affected area and a swab (as a control) from an unaffected area were collected by a qualified dental officer at the OMF clinic. The pus sample was aspirated beneath the operculum overlying the third molar using a sterile disposable syringe. A control swab was obtained from the same anatomical region on the contralateral side. If both sides were affected, a swab specimen was collected from one specific region (first molar) as the control. Depth of the impaction, angulation and the degree of the eruption were assessed by intraoral and radiological examination.

The aspirated pus specimen was dissolved in 0.5 ml normal saline at the time of collection. An aliquot of 100 µl from the suspension was transferred into sterile Robertson's Cooked Meat (RCM) (Himedia, India) medium and a sterile paraffin layer was laid along the inner wall of the tube. The same procedure was followed for the swab specimen collected from the opposite site. These two tubes were then incubated at 37ºC until the appearance of turbidity. The rest of the specimen (0.4 ml) for aerobic culture was transported immediately at 4ºC inside a portable cooler while the inoculated RCM medium was transported at room temperature to the Microbiology laboratory at Faculty of Medical Sciences, University of Sri Jayewardenepura where laboratory experiments were carried out.

Aerobic and facultative bacterial identification: Suspensions of 0.4 ml (aspirated pus specimen from the affected site and the swab specimen taken from the opposite site) were centrifuged at 3000 rpm for 5 minutes and observed for pellets. The pellets were resuspended in 0.2ml sterile normal saline and vortex mixed for a few minutes. Both tests and controls (0.1 ml) were used for Grams' staining. Another 0.1 ml was subjected to tenfold serial dilution. A hundred microliter from each diluted suspension was inoculated on 7% blood agar (Oxoid, UK) and incubated in 5% CO_2 at 37^0C for 18-24h and bacterial colony counts were taken. A 100µl aliquot from the initial homogenate was also inoculated on blood agar, chocolate agar and MacConkey agar (Oxoid, UK) for bacterial growth. Each type of colony was identified based on the morphology (color, size, topography and texture) of the colony, Grams' staining and conventional biochemical tests (Catalase test, Coagulase test, Oxidase test, Optochin sensitivity test, Bile solubility test, Bacitracin sensitivity test, Indole test, Methyl Red (MR) test, Voges Proskauer (VP) test, Citrate test, Urease test). Bacterial colonies were stored for future antibiotic sensitivity testing by transferring 24 h incubated cultures onto sterile Whatman No. 1 filter paper strips in sterile eppendorf tubes and stored at -80^0C.

Antibiotic sensitivity testing: Antibiotic sensitivity testing was performed according to the clinical and laboratory standards institute (CLSI) method [19] for the predominantly isolated aerobic /facultative anaerobic bacterial strains.

Mueller Hinton agar (MHA) (Oxoid, UK) plates were used for Enterococci/Group D and Staphylococci species antimicrobial testing while Mueller Hinton Blood agar plates were used for Streptococci species. Zones of inhibition were measured and zone sizes were interpreted using an interpretative chart [17]. Organisms were reported as resistant, intermediate and sensitive.

Anaerobic bacterial identification: The Robertson cooked meat medium was incubated at 35-37^{0}C for 48 h. After the appearance of turbidity, a portion (0.1 ml each) of suspension was inoculated on Brucella Blood agar (Oxoid, UK), Bacteroides Bile Esculin agar (Himedia, India) and Blood agar (Oxoid, UK) and incubated in an anaerobic gas jar for 48h at 37^{0}C. After 48-hour incubation, the plates were examined and Grams' staining was done for each type of colony. The colonies were subcultured on both blood agar and Brucella blood agar. Brucella blood agar plates were placed in the gas jar for 48h. Blood agar plates were aerobically incubated at 35-37°C for 24h. Organisms that were grown only in Brucella blood agar in the gas jar were considered strict anaerobes. Organisms that grow on both blood agar and Brucella blood agar were considered facultative anaerobes. Colonies of the facultative anaerobes were identified based on the morphology (colour, size, topography and texture) of the colony, Grams' staining and using a series of conventional biochemical tests as mentioned above.

Statistical analysis: The statistical analysis was carried out using Statistical Package for Social Sciences (SPSS) software version 25.0. Descriptive statistics were represented as a percentage (%) value. Statistical tests for qualitative variables were carried out using the chi-square test (x^2test) and Fisher's exact tests. All these tests were two-sided. The independent sample t-test was used for quantitative variables. The level of significance was taken at 5% ($p<0.05$).

Results

Of the total 35 pericoronitis patients, 21 had chronic pericoronitis while 14 had acute pericoronitis. The majority (22/35; 62.9%) were female patients and 13% (22/35) of them had chronic pericoronitis. Out of the 13 male patients, 8 had chronic pericoronitis (Table 1). The mean age of the study population was 28 ± 7 years. The mean ages of the acute and chronic pericoronitis groups were 25.57 ± 5.199 years and 30.33 ± 7.539 years, respectively (Table 1). A statistically significant difference was found between these two groups (p=0.048). The majority of the pericoronitis patients were nonsmokers (32/35; 91.42%) and 13 (40.6%) had acute pericoronitis while 19 (59.4%) had chronic pericoronitis. Only 3 patients who had the habit of smoking and betel quid chewing had chronic pericoronitis (8.6%). Most of the patients had brushed their teeth twice a day (34/35; 97.14%).

Table 1. Socio-demographic data of acute and chronic pericoronitis (n=35)

Characteristics		Total Pericoronitis (n=35)	Acute Pericoronitis (N=14)	Chronic Pericoronitis (N=21)	p value
Age (years)	Mean ± SD	28.43 ± 7.026 (18-46)	25.57 ± 5.199 (18-35)	30.33 ± 7.539 (18-46)	0.048*
Sex	Female	22 (62.9%)	9 (40.9%)	13 (59.1%)	0.886#
	Male	13 (37.1%)	05 (38.5%)	08 (61.5%)	

SD : standard deviation
* : p value was calculated by two sample T test
\# : p value was calculated by X^2 test

The most common symptoms associated with both acute and chronic forms of pericoronitis were gingival swelling in the third molar position (30/35; 85.7%), pain while biting (24/35; 68.5%), reddish soft tissue around the third molar position (14/35; 40%) and foul taste (14/35; 40%). Gingival swelling in the third molar position was the most common symptom observed in the chronic form of pericoronitis. Pain during swallowing was a rarely observed symptom among the study population (10/35; 28.6%). There was no statistically significant association between patients' habits, signs and symptoms and acute/chronic pericoronitis ($p>0.05$) (Table 2).

Maximum incidence of pericoronitis was observed with vertical impaction, accounting for 54.3% (19/35). Horizontal impaction, which had the least association with pericoronitis, was observed only in one case (2.9%). Angular impaction was observed in 15/35 (42.9%) patients. Thus, impaction was varied as vertical > angular > horizontal. Pericoronitis was commonly seen in the third molar position in the lower right side of the jaw (19/35; 54.3%). Thirteen patients (68.4%) had chronic pericoronitis while 6 (31.6%) had acute pericoronitis. Both lower third molars were rarely affected by pericoronitis (4/35; 11.4%). Partially erupted mandibular third molars were also frequently affected by pericoronitis (34/35; 97.1%).

Partially covered mandibular third molars were the commonly affected site which was seen in 32 patients (91.4%). Mandibular third molars that were fully covered with soft tissue were the least commonly affected site which was observed in 3 patients (3/35; 8.6%) and they had chronic pericoronitis. No statistically significant association was observed between acute/chronic

Table 2. Patient's habits, signs and symptoms and acute/chronic pericoronitis

Variable			Acute pericoronitis N (%)	Chronic pericoronitis N (%)	p value
Habits	Smoking	Yes	01 (33.3)	02 (66.7)	-
		No	13 (40.6)	19 (59.4)	
	Betel quid	Yes	02 (66.7)	01 (33.3)	-
		No	12 (37.5)	20 (62.5)	
	Tooth brushing	Twice a day	14 (41.2)	20 (58.8)	-
		After each meal	00	01 (100)	
	Mouth washing	Yes	06 (42.9)	08 (57.1)	0.778#
		No	08 (38.1)	13 (61.9)	
Signs and symptoms	Foul taste		05 (35.7)	09 (64.3)	0.673#
	Reddish soft tissue around the third molar position		06 (42.8)	08 (57.2)	0778#
	Gingival Swelling in the third molar position		11 (36.7)	19 (63.3)	0.369*
	Pain while biting		12 (50)	12 (50)	0.137*
	Inability to close the Jaw		06 (50)	06 (50)	0.477*
	Pain during swallowing (dysphagia)		05 (50)	05(50)	0.474*

: p value was calculated by X^2 test
* : p value was calculated by Fisher's exact test
- : p value cannot be calculated

pericoronitis and position, affected site, state of eruption and soft tissue coverage (Table 3).

All thirty-five pus specimens were positive for microorganisms including aerobes/facultative anaerobes. The cell densities were greater than 10^5 Colony Forming Units (CFU)/ml. The average cell density of lesions of 35 patients (test) was $\log_{10}$ 5.586 ± 0.760 CFU/ml. The non-affected (control) site had an average cell density of $\log_{10}$ 4.846 ± 0.668 CFU/ml. The bacterial colony count of the lesions was found to be significantly higher than that of the control sites of the patients with pericoronitis (p = 0.000). Lesions of 14 patients with acute pericoronitis gave an average microbial cell density of $\log_{10}$ 5.675 ± 0.843 CFU/ml while their non-affected control sites gave an average cell density of $\log_{10}$ 4.822 ± 0.688 CFU/ml. Similarly, the lesions of 21 patients with chronic pericoronitis showed an average cell density of $\log_{10}$ 5.526 ± 0.715 CFU/ml. Their non-affected control sites resulted in an average cell density of $\log_{10}$ 4.862 ± 0.672 CFU/ml. In both acute and chronic pericoronitis patients, the lesions had significantly higher bacterial colony counts compared to the control of non-affected sites (p=0.042 and p=0.000 respectively). However, there was no significant difference between the colony count of the lesions of both acute and chronic pericoronitis patients (p=0.566).

Eleven different types of aerobic/facultative anaerobic bacteria were identified. Out of 35 pericoronitis samples, aerobic/facultative anaerobic bacteria were observed in all the test samples (35/35;100%). Strict anaerobic bacteria were observed in 30 test samples (30/35;85.7%) (Table 4). Out of 35 control samples, aerobic/facultative anaerobic bacteria were observed in 33 samples. Strict anaerobic bacteria were isolated from 23 control samples (Table 4). Table 5 shows the frequency of isolation of aerobic/facultative anaerobes from acute and chronic pericoronitis. Streptococci were isolated from 28 test samples (80.0%). Viridans group streptococci were the most commonly detected organism in acute and chronic pericoronitis. Group B streptococci (1/35; 2.9%) and Group A Streptococci (1/35; 2.9%) were found only in chronic pericoronitis samples. Staphylococci were isolated from 24 pericoronitis samples (68.6%). All staphylococci were coagulase-negative. Among Gram-negative bacilli, *Klebsiella* spp. (22.9%), *Serratia* spp. (11.4%), *Enterobacter* spp. (17.1%), *Hafnia* spp. (5.7%) and *Proteus* spp. (8.6%) were isolated from these samples. *Hafnia* spp. was found only

Table 3. Position, affected site, state of eruption, soft tissue coverage and acute /chronic pericoronitis

Variable		Acute pericoronitis N (%)	Chronic pericoronitis N (%)
Type of impaction	Horizontal	00	01 (100)
	Vertical	09 (47.4)	10 (52.6)
	Angular(mesioangular/distoangular)	05 (33.3)	10 (66.7)
Affected site	Left	05 (41.7)	07 (58.3)
	Right	06 (31.6)	13(68.4)
	Both	03 (75)	01 (25)
States of eruption	Un-erupted	00	01 (100)
	Partially erupted	14 (41.2)	20 (58.8)
Extend of area covered with Operculum	1/2 of the tooth	07 (50)	07 (50)
	2/3 of the tooth	07 (38.9)	11(61.1)
	Completely	00	03 (100)

in acute pericoronitis patients (2/35; 5.7%). *Serratia* spp. was found only in pus samples collected from the lesions (4/35; 11.4%) but not in swab samples collected as control specimens (Table 5).

All enterococci strains were sensitive to clindamycin, ciprofloxacin, tetracycline and two strains were resistant to vancomycin while 9/13 (69.2%) strains were resistant to ampicillin. All the Viridans Group Streptococci were sensitive for tetracycline and cefepime while 21/26 (80.8%) were sensitive for clindamycin, 23/26 (88.5%) were sensitive for vancomycin and 25/26 (96.2%) were sensitive for chloramphenicol. Only 5/26, 3/26 and 1/26 were resistant to clindamycin, vancomycin and chloramphenicol respectively. All the isolated strains of the staphylococci were sensitive for chloramphenicol, gentamycin, and cefepime while 21/24(87.5%) were sensitive for ciprofloxacin, 20/24 (83.3%) were sensitive for tetracycline and 1/24 (4.2%) were sensitive for clindamycin. All strains were resistant to ampicillin.

