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Comparative analysis of the success rate of direct and indirect pulp capping procedures - A retrospective analysis

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ABSTRACT

Treatment options of pulp exposure involve either extraction or root canal therapy, as latter involves multiple appointments and considerable expense. An alternate procedure is pulp capping, which is divided into two types- direct, indirect pulp capping. The aim of this study was to assess and compare the success rate of direct and indirect pulp capping procedures based on post-operative pain and patient's visit after pulp capping procedure. As it was a retrospective analysis, data collected from Saveetha hospital, Chennai, and it consisted of a total of 439 cases evaluated based on the type of pulp capping done. Inclusion criteria consisted of Patients aged 18 – 50 years who received direct, indirect pulp capping procedures. Patients who received deep caries management. Patients who have obvious carious lesions noted clinically, radio graphically and received either complete/ partial caries removal followed by placement of cavity liner. The collected data was imported to excel sheet, analyzed using SPSS software. In this study of 261 patients (99 are females, 162 are males with a mean age of 18-40) were included. It was observed that there was not a significant difference among the groups. Indirect pulp capping has a higher success rate over Direct pulp capping with a p-value greater than 0.05. Within the limitations of this study, it can be concluded that the indirect pulp capping has a higher success rate over the direct pulp capping procedures, although it's not statistically significant.

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INTRODUCTION

Preserving the natural tooth structure seems to be vital for many reasons beyond cosmetic purpose. The consequences of pulp exposure occur as a result of caries, trauma, or misadventure occurs during tooth preparation, and end results occur with the pain and infection (Oen *et al.*, 2007). Treatment options for pulp exposure involve either extraction or root canal therapy (Mertz-Fairhurst *et al.*, 1998). An alternate procedure is pulp capping which is divided into two types- direct, indirect pulp capping (Maltz *et al.*, 2007). The success of pulp vitality procedures depends upon many factors (Stanley, 1998). Different types of restorations used in pulp capping procedures affect outcome results. Calcium hydroxide has a higher success rate of up to 10 years (Bogen *et al.*, 2008).

Dental pulp has a natural potential for tissue repair, which leads to the formation of reparative dentin. Direct pulp capping consists of the application of bio compatible materials in the exposure tissue to seal the communication as a barrier; It protects the pulp

complex and vitality (Bleicher, 2014).

The bio compatible materials used for pulp vitality procedures are calcium hydroxide, MTA (Mineral trioxide aggregate) (Poggio *et al.*, 2014a). The MTA cement is bio active, bio compatible, antibacterial and has good stability, sealing ability. Some disadvantages are long setting time, poor handling properties, high cost, the potential for discoloration (Cooper *et al.*, 2010; Salehi *et al.*, 2016).

The aim of this study was to assess and compare the success rate of direct and indirect pulp capping procedures based on postoperative pain and patient's visit after pulp capping procedure.

MATERIALS AND METHODS

Study Design

A 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.

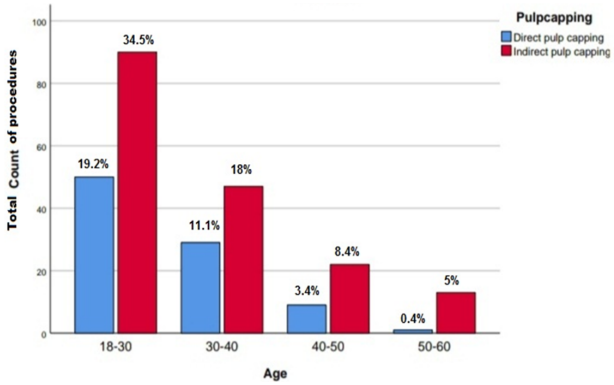

Chart 1: Bar chart showing an association between age and pulp capping.

Eligibility Criteria

Inclusion criteria

Patients of age 18 – 50 years who received direct, indirect pulp capping procedures, patients who received deep caries management, patients who have obvious carious lesions noted clinically, radio graphically and received either complete/ partial caries removal followed by placement of cavity liner were all included.

