International Journal of Psychosocial Rehabilitation, Vol. 24, Issue 02, 2020
ISSN: 1475-7192

COMPARATIVE EVALUATION OF MATRICING TECHNIQUES USED IN CLASS II AMALGAM RESTORATIONS -A RETROSPECTIVE STUDY

Swathi UB[1], Sindhu Ramesh[2], Delphine Priscilla Antony[3]

Abstract

In class II amalgam restorations,the matrix band serves as a missing wall in such preparations to contain the amalgam during condensation,restoring form to the restoration.In dentistry Matrix band plays an important role in restoring interproximal surfaces of the tooth.The purpose of this study was to evaluate the various types of matrices that were used for reconstructing the proximal contact area in class II amalgam restorations.For this retrospective study,Data was taken from the patient records collected from Saveetha Dental College Chennai. Data collected consisted of 853 cases of Class II Amalgam restorations,in which the type of Matricing technique was evaluated over a period of one year from 10th june 2019 to 1st march 2020 .Chi square test was used for statistical analysis .In this study ,the type of Matricing technique used in class II Amalgam restorations were evaluated based on the patient's age,gender,procedure ,tooth in which the restoration was done. Results of the study were not found to statistically significant.(P value >0.5).Tofflemire Matricing technique was the most preferred technique of Matricing for Class II amalgam restorations (38%) followed by sectional matrix (35%) and Ivory number 1 (19.3%) and Ivory No 8 (8.1%). Tofflemire matrices technique was the most commonly preferred technique for restoring proximal contacts of class II amalgam restorations. A Tofflemire type retainer helps to lock the tooth securely ,can be released instantly and is easily adjustable .

Keywords: *Amalgam restorations; Class II restorations; Matrix band; Matrix Retainer*

Introduction

Dental diseases mainly include tooth decay caused by dental caries or cavities and gum diseases caused by diseases to the periodontium. Tooth decay is the most prevalent causing greater needless loss to the quality of life .Pulpal diagnosis is crucial in deciding the treatment protocol.(Janani, Palanivelu and Sandhya, 2020)When dental caries extend to involve the dental pulp causing pain and discomfort there is need for root canal treatment.Pulpal diagnostics can be improved by using molecular markers found in dentinal fluid.(Teja, Ramesh and Priya, 2018)Many factors can influence the status of the pulp during traumatic injuries ,avulsion,calcifications.(Ramamoorthi, Nivedhitha and Divyanand, 2015; Kumar and Antony, 2018; R, Rajakeerthi and Ms, 2019; Jose and Subbaiyan, 2020) Success of endodontic treatment depends on the diagnosis and treatment planning.(Ramanathan and Solete, 2015; Noor, S Syed Shihaab and Pradeep, 2016; Kumar and Antony, 2018; Manohar and Sharma, 2018; Nandakumar and Nasim, 2018; Siddique *et al.*, 2019; Teja and Ramesh, 2019)

[1] S Department of Conservative Dentistry and Endodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences,Saveetha University, Chennai, India, Email:151906005.sdc@saveetha.com
[2]Corresponding Author, Professor, Department of Conservative Dentistry and Endodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences,Saveetha university, Chennai, India, Email:sindhuramesh@saveetha.com
[2]Senior Lecturer,Department of Conservative Dentistry and Endodontics, Saveetha Dental College and hospitals, Saveetha Institute of Medical and Technical Sciences,Saveetha university, Chennai, India, Email:delphine.sdc@saveetha.com

When dental caries extend to the enamel and dentin,the tooth can be saved with placement of a good restoration.(Rajendran *et al.*, 2019) In case of Class II amalgam restoration the height, contour of the restorations, good adaptation of the restoration are of importance.Matrix band may be defined as a thin strip adapted around the tooth to help restore missing walls and contours against which the restorative material maybe condensed and placed.Rutsky states that matrix band is the most crucial factor for the success or failure of proximo-occlusal amalgam restorations.Overhang of an amalgam restoration may result from failure of proper adaptation of the matrix band to the external surface of the tooth.(Rutsky, 1968) A good matrix band retainer should be able to be easily adaptable and fixed in position.Sufficient amount of separation is needed to compensate for the thickness of the matrix band.Matrix Retainer should allow the band to be adapted,contoured properly and it must be easily removable.(Biales, 1944)It should be rigid enough to maintain its position during condensation of amalgam.Rigid or unyielding Matrix bands should support the restoration and define contour on the surfaces by means of proper adaption to the tooth surfaces.(Markley, 1951; Kaplan and Schuman, 1986) Flexibility of the matrix band allows for burnishing of the contact area to a degree that can be controlled by the operator. (Graham *et al.*, 1980; Kaplan and Schuman, 1986)Matrix bands should be capable of being sterilised ,compatible with other restorative materials and should be non toxic ,economical.

