

Comparative Analysis Of Success Rate In Class II Cavities with Direct and Indirect Restorations - A Retrospective Analysis

Research Article

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Abstract

Aim: An adhesive restoration is a substance capable of holding two surfaces in a strong and permanent manner. There are two strategies in restoring class II cavities- direct, indirect restorations. Indirect technique refers to fabrication of the restoration outside the oral cavity in the laboratory following which it is luted to the tooth with resin cement. The aim of this current study was to analyse and compare direct, indirect restorations done in class II cavities.

Materials and Methods: As it was retrospective analysis, data collected from Saveetha Dental College and Hospitals, Chennai and evaluated the patients who received direct and indirect restorative procedures for class II cavities. Data was evaluated from patient's records from June 2019 to March 2020 and the data consisted of 548 patients. Inclusion criteria consisted of patients aged 18-70 years who received direct restorative procedures such as composite or amalgam restorations, patients who received indirect restorative procedures such as metal or ceramic inlay for class II cavities. Exclusion criteria consisted of patients who have received restorations other than class II cavities, sealants, temporary restorations and endodontic procedures.

Results: In this study of 309 class II restorations (156 males, 153 females with a mean age group of 30 years) were included. Group A (direct restorations) has higher preference rate and success rate over group B (indirect restorations) comprising class II cavities with p value < 0.05.

Conclusion: The clinical success rate of direct restorations were higher than that of indirect restorations in class II cavities.

Keywords: Class II Cavities; Direct Restorations; Indirect Restorations; Success Rate; Contour; Contacts.

Introduction

Current evidence supports the preservation of tooth structure over other invasive procedures. Restoring carious lesions and preserving tooth structure is an integral part in the field of conservative dentistry. Restoration is a term used in dentistry to describe the repair of a missing or damaged tooth structure. Restorations are classified as either direct or indirect. Direct restorations are repairs made inside of the mouth (fillings), while indirect restorations are fashioned outside of the mouth and then affixed to either the tooth or the supporting tooth structure in a separate procedure [1].

Amalgam restorative material has been widely used in dental filling material worldwide for the restoration of posterior teeth because of its easy handling procedures, well-tested material properties, and clinical success. Patients' esthetic preferences in the restoration of posterior teeth have stimulated the development of new, tooth-colored, non-metallic restorative materials. Esthetic alternatives to amalgam restorations and cast-gold inlays include direct composite resins, composite inlays, and ceramic inlays [2]. Lately, resin-based adhesives and restorative materials have stimulated an increase in the use of resin-based composites in posterior teeth [3, 4].

Direct restorations are composite and amalgam restorations. Indi-

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rect restorations are inlays and onlays [5]. The different restorative materials used for indirect restorations are ceramic, composite, metal [6, 7].

In direct composite resin restorations the most important problems were various fractures, wear, loss of marginal seal leading to pulpal irritation, post operative sensitivity, marginal staining and secondary caries [8]. Several restorative techniques have been used to minimize polymerization shrinkage and stress such as multiple increment technique, use of glass ionomer cement as sandwich technique [9]. The use of composite resin inlay/onlay technique has been widely used to reduce polymerization shrinkage. The noticeable advantages of indirect restorations relates to its better potential for generating appropriate anatomic form as well as proximal contact and contour [10, 11]. Indirect laboratory processed composite systems present aesthetic alternatives for intracoronal posterior restorations and provide aesthetic results that may also reinforce the teeth [12]. Additional benefits include exact marginal integrity, wear resistance, wear compatibility with opposing dentition, optimal esthetics, ideal proximal contacts [13].

However, for the management of caries, it is difficult to achieve the correct balance between an eagerness to remove the lesion and the continued monitoring of lesion progression [14]. The selection of either treatment strategy is relevant to the risk of creating pulp complications, because the selection of approach can mediate the quantity of caries excavation, risk of pulp injury and exposure, size of cavity preparation etc. The important factor to be considered is protecting the pulp status and remineralizing the carious structure [15, 16].

The faulty restorations invariably affects the pulp status which in turn requires endodontic therapy. Successful endodontic therapy involves many factors including proper disinfection and shaping of the root canal [17-21]. In some cases the placement of intracanal medicament also plays a major role [22]. In order to avoid that complex procedures, carious lesion to be treated at earlier stage. The aim of this present study was to analyse the success rate of direct, indirect restorations in class II cavities.