Exclusion criteria

Patients who have not undergone deep caries management, and patients who received endodontic therapy, patients who received mild class I cavity restorations were excluded from the study.

Data Extraction

Data were evaluated using 439 patient's records from June 2019 to March 2020. Data collection was accomplished using standardized software. It consists of the patient's demographic information and procedural data. The final data was exported to excel and analyzed. The case selection and data extraction is shown in Figure 1.

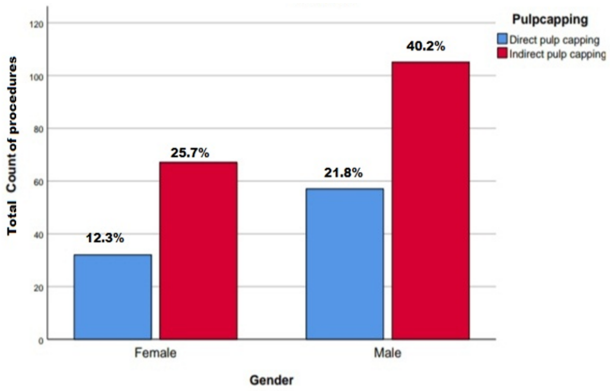

Chart 2: Bar chart showing an association between gender and pulp capping.

Sample size

A total of 439 patients charts, identifying pulp capping procedures completed over a period of one year. Among that, 261 cases met the eligibility criteria. The sampling method used was the data evaluated, collected from the patient record at Saveetha Dental College, Chennai. Among the total cases, 97 patients underwent direct pulp capping procedures, and 164 patients underwent indirect pulp capping procedures.

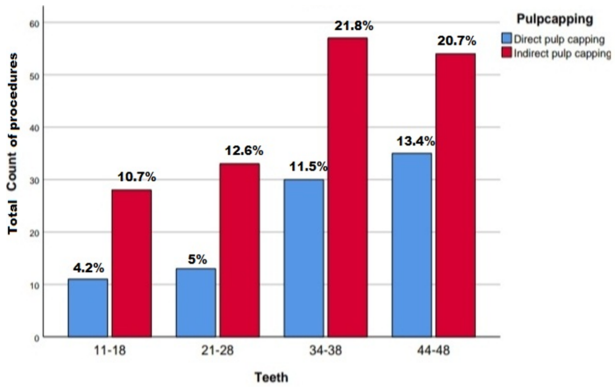

Chart 3: Graph showing the correlation between age and the count of pulp capping.