Types of matrix bands available for clinical use can be divided into three main categories custom made,preformed or mechanical.(Kaplan and Schuman, 1986)Types of matrix retainers used in this study include Tofflemire Matrix retainer,Ivory No 1,Ivory No 8 and sectional matrix.Main advantages of Tofflemire system is that the band can be placed either lingually or Buccally adapted in straight or contrangle styles and in regular /smaller sizes. A Tofflemire type retainer locks securely ,releases instantly and adjusts easily.(Kaplan and Schuman, 1986; Qualtrough and Wilson, 1991) Ivory no 1 retainer is useful for class 1 or unilateral restorations.(Green, Shellman and Simon, 1943) This type of matrix retainer will work when a circumscribed matrix cannot be used in restoring a cavity where contact is too tight for circumferential matrix or in case where no adjacent tooth is present.(Kaplan and Schuman, 1986; Qualtrough and Wilson, 1991) Most circumferential mechanical matrices require a retainer to hold against and withdraw a matrix.Ivory no 8 and Ivory no 9,Tofflemire can be used for this purpose.Another type of matrix available for clinical use is the sectional matrix system used during placement of interproximal amalgam,composite restorations.Composite Resins are the most commonly used tooth coloured restorative materials in both anterior and posterior teeth. (Hussainy *et al.*, 2018; Ravinthar and Others, 2018)

The purpose of this study was to evaluate the various Matricing techniques preferred for restoring the proximal contact area of class II amalgam restorations .

MATERIALS AND METHODS

Study Design

Single centered retrospective study

Ethical Approval

Approval for the project was obtained from the Institutional Review Board of Saveetha Institute of Medical and Technical Sciences, Chennai, India on Date 18/04/2020.Ethical approval No - SDC/SIHEC/2020/DIASDATA/0619-0320.

Eligibility Criteria

Inclusion criteria

Included patients were of age group of 18 to 60 years,teeth restored with class II amalgam restoration, permanent teeth, type of matricing technique used in teeth restored with class II amalgam restorations.

Exclusive criteria

Patients of age group more than 60 years,primary teeth ,endodontically treated teeth ,teeth with severe periodontal disease,teeth apart from class II lesions,teeth restored with other restorations apart from amalgam .

Data Extraction

For this retrospective study,conducted in Saveetha Dental College,Chennai Data was collected from patient records which is an online software system recording patient data.Retrospective Data collection was done from a period of one year from 10th june 2019 to 1st march 2020. Data was collected based on the type of matricing technique preferred for class II amalgam restorations .

Sample Size

A total of 880 charts, identifying the type of matricing technique preferred for class II amalgam restoration completed over a period of one year. After applying the inclusion and exclusion criteria, around 853 cases met with the criteria. A total of 853 clinical cases were evaluated based on the type of matricing technique used in class II amalgam restoration were selected for this study from patient records within the time frame of 10^{th} June 2019 to 1^{st} March 2020.

Groups

Types of matricing technique preferred for class II amalgam restorations were divided into four groups.

Group A : Tofflemire

Group B: Ivory No 1

Group C : Ivory No 8

Group D : Sectional matrix

Clinical Outcome

In this retrospective study, the type of matricing technique used for class II amalgam restorations were considered as the primary outcome of the study .

Clinical Protocol

The primary outcome of this clinical treatment evaluated was the success rate of the class II amalgam restorations based on the patient revists for restoration on the same tooth .All patients were followed up and evaluated for fractured restoration and pain.

Study Outcome

Success rate was assessed based on patient visits, because of pain ,improper contour and contacts after placement of amalgam restoration in class II cavities.Choice of the Matrix band used is the most crucial factor for the success or failure of proximo-occlusal amalgam restorations.

Statistical Analysis

Data entry was done using SPSS software 21.0.Chi square test was used for statistical analysis between various Matricing techniques preferred for restoring class II amalgam restorations. Age,gender of the patients were considered as independent variables.Matricing technique used and the tooth in which the matrix band was adapted were considered as dependent variables for statistical analysis.The final data was exported to excel and saved on a secure server for analysis.