Materials and Method

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 .This retrospective clinical study evaluated the patients who received direct and indirect restorative procedures for class II cavities Saveetha Dental College, Chennai.

Inclusion Criteria

Patients aged 18-70 years who received direct, indirect restorative procedures for class II cavities, patients who received direct restorative procedures such as composite restorations, and amalgam restorations in class II cavities, patients who received indirect restorative procedures such as metal inlay and ceramic inlay for class II cavities.

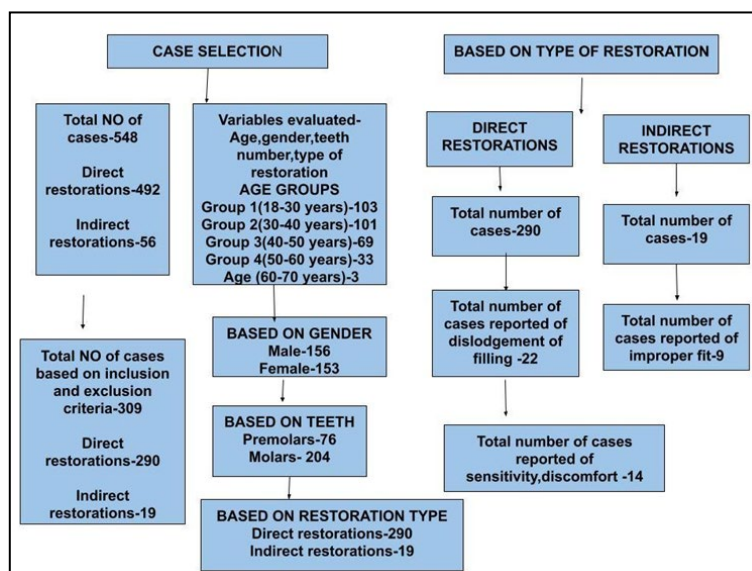
Exclusion Criteria

Patients who have received restorations other than class II cavities, endodontic procedures were excluded from this study, Exclusion criteria consisted of patients who have received restorations other than class II cavities, pit and fissure sealant, temporary restorations and endodontic procedures were excluded from this study.

Data Extraction

Data extraction was done from 548 patient's records. Data collection was accomplished using standardized electronic form designed to collect information related to subjects' demographic features, type of restoration. The final data was exported to excel and saved on a secure server for analysis. The case selection and data extraction is shown in (Flow chart 1).

Flowchart 1. Shows total number of cases and cases included based on the Inclusion and Exclusion criteria.



Sample Size

The sampling method was used to evaluate data .Of total, 548 patients, 309 patients were selected for this study based on inclusion and exclusion criteria. Among that, 19 teeth were restored by indirect restorations and 290 teeth were restored with direct restorations.

Groups

The restorations done were divided into:

- Group A-Direct restorations
- Group B-Indirect Restorations

Clinical outcome

Success rate is assessed based on Patient’s visit after restoration because of pain or difficulty during mastication. All patients were followed up to note the clinical performance of restoration. If the patient’s visit was due to discomfort or minor issues, and the restoration was adjusted it affects the restoration’s success to a certain level.

Clinical Protocol

The clinical protocol for the patients undergoing restorative procedure is to assess the pulp status by pulp vitality tests, clinical and radiographic findings. After diagnostic procedures, caries excavated and decided whether direct or indirect restoration needed for the particular scenario. Most commonly preferred direct restorations are composite restorations and amalgam restorations. Indirect restorations involve two visits, in the first visit, cavity preparation done, impression made and sent to the lab and in the subsequent visit fabrication of indirect restoration done. materials used for indirect restoration were metal, composite and ceramics.

Study Outcome

Success rate is assessed based on patients visit because of pain, improper contour and contacts after restorative procedure.And

in case of direct restoration patients reported back mainly because of discomfort during mastication, and adjustments made by reducing high points and this affects the success rate to certain levels. Post operative sensitivity too affects the success rate.