Groups

The pulp capping procedures done were

Group A: Direct Pulp Capping

Group B: Indirect Pulp Capping

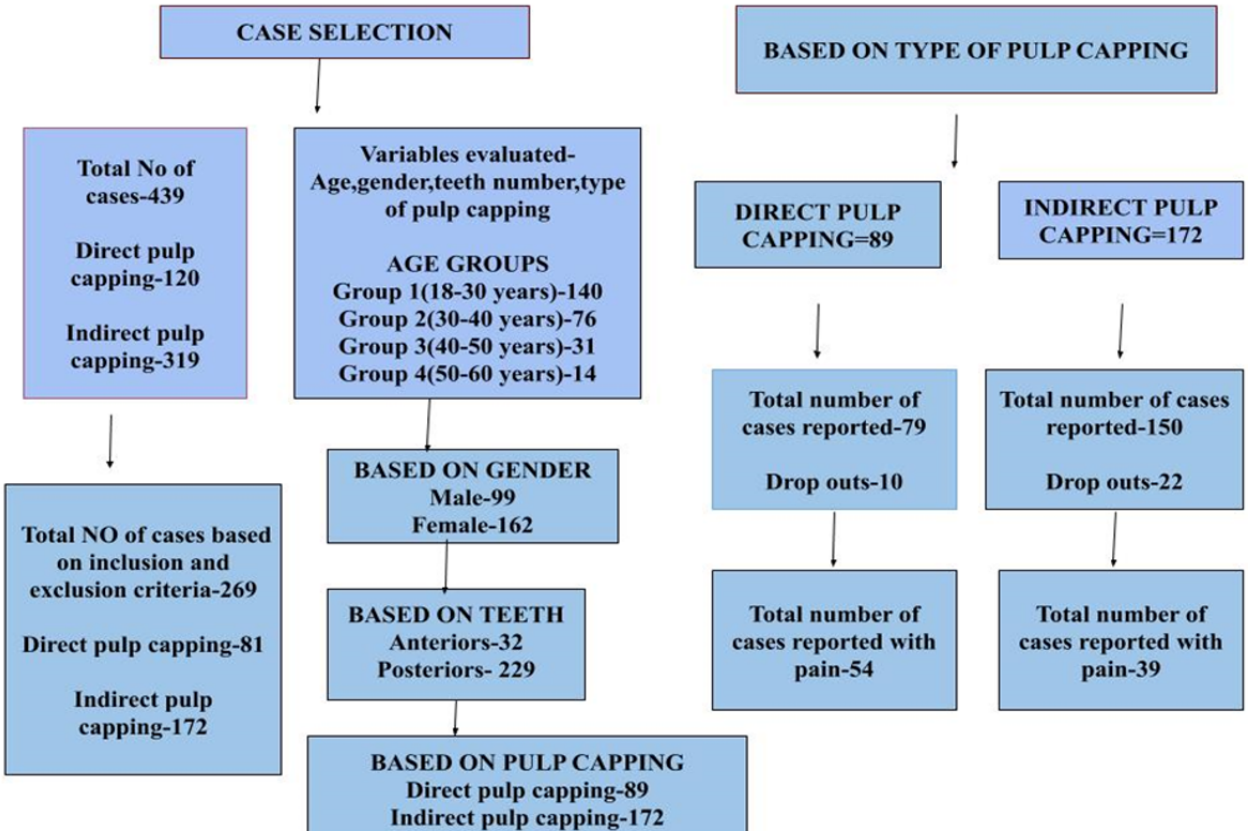

Figure 1: Selection of Cases in the Study.

Clinical outcome

The primary clinical outcome of this procedure was to evaluate the success rate. The success rate is assessed based on Patients visit the clinics because of pain after pulp capping procedure and also the maintenance of pulp vitality. All patients were followed up and received a permanent restoration within the period of one month.

Clinical Protocol

The clinical protocol for the patients undergoing pulp capping procedure is to assess the pulp status by pulp vitality tests, clinical and radio graphic findings. After performing the diagnostic procedures, the caries was removed, and a radio graph was taken to confirm the status of pulpal involvement after caries removal and then based on clinical and radio graphic findings, the decision of whether direct/indirect pulp capping was taken. Calcium hydroxide was used in both direct and indirect pulp capping cases predominantly followed by cavity liner, temporary restoration.

Study Outcome

The success rate is assessed based on Patients visit because of pain after pulp capping procedure. Since the patient's next visit for patients who received temporary restorations is to be replaced with permanent restorations, many patients reported pain after pulp capping procedure.

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 of the patient. The graphs are representing the correlation between these parameters- Correlation of age and type of pulp capping, gender and type of pulp capping, teeth number and type of pulp capping.

RESULTS AND DISCUSSION

In this study comparing direct, indirect pulp capping procedures, indirect pulp capping procedures (group B) has a higher success rate than direct pulp capping procedures (group A). In this study comprising 261 cases, 32 patients did not report back for a permanent restoration. Among 97 direct pulp capping cases, 79 patients reported for permanent restoration, and 54 patients reported pain and the endodontic procedure was initiated in 31 patients and others kept under observation. Among 164 indirect pulp capping procedures, 132 patients reported back, and 39 patients complaints of pain

and the endodontic procedure were initiated in 19 patients.