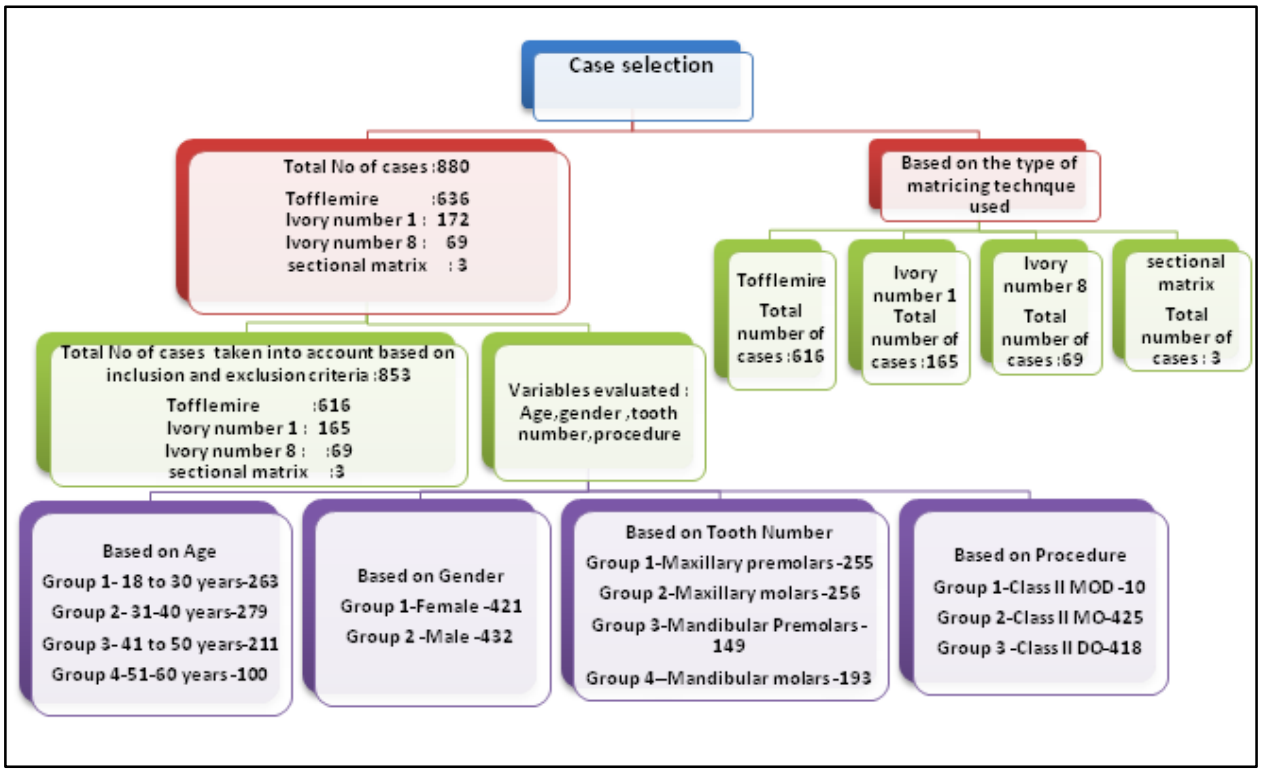

Figure 1 : Shows total number of cases and cases included based on the inclusion and exclusion criteria

RESULTS AND DISCUSSION

The clinical database system resulted in a total of 880 patient charts, identifying the type of matricing technique preferred for class II amalgam restoration completed over a period of one year. After applying the inclusion and exclusion criteria, around 853 cases met with the criteria (Figure 1).

The data after applying the inclusion and exclusion criteria consisted of 616 cases of tofflemire type of matricing technique,165 cases of ivory no 1 matricing technique,69 cases of ivory no 8 and 3 cases of sectional matricing technique.With a total of 853 cases, 421 were females and 432 males.Based on the tooth distribution ,255 cases consisted of maxillary premolars,256 were maxillary molars,149 were mandibular premolars and 193 cases consisted of mandibular molars (Table 1).Results of the study were not found to be statistically significant.(P value >0.5).

In this study analysing the type of Matricing technique used in class II amalgam restorations, Tofflemire matricing technique was preferred for restoring Class II amalgam restorations in the majority of the cases.Based on the age of the patient,age groups of 31-40 years (32.7%) accounted for maximum number of cases followed by age group of 18-30 years which included 30% overall cases.Age group of 41-50 years included 25% of overall cases and age groups of 51-60 years accounted 11.7% of overall cases (Figure 2).Based on the gender males accounted 50% of overall cases and females accounted 49% of overall cases.Based on the tooth in which the matrix band retainer is adapted,upper molars accounted maximum number of cases 30% ,upper Premolar accounted 29% of overall cases,lower molars accounted 23% of overall cases and lower Premolars accounted 18% of overall cases(Figure 3).Based on the procedure done ,maximum cases accounted for class II cavities with mesio -occlusal amalgam restorations (50% of overall cases),followed by class II cavities with Disto -

occlusal amalgam restorations accounting 49% of overall cases and mesio-occluso -distal restorations accounting 1.2% of overall cases .(Figure 4)(Table 1)

Tooth Distribution	**No of Teeth**	**Percentage value**
Jaw		
Maxillary	511	59.9
Mandibular	342	40.1
Teeth Type		
Premolars	736	38.7
Molars	1176	61.3
Type of Matricing Technique		
Tofflemire	616	72.2
Ivory no 1	165	19.3
Ivory No 8	69	8.1
Sectional Matrix	3	0.4

Table 1:Showing Tooth distribution of the various teeth that received class II amalgam restorations and the type of matricing technique used. A total of 511 maxillary teeth and 342 mandibular teeth were evaluated.A total of 616 cases included placement of Tofflemire matricing technique ,165 cases included Ivory no 1,69 cases included Ivory no 8 and 3 cases included sectional matricing technique in class II amalgam restorations.