Statistical Analysis

Chi- square test was done to assess these parameters. The outcome data was represented in the form of tables and graphs. The four tables represent the frequency of pulp capping procedure done based on the age, gender, teeth number and the type of restoration of the patient. The graphs represent the correlation between these parameters - Correlation of age and type of restoration, gender and type of restoration, teeth number and type of restoration.

After grouping of parameters, data was copied to SPSS software. The statistical analysis between direct, indirect restorative procedures were carried out in SPSS software. Chi square test was done to compare the direct/indirect restorative procedures to other three parameters - age, gender, teeth number and restoration type.

Results and Discussion

The clinical data base system resulted in a total of 548 patients charts, identifying direct and indirect class II restorations completed in patients over a period of one year. After applying the inclusion and exclusion criteria, around 309 teeth met with the criteria.

In this study comparing direct, indirect restorative procedures in class II MO cavities, direct restorative procedures (group A) have a higher preference, success rate than indirect restorative procedures (group B). In this study comprising 309 cases, 45 cases reported with discomfort during mastication,improper fit, dislodgement, sensitivity issues.

Among 290 direct restoration cases, 14 cases reported either due to discomfort during mastication,sensitivity issues and in these cases, proper contacts and contours were rechecked and occlusal

Table 1. Showing distribution of cases which were included for the study based on Age, Gender and type of restoration. Maximum number of cases were reported in the age group of 18-30 years. Out of 309 cases, 50.5% were male and 49.5% were female.

Patients Characteristics	No of Patients	Percentage value
Gender		
Male	156	50.50%
Female	153	49.50%
Age		
18- 30 years	103	33.30%
30- 40 years	101	33.10%
40- 50 years	69	22.50%
50- 60 years	33	10.70%
60- 70 years	3	1.30%
Type of restoration		
Direct restorations	290	93.90%
Indirect restorations	19	6.10%

adjustments made and 22 cases reported dislodgement of filling and in these cases, re restoration done. Among 19 indirect restorations cases, 9 cases reported due to discomfort, improper fit and in these cases, 5 indirect restorations sent to lab and rechecked in occlusal aspects.

Traditionally, indirect restorations are expected to have better longevity than direct restorations. The introduction of adhesive dentistry has changed this aspect and direct restorations have equal success rate as that of indirect restorations.

In this study, direct restorations were highly preferred in the majority of cases because of patient's preference avoiding multi visit in case of indirect restorations. The clear indications of indirect restoration are large cavities/failed direct restorations, multiple missing cusps. Previous *in vitro* studies analysed the direct, indirect restorations based on the USPHS criteria such as colour match, marginal integrity, marginal discoloration, surface texture, post-operative sensitivity and gingival bleeding [23, 24]. Some clinical trials have used the USPHS criteria to evaluate the direct, and indirect composite restorations [25]. Loguerico and Dresch, 2006 stated that, 100% alpha ratings were obtained for retention crite-

ria according to modified USPHS criteria in 12 month evaluation of direct restorations [26]. Considering the retention aspect in this study, 7 patients who received indirect restorations reported due to improper fit.

Yip 2007, evaluated and stated that all direct posterior composite restorations were also rated excellent for surface staining criteria. Considering the direct posterior composite restorations in staining criteria in this study, it exhibited good results [27]. Turkun found that in 2 year clinical evaluation for marginal discoloration, all direct restorations showed 100% alpha ratings during six month evaluation. At two years recall evaluation, there were 5 bravos for marginal discoloration, at the end 6% of restorations had a slight crevice along the marginal interface [28, 29]. As this study is a retrospective analysis of one year, direct restorations did not exhibit any marginal discoloration in the majority of cases.

Cetin and Unlu, 2008 stated that better clinical performance might be obtained using indirect inlay systems since they are indirect composite resins specifically designed for restoring posterior teeth [30]. Manhart found that 97% alpha scores in indirect composite restorations, 93% alpha scores in direct composite restora-

Table 2. Showing distribution of cases which were included for the study based on teeth type. Out of 309 cases, 67.3% were molars with maximum and 30.6% were premolars with the minimum.

Tooth Distribution	No of Teeth	Percentage value
Jaw		
Maxillary	198	68.30%
Mandibular	111	31.70%
Teeth Number		
Posterior	309	99.60%
Teeth Type		
Premolars	76	30.60%
Molars	204	67.30%

Table 3. Showing distribution of frequency among Age, Gender, Teeth number and Type of restorations.