Chart 1 shows that the X-axis denotes age group. Y-axis denotes the count of pulp capping. Depending on the frequency of pulp capping procedure based on the age of the patient 18-30 years accounted for 53.6% overall cases, 30-40 years accounted for 29.1% overall cases, 40-50 years accounted for 11.9% overall cases, and the least was 50-60 years accounted 5.4% of overall cases. Based on the age and the type of pulp capping technique used maximum cases in males accounted for indirect pulp capping and in females maximum cases accounted for indirect pulp capping There is no significant difference in between the groups in Chi-Square test-1.686, the p-value is 0.54>0.05 Table 1.

Chart 2 shows that the X-axis shows gender. Y-axis is the count of pulp capping. Indirect pulp capping appears to be the predominant pattern. Depending on the frequency of pulp capping procedure based on the gender of the patient males accounted for 62.9% overall cases and females accounted 37.1% overall cases. Based on gender and the type of pulp capping technique, maximum cases in males accounted for indirect pulp capping, and in females, maximum cases accounted for indirect pulp capping. There is no significant difference in between the groups in Chi-Square test -2.472; the p-value is 0.43>0.05 Table 2.

Chart 3 shows that the X-axis denotes the teeth and Y-axis denotes the count of pulp capping. Depending on the frequency of pulp capping procedure based on the teeth of the patient, anterior accounted for 13.6% overall cases, and posteriors accounted for 86.4% overall cases. Based on teeth and the type of pulp capping used maximum cases accounted for indirect pulp capping. There is no significant difference in between the groups in Chi-Square test-1.485, the p-value is 0.74>0.05 Table 3. The success of pulp vitality procedures is influenced by many factors ranging from the age of the patient to the type of restorative material used (Song *et al.*, 2017; Poggio *et al.*, 2014b).

Among 97 direct pulp capping cases, 79 patients reported for permanent restoration, and 54 patients reported pain and the endodontic procedure was initiated in 31 patients and others kept under observation. Among 164 indirect pulp capping procedures, 132 patients reported back, and 39 patients complaints of pain and the endodontic procedure were initiated in 19 patients in this study.

Previous studies showing the success rate for teeth treated with CaOH ranged from 19.8% — 82% with an average of 55.20% (Chang *et al.*, 2014b). Horsted et al.,2003 analyzed pulp vitality success rate based on dentin adhesion. The presence of intense inflammatory response for teeth treated showed a variation of 0-100% (mean of 41.6%) compared to the variation of 0-20% (mean of 7.4%) treated with calcium hydroxide (Smith *et al.*, 2012; Larmas and Sándor, 2014). In teeth treated with calcium hydroxide, expression of three collagen, fibronectin was increased over a period of time (Atari *et al.*, 2012; Chang *et al.*, 2014a).

The true gold standard of pulp status is histological analysis. Unfortunately, the true state of pulp health/ pathology cannot be determined using clinical/ radio graphic appearance (Khademi and Akhlaghi, 2015; Min *et al.*, 2008). A study analyzed the series of changes occurring to carious lesions after partial removal for a time duration of 4-12 months, such as reduction of microbial load, color change and consistency of carious lesion (Ferracane *et al.*, 2010; de Lourdes R. Accorinte *et al.*, 2008). The type of liner is less important to success than the placement of the well-sealed restoration. Substantial evidence showing that complete removal of caries is not needed for success provided the restoration is well sealed (Sawicki *et al.*, 2008).

Caries preservation to a pulp will result in bacterial invasion of pulp, resulting in pulpal inflammation. For attaining clinical success, placing the well-sealed permanent filling is important (Shahravan *et al.*, 2011). Another factor which is having an effect on the success of direct pulp capping is controlling pulpal bleeding (Accorinte *et al.*, 2009). The materials used in direct pulp capping procedure were zinc oxide eugenol, glass ionomer cement, adhesive cement and these cement have good aesthetic properties (Jose *et al.*, 2020; Ravinthar and Jayalakshmi, 2018). The advantages of glass ionomer cement include fluoride release and remineralization of carious lesions to some extent (Nasim *et al.*, 2018; Nasim and Nandakumar, 2018; Rajendran *et al.*, 2019).