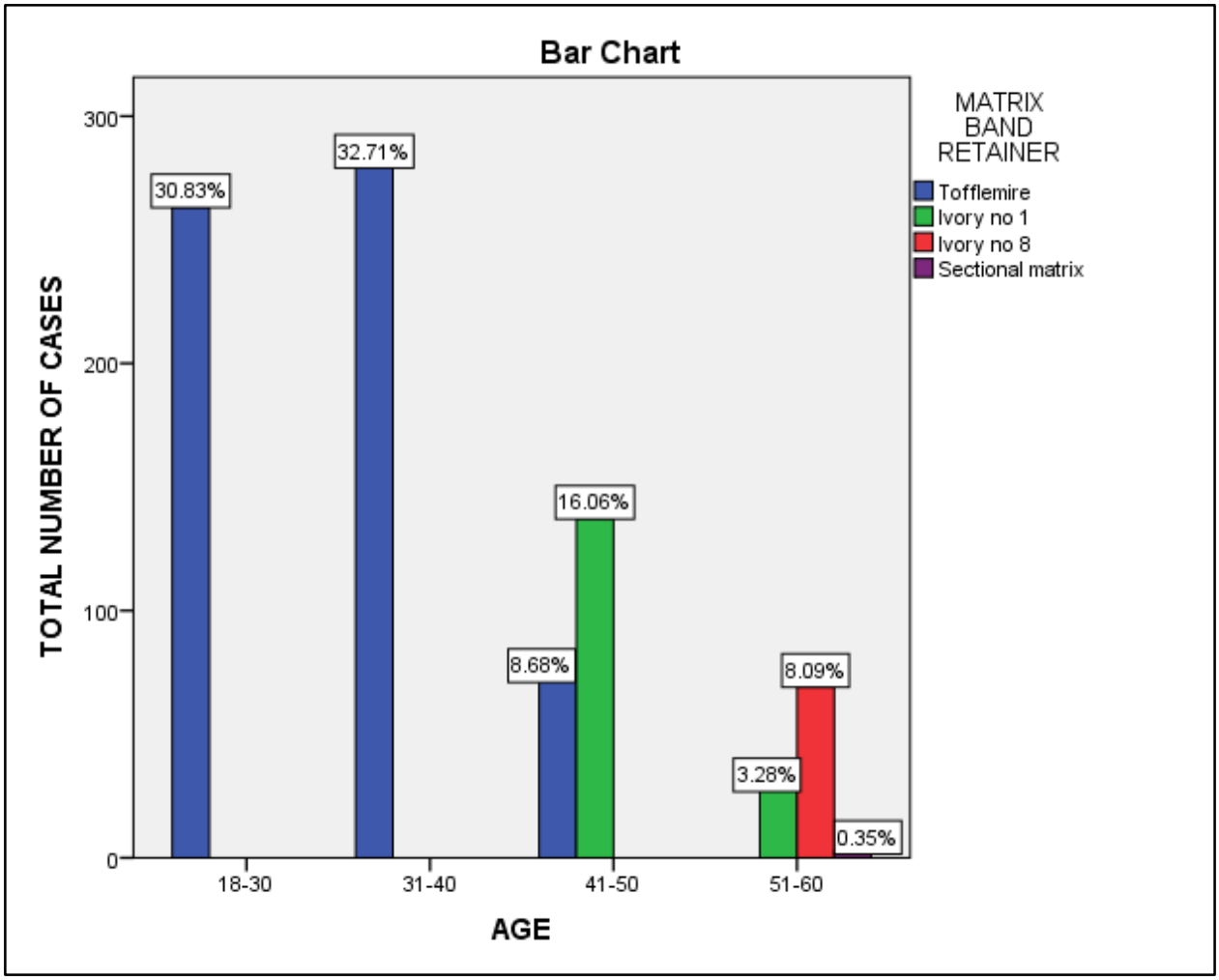

Figure 2 :This graph represents association of age and type of matricing technique preferred in class II amalgam restorations..X axis denotes the age and Y axis denotes total number of cases. There is significant association between the age group of 31-40 years and the type of matricing technique used in class II amalgam restorations which was tofflemire matricing technique(Group A). Chi square test (0.35)was done and association was found to be not statistically significant. Pearson's Chi square P value 0.790 > 0.05.