Discussion

Pericoronitis is a common infection in the mandibular third molar [18]. It is a dental emergency and leads to several complications if untreated[7]. The treatment varies among health professionals and proper evidence-based treatment should be implemented for a better outcome. Although pericoronitis is a common dental problem in Sri Lanka, its

Table 4. Frequency of isolation of aerobic/facultative anaerobes and strict anaerobes from acute and chronic pericoronitis

Organisms	Test		Control	
	Acute pericoronitis	Chronic pericoronitis	Acute pericoronitis	Chronic pericoronitis
	N (%)	N (%)	N (%)	N (%)
Aerobic/ facultative anaerobic bacteria	14 (40)	21 (60)	14 (42.4)	19 (57.6)
Strict anaerobic bacteria	12 (37.5)	18 (62.5)	09 (39.1)	14 (60.8)

Table 5. Number of aerobic/facultative anaerobic bacteria isolated from affected sites of acute/chronic pericoronitis (test) and their non-affected sites (control)

Organisms	Acute pericoronitis		Chronic pericoronitis	
	Test	Control	Test	Control
Viridans group Streptococci	11	13	15	16
Enterococci /group D	5	6	8	6
Group B Streptococci	0	1	1	0
Group A Streptococci	0	0	1	2
Coagulase negative Staphylococci	9	10	15	17
Klebsiella spp.	5	3	3	3
Serratia spp.	1	0	3	0
Enterobacter spp.	4	4	6	2
Hafnia spp.	2	1	0	0
Proteus spp.	2	4	1	1

microbial etiology is less understood. In the present study, pericoronitis was predominantly observed among the young age group. Most of the previously published literature also supports the current finding[19,20,21]. Declined incidence in pericoronitis in older age supports the fact that there is a relationship between pericoronitis and period of eruption[22]. Women (62.9%) were more prone to get pericoronitis than men. This finding coincides with the observations of Yamalik *et al*[23]. Jaws of the females stop growing when the third molars just begin to erupt. In males, jaws continue to grow beyond the time of eruption of the third molar. This may be the reason for the preponderance of pericoronitis among females [20, 24].

In the present study, vertical impactions (54.3%) were observed to be associated more with pericoronitis[25] when compared to other types of impactions i.e: angular (disto/mesio) and horizontal respectively. Yamalik *et al*. also had reported a similar finding[23]. Genetic variation, racial difference and different socioeconomic status could be responsible for this finding[22]. The majority of patients (97%) had partially erupted mandibular third molar. The study by Halverson and Anderson in 1992 had reported a similar finding [25]. Mandibular third molars partially covered by soft tissue had a significant association with pericoronitis [26]. In the partially erupted teeth, the space is more likely to trap food debris leading to stagnation, bacterial colonization and subsequent inflammation[21].

The majority of the pericoronitis patients were non-smokers and few had the habit of betel quid chewing. Although habits like smoking and betel quid chewing are associated with many oral diseases like oral cancers and leukoplakia [27], the current study could not find any significant association between these habits and the occurrence of pericoronitis. Swelling around the third molar, foul taste, pain while biting, reddish soft tissue, inability to close the jaw, pain during swallowing were found as the common sign and symptoms associated with pericoronitis. Most of the previously published literature also supports the current finding [24,28].

In the present study, aerobic and facultative anaerobic bacteria were identified in the pus specimens such as Viridans group, *Enterococcus*/ group D, Group A and B streptococcus, CNS, *Klebsiella* spp., *Serratia* spp., *Enterobacter* spp., *Hafnia* spp. and *Proteus* spp. On the other hand, control samples did not contain *Serratia* spp. Previous studies had reported strict anaerobes in pericoronitis samples[11, 16]. However, in the present study, anaerobic identification was not done which is a limitation of the study.

According to the present study, most of the aerobic and facultative anaerobic bacteria isolated from lesions were also present in the contralateral control sample. They may act as pathogens in the presence of predisposing factors or conditions that lead to the disturbance of the microbial balance and disruption of mucosal barriers by spontaneous or induced trauma [29]. Viridans group streptococci were the frequently detected microorganisms in acute and chronic pericoronitis. The study by Bean and King also reported a similar finding [30]. Group B *Streptococcus* and Group A *Streptococcus* were found only in chronic pericoronitis samples whereas *Hafnia* spp. was found only in acute pericoronitis samples. According to the study by Peltroche *et al*, organisms like *Rotbiadentocariosa, Actinomyces israelii, Stomatococcus mucilagino*, *A. naeslundii* are found in pericoronitis samples[3]. Contrary to their findings, aforementioned organisms were not reported in the present study. The reason for the differences in the observations may be due to the different techniques used for the cultivation and identification of organisms and also due to the geographic variation of the study population.

Treatment modalities such as pain and infection management, operculectomy and removal of the tooth are based on the severity of pericoronitis.

If the pain and swelling are limited to the tooth, the infection can be treated by oral rinses such as 0.12% chlorhexidine mouthwash and warm salt water. If the tooth is still useful, operculectomy may be used other than removing the third molar. Antibiotic therapy can be used as an alternative method other than these treatment methods[11,31]. In the present study, the majority of the predominant species such as Enterococci/ Group D, Staphylococci and Viridians Group Streptococci were sensitive to chloramphenicol, gentamycin. cefepime, ciprofloxacin and tetracycline.

Summary

Pericoronitis was common among young adults, especially seen among females. Chronic pericoronitis was the commonest entity. The majority of the pericoronitis patients in the present study were non-smokers. Pericoronitis was frequently associated with vertically impacted, partially erupted third molars than teeth that are soft tissue impacted. The lower right third molar was the commonly affected tooth while gingival swelling in the third molar position was the commonest symptom of pericoronitis. Aerobic/Facultative anaerobic bacteria were predominantly associated with pericoronitis and the Viridians group was predominant. Lesions were significantly colonized by bacteria compared to that of un-affected control sites. Cefepime, chloramphenicol, ciprofloxacin were the most sensitive antibiotics for aerobic/ facultative anaerobic bacteria. Other than removing the third molar, pericoronitis can be efficiently treated with these antibiotics.

Acknowledgment

The authors wish to thank the participating patients and staff of the Oral and Maxillofacial Clinic, Colombo South Teaching Hospital, Mr. H.P. Dharmasiri, Mr. V.C.P. Vithana for their laboratory assistance and to all the staff of the Department of Microbiology, Faculty of Medical Sciences, University of Sri Jayewardenepura, Department of Community Medicine and Ethical Review Committee, Faculty of Medical Sciences, University of Sri Jayewardenepura, Sri Lanka for their support in this study.

References

1. Ayanbadejo PO, Umesi-Koleoso DC. A retrospective study of some socio demographic factors associated with pericoronitis in Nigerians. West Afr J Med. 2007;26(4):302–5 https://dio.10.4314/ wajm.v26i4.28331.

2. Wehr C, Cruz G, Young S, Fakhouri WD. An Insight into Acute Pericoronitis and the Need for an Evidence-Based Standard of Care. Dent J (Basel). 2019;7(3):88. https:// dio.10.3390/dj7030088.

3. Peltroche-Llacsahuanga H, Reichhart

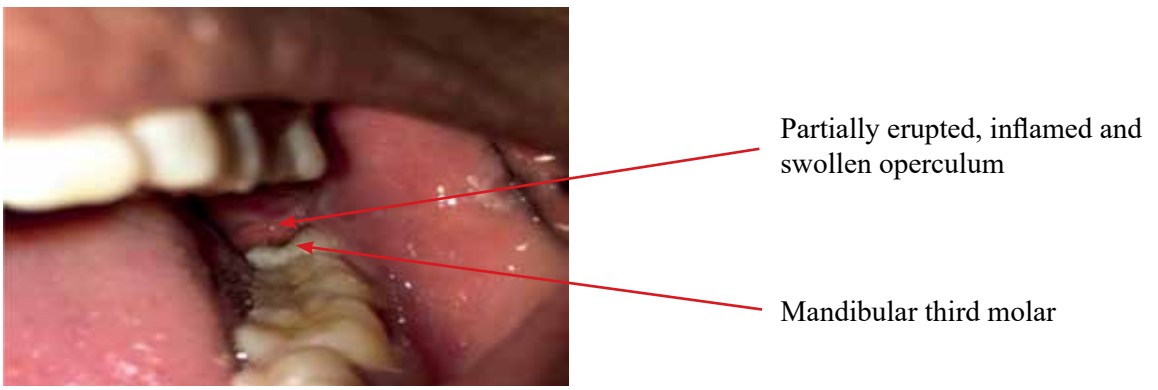


Figure 1. Pericoronitis

E, Schmitt W, Lütticken R, Haase G. Investigation of infectious organisms causing pericoronitis of the mandibular third molar. J Oral Maxillofac Surg. 2000;58(6):611–6.https://dio.10.1111/j.1399-302x.1993.tb00579.x.

4. Mansour MH, Cox SC. Patients presenting to the general practitioner with pain of dental origin. Med J Aust. 2006;185(2):64-7. https: //dio.10.5694/j.1326-5377.2006.tb00472.x.

5. Douglass AB, Douglass JM. Common dental emergencies. Am Fam Physician. 2003;67(3):511–6.

6. Folayan MO, Ozeigbe EO, Onyejaeka N, Chukwumah NM, Oyedele T. Non-third molar related pericoronitis in a sub-urban Nigeria population of children. Niger J Clin Pract. 2014;17(1):18–22.https://dio.10.4103/1119-3077.122826.

7. Moloney J, Stassen LF. Pericoronitis: treatment and a clinical dilemma. J Ir Dent Assoc. 2009;55(4):190–2.

8. Dhonge RP, Zade RM, Gopinath V, Amirisetty R. An insight into pericoronitis. Int J Dent Med Res. 2015;1(6):172–5. https://doi.org/10.3390/ijerph18136796.

9. Leone SA, Edenfield MJ, Cohen ME. Correlation of acute pericoronitis and the position of the mandibular third molar. Oral Surgery, Oral Med Oral Pathol. 1986;62(3):245–50. https://doi.10.1016/0030-4220(86)90001-0.

10. Ogle OE. Odontogenic Infections. Dent Clin North Am. 2017;61(2):235-52. https://doi.10.1016/j.cden.2016.11.004.

11. Sixou J-L, Magaud C, Jolivet-Gougeon A, Cormier M, Bonnaure-Mallet M. Evaluation of the mandibular third molar pericoronitis flora and its susceptibility to different antibiotics prescribed in France. J Clin Microbiol. 2003;41(12):5794–7. https://doi.10.1128/JCM.41.12.5794-5797.2003.

12. Stassen LFA. Pericoronitis : treatment and a clinical dilemma Pericoronitis : treatment. J Ir Dent Assoc. 2009;55(4):190–2.

13. Tsvetanov T. Association of the mandibular third molar position to the pericoronitis. Int J Med Res Heal Sci. 2018;7(2):35–40. https://doi.10.4103/jfmpc.jfmpc_1101_19 https://doi.10.4103/njms.NJMS_13_17.

14. Magraw CBL, Golden B, Phillips C, Tang DT, Munson J, Nelson BP, et al. Pain with pericoronitis affects quality of life. J Oral Maxillofac Surg. 2015;73(1):7–12. https://doi.10.1016/j.joms.2014.06.458.

15. Ventä I, Turtola L, Murtomaa H, Ylipaavalniemi P. Third molars as an acute problem in Finnish university students. Oral surgery, oral Med oral Pathol. 1993;76(2):135–40. . https://doi.10.1016/0030-4220(93)90192-7.

16. Wade WG, Gray AR, Absi EG, Barker GR. Predominant cultivable flora in pericoronitis. Oral Microbiol Immunol. 1991;6(5):310–2. https://doi.10.1111/j.1399-302x.1991.tb00499.x.

17. Limbago B. Performance standards for antimicrobial susceptibility testing [Internet]. Clinical and Laboratory Standards Institute. 2018. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0196439901880090.

18. Barbalho JC, Vasconcellos RJH, De Morais HH, Santos LAM, de AC Almeida R, Rêbelo HL, et al. Effects of co-administered dexamethasone and nimesulide on pain,

swelling, and trismus following third molar surgery: a randomized, triple-blind, controlled clinical trial. Int J Oral Maxillofac Surg. 2017;46(2):236–42. https://doi.10.1016/j.ijom.2016.10.011.

19. Ayanbadejo PO, Umesi-Koleoso DC. A retrospective study of some socio-demograhic factors associated with pericoronitis in Nigerians. West Afr J Med. 2007;26(4):302-5. 10.4314/wajm.v26i4.28331. https://doi.10.4314/wajm.v26i4.28331.