Age group	Frequency	Percent	Valid percent	Cumulative percent
1	103	47.4	49.7	50.7
2	101	47.8	50.1	81.4
3	69	9.2	9.2	85.5
4	33	9.1	9.1	100
Gender	Frequency	Percent	Valid percent	Cumulative percent
Female	156	49.3	49.5	49.5
Male	153	49.2	50.5	100
Quadrant	Frequency	Percent	Valid Percent	Cumulative percent
First quadrant	94	17.8	18.3	18.4
Second quadrant	97	18.3	18.6	37.7
Third quadrant	54	29.9	30.2	67.7
Fourth quadrant	56	32.6	32.7	100
Type of restoration	Frequency	Percent	Valid Percent	Cumulative percent
Direct restorations	290	87.3	87.7	88.1
Indirect restorations	19	11.6	12.2	100

tions for post operative sensitivity [31]. Yet, the results of *in vitro* studies differ in clinical scenarios.

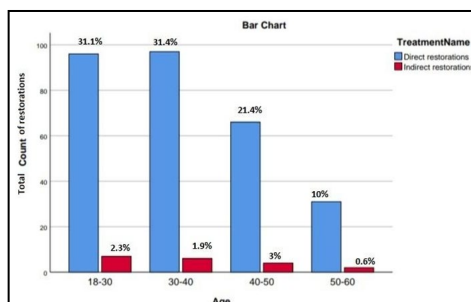
The patient's preference for direct restorations over indirect restorations is noted in the majority of the cases. Although if it's a clear indication of indirect restoration, the clinician must emphasise the importance of giving proper contacts and contours which

can be achieved by giving indirect restorations [32]. The majority of clinical decision regarding the most appropriate choice of restorative material, technique as straightforward & dictated by many factors such as lesion size, etiology, aesthetic, occlusal, endodontic, periodontal considerations-number of teeth affected, patient compliance, habit, preferences, the dentist's own competence and underlying beliefs over the restoration [33].

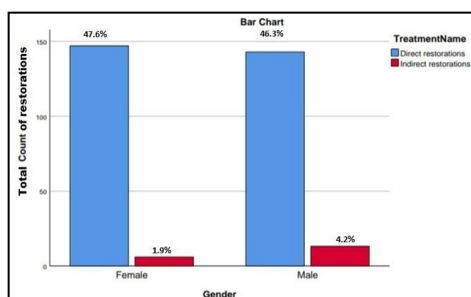
Table 4. Showing success rate in direct and indirect restorations; In the table, it can be noted that the number of failure cases is higher in indirect restorations than direct restorations.

Type of restoration	Total number of cases	Number of failure cases reported	Number of cases reported due to dislodgement of restoration	Number of cases in which occlusal adjustments done	Number of cases in which re-restoration was done
Direct restorations	290	36(12.4%)	22(7.5%)	12(4.13%)	24(8.2%)
Indirect restorations	19	9(47.3%)	5(26.3%)	1(5.2%)	4(21%)

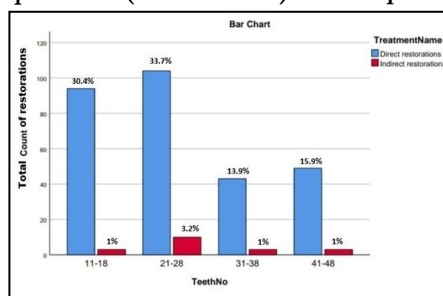
Graph 1. Bar chart showing the association between age and type of restorations, X axis represents the age of the patient and Y axis represents the number of direct and indirect restorations; blue colour depicts the direct restorations and red colour depicts the indirect restorations. Based on age and the type of restorative procedure done maximum cases in all the age groups accounted for direct restorations. There is a significant difference among the groups in the Pearson Chi square test (value is 1.203) and p value is 0.02 < 0.05.



Graph 2. Bar chart showing the association between gender and type of restorations, X axis represents the gender of the patient and Y axis represents the number of direct and indirect restorations; blue colour depicts the direct restorations and red colour depicts the indirect restorations. Based on gender and the type of restorative procedure, maximum cases in male patients-46.3% accounted for direct restorations and maximum cases in female patients-47.6% accounted for direct restorations. There is a significant difference among the groups in the Pearson Chi square test (value is 1.611) and p value is 0.04 < 0.05.