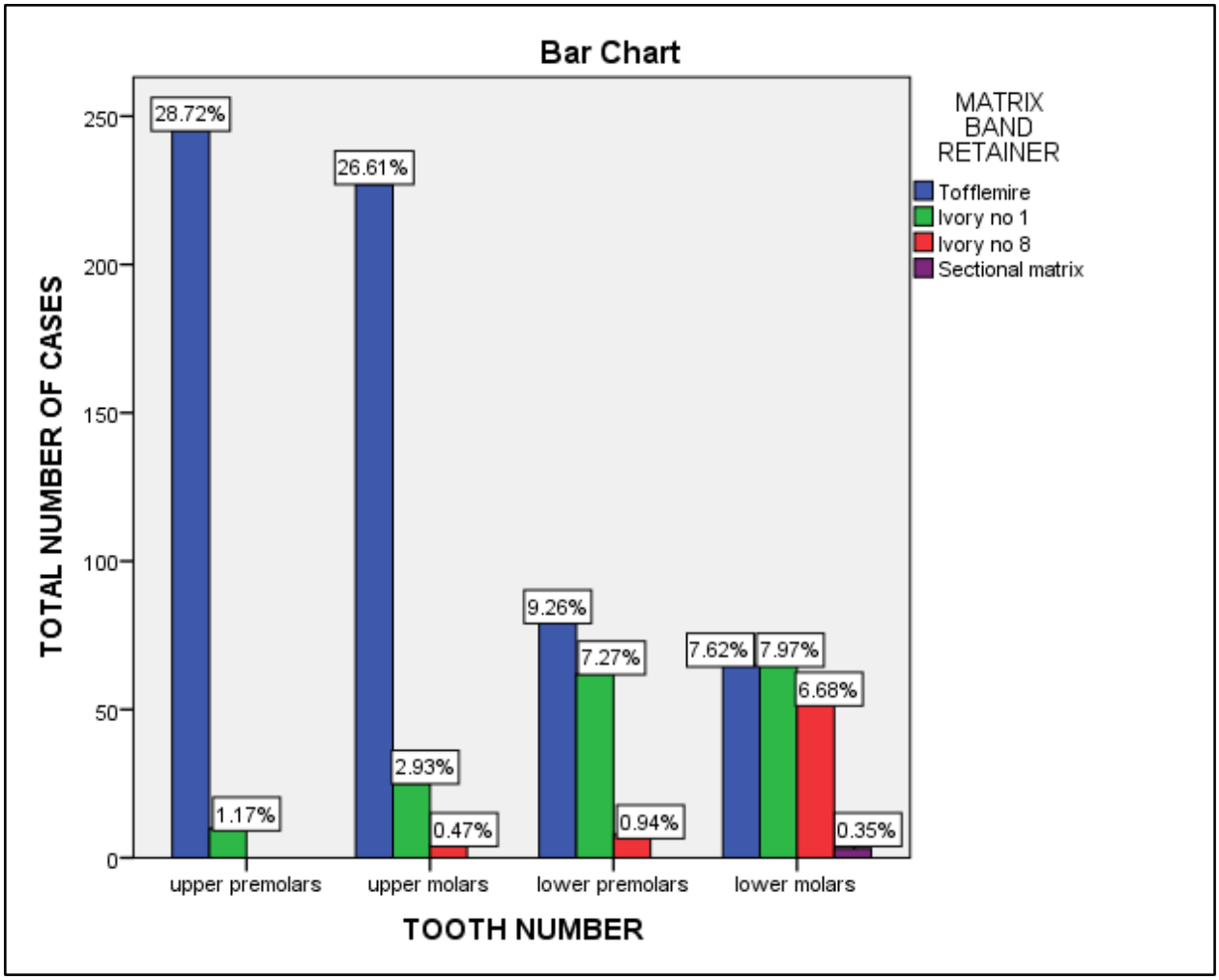

Figure 3 :This graph represents association of the tooth number and type of matricing technique preferred in class II amalgam restorations.X axis denotes the tooth in which the matricing technique is done and Y axis denotes total number of cases.There is significant association between upper premolars and the type of matricing technique used in class II amalgam restorations which was Tofflemire matricing technique(Group A).Chi square test (0.52)was done and association was found to be not statistically significant.Pearson's Chi square P value 0.56>0.05.