20. Hazza'a AM, Bataineh AB, Odat A-A. Angulation of mandibular third molars as a predictive factor for pericoronitis. J Contemp Dent Pr. 2009;10(3):51–8.

21. Kay LW. Investigations into the nature of pericoronitis—II. Br J Oral Surg. 1966;4:52–78. https://doi.10.1016/s0007-117x(65)80033-6.

22. Nitzan DW, Tal O, Sela MN, Shteyer A. Pericoronitis: a reappraisal of its clinical and microbiologic aspects. J oral Maxillofac Surg. 1985;43(7):510–6. https://doi. 10.1016/s0278-2391(85)80029-x.

23. Yamalik K, Bozkaya S. The predictivity of mandibular third molar position as a risk indicator for pericoronitis. Clin Oral Investig. 2008;12(1):9-14. https://doi.10.1007/s00784-007-0131-2.

24. Quek SL, Tay CK, Tay KH, Toh SL, Lim KC. Pattern of third molar impaction in a Singapore Chinese population: a retrospective radiographic survey. Int J Oral Maxillofac Surg. 2003;32(5):548-52.

25. Halverson BA, Anderson WH 3rd. The mandibular third molar position as a predictive criteria for risk for pericoronitis: a retrospective study. Mil Med. 1992;157(3):142-5.

26. Campbell JH. Pathology associated with the third molar. Oral Maxillofac Surg Clin. 2013;25(1):1–10. https://doi.10.1016/j.coms.2012.11.005.

27. Dilhari A, Weerasekera MM, Siriwardhana A, Maheshika O, Gunasekara C, Karunathilaka S, et al. Candida infection in oral leukoplakia: an unperceived public health problem. Acta Odontol Scand. 2016;74(7):565–9. https://doi.10.1080/00016357.2016.1220018.

28. Blakey GH, White Jr RP, Offenbacher S, Phillips C, Delano EO, Maynor G. Clinical/biological outcomes of treatment for pericoronitis. J oral Maxillofac Surg. 1996;54(10):1150–60. https://doi.10.1016/s0278-2391(96)90339-0.

29. Rajasuo A, Jousimies-Somer H, Savolainen S, Leppänen J, Murtomaa H, Meurman JH. Bacteriologic findings in tonsillitis and pericoronitis. Clin Infect Dis. 1996;23(1):51-60. https://doi.10.1093/clinids/23.1.51.

30. Bean LR, King DR. Pericoronitis: its nature and etiology. J Am Dent Assoc. 1971;83(5):1074-7 https://doi.10.14219/jada.archive.1971.0439.

31. Sencimen M, Saygun I, Gulses A, Bal V, Acikel CH, Kubar A. Evaluation of periodontal pathogens of the mandibular third molar pericoronitis by using real time PCR. Int Dent J. 2014;64(4):200–5. https://doi.10.1111/idj.12109.

Case Report

Sri Lanka Dental Journal 2022; 52(01) 31-36
Received: 12.02.2022 | Revised: 21.03.2022 | Accepted: 22.03.2022

Post COVID-19 acute invasive fungal rhino-orbital sinusitis: A rare presentation

PDC Fernando, KA Fernando, BSMS Siriwardena

Abstract

Acute invasive fungal rhino-orbital sinusitis is a rapidly progressive, angio-invasive life-threatening infection that is seen commonly among immunocompromised patients. With the emergence of COVID-19 pandemic, incidence of fungal sinusitis has reportedly increased specially in south Asian subcontinent. Two patients (49-year female and 72-year male) presented with paranasal sinusitis were unresponsive for conventional management. Both of them were infected with COVID-19 during previous two months and had uncontrolled diabetes mellitus. The exploratory biopsy and histopathologically confirmed the condition as acute invasive fungal rhinosinusitis. Total debridement of the involved sinus mucosae and adjacent soft tissues were done through Caldwell-Luc approach. The female had mucormycosis and more interestingly the male had mucormycosis on left side and aspergillosis on right side of para-nasal sinuses. Both patients underwent three serial surgical debridement periodically with systemic antifungal therapy along with proper glycemic control. Patients were followed up for 6 months. Both patients were considered cured after negative histopathological evaluation. Two different types of fungal infections in either side sinuses in the same patient was an extremely rare presentation. Acute invasive fungal rhino-orbital sinusitis is a potentially fatal condition, however, early diagnosis, systemic antifungal therapy, aggressive serial surgical debridement and management of the cause, appears to be effective in reducing mortality in most patients.

Introduction

Coronavirus Disease-2019 (COVID-19) is an infectious, multisystem disease that resulted in the current global health crisis. COVID-19 has presented with atypical cutaneous, muco-cutaneous, nasal, para-nasal, orbital as well as oral complications[1,2]. Recent literature provides strong evidences of correlation between COVID-19 and mucormycosis-related acute invasive fungal infections or the "black fungus", which is a potentially lethal condition[1,2,3]. Invasive fungal infections of nose and para-nasal sinuses are uncommon and usually occur in immune-compromised individuals[1,2]. However, COVID-19 itself may cause dysregulation of the innate immune system even in normal individuals, resulting in vulnerability of patients to fungal infections particularly to mucormycosis[2,4,5,6]. Early detection of the condition is very important based on high index of clinical suspicion, because clinical history and physical examination of the patient *per se* are rarely conclusive[1,7]. Two cases of acute invasive fungal rhino-orbital sinusitis (AIFROS) are described here, which resulted from a rapid spread of fungi through vascular invasion among the para-nasal sinuses to the orbits without spreading into the cranial cavity[7]. Successful management of AIFROS requires

PDC Fernando (Correspondence) — Consultant Oral and Maxillofacial surgeon, District General Hospital, Ampara, Sri Lanka. E-mail: dilan4fernando@gmail.com ORCID: 0000-0002-2954-6758

KA Fernando — District General Hospital, Ampara, Sri Lanka.

BSMS Siriwardena — Department of Oral Pathology, Faculty of Dental Sciences, University of Peradeniya, Sri Lanka.

early diagnosis, aggressive surgical intervention with prompt initiation of antifungal therapy and management of the complications[1].

Case Report

A 47-year-old female and 72-year-old male were referred to Oral and Maxillo-facial Unit, due to unresponsiveness to conventional management of para-nasal sinusitis for more than two weeks. Both had uncontrolled type II Diabetes mellitus (DM) and infected with COVID-19 infection during past two month and recovered without any complications. 47-year female had headache, severe pain, swelling and numbness of the right inferior orbital region with gradually increasing ipsilateral nasal obstruction. Grade III mobility of the right maxillary posterior teeth was observed recently. 72-year male had bilateral inferior orbital numbness, bilateral blood-stained nasal discharge and pain, predominantly on left side of the face. He had recent onset blurred vision with opthalmoplegia on left eye.

Presence of Radio-opacity of the Occipito-Mental Skull radiograph, resistance for conventional management of the para-nasal sinusitis and uncontrolled DM suggested an explorative maxillary antral biopsy under local anesthesia in both patients. Histopathology of both patients confirmed the condition as AIFROS. In order to see the extension of the spread and for further management, contrast enhanced CT scans were done, which revealed involvement of maxillary, ethmoidal, sphenoidal sinuses and masticatory space on right side in female patient and both sides in the male patient. Orbital floor perforations were noted in left side in male and right side in female respectively, without any cerebral spread of the disease (Figure 1).

Due to invasive nature of the condition, early surgical intervention was planned under general anesthesia. Total debridement of involved paranasal sinuses with adjacent tissues including eroded bony margins were performed right side for the female and both sides for the male, using Caldwell-Luc surgical approach to the maxillary sinus (Figure 2a). Through the same opening ethmoidal and sphenoidal sinuses were also reached and debrided. Whole sinus lining was enucleated including the bony spicules. Central part of the orbital floor erosions were seen in left side in the male and right side in the female patient. All involved para-nasal sinuses were copiously irrigated with warm saline. Rubber tubes were placed across the Caldwell-Luc approach site to equalize the pressure between maxillary sinus and the oral cavity (Figure 2b). During the surgical debridement, IV Amphotericin B stat dose was administered to minimize the

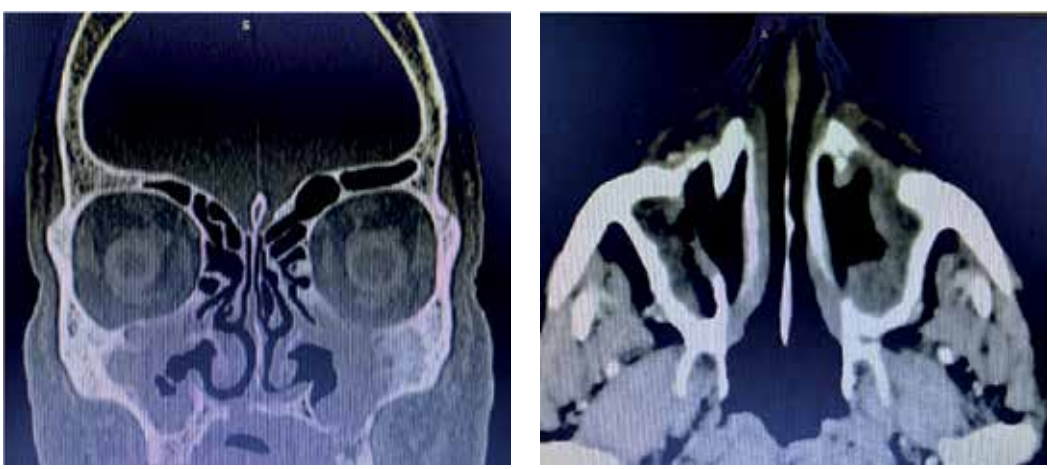


Figure 1. Computer tomography showing A. involvement of bilateral para-nasal sinuses and B. erosion of the right orbital floor of the male patient

Figure 2a. *Caldwell-luc* approach

Figure 2b. *Decompression tubes in situ*

Figure 3a. Macroscopic specimen

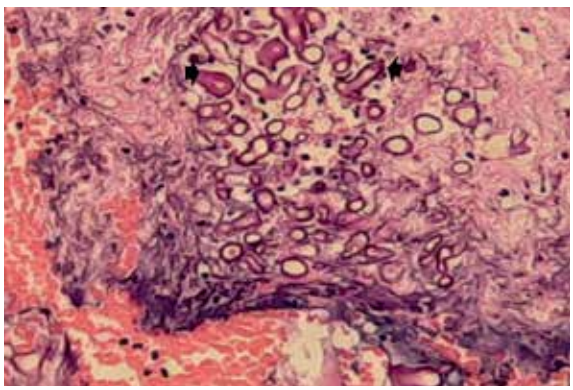


Figure 3b. non-septate large hyphae (arrows) within necrotic tissue (H&E x200)

dissemination of the infection due to surgical intervention. Once the patients were surgically stable, they were transferred to medical ward and continued antifungal treatment for four weeks with close monitoring for complications. Glycemic control was obtained. In male patient, Amphotericin B dose was reduced after seven days due to high liver enzyme levels and was replaced by IV Voriconazole after ten days.

In both cases, Saline irrigation through the inserted rubber drain tube to maxillary sinuses were started and continued every day from the third post-operative day. Pressure equalization between para-nasal sinuses and oral cavity, fast healing and elimination of infections were expected by this. According to the microbiological diagnosis, female patient had mucormycosis of the right para-nasal sinuses except the frontal sinus. Interestingly, the male patient had mucormycosis (Figures 3a and 3b) in the left side and aspergillosis in the right-side para-nasal sinuses except the frontal sinus.

Both patients were assessed with CT scans after one month and found the sinuses were filled again with opacified contents. Re-exploration and debridement of the para-nasal sinuses were done for both patients and still were positive for the same fungal infections. Therefore, same antifungal management and daily irrigation was continued for another one month. Re-exploration and debridement for the second time for both patients confirmed there were no residual fungal infection and only scar tissues present.

Both patients were discharged after confirming elimination of the infection. However, oral

Voriconazole was continued for another two weeks. Daily irrigation was continued at home for another one month. Drain tubes were removed with surgical closure of the Caldwell-Luc exposure site under local anesthesia after one month. They were followed up at once-a-month intervals in the clinic with periodic CT scans. Both patients were thoroughly advised about the importance of diabetes control and the importance of regular monitoring in the medical and OMF clinics.

Discussion

The impact of the COVID-19 pandemic on the incidence and pattern of mucormycosis-related acute invasive fungal infections has increased sharply and the majority of cases were detected at late stages. Barriers to accessing health care services in the lockdown period of COVID-19 also contributed to this diagnostic delay[2,3]. Invasive fungal rhinosinusitis is featured by the gradual spread of fungal infection by destruction of adjacent structures, characterized by dark, thick, greasy material found in the sinuses[7]. In its early stage, the fungal invasion is often localized within the mucosa and bony walls of a single para-nasal sinus. Then, it may gradually invade the adjacent sinuses and nasal cavity, although the symptoms are not obvious[7,8]. In the later stages, the lesion can invade the orbits and skull base[7,8].