Graph 3. Bar chart showing the association between teeth number and type of restorations, X axis represents the teeth number of the patient representing the quadrant and Y axis represents the number of direct and indirect restorations. In the fourth quadrant- 15.9% of the cases accounted for direct restorations. Based on the quadrant of teeth and the type of restorations, maximum cases accounted for direct restorations. There is a significant difference among the groups in the Pearson Chi square test (value is 2.616) and the p value is 0.01 < 0.05.



As this study involves the dentists who are pursuing undergraduate courses, clinician skill plays a huge role in determining the success rate. In terms of direct restorative procedures many factors such as proper isolation, cavity preparation, placement of restorative materials should be considered when compared to indirect restorative procedures. In terms of Indirect restorative procedures, impression plays a huge role in fabricating the restoration. In this study, failure percentages in indirect restorative procedures were higher than direct restorative procedures (Table 4).

The decision making process involved when choosing to use either direct/indirect approach for any given clinical situation can be facilitated by considering the above factors.

Direct composite restorations are more likely to be aesthetic, functional, durable when cavity margins are situated within enamel, free from occlusal contact, easily accessible in terms of visibility, ease of isolation and relationship to gingival tissues [34]. Apart from likelihood of significant loss of tooth substance, the main problem arising in such a situation is difficulty inherent in trying to seal subgingival cervical margins located within dentin, cementum [35].

Hashimoto, 2000 stated that the majority of cavities are entirely bounded by enamel and it is thought that seal achieved at margin protects any internal resin dentin bond at floor of cavity. Lie lenberg, 2005 advocates a resin modified GIC – sandwich technique. Anderson, 2004 examined the durability for extension of carious lesion and concluded it exhibited structural durability [36].

The faulty restoration affects the pulp status requiring endodontic therapy. Many factors influencing the therapy are canal anatomy, calcified nature and in case of traumatic injuries such as avulsion, the treatment protocol differs [37, 38].

Watts, 2001 observed a large number of discoloured teeth after restorations and stated that correct diagnosis should be made and the mechanism of staining have a great outcome on treatment. In this study comprising cases restored with direct composite restoration, discoloration was not noted in the majority of the cases [39].

In virtually, every clinical case there will be more than one way to achieve the result. Many decisions regarding treatment are straightforward, as the advantages of one particular procedure outweigh its own disadvantages and the relative advantages of other available options. As long as treatment is performed with proper care, to a high standard with understanding of the concept, it will more than likely be successful.

Conclusion

Within the limitations of this study, it can be concluded that the direct restoration has a higher preference, success rate over indirect restorations in class II cavities in terms of parameters such as dislodgement of filling, discomfort and pain during mastication as it shows statistically significant difference. This disagrees with the previous evidence based on *in vitro* studies which stated that indirect restorations are superior to direct restorations.

Study Limitation

In this study, success rate was evaluated based on one factor in USPHS criteria. This study involved a relatively smaller number of people.

Future Scope

Long term evaluation of both direct, indirect restorations in class II cavities should be done based on modified USPHS criteria. Future studies can evaluate in a larger number of populations, the factors can be assessed based on modified USPHS criteria for more reliable clinical results.