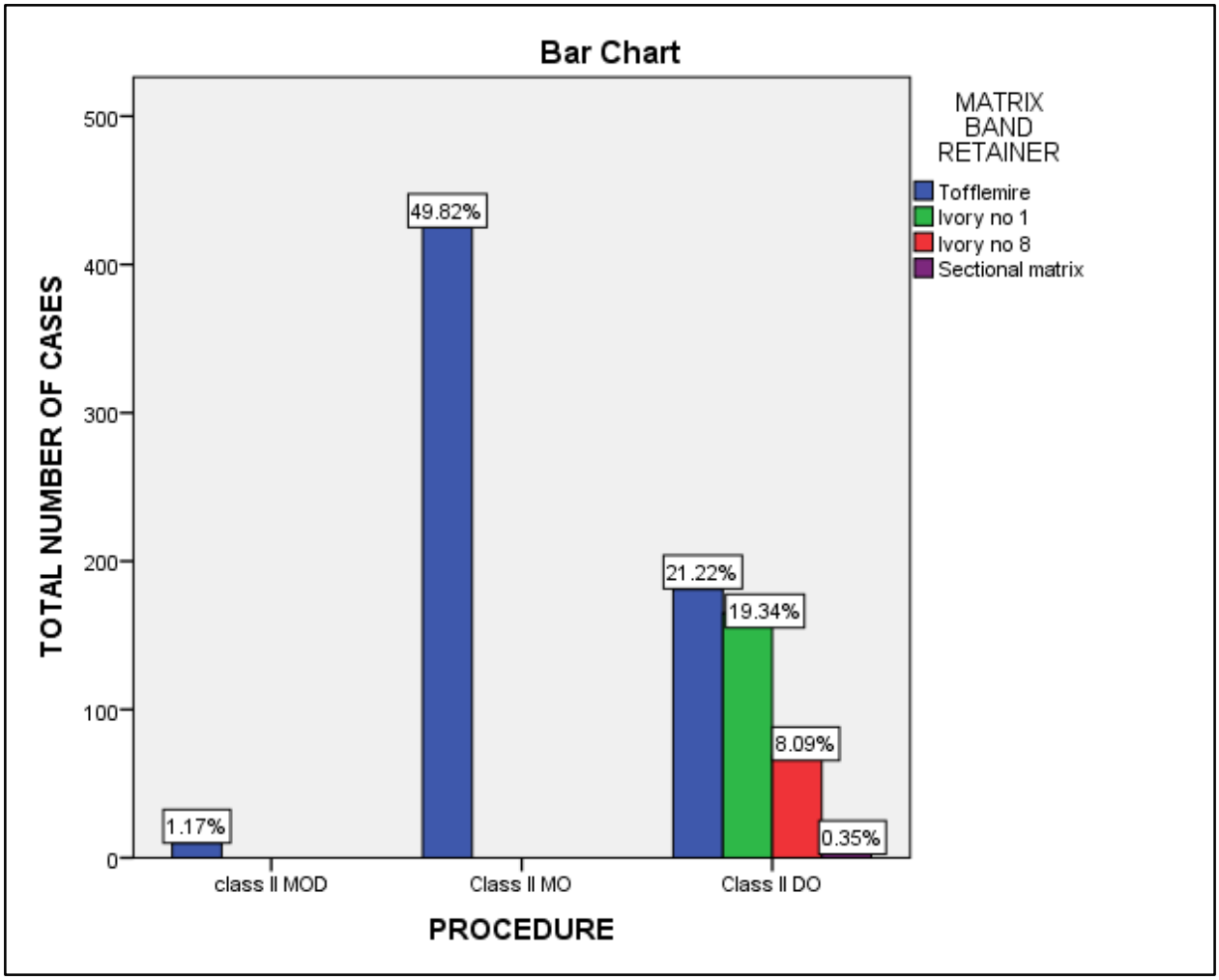

Figure 4 :This graph represents association of the procedure done and type of matricing technique preferred in class II amalgam restorations.X axis denotes the procedure done and Y axis denotes total number of cases. There is significant association between Class II Mesio-occlusal amalgam restorations and the type of matricing technique used which was Tofflemire matricing technique(Group A). Chi square test (0.04)was done and association was found to be not statistically significant. Pearson's Chi square P value 0.567 > 0.05.

Tightness and point of contact between adjacent teeth and contour of proximal surfaces are critical factors to the health of the periodontal tissues.(Hancock *et al.*, 1980; Jernberg, Bakdash and Keenan, 1983; Dörfer *et al.*, 2000) In Vivo studies have proved that contact strength is influenced by several factors such as tooth type ,postural change and periodontal condition of the tooth.(Southard, Southard and Tolley, 1990)

The palodent matrix system created by far the tightest contact between the restoration and the adjacent tooth.(Loomans *et al.*, 2006) Contact point between the posterior tooth is located at the transition of the middle to occlusal third of the proximal surface cervico-occlusally and morphology of the proximal surface shows considerable variability.(Peumans *et al.*, 2001)Ivory no 1 Matrix is a mechanical matrix that is useful for placement of a a simple class II or unilateral restoration.(McGehee, True and Inskipp, 1956; Simon, 1956; Charbeneau, 1988; Sturdevant, 1995)Disadvantages include difficulty in placement and more time compared to other matrices.Advantages include it works efficiently when other matrices cannot be placed such as disto - occlusal preparation of most posterior tooth where contact on mesial side is too tight for placement of circumferential matrix.(Kaplan and Schuman, 1986; Qualtrough and Wilson, 1991)Circumferential matrix can be used for simple class II restorations or complex multi surface restorations.(Baum, Phillips and Lund, 1995)

Tofflemire Matrix is the most popular mechanical matrix used ,referred to a unilateral retainer.It is easy to use and durable.(Hill, 1983)However disadvantages included contact surface is usually located incorrectly near marginal ridge leading to an abnormal embrasure space and an unnatural look.Apart from contact point strength,

formation of anatomically correct proximal contour reproduction is a major prerequisite for a success restoration.

Tofflemire,siqveland, Ivory No 1, Ivory No 8 and universal matrix retainers were used based on the techniques advocated by hold back, Miller and Markey.(Hollenback, 1937; Miller, 1948; Markley, 1951) In this study based the evaluation of different Matricing techniques for class II amalgam restorations Tofflemire matrix was the most preferred Matricing technique used.