Mucormycosis has emerged as the most common invasive fungal infection and featured as an epidemic within a pandemic of COVID-19 [2,3]. In these cases, orbital extension of the infection was radiologically and surgically confirmed, right orbit in female and left orbit in male, respectively. Accordingly, the condition could classify as AIFROS with no central nerves system involvement.

Histopathological examinations of fungi mainly include hematoxylin-eosin (HE) staining, special stains for fungi sch as periodic acid Schiff (PAS), Grocott-Gomori's methenamine silver stain, and fungal culture studies. Though fungal culture was not carried out in the confirmation of the diagnosis, histopathologically, necrosis is more prominent. Within the necrotic debris non-septate broad hyphae with right angle branching are frequent. There are coagulative necrosis of tissues, vasculitis, chronic suppurative granulomatous inflammation and chronic nonspecific inflammation in the affected area [8,9]. Mycotic vasculitis and vascular invasion is another common feature of fungal infections. The hyphae of mucorales invade the small vascular walls and small arteries, leading to swelling of vascular endothelial cells, intimal thickening, luminal narrowing, and even luminal occlusion or fungal embolism [8]. In these patients' antifungal medication was commenced at the time of the surgical debridement in order to minimize the dissemination of these emboli.

AIFROS is typically caused by mucorales. The mucorales are more invasive and often cause acute invasion and massive tissue necrosis; termed as black fungi. In contrast, the aspergillus invades tissues in a slower pace[8]. In these patients, mucormycosis infected right-side para-nasal sinuses of the female and left side para-nasal sinuses of the male with orbital floor destruction. However, aspergillus infected right-side para-nasal sinuses of the male did not show any orbital involvement and was less aggressive in nature comparatively.

A "diabetes like state" is created due to the extensive and prolonged use of steroids against COVID-19. The raised glucose level provides a nutritional source for mucorales to multiply. The combination of virus and diabetes-induced immunosuppression of these patients led to increased risks of development and exacerbation of fungal infections[2]. Additionally, uncontrolled diabetes mellitus or diabetes ketoacidosis conditions and acidic pH in the blood reduce the Iron binding capacity of Transferrin. Increased free iron facilitates profuse growth of the fungi[4]. Both these factors would have contributed to initiation and progression of the disease condition

in these two patients. More interestingly, two different types of fungal infections in either side sinuses in the same patient was an extremely rare presentation.

Beyond the conventional Occipito-Mental sinus X-rays, contrast enhanced CT is invaluable to assess the extensions and involvement of the infection in para-nasal sinuses and adjacent vital structures. Ethmoid sinus was most often affected, followed by sphenoid sinus and maxillary sinus. The sinus cavities are filled with soft tissuedensities of irregular shapes whilebone destruction and osteosclerosis were also found. MRI is mainly indicated if suspect the involvement of cavernous sinus, meninges, and peripheral nerves[8]. In these two cases para-nasal sinuses except the frontal sinus for both sides for the male and right side for the female were infected according to the CT. Bone destruction also seen among the boundaries of the sinuses and the orbital floor in both cases. Fortunately, the infectionhadnot extended to the cranial cavity by the time of diagnosis and commencement of treatment.

Surgery is the mainstream treatment for AIFRS. Without undue delay, surgical intervention and complete elimination of the necrotic tissues should be done. It is important to completely remove the lesions including sinus lining and establish adequate ventilation in the para-nasal sinuses, so it will thoroughly change the microenvironment where the fungi exist[8]. In both cases, rubber drain tubes were kept to equalize the sinus pressure with the oral cavity and to change the supportive microenvironment within the sinuses.

Not only the surgical debridement, but also the long-term antifungal medication, managing the complications and reversal of the underneath medical condition leading to immunosuppression are equally important for successful outcome of the disease.Two commonly used antifungal drugs are Itraconazole and Amphotericin B, whereas other drugs such as Voriconazole, Clotrimazole, Nystatin, and Posaconazole also used. Itraconazole is effective for Aspergillus, with little side effects. Amphotericin B is a broad-spectrum antifungal agent for Cryptococcus, Histoplasma, Blastomyces, Paracoccidioides, Coccidioides, Aspergillus, Mucorales, and some Candida species, but with severe side effects. Voriconazole or Itraconazole can replace amphotericin B once the acute stage has passed or if the patient develops severe side effects [8]. Amphotericine B was administered for both patient in this case since it is sensitive for both mocormycosis and aspergillosis however was replaced with Voriconazole in male patient after ten days considering complications and the age of the patient[8].

Antifungal treatment should not be stopped until the clinical symptoms and signs are dissolved, the potential infection factors are eliminated, the imaging modes reveal normal findings and the results from the culture are negative. Further, patients need to have antifungals for two weeks after complete elimination of the disease[8]. In our patients, oral Voriconazole was given for two weeks after complete eradication of the disease and rubber tube irrigation were continued for another one month.

AIFROS carries a poor prognosis. Mortality rate reports 50%, even with aggressive surgical and medical treatment[7,8]. Once the orbit involves, the orbital bone can be eroded, which can manifest as exophthalmoses, eyeball displacement, superior orbital fissure syndrome or orbital apex syndrome, and visual impairment[8].Both cases here had orbital floor destruction, right side for the female without any symptoms and left side for the male with blurred vision however, completely recovered with the post-surgical antifungal medication. The fungi can further spread to pterygopalatine fossa, infra-temporal fossa and nasopharynx. Intracranial extension may affect meninges, cerebral parenchyma, lead to cerebral artery aneurysms and cause cavernous

sinus thrombosis increasing the mortality to 50-80%[7,10]. Lack of a fungal culture is a draw-back in the presentation of this case-report.

Conclusion

Acute invasive fungal rhino-orbital-cerebral sinusitis, mostly caused by mucormycosis, is an emerging problem requiring increased vigilance in post COVID-19 patients, especially who have diabetes mellitus or who had received high doses of glucocorticoids. Early diagnosis, systemic antifungal therapy, aggressive serial surgical debridement, management of the underneath medical condition and addressing the complications appear to reduce mortality. Regular follow-up even after full recovery is imperative.

References

1. Drissi C. Black fungus, the darker side of COVID-19. Editorial. Journal of Neuroradiology 2021;41: 317−318. https://doi.org/10.1016/j.neurad.2021.07.003.

2. Saad RH, Mobarak FA. The diversity and outcome of post-covidmucormycosis: A case report. International Journal of Surgery Case Reports 2021;(88). https://doi.org/10.1016/j.ijscr.2021.106522.

3. Mahalaxmi I, Jayaramayya K, Vellingiri B. Mucormycosis: An opportunistic pathogen during COVID-19. Environmental Research 2021;(201). https://doi.org/10.1016/j.envres.2021.111643.

4. Chao CM, Lai CC, Yu WL. COVID-19 associated mucormycosis: An emerging threat Journal of Microbiology, Immunology and Infection 2022. https://doi.org/10.1016/j.jmii.2021.12.007.

5. Ismaiel WF, Abdelazim MH,Hasan A. The impact of COVID-19 outbreak on the incidence of Acute invasive fungal rhinosinusitis. American Journal of Otolaryngology 2021;42(6). https://doi.org/10.1016/j.amjoto.2021.103080.

6. Meher R, Wadhwa V, Kumar V, et al. COVID associated mucormycosis: A preliminary study from a dedicated COVID Hospital in Delhi. American Journal of Otolaryngology 2021; 43(1). https://doi.org/10.1016/j.amjoto.2021.103220.

7. Prateek S, Banerjee G, et al. Fungal rhinosinusitis: A prospective study in a university hospital of Uttar Pradesh: Indian Journal of Medical Microbiology2013; 31(3): 266-269.

8. Wang T, Zhang, Hu C, et al.Clinical Features of Chronic Invasive Fungal Rhinosinusitis in 16 Case. Ear, Nose Throat Journal 2020; 99(3): 167–172.

9. Alotaibi AH, Omar OA, et al. Chronic Invasive Fungal Rhinosinusitis in Immuno-competent Patients: A Retrospective Chart Review.Frontiers in Surgery 2020. htpp://www.frontiersin.org .2020(7)doi: 10.3389/fsurg.2020.608342.

10. Horton S,Mirman I,Malkoff M. A case of middle cerebral artery aneurysm secondary to Acute Invasive Fungal Rhinosinusitis. Medical Mycology Case Reports 35 (2022) 30–34. https://doi.org/10.1016/j.mmcr.2022.01.00.

Mini Review

Sri Lanka Dental Journal 2022; 52(01) 37-44
Received: 01.02.2022 | Revised: 24.03.2022 | Accepted: 29.03.2022

Polarization of dental caries among Sri Lankan children and the importance of caries risk assessment

D Wickramasinghe, U Usgodaarachchi

Abstract
Dental caries is a multifaceted public health challenge. Even though a reduction in prevalence and severity of caries are noted over the years, segments of the child population still suffer from a higher disease burden, denoted by polarization of the disease. School Dental Service serving the child population in Sri Lanka is challenged by gross deficiencies in human resources to address the huge proportion of untreated caries. Polarization of the disease enables identify most vulnerable children with the highest risk for caries at school settings by field level risk assessment and prediction. Clinical preventive measures such as fissure sealants through the national save molar programme together with behavioural modification targeting high-risk children and policies for improving the service availability in socioeconomically deprived underserved areas, has the potential to improve oral health outcomes of children. With the increased use of information technology and availability of increased amounts of data in Sri Lanka, possibility of using advanced analytics and operational research techniques such as simulation on how to use resources efficiently to address polarized caries burden, particularly among the most vulnerable is promising.

Introduction

Together with the high prevalence, incidence, negative impact on quality of life, there is a huge economic cost in managing caries. Untreated caries in the deciduous teeth was the 10th most prevalent condition affecting 621 million children across the globe[1]. The global economic impact of dental diseases dominated by dental caries in terms of direct and indirect economic cost amounted to US$ 442 billion in 2010, thus reporting an economic loss within the range of the ten most frequent global causes of mortality[2]. Recurrent expenditure on dental services in Australia which has similar caries indices, is estimated to be $9.5 billion for 2019–20, up from $7.8 billion in 2009-10, illustrates the increasing cost in dental treatment[3].

Over the years, among child population a decline in prevalence and severity of caries together with a skewed distribution and concentration of caries in pits and fissures are seen[4]. This is characterized by majority of young children being caries-free, and most carious lesions being concentrated in a small number of children. Increased concentration of childhood caries within a specific group signifies a polarizing phenomenon. Polarization of caries is defined as observing a greater number of cases within a small segment of the population. The evidence for polarization of dental caries among children appeared from developed countries and as at present the trend continues[5,6].

Polarization among children has been associated with social deprivation. Higher prevalence of caries is seen in developing countries and socioeconomically disadvantaged groups living in low, middle and high-income countries[7]. One

D Wickramasinghe (Correspondence) — Health Promotion Bureau, Ministry of Health, Sri Lanka. E-mail: danushi13@gmail.com ORCID: 0000-0003-0022-5341

U Usgodaarachchi — National Cancer Control Programme, Ministry of Health, Sri Lanka.

hypothesis for polarization of caries is based on accumulation of biological and social risks during the life course[8]. Therefore, it is important to identify possible risk indicators early in life[8,9]. Evidence shows modifiable proximal factors (such as higher sugar consumption) to be mediating the association between socioeconomic status and polarization of childhood caries[7]. Thus, addressing such modifiable factors among individuals and sub-groups in a population carrying the highest burden of dental caries is important.

Sri Lankan situation

In Sri Lanka, sequential reductions in prevalence and severity of dental caries among children is reported by National Oral Health Surveys conducted in over a period of thirty years. It could mainly be attributed to effective adaption of population level preventive efforts such as usage of fluoridated toothpaste which is currently around 75% among 5-year-olds[10]. Yet a small proportion of 5-6-year-old children carry a high disease burden indicating a non-homogenous skewed distribution of caries[11].

Significant Caries Index (SiC index) is used in identifying individuals with the highest prevalence of caries in each population. It is the mean DMF/dmf (decayed, missing and filled teeth) for the one-third of the study group with the highest caries score and it is useful in presenting the skewed distribution of caries[12]. Even though, SiC index for the whole Sri Lankan population is not available, a SiC index of 7.62 (95% CI of 7.34-7.9) in comparison to a mean dmft of 3.01 (95% CI of 2.61-3.41) was observed among 5-6-year-old children in the Western province of Sri Lanka[11] clearly indicating a polarized disease burden.