Declaration of Patient Consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

References

- [1]. Brunthaler A, König F, Lucas T, Sperr W, Schedle A. Longevity of direct resin composite restorations in posterior teeth: a review. *Clin Oral Investig.* 2003 Jun;7(2):63-70.
- [2]. Manhart J, Scheibenbogen-Fuchsbrunner A, Chen HY, Hickel R. A 2-year clinical study of composite and ceramic inlays. *Clin Oral Investig.* 2000 Dec;4(4):192-8.
- [3]. Cobb DS, MacGregor KM, Vargas MA, Denehy GE. The physical properties of packable and conventional posterior resin-based composites: a comparison. *J Am Dent Assoc.* 2000 Nov;131(11):1610-5. Pubmed PMID: 11103581.
- [4]. Cavalcanti SC, de Oliveira MT, Arrais CA, Giannini M. The effect of the presence and presentation mode of co-initiators on the microtensile bond strength of dual-cured adhesive systems used in indirect restorations. *Oper Dent.* 2008 Nov-Dec;33(6):682-9. Pubmed PMID: 19051862.
- [5]. Soderholm KJ. Review of the fracture toughness approach. *Dent Mater.* 2010 Feb 1;26(2):e63-77.
- [6]. Aggarwal V, Logani A, Jain V, Shah N. Effect of cyclic loading on marginal adaptation and bond strength in direct vs. indirect class II MO composite restorations. *Oper Dent.* 2008 Sep-Oct;33(5):587-92. Pubmed PMID: 18833866.
- [7]. Solomon P, Krishna G, Parameswaran A, Pradeep G, Kandaswamy D. Fracture resistance of premolar teeth with class II preparations restored with light cured composite with beta quartz inserts, light cured composite and silver amalgam in comparison with intact unrestored teeth-An *in vitro* study. *J Conserv Dent.* 2007 Oct 1;10(4):122.
- [8]. Assif D, Nissan J, Gafni Y, Gordon M. Assessment of the resistance to fracture of endodontically treated molars restored with amalgam. *J Prosthet Dent.* 2003 May;89(5):462-5. Pubmed PMID: 12806323.
- [9]. Christensen GJ. Should resin-based composite dominate restorative dentistry today? *J Am Dent Assoc.* 2010 Dec;141(12):1490-3. Pubmed PMID: 21119133.
- [10]. Jose J, Subbaiyan H. Different treatment modalities followed by dental practitioners for Ellis class 2 fracture—A questionnaire-based survey. *Open Dent. J.* 2020 Feb 18;14(1):59-65.
- [11]. Nandakumar M, Nasim I. Comparative evaluation of grape seed and cranberry extracts in preventing enamel erosion: An optical emission spectrometric analysis. *J Conserv Dent.* 2018 Sep-Oct;21(5):516-520. Pubmed PMID: 30294113.
- [12]. Schmalz G, Federlin M, Reich E. Effect of dimension of luting space and luting composite on marginal adaptation of a class II ceramic inlay. *J Prosthet Dent.* 1995 Apr;73(4):392-9. Pubmed PMID: 7783020.
- [13]. Hussainy SN, Nasim I, Thomas T, Ranjan M. Clinical performance of resin-modified glass ionomer cement, flowable composite, and polyacid-modified