CONCLUSION

Within the limitations of the study,Tofflemire matrix(Group A) was the most preferred Matricing technique used for class II amalgam restorations in comparison to ivory no 1(Group B),ivory no 8(Group C) and sectional matrix technique (Group D).

StudyLimitation

This study included only a few cases of sectional matricing .Tofflemire matrix technique has limitations such as the contact surface is often located incorrectly leading to an abnormal embrasure space.

FutureScope

Future studies should be undertaken to focus on the sectional matrix technique and newer techniques of matricing.

Declaration of Patient Consent

The authors certify that they have obtained all appropriate patient consent forms needed to conduct the study. In the patient consent form, the patient(s) have given his/her/their consent for usage of his/her/their clinical images and other clinical information.Patients are acknowledged that efforts will be made to conceal their name and identity.

Author Declaration

We confirm that the manuscript has been read and approved by all the named authors and that there is no other person who satisfied the criteria for authorship but is not listed.

Acknowledgement

With Sincere gratitude, we acknowledge the staff members of the department of Conservative Dentistry and Endodontics and Saveetha Dental College and study participants for their extended support towards the completion of research.

Conflicts of Interest

There are no conflicts of interest.

Overall Consensus : In agreement with the findings of this retrospective study.

REFERENCES

1. Baum, L., Phillips, R. W. and Lund, M. R. (1995) *Textbook of Operative Dentistry*. Saunders.
2. Biales, L. B. (1944) 'The Mesioclusodistal Matrix', *The Journal of the American Dental Association*, pp. 95–98. doi: 10.14219/jada.archive.1944.0031.
3. Farhat Yaasmeen Sadique Basha, Rajeshkumar S, Lakshmi T, Anti-inflammatory activity of Myristica fragrans extract . Int. J. Res. Pharm. Sci., 2019 ;10(4), 3118-3120 DOI: https://doi.org/10.26452/ijrps.v10i4.1607
4. Charbeneau, G. T. (1988) *Principles and practice of operative dentistry*. Lea & Febiger.
5. Dörfer, C. E. *et al.* (2000) 'Factors influencing proximal dental contact strengths', *European journal of*

oral sciences, 108(5), pp. 368–377.