Together with uneven disease burden, higher proportion of untreated caries is seen among segments of the child population. To measure the clinical consequences of untreated caries PUFA/pufa index is used[13]. This index records the presence of severely decayed teeth with visible pulpal involvement (P/p), ulceration caused by dislocated tooth fragments (U/u), fistula (F/f) and abscess (A/a). PUFA/pufa index is calculated as sum of teeth with these four diagnoses. Recently, the pufa index is used particularly in low- and middle-income countries to display the severity of oral health neglect[14]. Sri Lankan studies have reported a pufa prevalence of 32.77% (95% CI: 32.32%- 33.22%) in Western province among 5-6-year-olds[11] and a pufa prevalence of 34.2% among rural and remote grade 1 children[15]. When used in conjunction with dmft/ DMFT index, these indices are useful in addressing polarization of the disease.

Oral health care delivery for children in Sri Lanka

Oral health care for Sri Lankan children is mainly provided by the School Dental Services. School Dental Services in Sri Lanka started in the year 1951 as a treatment-oriented service, utilizing School Dental Therapists (SDT) to cater to the high treatment need of children between the ages of 3 to 13 years. School Dental Therapists carry out the first compulsory screening when the child is in grade 1. Children are screened again when they are in grades 4 and 7, except in small schools where there are less than 200 students in which case all students are screened. As more than 98% of students complete their primary education in Sri Lanka[16] school based oral health interventions during early years of schooling has the potential to achieve a high coverage among the child population. It is a cost-effective field level island-wide service which has contributed towards narrowing down social inequalities in oral health among school children. Yet, routine monitoring of School Dental Services revealed an unmet need of 44% for the target group, in terms of screening and those awaiting treatment after screening. Screening was completed only in 64% of the children and only 56% of the children were identified as either healthy or as having successfully treated dental problems[17]. In the year 2015, screening was completed only in 75%

of the total target group in 72% of the schools[18]. Therefore, provision of services for the target population remains a challenge.

There are gross deficiencies in numbers of SDT and huge disparities in availability and accessibility of services between districts. A recent geo-spatial analysis of access to oral health care revealed only 53% of the most socially disadvantaged children to be living within 5 kilometres from a School Dental Clinic, compared to 75% of the least disadvantaged[19]. Currently, to improve the service coverage, School Dental Therapists engage in relief duty and conduct outreach clinics, to cover entire districts by sharing the workload irrespective of individual based targets. However, the conduct of outreach clinics is sometimes hindered by inadequate transport facilities. Furthermore, as SDT do not provide services outside their assigned district it does not help in reducing maldistribution between districts.

Efforts in orientating the services towards prevention in recent times is commendable yet, the three-year gap between screenings undermines preventive efforts for most vulnerable children with the highest risk for caries. As preventive oral health care services are exclusively provided by the public sector, public health interventions addressing polarized caries burden should aim at optimizing oral health outcomes for the whole target population while overcoming current limitations.

Population and individual approaches to address polarization of dental caries in children

Even though population and individual approaches are fundamentally different, both are needed and complimentary to each other for overall prevention and control of a given disease. There are policy drawbacks of adapting one approach exclusively[20]. Another concept known as populations at risk offered by Marc Lalonde focuses preventive efforts on 'the right-hand tail' in the distribution of risk. It has been widely criticized for drawbacks such as victim blaming and not preventing individuals becoming at risk. Rose's population approach (1992) is aimed at increasing the overall population health by shifting the distribution of population risk exposure towards a lower mean through environmental changes. Therefore, in population approach determinants of incidence in the population as a whole are controlled.

Currently, population approach has also been criticized as increasing health inequalities due to the differential capacity throughout the risk-exposure distribution, to transform resources provided through population approach interventions into health: inequality paradox[21,22]. It may be due to life-course epidemiology, concentration of risk factors and the concept of fundamental causes of disease. Population strategies may disproportionately benefit those at lower risk.

Since Rose's original publication on population strategy, there is considerable increase in accuracy in identification of high-risk individuals. Risk identification has evolved over the years from using a single variable into multi-component risk approach derived using population-based data. Furthermore, a higher yield may accrue from the high-risk strategy than the population strategy. At present effective medical interventions are available for individuals with elevated risk[23]. Nevertheless, temporary, palliative and down-stream nature of high-risk approach will result in continuous emergence of high-risk individuals[24]. Majority of cases of a disease coming from a population at low or moderate risk of that disease, and only a minority of cases coming from the high-risk population, known as the prevention paradox, further caveats the high-risk approach. Therefore, many diseases call for both approaches. Additionally, extending Lalonde's idea of 'populations at risk' by decomposing the distribution of risk into refined and actionable target sub-distributions through the application

of technology, one may be able to reap public health gains[25].

Association between epigenetics and dental caries are being increasingly researched in recent times[26,27]. Those who are socioeconomically deprived are a particularly vulnerable group whose risk for exposure is defined throughout the life course and are likely that of their forebears through epigenetic inheritance[25]. The importance of incorporating knowledge on genomics into public health practice in areas such as health service organization and planning has been increasingly acknowledged. Even though genetic factors which dominate the individual disease susceptibility explain little of population differences in incidence[28], such advances are encouraging in better management of polarization of caries in children.

With high quality data and rigorous methodology accurate caries risk assessment at the population level and "precision dentistry" at the person level are both desirable and achievable[29]. When caries is managed through a risk assessment, the focus is on treatment of the disease process instead of treating the outcome of the disease, which are cavities. Therefore, in most health systems risk factor detection and patient categorization according to risk, is an integral part of caries management.

Addressing polarization of caries through the current system

There are service accessibility issues to consider in addressing the polarized caries burden in the country. The availability of good health care tends to vary inversely with the need for it in the population known as the inverse care law[30,31]. This is seen in provision of oral health care services where health care is exposed to market forces, which could perpetuate the polarized caries burden. The circular on National Targets for School Dental Services in Sri Lanka recommends on having one School Dental Clinic and one School Dental Therapist per MOH area[32], could improve accessibility. Identifying locations for setting up of new clinics in areas of greatest deprivation and, enrolment and allocation policy by which specific places could be allocated to School Dental Therapist students willing to serve in disadvantaged regions could mitigate service accessibility issues associated with the polarized caries burden.

Under current shortage and maldistribution of human resources within School Dental Services with a considerable proportion of untreated caries, implementing a high-risk approach may further widen oral health inequalities for some children. Therefore, possibility of going for a skill-mix with Community Dental Surgeons to optimize oral health outcomes of the target population is worthy of consideration in addressing the polarized caries burden among children.

The 'National Save Molar Programme' introduced in the year 2014, aims at preventing caries in permanent molar teeth through application of fissure sealants. As at present the potential of this programme had not been harnessed due to many inherent limitations such as lack of agreed criteria for assessing and predicting risk to prioritize children. If high risk children could be identified at the first screening in grade 1, together with application of sealants, recall periods could be altered for early intervention and behavioural modification, for prevention of caries depending on the risk.

Sri Lanka at present is using risk assessment and early detection to address non-communicable diseases such as cancer. A risk assessment model has been developed for early detection of oral cancer as well[33]. A formal systematic risk assessment for dental caries which is one of the most common health problems among children has not been attempted through the School Dental Services.

Identifying vulnerable children at a higher caries risk

Caries risk assessment and prediction are important in identifying children with a higher risk for caries. Risk assessment helps in deciding appropriate recall intervals and enable early detection of caries through monitoring the disease status. Therefore, caries could be managed by non-invasive or minimally invasive techniques minimizing distress for patients[34]. Furthermore, caries risk assessment is cost-effective and economically beneficial[35]. Cost savings of preventive measures are shown to be most effective for children with the highest risk of caries[36]. However, risk assessment and prediction has been stated as a "risky" concept[29]. Effective methods for predicting caries risk are yet to be developed, and validity of standardized caries risk assessment systems remains limited[37]. The limited accuracy of prediction models remains a potential barrier for managing the disease through primary preventive measures[38]. Yet, they serve as valuable resources in dental education, facilitates communication with patients and their families, serve as guides for development of public health programmes and allocation of resources among vulnerable segments of the population[29]. To increase the yield of risk prediction it could be done among high-risk vulnerable groups making use of indices such as SiC and pufa.

In a longitudinal study carried out in children attending South Australian School Dental Services for 5-15-year-olds to assess the accuracy of caries risk assessment, a sensitivity of 0.48 and a specificity of 0.86 was observed. It was also noted that the accuracy was acceptable in children who had prior caries experience at baseline examination, while it was poor among children with no caries experience[39]. A Sri Lankan study on development of a caries risk prediction model in 5-year-old students using backward logistic regression, following external validation achieved a sensitivity of 31% (95% CI: 22.1%-41.0%) and a specificity of 87% (95% CI: 78.8% -92.9%)[11].

The inadequacy of using frequentists versus Bayesian modelling approaches to derive individual disease propensity estimates[29] is evident from the low levels of sensitivities achieved. With advances in computer technology, the principals of data mining have been satisfactorily used for predictive purposes. Data mining aims to identify associations, anomalies, and statistically significant patterns in large volumes of data. Studies comparing prediction models constructed by logistic regression, neural network and decision analysis concluded that prediction performance of neural network approach or decision analysis to be better than logistic regression model. As the distribution of dental caries is skewed, the inability to develop precise prediction models using all the data is noted. Therefore, balancing techniques are being used to obtain more appropriate and robust models[40]. Thus, the search for newer methods of data analysis for disease prediction continues. In the Sri Lankan context with the upgrading of management information systems in the health sector, and the increased availability of individual and population level data, there is potential for making use of such techniques for better outcomes in preventing childhood caries.

Conclusion

Directing resources from the orally healthy children towards those who are high-risk and vulnerable together with early intervention, could reduce overall disease burden, future treatment costs and improve quality of life of children. Drawbacks of confining all efforts on vulnerable high-risk individuals are relative imprecision in identifying them, late, unexpected and often severe first manifestations of disease and missing 'not-yet-at-high-risk' individuals entirely. Another problem with this approach is that the appropriate level of some interventions may well be for the whole of society rather than targeting at certain children. Therefore, careful planning and monitoring of public health interventions is needed. Planning interventions to optimize the impact on children's oral health

with available resources, involves decision making and problem solving. Operational research techniques such as simulation could be used in a risk-free environment to visualize and analyse issues arising in practical implementation of interventions. Different thresholds for risk categorization, how screening coverage and treatment completion could be increased with a skill-mix, cost effectiveness and disease prognosis of different preventive interventions targeted at different segments of the population are some of the aspects which could be simulated and considered to be implemented if found favourable in addressing the polarized caries burden.

References

1. Kassebaum NJ, Bernabé E, Dahiya M, Bhandari B, Murray CJ, Marcenes W. Global burden of untreated caries: a systematic review and metaregression. J. Dent. Res. 2015;94(5):650-8. https://doi.10.1177/0022034515573272.

2. Listl S, Galloway J, Mossey PA, Marcenes W. Global economic impact of dental diseases. J. Dent. Res. 2015;94(10):1355-61. https://doi. 10.1177/0022034515602879.

3. Australian Institute of Health and Welfare. Oral health and dental care in Australia, Summary. 2022. https://www.aihw.gov.au/reports/dental-oral-health/oral-health-and-dental-care-in-australia/contents/summary

4. Burt BA. Prevention policies in the light of the changed distribution of dental caries. Acta Odontol. Scand. 1998;56(3):179-86. https://doi.10.1080/000163598422956.

5. Vehkalahti, M., Tarkkonen, L., Varsio, S., &Heikkilä, P. Decrease in and polarization of dental caries occurrence among child and youth populations, 1976–1993. Caries Res. 1997;31(3), 161-165.https://doi.10.1159/000262392.

6. Narvai, P. C., Frazão, P., Roncalli, A. G., & Antunes, J. L. Dental caries in Brazil: decline, polarization, inequality and social exclusion. Rev PanamSalud Publica. 2006;19(6), 385-393. https://doi.10.1590/s1020-49892006000600004.

7. Nunes AM, da Silva AA, Alves CM, Hugo FN, Ribeiro CC. Factors underlying the polarization of early childhood caries within a high-risk population. BMC Public Health. 2014;14(1):1-9.

8. Zemaitiene M, Grigalauskiene R, Andruskeviciene V, Matulaitiene ZK, Zubiene J, Narbutaite J, Slabsinskiene E. Dental caries risk indicators in early childhood and their association with caries polarization in adolescence: a cross-sectional study. BMC Oral Health. 2017;17(1):1-6.. https://doi.10.1186/s12903-016-0234-8.