(Manohar and Sharma, 2018; Noor and Pradeep, 2016; Ramamoorthi *et al.*, 2015) The above factors should be considered in pulp capping procedures. It is similar to many factors that influence the endodontic therapy such as proper disinfection, shaping, placement of intracanal medicament (Ramanathan and Solete, 2015; Siddique *et al.*, 2019; Teja and Ramesh, 2019). Similarly, many factors influence the vital status of pulp in case of Inflammation, traumatic injury, calcified canal (Kumar and Antony, 2018; R and Ms, 2019). The pulpal diagnosis should be made properly with advanced armamentarium (Janani *et al.*,

Table 1: Distribution of cases which were included for the study based on Age and Gender.

Patients Characteristics	No of Patients	Percentage value
Gender		
Male	162	62.1%
Female	99	37.9%
Age		
18- 30 years	140	53.6%
30- 40 years	76	29.1%
40- 50 years	31	11.9%
50- 60 years	14	5.4%
Type of Pulp Capping		
Direct pulp capping	97	37.8%
Indirect pulp capping	164	62.2%

Table 2: Distribution of cases which were included for the study based on teeth type.

Tooth Distribution	No of Teeth	Percentage Value
Jaw		
Maxillary	85	37%
Mandibular	176	63%
Teeth Number		
Anterior	32	13.3%
Posterior	229	86.4%
Central Incisors	11	34.3%
Lateral Incisors	12	37.5%
Canine	9	28.1%
Premolars	80	30.6%
Molars	149	57.4%

Table 3: Distribution of frequency among Age, Gender, Teeth number and type of pulp capping.

Age Group	Frequency	Percent	Valid Percent	Cumulative Percent
1	140	57.4	57.7	57.7
2	76	37.8	39.1	81.6
3	31	11.2	12.2	85.9
4	14	9.1	9.4	100
Gender	**Frequency**	**Percent**	**Valid percent**	**Cumulative Percent**
Female	162	57.3	57.5	49.5
Male	99	39.2	39.5	100.0
Teeth Number	**Frequency**	**Percent**	**Valid Percent**	**Cumulative Percent**
First quadrant	43	37.8	38.3	38.4
Second quadrant	41	38.3	38.4	57.7
Third quadrant	84	39.9	40.2	68.7
Fourth quadrant	92	42.6	42.7	100.0
Type of Pulp Capping	**Frequency**	**Percent**	**Valid Percent**	**Cumulative Percent**
Direct pulp capping	97	28.8	28.9	31.3
Indirect pulp capping	164	71.2	71.5	100.0

2020; Ramesh *et al.*, 2018).

The chances of tooth survival after pulp capping were found to be well provided if the patient doesn't have symptoms (Nair *et al.*, 2008). Yet, misconceptions are noted in pulp vitality procedures starting from proper diagnosis to follow up (Ritter, 2007). In this study, the overall consensus it agreed with previous literature showing that success rate is excellent if properly sealed irrespective of residual caries noted in teeth underwent pulp capping procedures.

Overall Consensus

In agreement with the findings of the study.

Study Limitation

The limitations of this study were it involved relatively a smaller number of population. The success rate evaluated based on one parameter- postoperative pain and not based on restorative material used for pulp capping procedure.

Future Scope

The future scope can be focused on a relatively larger number of populations to be assessed for attaining a clear protocol regarding success rate. The restorative material used in direct, indirect pulp capping procedures to be assessed based on their bio compatible nature, sealing ability, adhesion to teeth.

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.

CONCLUSION

Within the limitations of this study, it can be concluded that the indirect pulp capping has a higher success rate over the direct pulp capping procedures, although it's not statistically significant.

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Conflict of Interest

The authors declare that they have no conflict of interest for this study.

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