- resin composite in noncarious cervical lesions: One-year follow-up. *J Conserv Dent.* 2018 Sep-Oct;21(5):510-515. Pubmed PMID: 30294112.
- [14]. Teja KV, Ramesh S, Priya V. Regulation of matrix metalloproteinase-3 gene expression in inflammation: A molecular study. *J Conserv Dent.* 2018 Nov;21(6):592-6.
- [15]. Janani K, Palanivelu A, Sandhya R. 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. *Braz. Dent. Sci.* 2020 Jan 31;23(1):8.
- [16]. Rajendran R, Kunjusankaran RN, Sandhya R, Anilkumar A, Santhosh R, Patil SR. 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. *Pesqui. Bras. Odontopediatria Clín. Integr.* 2019;19:1-10.
- [17]. Ramanathan S, Solete P. Cone-beam Computed Tomography Evaluation of Root Canal Preparation using Various Rotary Instruments: An in vitro Study. *J Contemp Dent Pract.* 2015 Nov 1;16(11):869-72. Pubmed PMID: 26718293.
- [18]. Noor SS. Chlorhexidine: Its properties and effects. *Res J Pharm Technol.* 2016 Oct 1;9(10):1755.
- [19]. Ramamoorthi S, Nivedhitha MS, Divyanand MJ. Comparative evaluation of postoperative pain after using endodontic needle and EndoActivator during root canal irrigation: A randomised controlled trial. *Aust Endod J.* 2015 Aug;41(2):78-87. Pubmed PMID: 25195661.
- [20]. Siddique R, Sureshbabu NM, Somasundaram J, Jacob B, Selvam D. Qualitative and quantitative analysis of precipitate formation following interaction of chlorhexidine with sodium hypochlorite, neem, and tulsi. *J Conserv Dent.* 2019 Jan-Feb;22(1):40-47. Pubmed PMID: 30820081.
- [21]. Teja KV, Ramesh S. Shape optimal and clean more. *Saudi Endod. J.* 2019 Sep 1;9(3):235.
- [22]. Manohar MP, Sharma S. A survey of the knowledge, attitude, and awareness about the principal choice of intracanal medicaments among the general dental practitioners and nonendodontic specialists. *Indian J Dent Res.* 2018 Nov-Dec;29(6):716-720. Pubmed PMID: 30588997.
- [23]. Sankaranarayanan S, Jayalakshmi S, Gupta M. Effect of nano-Al₂O₃ addition and heat treatment on the microstructure and mechanical properties of Mg-(5.6 Ti+ 3Al) composite. *Mater. Charact.* 2013 Jan 1;75:150-64.
- [24]. Ravinthar K. Recent advancements in laminates and veneers in dentistry. *Res J Pharm Technol.* 2018 Feb 1;11(2):785-7.
- [25]. Monalisa R. A Comparative study on the occurrence of Internal Voids in Composite Restoration Using Different Incremental Techniques. *Res J Pharm Technol.* 2016 Oct 1;9(10):1596.
- [26]. Rajan K, (2014) Saveetha Dental College and Hospitals, Chennai, India, Ramamurthy J. Effect of Restorations on Periodontal health [Internet]. Vol. 13, *IOSR Journal of Dental and Medical Sciences.* p. 71-3.
- [27]. Azeem RA, Sureshbabu NM. Clinical performance of direct versus indirect composite restorations in posterior teeth: A systematic review. *J Conserv Dent.* 2018 Jan-Feb;21(1):2-9. Pubmed PMID: 29628639.
- [28]. Anitha KV, Dhanraj M, Haribabu R. Comparison of the Effect of Different Ceramic Alloys and Porcelain Systems upon the Color of Metal-Ceramic Restorations: An In Vitro Study. *J Indian Prosthodont Soc.* 2013 Sep;13(3):296-302. Pubmed PMID: 24431750.
- [29]. Neelakantan P, Rao CV, Indramohan J. Bacteriology of deep carious lesions underneath amalgam restorations with different pulp-capping materials - an in vivo analysis. *J Appl Oral Sci.* 2012 Mar-Apr;20(2):139-45. Pubmed PMID: 22666827.
- [30]. Anand VS, Kavitha C, Subbarao CV. Effect of Cavity Design on the Strength of Direct Posterior Composite Restorations: An Empirical and FEM Analysis. *Int J Dent.* 2011;2011:214751. Pubmed PMID: 22216030.
- [31]. Hussainy SN, Nasim I, Thomas T, Ranjan M. Clinical performance of resin-modified glass ionomer cement, flowable composite, and polyacid-modified resin composite in noncarious cervical lesions: One-year follow-up. *J Conserv Dent.* 2018 Sep-Oct;21(5):510-515. Pubmed PMID: 30294112.
- [32]. Sunitha N, Ariga P, Jain AR, Philip JM. An In vitro Evaluation of Flexural Bond Strength of Indirect Composites Fused to Metal. *J Indian Prosthodont Soc.* 2013 Jun;13(2):122-7. Pubmed PMID: 24431721.
- [33]. Arhun N, Tuncer D. Repair of Direct Resin Composite Restorations [Internet]. *Dental Composite Materials for Direct Restorations.* 2019; 245-67.
- [34]. Hunt PR. (1983), Amalgam vs Composite [Internet]. Vol. 107, *The Journal of the American Dental Association.* 384-6.
- [35]. Amalgam-composite resin restorations [Internet]. Vol. 59, *Dental Abstracts.* p. 109.
- [36]. Goldberg M. From the Initial Carious Lesion of Enamel to the Early Development of Coronal Dentin Carious Lesion. *Understanding Dental Caries.* 2016:63-71.
- [37]. Kumar D, Antony SD. Calcified canal and negotiation-A review. *Res J Pharm Technol.* 2018 Aug 1;11(8):3727-30.
- [38]. Rajakeerthi R, Nivedhitha MS. Natural Product as the Storage medium for an avulsed tooth-A Systematic Review. *Cumhur. Dent. J.* 2019;22(2):249-56.
- [39]. Greenwall L. Discoloration of Teeth [Internet]. *Tooth Whitening Techniques.* 2017; p. 1-19.