9. Peres, M. A., Latorre, M. D. R. D. D. O., Sheiham, A., Peres, K. G., Barros, F. C., Hernandez, P. G., ... &Victora, C. G. Social and biological early life influences on severity of dental caries in children aged 6 years. Community Dentistry and Oral Epidemiology. 2005;33(1):53-63. https://doi.10.1111/j.1600-0528.2004.00197.x

10. Ministry of Health. National Oral Health Survey Sri Lanka 2015-2016. Colombo: Ministry of Health. 2015.

11. Wickramasinghe, D. Caries risk prediction model for 5-year-old school children in the Western Province of Sri Lanka. [Thesis for MD (Community Dentistry)]. Post Graduate Institute of Medicine (PGIM), University of Colombo, Sri Lanka. 2018.

12. Bratthall D. Introducing the Significant Caries Index together with a proposal for a new global oral health goal for 12-year-olds. International dental journal. 2000;50(6):378-

84. https://doi.10.1111/j.1875-595x.2000.tb00572.x

13. Monse B, Heinrich-Weltzien R, Benzian H, Holmgren C, van PalensteinHelderman W. PUFA–an index of clinical consequences of untreated dental caries. Community Dent Oral Epidemiol.2010;38(1):77-82. https://doi.10.1111/j.1600-0528.2009.00514.x

14. Singhal, D. K., & Singla, N. Severity and clinical consequences of untreated dental caries using PUFA index among schoolchildren in Udupi Taluk, India. J Orofac Sci. 2018;10(1), 19.https://doi.10.4103/jofs.jofs_62_17.

15. Kumari, K.L.M., &Perera, I. R. Public health perspectives of clinical consequences of untreated dental caries among a group of rural & remote Grade 1 school children in Sri Lanka. Paper presented at the 35th year Annual Scientific Sessions College of Community Dentistry of Sri Lanka, Colombo. 2018. https://doi.10.25259/JGOH_52_2020.

16. Ministry of Education. School Census 2012. Colombo: Ministry of Education.2012.

17. Ministry of Health. Annual Report on Family Health Sri Lanka, Family Health Bureau. Colombo: Ministry of Health.2014.

18. Ministry of Health. Annual Report on Family Health Sri Lanka, Family Health Bureau. Colombo: Ministry of Health.2015.

19. Ranasinghe N, Kruger E, Tennant M. School Dental Service in Sri Lanka: geo-spatial analysis of access to oral health care. Int. J. Paediatr. Dent. 2018;28(5):490-6. https://doi.10.1111/ipd.12410.

20. Doyle YG, Furey A, Flowers J. Sick individuals and sick populations: 20 years later. J. Epidemiol. Community Health. 2006;60(5):396-8. https:// doi. 10.1136 /jech. 2005. 042770.

21. Allebeck P. The prevention paradox or the inequality paradox?.Eur. J. Public Health. 2008;18(3):215-.https://doi.org/10.1093/eurpub/ckn048.

22. Frohlich KL, Potvin L. Transcending the known in public health practice: the inequality paradox: the population approach and vulnerable populations. Am. J. Public Health. 2008;98(2):216-21. https://doi.10.2105/AJPH.2007.114777.

23. Yon, M., Gao, S. S., Chen, K. J., Duangthip, D., Lo, E., & Chu, C. H. Medical Model in Caries Management. Dentistry journal. 2019;7(2):37. https://doi.10.3390/dj7020037

24. McLaren L, McIntyre L, Kirkpatrick S. Rose's population strategy of prevention need not increase social inequalities in health. Int.J.Epidemiol. 2010;39(2):372-7. https://doi10.1093/ije/dyp315.

25. Leung GM, Gray S. Rose and Lalonde in the age of genomics, epigenetics and disparities. J. Public Health. 2011;33(4):473-4.https://doi10.1093/pubmed/fdr08.

26. Mohsin A, Barshaik S. Epigenetics in dentistry: A literature review. J Clin Epigenet. 2017;3(1):2472-1158.https://doi10.21767/2472-1158.100035.

27. Fernando S, Speicher DJ, Bakr MM, Benton MC, Lea RA, Scuffham PA, Mihala G, Johnson NW. Protocol for assessing maternal, environmental and epigenetic risk factors for dental caries in children. BMC Oral Health. 2015;15(1):1-8. https://doi10.1186/s12903-015-0143-2.

28. Zimmern RL. Genomics and individuals

in public health practice: are we luddites or can we meet the challenge?. J. Public Health. 2011 Dec 1;33(4):477-82. https://doi10.1093/pubmed/fdr080.

29. Divaris K. Predicting dental caries outcomes in children: a "risky" concept. J. Dent. Res. 2016;95(3):248-54.https://doi10.1177/0022034515620779.

30. Hart JT. The inverse care law. The Lancet. 1971;297(7696):405-12.https://doi10.1016/s0140-6736(71)92410-x.

31. Fiscella K, Shin P. The inverse care law: implications for healthcare of vulnerable populations. J Ambul Care Manage. 2005;28(4):304-12.https://doi10.1097/00004479-200510000-00005.

32. Ministry of Health. General Circular Letter No: 02-177/2011: National Targets for School Dental Services, Family Health Bureau. Colombo: Ministry of Health.2015.

33. Amarasinghe, H. K., Johnson, N. W., Lalloo, R., Kumaraarachchi, M., &Warnakulasuriya, S. Derivation and validation of a risk-factor model for detection of oral potentially malignant disorders in populations with high prevalence. Br.J.Cancer. 2010;103(3): 303-309. https://doi10.1038/sj.bjc.6605778.

34. Council O. Guideline on Caries-risk Assessment and Management for Infants, Children, and Adolescents. Am AcadPediatr Dent. 2013;37:132-9.

35. Davidson, T., Blomma, C., Bågesund, M., Krevers, B., Vall, M., WärnbergGerdin, E., &Tranæus, S. Cost-effectiveness of caries preventive interventions–a systematic review. Acta Odontologica Scandinavica. 2021;79(4):309-320. https://doi10.1080/00016357.2020.1862293.

36. Stearns SC, Rozier RG, Kranz AM, Pahel BT, Quinonez RB. Cost-effectiveness of preventive oral health care in medical offices for young Medicaid enrollees. Arch. Pediatr. Adolesc. Med. 2012;166(10):945-51. https:// doi10.1001 / arch pediatrics. 2012.797.

37. Cagetti MG, Bontà G, Cocco F, Lingstrom P, Strohmenger L, Campus G. Are standardized caries risk assessment models effective in assessing actual caries status and future caries increment? A systematic review. BMC Oral Health. 2018;18(1):1-0. https://doi10.1186/s12903-018-0585-4.

38. Senneby A, Mejàre I, Sahlin NE, Svensäter G, Rohlin M. Diagnostic accuracy of different caries risk assessment methods. A systematic review. Am. J. Dent. 2015;43(12):1385-93. https://doi10.1016/j.jdent.2015.10.011.

39. Ha DH, Spencer AJ, Slade GD, Chartier AD. The accuracy of caries risk assessment in children attending South Australian School Dental Service: a longitudinal study. BMJ open. 2014;4(1):e004311.

40. Tamaki Y, Nomura Y, Katsumura S, Okada A, Yamada H, Tsuge S, Kadoma Y, Hanada N. Construction of a dental caries prediction model by data mining. J. Oral Sci. 2009;51(1):61-8. https://doi10.2334/josnusd.51.61

Review

Sri Lanka Dental Journal 2022; 52(01) 45-52
Received: 08.02.2022 | Revised: 09.03.2022 | Accepted: 11.03.2022

An exploration of factors associated with job satisfaction among dental surgeons - a critical review guided by content analysis

AADC Dias, DS Brennan

Abstract

Introduction: Job satisfaction can be considered as an individual's general attitude toward his or her job and is associated with both organizational performance and individual productivity. In the health care sector, job satisfaction among health personnel is also correlated with patient satisfaction and the quality of services. Dentistry has been identified as a stressful occupation in several global studies.

Objective: To investigate whether recent research on job satisfaction among dental surgeons have addressed the factors in recognized job satisfaction theories adequately and provide suggestions for future job satisfaction studies.

Material and Methods: We reviewed articles on factors and determinants of job satisfaction among dental surgeons. Google Scholar, PubMed, Scopus, and Wiley online library were searched for articles on job satisfaction of dentists. The search was limited to articles published in the English language and since 2010. Factors associated with job satisfaction were identified and recorded using content analysis. Study instruments of the studies were also reviewed to further clarification of factors when needed and then recorded factors were classified.

Results: A total of 38 articles were screened and 15 articles were selected for the review. Socio-demographical features were the most explored factor (n=14) followed by salary, mode of finance, financial security (n=11) and workload, nature of work, delivery of care, personal time (n=11). Experienced Psychological meaningfulness (n=1), Emotional exhaustion (n=1) and work fulfilment, achievements (n=1) policies (n=1) were least explored factors.

Conclusion: Socio-demographic features were the most explored factor and dispositional approach including personality traits was not explored in recent research involving job satisfaction among dental surgeons.

Keywords: Job Satisfaction, Dental Surgeons, Content analysis

Introduction

Job satisfaction is a complex and dynamic concept. In general terms, job satisfaction can be defined as an individual's general attitude toward his or her job. Studies have mainly focused on job satisfaction as an important component of organizational climate and its relation to organizational performance and individual outcomes. Locke 1976 [1] described job satisfaction as a pleasurable or positive emotional state resulting from the appraisal of one's job or job expectation.

Several types of theories on human motivation

AADC Dias (Correspondence) Department of Health, Sri Lanka. E-mail: diasduminda74@yahoo.com ORCID: 0000-0002-9712-7379

DS Brennan Australian Research Centre for Population Oral Health (ARCPOH) University of Adelaide, Australia.

and job satisfaction can be found in the global literature representing physical, social, economical, and psychological aspects [2]. Content theories are based on people's needs and their contribution to performance[2]. As an alternative to content theory, process theories describe the relationship in dynamic variables that make up motivation within individuals and direct to desired behaviour[2]. The dispositional approach on job satisfaction suggests that people have innate dispositions that can have tendencies toward a certain level of satisfaction, regardless of one's job[3]. The Job Characteristics Model (JCM) introduced by Hackman and Oldham describes the association of job satisfaction with an encouraging work environment and intrinsically motivating characteristics [4].

The level of job satisfaction is related to important features in organizations such as retention of employees, rate of turnover, emotionally exhausting, and finally to the quality of service. Moreover, the health workforce has been listed as one of the six pillars in the health system by the World Health Organization (WHO)[5]. Although every health care profession contains a certain extent of stress, some occupations are more stressful, including the occupation of dentistry[6].

Exploring factors and determinants representing many areas across the social, physical, psychological dimensions in job satisfaction of dental surgeons would suggest better interventions to increase job satisfaction and customer satisfaction. Therefore, the objective of the present study is to investigate whether recent research on job satisfaction among dental surgeons have addressed the factors in recognized job satisfaction theories adequately.

Material and Methods

This study reviewed the articles related to factors, and determinants of job satisfaction among dental surgeons. Electronic searches were carried out in four different databases of Google Scholar, PubMed, Scopus, and Wiley online library. Combined keywords including job satisfaction, dental surgeons, determinants, associated factors were used for the literature search, and articles which did not contain the keywords in their title or abstract were excluded. A search was carried out for articles published in the English language. As job satisfaction is a highly dynamic area, research conducted between 2010 to 2020, were only considered. Duplicate articles were removed. Studies that mainly measured different outcomes other than job satisfaction (job performances, job engagement) were also removed. Information such as authors, the topic of the study, the country where the study was undertaken and the year of publication of selected articles were recorded. While careful reviewing of full articles, associated factors of job satisfaction were identified and recorded using content analysis. Study instruments of the studies were also reviewed to further clarification of factors when needed. Representation of associated factors was analysed using content tables and word cloud software, a widely using tool to generate word pictures in content analysis.

Results

Figure 1 shows a flowchart of the study selection. From the electronic searches with the keywords, 38 potential articles were found after reading of abstracts. Six duplicate articles were found, and full texts were not found in 2 selected abstracts. Seven articles were published before 2010 and 4 articles were involved other oral health care workers such as hygienists and therapists with dental surgeons. Therefore, those articles were excluded from the review. Four articles were not considered as they have measured different outcomes than job satisfaction. With the application of exclusion criteria, a total of 23 articles were excluded and 15 articles were finally selected for the critical review.