6. Graham, D. A. *et al.* (1980) 'Pre-contoured matrix bands for Class II amalgam restorations', *General dentistry*, 28(3), pp. 52–57.
7. Green, R. O., Shellman, J. F. and Simon, W. J. (1943) 'Manipulation of Amalgam', *The Journal of the American Dental Association*. Elsevier, 30(15), pp. 1168–1178.
8. Hancock, E. B. *et al.* (1980) 'Influence of interdental contacts on periodontal status', *Journal of periodontology*, 51(8), pp. 445–449.
9. Hill, G. L. (1983) 'Operative dentistry, ed 4: H. William Gilmore, DDS, MSD, Melvin R. Lund, DMD, MS, Colonel David J. Bales, DDS, MSD, and James P. Vernetti, DDS St. Louis, 1982, The CV Mosby Co., 379 pages, illustrated, indexed. Price $34.95', *The Journal of prosthetic dentistry*. Elsevier, 49(2), p. 292.
10. Hollenback, G. M. (1937) 'The Economic Value of Amalgam in Operative Dentistry and the Technic of Its Use', *The Journal of the American Dental Association and The Dental Cosmos*. Elsevier, 24(8), pp. 1318–1326.
11. Hussainy, S. N. *et al.* (2018) 'Clinical performance of resin-modified glass ionomer cement, flowable composite, and polyacid-modified resin composite in noncarious cervical lesions: One-year follow-up', *Journal of conservative dentistry: JCD*, 21(5), pp. 510–515.
12. Janani, K., Palanivelu, A. and Sandhya, R. (2020) 'Diagnostic accuracy of dental pulse oximeter with customized sensor holder, thermal test and electric pulp test for the evaluation of pulp vitality: an in vivo study', *Brazilian Dental Science*, 23(1), p. 8.
13. Jernberg, G. R., Bakdash, M. B. and Keenan, K. M. (1983) 'Relationship between proximal tooth open contacts and periodontal disease', *Journal of periodontology*, 54(9), pp. 529–533.
14. Jose, J. and Subbaiyan, H. (2020) 'Different Treatment Modalities followed by Dental Practitioners for Ellis Class 2 Fracture–A Questionnaire-based Survey', *The open dentistry journal*. opendentistryjournal.com. Available at: https://opendentistryjournal.com/VOLUME/14/PAGE/59/FULLTEXT/.
15. Kaplan, I. and Schuman, N. J. (1986) 'Selecting a matrix for a Class II amalgam restoration', *The Journal of prosthetic dentistry*, 56(1), pp. 25–31.
16. Kumar, D. and Antony, S. (2018) 'Calcified Canal and Negotiation-A Review', *Research Journal of Pharmacy and Technology*. A & V Publications, 11(8), pp. 3727–3730.
17. Loomans, B. A. C. *et al.* (2006) 'Influence of composite resin consistency and placement technique on proximal contact tightness of Class II restorations', *The journal of adhesive dentistry*, 8(5), pp. 305–310.
18. Manohar, M. P. and Sharma, S. (2018) 'A survey of the knowledge, attitude, and awareness about the principal choice of intracanal medicaments among the general dental practitioners and nonendodontic specialists', *Indian journal of dental research: official publication of Indian Society for Dental Research*. Medknow Publications and Media Pvt. Ltd., 29(6), p. 716.
19. Markley, M. R. (1951) 'Restorations of silver amalgam', *Journal of the American Dental Association* , 43(2), pp. 133–146.
20. McGehee, W. H. O., True, H. A. and Inskipp, E. F. (1956) *A textbook of operative dentistry*. Blakiston Division, McGraw-Hill.
21. Miller, E. C. (1948) 'Clinical procedures which affect amalgam restorations', *Northwest dentistry*, 27(4), pp. 173–180.
22. Nandakumar, M. and Nasim, I. (2018) 'Comparative evaluation of grape seed and cranberry extracts in preventing enamel erosion: An optical emission spectrometric analysis', *Journal of conservative dentistry: JCD*, 21(5), pp. 516–520.
23. Noor, S. S. S. E., S Syed Shihaab and Pradeep (2016) 'Chlorhexidine: Its properties and effects', *Research Journal of Pharmacy and Technology*, p. 1755. doi: 10.5958/0974-360x.2016.00353.x.
24. Peumans, M. *et al.* (2001) 'Do condensable composites help to achieve better proximal contacts?', *Dental materials: official publication of the Academy of Dental Materials*, 17(6), pp. 533–541.
25. Qualtrough, A. J. and Wilson, N. H. (1991) 'The history, development and use of interproximal wedges in clinical practice', *Dental update*, 18(2), pp. 66–70.
26. Rajendran, R. *et al.* (2019) 'Comparative Evaluation of Remineralizing Potential of a Paste Containing Bioactive Glass and a Topical Cream Containing Casein Phosphopeptide-Amorphous Calcium Phosphate: An in Vitro Study', *Pesquisa brasileira em odontopediatria e clinica integrada*. SciELO Brasil, 19. Available at: http://www.scielo.br/scielo.php?pid=S1983-46322019000100364&script=sci_arttext.
27. Ramamoorthi, S., Nivedhitha, M. S. and Divyanand, M. J. (2015) 'Comparative evaluation of postoperative pain after using endodontic needle and EndoActivator during root canal irrigation: A randomised controlled trial', *Australian endodontic journal: the journal of the Australian Society of*

Endodontology Inc, 41(2), pp. 78–87.

28. Ramanathan, S. and Solete, P. (2015) 'Cone-beam Computed Tomography Evaluation of Root Canal Preparation using Various Rotary Instruments: An in vitro Study', *The Journal of Contemporary Dental Practice*, pp. 869–872. doi: 10.5005/jp-journals-10024-1773.
29. Ravinthar, K. and Others (2018) 'Recent Advancements in Laminates and Veneers in Dentistry', *Research Journal of Pharmacy and Technology*. A & V Publications, 11(2), pp. 785–787.
30. R, R., Rajakeerthi, R. and Ms, N. (2019) 'Natural Product as the Storage medium for an avulsed tooth – A Systematic Review', *Cumhuriyet Dental Journal*, pp. 249–256. doi: 10.7126/cumudj.525182.
31. Rutsky, P. P. (1968) 'Matrixes for compound cavities', *Journal of the American Dental Association* , 76(5), pp. 1006–1010.
32. Siddique, R. *et al.* (2019) 'Qualitative and quantitative analysis of precipitate formation following interaction of chlorhexidine with sodium hypochlorite, neem, and tulsi', *Journal of conservative dentistry: JCD*, 22(1), pp. 40–47.
33. Simon, W. J. (1956) *Clinical Operative Dentistry. Edited by W.J. Simon*. Philadelphia & London.
34. Southard, T. E., Southard, K. A. and Tolley, E. A. (1990) 'Variation of approximal tooth contact tightness with postural change', *Journal of dental research*, 69(11), pp. 1776–1779.
35. Sturdevant, C. M. (1995) *The art and science of operative dentistry*. Mosby Elsevier Health Science.
36. Teja, K. V. and Ramesh, S. (2019) 'Shape optimal and clean more', *Saudi Endodontic Journal*. Medknow Publications and Media Pvt. Ltd., 9(3), p. 235.
37. Teja, K. V., Ramesh, S. and Priya, V. (2018) 'Regulation of matrix metalloproteinase-3 gene expression in inflammation: A molecular study', *Journal of conservative dentistry: JCD*, 21(6), pp. 592–596.