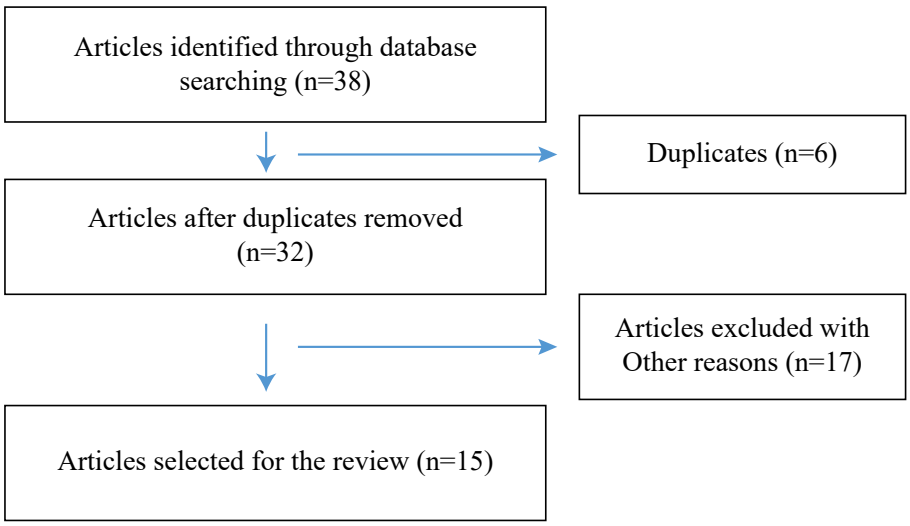


Figure 1. Flow diagram of selection of articles for review

As described in materials and methods, selected articles were analysed with regard to basic factors such as author and year, country, topic, and associated factors of job satisfaction. Findings were summarized in Table 1.

Table 1. Factors associated with job satisfaction of dental surgeons

Author, Year	Country	Topic	Associated factors
Bergström K *et al*., 2010[7]	Sweden Denmark	Overall job satisfaction among dentists in Sweden and Denmark: A comparative study, measuring positive aspects of work	Socio-demographical, Workload, Work fulfillment (achievement), practice size (environment), working experience, type of practice.
Luzzi L and Spencer AJ, 2011[8]	Australia	Job satisfaction of the oral health labour force in Australia	Socio-demographical, Autonomy, Relationships, Personal time (Workload) Salary, Resources, Administrative Responsibilities, Working speciality, Type of practice.
Goetz K *et al*., 2012[9]	Germany	The impact of intrinsic and extrinsic factors on the job satisfaction of dentists	Socio-demographical, Income, Workload, working environment, Recognition, Relationships, Opportunities to use abilities, Freedom of working methods.
Fahim A, 2013[10]	Egypt	Predictors of job satisfaction among practicing dentists at hospitals in Suez Canal Area, Egypt.	Socio- demographical, patient relationships, Delivery of Care, Personal time, Professional time, Income, Staff cooperation (relationships).
Sudhakar *et al*., 2015[11]	India	Career satisfaction among dental practitioners in Srikakulam, India.	Socio- demographical, Income, Staff relationships, Professional relations, Professional time.
Balasubramanian *et al*., 2016[12]	Australia	Job satisfaction among 'migrant dentists' in Australia: implications for dentist migration and workforce policy.	Socio- demographical. Type of practice, Workload, Location of practice,

Aljanakh M, 2017[71]3	SaudiArabia	Job satisfaction among Saudi public sector dentists in Hail region	Socio- demographical, Quality of Care, Professional development, Patients relationships, Personal time (Workload), Staff performances.
Cui *et al*., 2017[14]	China	Satisfaction among early and mid-career dentists in a metropolitan dental hospital in China.	Socio- demographical, Professional and patient relationships, Income, Professional time and Personal time (workload), Recognition, Delivery of care.
Murariu *et al*., 2017[15]	Romania	Job satisfaction among Romanian dental surgeons.	Socio- demographical, Income, Financial security, Career development, Personal time (workload), Pleasant atmosphere (working environment) Relationships with co-workers and patients. Autonomy
Paul *et al*., 2017[71]6	India	Impact of work environment on job satisfaction of dentists with respect to demographics	Socio- demographical, Workload, Recognition, Salary, CPD (career development), Working environment (equipment, occupational risks, ventilation,) Working condition (Training, leaves)
Sasso *et al*., 2017[71]7	USA	Practice settings and dentists' job satisfaction	Socio- demographical, Salary, Workload, Clinical autonomy, Career development,
Chevalier *et al*., 2018[18]8	France	Beyond working conditions, psychosocial predictors of job satisfaction, and work engagement among French dentists and dental assistants	Salary, Workplace ergonomics, Perceived Organizational Support/POS (Recognitions from the organization) Psychological meaningfulness
Kobza J *et al*., 2018[19]	Poland	Job satisfaction and its related factors among dentists: A cross-sectional study.	Socio- demographical, Working hours (Workload), Practice location, Form of financing, Policy, Resources.
Fajer *et al*., 2019[20]	UAE	Job Satisfaction of U.A.E. Dental Practitioners	Socio- demographical, Working environment, Income, Autonomy, Career development, Workload, Relationships.
Matjila *et al*., 2019[92]1	South Africa	Assessment of job satisfaction among dental surgeons working in different settings in the Tshwane metro.	Socio- demographical, Income, Professional and Personal time (workload), Relationships, Delivery of care.

Content analysis of the findings was categorized according to associate factors in job satisfaction and indicated in Table 2. The number of articles was counted under each factor.

Table 2. Frequency of representation of identified factors

Factors	Number of articles (n)
Socio -demographical	14
Salary, Income, mode of financing, financial security	11
Workload, personal time, delivery of care, nature of work	11
Career development, professional development, professional time and relationships	8
Relationships	8

Working environment, working condition, type of practice, location of practice	7
Autonomy, Freedom of working method	5
Recognition	3
Resources	2
Policies	1
Experienced Psychological meaningfulness	1
Emotional exhaustion	1
Work fulfillment, Achievements	1

Figure 2 shows the representation of each factor in a word picture which provides an understanding of content analysis at a glance. The font size of each word shows the frequency of representation of the associated factor.

Figure 2. Factors associated with job satisfaction of dental surgeons in a word picture

Discussion

This article was based on reviewing the existing literature on associated factors of job satisfaction among dental surgeons. Application of inclusion and exclusion criteria was carried out to ensure the appropriateness of the selected articles and then enhancing of the validity and scientific rigor of study[22]. Regarding the theoretical background for job satisfaction, several types of theories can be found in the global literature representing physical, social, economic, and psychological aspects. Content theories of motivation are based on people's needs and their contribution to performance. Maslow's needs hierarchy theory, Alderfer's ERG theory, Herzberg's two factors theory are prominent content theories[2]. Achievement, recognition, work itself, responsibilities, advancement are common motivational factors in Herzberg's two-factor theory which are similar to higher levels of Maslow's needs hierarchy theory such as esteem, self-actualization. Further, company policy, supervision, relationship, working condition and salary are similar to the lower level of Maslow's hierarchy of needs such as physiological, security, and social needs [2]. The aforementioned factors have been identified as prerequisites for job satisfaction by relevant theories.

All the studies in this review, except Chevalier *et*

al.,[18] found an association between job satisfaction and socio-demographical characteristics. Exploring the association of job satisfaction with socio-demographical features provides an understanding of how it changes with different socio-demographical levels. The amount of assigned work or working time reflects the workload and it is related with personal time, physical and mental wellbeing of employees and these features were found in 11studies. Nature and content of work itself have been identified as an external factor in the Herzberg theory [2,23] and working experience in process theory [2]. Autonomy in the workplace refers to how much freedom employees have while decision making, working, and have described in relation to job satisfaction of dental surgeons in 5 studies. Autonomy has been identified as an intrinsic factor for job satisfaction by Herzberg[23].

The Job Characteristics Model (JCM) introduced by Hackman and Oldham 1976 describes the association of job satisfaction with an encouraging work environment and intrinsically motivating characteristics[4]. Chevalier *et al*.,[18] found an association of job satisfaction of dental surgeons with experienced psychological meaningfulness, a psychological state described in the JCM. Workplace relationships with colleagues and patients were found in 8 studies. The relationship is an integral factor in all the content theories in job satisfaction[2,23]. In addition to that, Vroom's (Victor H. Vroom in 1964) expectancy theory, a process theory in workers' motivation and job satisfaction has also identified relationships in working settings in relation to perceived trust and support [2]. Salary or income has been identified as a prominent determinant in job satisfaction in many content and process theories [2,24]. Eleven studies have found associations between level of income and job satisfaction among dental surgeons. Working environment and condition may include several related areas such as physical environment, location, and type of practice. In this review 7 studies found satisfaction on the working environment. All the content theories in job satisfaction had identified achievements and recognition as associated factors on job satisfaction and 4 studies in this review found this theoretical association.

In addition to that career or professional development and related policies which had explored in several studies in job satisfaction of dental surgeons supported with the theoretical background of many job satisfaction theories [2,23]. Apart from the theories mentioned above on job satisfaction, the dispositional approach in job satisfaction suggests that people have innate dispositions that can have tendencies toward a certain level of satisfaction, regardless of one's job [3]. Expanding literature has given general support to the argument that job satisfaction is dispositionally-based and closely related to personality [3,25]. Although, studies in this review did not reveal the association of personality factors with job satisfaction of dental surgeons, many studies conducted with the general population [25] and other related professions had found the association of job satisfaction with psychological factors including personality traits.

Conclusion:

Job satisfaction is a key determinant in organizational culture and productivity. Several theories were found in relation to job satisfaction in global literature. Various factors in many job satisfaction theories were found within recent studies of dental surgeons except the personality traits. Therefore, it can be recommended to conduct further research on job satisfaction among dental surgeons exploring association with the dispositional approach which includes personality traits.

References

1. Locke, E.A."The nature and causes of job satisfaction", in Dunnette, M.D. (Ed.), Handbook of Industrial and Organizational Psychology, Rand McNally, Chicago, IL, pp. 1976: 1297-349.

2. Sahito Z, Pertti V. The Diagonal Model of Job Satisfaction and Motivation: Extracted from the Logical Comparison of Content and Process Theories. 2017:6(3); 209-230.

3. Judge TA, Relationship of core self-evaluations traits—self-esteem, generalized self-efficacy, locus of control, and emotional stability—with job satisfaction and job performance: A meta-analysis. Journal of applied psychology. , 2001:86(1) ;80.

4. Hackman JR, Oldham GR. Motivation through the design of work: Test of a theory. Organizational Behavior and Human Performance, 1976:16; 250-279.

5. Monitoring the building blocks of health systems: a handbook of indicators and their measurement strategies (WHO),2010: 42-37. https://www.who.int/healthinfo/systems/monitoring/en.

6. Indira M, Jahić 1, Jasmina B et al, Assessment of Stress among Doctors of Dental Medicine, Acta Stomatol Croat, 2019:53(4); 354–362.

7. Bergström K, Söderfeldt B, Berthelsen H , Hjalmers K, Ordell S , Overall job satisfaction among dentists in Sweden and Denmark: A comparative study, measuring positive aspects of work. Acta Odontologica Scandinavica, 2010; 68: 344–353. https://www.tandfonline.com/doi/full/10.3109/00016357.2010.514719.

8. Luzzi L, Spencer AJ. Job satisfaction of the oral health labour force in AustraliaAust Dent J 2011 Mar;56(1):23-32. https://pubmed.ncbi.nlm.nih.gov/21332737/

9. Goetz K, Campbell SM, Broge M, Dörfer CE, Brodowski M, Szecsenyi J. The impact of intrinsic and extrinsic factors on the job satisfaction of dentists, Community Dent Oral Epidemiol . 2012 40(5):474-80.

10. Fahim A E. Predictors of job satisfaction among practicing dentists at hospitals in Suez Canal Area, Egypt, Int J Occup Med Environ Health . 2013 ;26(1):49-57. https://pubmed.ncbi.nlm.nih.gov/23315471/

11. Sudhakar K, Pydi SK, Rathikota VS, et al. Career satisfaction among dental practitioners in Srikakulam, India. J Int Soc Prev Community Dent . Jan-Feb 2015;5(1):40-46. https://pubmed.ncbi.nlm.nih.gov/25767766/

12. Balasubramanian M, Spencer AJ, Short SD, Watkins K, Chrisopoulos S, Brennan DS. Job satisfaction among 'migrant dentists' in Australia: implications for dentist migration and workforce policy. Australian Dental Journal 2016; 61: 174–182 https://onlinelibrary.wiley.com/doi/epdf/10.1111/adj.12370.

13. Aljanakh M. Job satisfaction among Saudi public sector dentists in Hail region, Pakistan Oral & Dental Journal 2017(37)1: 123-127

14. Cui x, Dunning DG, An N. Satisfaction among early and mid-career dentists in a metropolitan dental hospital in China. J Healthc Leadersh . 2017;(6)9:35-45. https://pubmed.ncbi.nlm.nih.gov/29355243/

15. Murarium A,Forna DA, Forna NC. Job satisfaction among Romanian dentists, Rev. Med. Chir. Soc. Med. Nat., Iaşi 2017 (121) 2:421-426. https://www.revmedchir.ro/index.php/revmedchir/article/view/114.

16. Paul V, Ramgoplalan CS, Hemalatha N. Impact of work environment on job satisfaction of dentists with respect to demographics . ZENITH International Journal of Multidisciplinary Research 2017(7)7: 25-36 https://www.indianjournals.com/ijor.aspx?target=ijor:zijmr&volume=7&issue=7&article=004.

17. Sasso AL, Starkel RL, Warren MN, Guay AH, Vujicic M, Practice settings and dentists' job satisfaction. J Am Dent Assoc 2015 ,146(8):600-609. https://pubmed.ncbi.nlm.nih.gov/26227645/

18. Chevalier S,Fouquereau E, Bénichoux F, Colombat P. Beyond working conditions, psychosocial predictors of job satisfaction, and work engagement among French dentists and dental assistants. Journal of Applied behavioural research 2019(24) 1https://onlinelibrary.wiley.com/doi/full/10.1111/jabr.12152.

19. Kobza J, Świtała MS. Job satisfaction and its related factors among dentists: A cross-sectionalstudy.Work,2018(60)3:pp.357-363. https://content.iospress.com/articles/work/wor2749.

20. Fajer SA, Asma AA, Hissa AA et al. Job Satisfaction of U.A.E. Dental Practitioners, Eur J Dent. 2019 Jul; 13(3): 354–360. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6890485/

21. MatjilaI SA, MadibaII TK, Annandale DL, OlutolaIV BG. Assessment of job satisfaction among dentists working in different settings in the Tshwane metro. SADJ June 2019, Vol. 74 No. 5 p230 - p235 http://www.scielo.org.za/pdf/sadj/v74n5/04.pdf.

22. Neil J, Salkind, 2010: SAGE research methods. https://dx.doi.org/10.4135/9781412961288.n137.

23. Herzberg, F. One more time: how do you motivate employees? Harvard Business Review, 1968: 46(1), 53-62.

24. Porter LW . Lawler EE. Managerial attitudes and performance . New York: Irwi n-Dorsey, 1968.

25. Hong TM . Big Five personality traits and job satisfaction: Evidence from a national sample,Journal of General Management,2017: https://doi.org/10.1177/0306307016687990.

26. Kisten P, Kluyts HL. An evaluation of personality traits associated with job satisfaction among South African anaesthetists using the Big Five Inventory, Southern African Journal of Anaesthesia and Analgesia 2018; 24(1):9-15. https://www.tandfonline.com/doi/full/10.1080/22201181.2018.1433986

Instructions to Authors

The Sri Lanka Dental Journal (SLDJ) publishes the following categories of articles which have relevance to dentistry and allied sciences.

Leading articles
One article per issue may be published on a current topic of interest, one's expertise or commentaries of general practice etc. These articles are commissioned by the Editors and may be considered at the Editors' discretion. They should not exceed 2500 words (excluding the abstract and references) and 20 references.

Reviews / Clinical updates
These are summaries of recent insights in specific research/clinical areas within the scope of SLDJ. Key aims of Reviews/clinical updates are to provide systematic and substantial coverage of a research or clinical area of wide interest or to present a critical assessment of a specified area. These articles must focus on recent research and on a topic that is timely and relevant to the field. No word/ reference limits.

Research Articles
Articles resulting from research work belong to this group. Results from routine clinical examinations or laboratory investigations will not be considered under this category. Subjects may vary from clinical trials to basic science research, historical analysis to dental economics. No word/ reference limits.

Short Reports
These include reports on current topics, modified techniques. New materials, practice management etc. Interesting results from routine, clinical work or laboratory investigations also may be accepted. They should not exceed 1500 words (excluding the abstract and references) and 10 references.

Case Reports
Reports such as of rare diseases or conditions, modifications to accepted treatment procedures, new management methods etc. may be included in this category. Case reports should make a contribution to existing knowledge and must have educational value or highlight the need for a change in clinical practice or diagnostic/ prognostic approaches. They should not exceed 2000 words (excluding the abstract and references) and 15 references.

Letters to Editor
Subjects unlimited, but may include short critique of published papers in the SLDA. Maximum 1000 words; no references.

Proceedings on Annual Sessions
Abstracts from annual sessions of the SLDA, other colleges and professional associations related to dentistry can be published under this category, upon request by such associations.

Submission of Manuscripts
Authors submitting a paper do so on the understanding that no part has been published before. That it is not being considered for publication elsewhere and that it has been read and approved by all the authors.

The journal does not hold it responsible for statements made by the contributors. The author alone is responsible for the statements made in his/her paper.

Submission of a manuscript means that authors automatically agree to assign exclusive copyright to the Sri Lanka Dental Association if and when the manuscript is accepted for publication.

The Authors can submit manuscripts and associated files as E-mail attachments to one of

the co-editors or the SLDA office. The editors will acknowledge receipt of submissions.

Manuscript Style

All manuscripts should be written in English and prepared in Microsoft Word format (.doc or .docx format). They should be typed in size 12 - Times New Roman fonts, double-spaced, single column, on A4 (2I2x297 mm) paper. Both British and American spellings are acceptable, provided this is consistent throughout the manuscript. All measurements must be given in SI units. Correct unit abbreviations should be used. All abbreviations should be defined in the text at first use.

Manuscripts not submitted in proper format may be returned without review. The manuscript should be prepared in the form of a single file containing the following items arranged in the order shown: Title page, Abstract, Main text, Acknowledgements, References, Figures & legends, Tables & legends.

Title Page

The title page should contain the following information in the order given: (1) a concise but informative title; (2) authors' full names (without degrees and titles): (3) authors' institutional affiliations: (4) name, address, telephone, telefax and electronic mail address of the author responsible for correspondence.

Abstract

All articles must contain an abstract of approximately 250 words. Do not use abbreviations and/or references in the abstract. The abstracts for research articles should be prepared under the following specified subtitles:

1. **Objective:** An introductory sentence indicating the objective and purpose of the study.

2. **Materials and Methods:** A description of experimental procedure including applicable statistical evaluation.

3. **Results:** A summary of the new. Previous unpublished data and results.

4. **Conclusion:** A statement of the study's conclusion

5. **Key words:** 3-5 key-words according to the Index Medicus should be provided.

Main text / body of manuscript

Manuscripts of research articles should include the following separate sections; Introduction, Materials & methods, Results, Discussion, Conclusion, Acknowledgements (if any), References.

Introduction

The introduction should carry sufficient background information on the subject of study.

Materials and Methods:

Procedures should be described in such detail as to make it possible to repeat the work. Sub-headings may be used to improve clearness. The authors should consider the ethical aspects of their research and ensure that the work has been approved by an appropriate Ethical Committee. Where applicable, a copy of the ethical clearance certificate should be attached. All human studies should have been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and all subsequent revisions.

Results

The Results section should clearly and concisely present the findings of the research, as a rule in the past tense without subjective comments and reference to previous literature. The results should be supported by statistical or illustrative validation. For the sake of clarity this section may have subheadings.

Statistical Analysis

Since many scientific investigations rely on statistical treatment, authors are strongly urged

to consult a person with in-depth statistical knowledge. Manuscripts with a clear element of statistics are regularly refereed by the Journal's statistics consultant.

Discussion

This section should present the interpretations and /or implications of the findings in context of existing research and is the only proper section for subjective comments. Authors are strongly urged to avoid undue repetition of what has been reported in Results.

Conclusion

This should state clearly the main conclusions and provide an explanation of the importance and relevance of the study reported.

Acknowledgements

The source of financial grants and other funding should be acknowledged, including a frank declaration of the authors' industrial links and affiliations. The contribution of colleagues or institutions should also be acknowledged.

Tables

Tables should be self-contained and complement, but not duplicate, information contained in the text. Tables should be numbered consecutively in Arabic numerals. Each table should be presented on a separate sheet with a comprehensive but concise title above the table. Tables should be double-spaced and vertical lines should not be used to separate columns. There should be no left & right borders and no/ minimum internal horizontal lines to separate rows. Column headings should be brief, with units of measurement in parentheses; all abbreviations should be defined in footnotes. Footnotes to tables should be indicated by superscript lowercase letters (or asterisks for significance values and other statistical data) and included beneath the table body. Statistical measures such as SD or SEM should be identified in the headings. The table and its title/footnotes should be understandable without reference to the text.

Figures

All graphs, drawings, and photographs are considered as figures and should be numbered in Arabic numerals and cited in consecutive order in the text. All drawings and photographs should be supplied separately as JPEG files of adequate resolution (300 dpi or higher). Figures should be sized to fit within the column (75 mm), or the full text width (164 mm).

Each figure should have a legend which is concise but comprehensive: the figure and the legend must be understandable without references to the text. Include definitions of any symbols used and define/explain all abbreviations used and units of measurement. All legends should be typed together on a separate page.

References

The Vancouver system of referencing is used. References should be listed in a separate section immediately following the text. In the list, references should be numbered consecutively in the order in which they appear in the text; do not, alphabetise. Identify references in texts, tables and legends by Arabic numerals (superscripts). Cite the names of all authors when there are six or fewer; when more than seven list the first three followed by et al. Names of journals should be abbreviated in the style used in the Index Medicus.

Congress abstracts should not be used as references nor may "unpublished observations" and "personal communications" be placed in the reference list. References cited as "in press" must have been accepted for publication and not merely in preparation or submitted for publication.

Few examples of correct forms of references are given below.

Standard journal article

Bartlett IG, O'Keefe P. The bacteriology of the perimandibular space infections. J Oral Surg

1979; 37(6): 407-9.

Electronic journal article

Lemanek K. Adherence issues in the medical management of asthma. J Pediatr Psychol [Internet]. 1990 [cited 2010 Apr 22];15(4):437-58. Available from: http://jpepsy. oxfordjournals. org /cgi / reprint / 15 / 4 / 437 (If available, mention the DOI number at the end of the URL)

Unpublished article

Barker DS. Lucas RB. Localised fibrous growth of the oral mucosa. J Dent Res 1965: in press.

Books and other monographs

Becker A. Orthodontic treatment of impacted teeth. 3rd ed. Oxford, United Kingdom: Wiley-Blackwell;2012

Chapter in an edited book

Boyde A. Amelogenesis and the structure of enamel. In: Cohen B. Kramer KH (eds). Scientific Foundations of Dentistry. London: William Heinemann Medical Books Ltd.; 1976.p 335-352.

Chapter in a non-edited book

Speroff L, Fritz MA. Clinical gynaecologic endocrinology and infertility. 7th ed. Philadelphia: Lippincott Williams and Wilkins; 2005. Chapter 29, Endometriosis; p.1103-33.

No author given

International statistical classification of diseases and related health problems, 10th revision, vol J. Geneva: World Health Organisation, 1992; 550--564.

(Include the edition number after the book title for all editions except the first edition.)

Review policy

1. The Editorial Board reserves the right to publish or not submitted manuscripts, and informs the authors of its decision within a reasonable time frame. This decision is supported by an evaluation of the manuscripts based on a peer-review system, carried out in two consecutive stages:
   a) initial assessment by the Editorial Board, which decides on the manuscript's submission to the following stage of the process, involving its evaluation by anonymous reviewers; this decision is made taking into consideration criteria of relevance, interest and quality, defined according to the journal's editorial policy, as well as the manuscript's conformity to the submission guidelines contained in this document;
   b) detailed evaluation of the selected manuscripts by anonymous reviewers through a double-blind peer review system. Reviews resulting of this process will be used as a basis for the final decision on the manuscript's publication.

2. The Editorial Board may suggest revisions to authors, according to the recommendations made by the reviewers, and ask for a new evaluation of the revised paper in order to make the final decision on its publication.

3. In the case of manuscripts submitted to the second stage of evaluation, if they are not accepted for publication, editors will inform the authors of the reasons for this decision, generally attaching the reviewers' opinions and sending them to the authors.

4. Authors are fully responsible for the contents in published manuscripts.


Clogard
FRESH
FRESH MINT
FRESH CLOVE
FRESH LEMONGRASS
FRESH CINNAMON
Clogard
FOR EXTRA FRESHNESS
+
CAVITY PROTECTION

*In combination with tooth brushing.

References: 1. Jones CG. Chlorhexidine: is it still the gold standard? *Periodontology.* 2000;15(1):55-62. **2.** Schiott CR. Effect of chlorhexidine on the microflora of the oral cavity. *J Periodont Res.* 1973:8(suppl):7-10. **3.** GSK Data on file (CHM-BUH-RHS-00633 Study Report).

For adverse events reporting, please call: 0112636341 or email: pharmacovigilance@gsk.com
For the use of Registered Medical Practitioners or a Hospital or a Laboratory only.

SmithKline Beecham (Pvt.) Ltd. Level 34, West Tower, World Trade Center, Colombo 01, Sri Lanka.

PM-LK-CSYL-22-00004

DEFEAT PAIN IN 30 SECONDS*

helps to stop it from coming back**

SENSITIVE EXPERT by Signal

1323 (TOLL FREE) Call us

Rs. 135/- onwards

* Based on in-vivo study on finger application

**With brushing twice a day.

Unilever