



Questionnaire-Based Survey On Material Preference And Clinical Application Of Pulp Capping Among Dental Students

Kaviya. R(BDS), Dr Visithra(MDS), Dr Bharath(MDS)

Dr sujitha(MDS) -Department of conservative dentistry and endodontics

ABSTRACT

BACKGROUND:

Pulp capping is a minimally invasive therapeutic approach designed to preserve the vitality of the dental pulp. The effectiveness of this procedure largely depends on the clinician's knowledge, training, and appropriate selection of materials. Dental students' awareness and understanding of pulp capping materials and techniques are therefore critical in influencing clinical success.

AIM:

The present study aimed to evaluate the level of knowledge, preferred materials, and clinical application of pulp capping procedures among dental students across different academic years.

MATERIALS AND METHODS

A cross-sectional, questionnaire-based survey was carried out among 194 dental students, comprising third-year students, final-year students, and interns. The questionnaire assessed participants' knowledge and clinical practice related to pulp capping materials. Data were subjected to descriptive statistical analysis and compared using one-way analysis of variance (ANOVA), followed by Tukey's HSD post-hoc test. Statistical significance was established at $p < 0.05$.

RESULTS

A statistically significant difference in mean knowledge and clinical application scores was observed among the three academic groups ($F(2,191) = 5.82, p = 0.004$). Final-year students achieved significantly higher scores than third-year students ($p = 0.003$). Academic level contributed to 5.7% of the variability in scores ($\eta^2 = 0.057$).

CONCLUSION

Advancement in academic level significantly impacts students' knowledge and clinical application of pulp capping procedures. Final-year students demonstrated better understanding compared to junior students, underscoring the importance of progressive clinical exposure and structured teaching in conservative dentistry.

KEYWORDS-Pulp capping, Dental students, Material preference, Calcium hydroxide, Mineral trioxide aggregate, Knowledge assessment

INTRODUCTION

Maintaining pulp vitality is an important aim in conservative dental practice. Preserving the pulp helps maintain the natural function of the tooth for a longer period. Pulp capping procedures are commonly used for this purpose. These include both direct and indirect pulp capping techniques. They are performed after deep carious lesions or accidental pulp exposure. The success of pulp capping depends on several factors. These include proper case selection, strict aseptic conditions, and the correct choice of pulp capping material.

Pulp capping techniques are generally classified as direct or indirect, depending on whether the pulp is exposed. Indirect pulp capping is carried out in teeth with deep carious lesions where the pulp is not exposed. In this technique, a thin layer of affected dentin is intentionally left near the pulp. A biocompatible material is then placed over this dentin. The main aim is to avoid pulp exposure and to stimulate the formation of tertiary dentin. This helps protect the pulp and maintain its vitality.

Direct pulp capping is performed when the pulp is already exposed, either due to caries removal or trauma. In this procedure, the pulp capping material is placed directly over the exposed pulp tissue. The goal is to promote healing of the pulp and encourage the formation of reparative dentin. The success of both direct and indirect pulp capping depends on correct case selection, careful clinical technique, proper control of pulpal inflammation, and the ability of the restorative material to provide a good seal.

The clinical outcome of pulp capping does not depend only on the material used. The accuracy of the clinical technique also plays a major role. Proper diagnosis is essential before planning the procedure. Pulp capping should be performed only in teeth with reversible pulpitis or minimal pulp exposure. Teeth showing signs

of irreversible pulp damage are not suitable for this treatment. Strict isolation is required during the procedure, and the use of a rubber dam is preferred to prevent bacterial contamination.

Adequate caries removal is an important step before placing the pulp capping material. Care should be taken to avoid unnecessary pulp trauma. Control of pulpal bleeding is essential before material placement. Hemostasis can be achieved using sterile saline or mild disinfecting agents. Excessive pressure or harsh chemicals should be avoided. The pulp capping material should be placed gently over the pulp exposure in a thin and uniform layer. This supports dentin bridge formation and helps maintain pulp vitality. After this step, a well sealed permanent restoration should be placed. A poor seal can lead to microleakage, which is one of the main causes of pulp capping failure.

Dental students must have a clear understanding of each step involved in pulp capping. This includes isolation methods, bleeding control, proper handling of materials, and placement of the final restoration. Inadequate knowledge or improper technique can allow bacterial contamination. This may result in pulp inflammation and eventual failure of treatment. Therefore, assessing dental students' awareness and clinical application of pulp capping procedures is important for improving clinical education and strengthening evidence based practice.

In modern vital pulp therapy, both the material used and the clinical technique significantly affect treatment success. For many years, calcium hydroxide was the most commonly used pulp capping material. It was favored due to its high alkalinity and ability to stimulate reparative dentin formation. However, calcium hydroxide has several limitations. It has poor sealing ability, is soluble over time, and may produce an irregular dentin bridge. These factors can reduce long term success.

The introduction of calcium silicate based and bioceramic materials has improved pulp capping outcomes. Materials such as MTA and Biodentine show good biocompatibility and bioactivity. They also provide better sealing ability and promote improved pulp healing and tertiary dentin formation. MTA has long been considered a reliable pulp capping material. It produces predictable dentin bridge formation and offers superior sealing when compared to calcium hydroxide. However, it has some disadvantages. These include a long setting time, difficult handling, and the risk of tooth discoloration.

Biodentine is a newer tricalcium silicate based material developed to overcome the drawbacks of MTA. It has a faster setting time of around twelve minutes. It also has better handling properties and improved mechanical strength. Tooth discoloration is minimal when compared to MTA. These features allow smoother clinical procedures and may improve patient comfort.

Dental students gradually gain knowledge of pulp capping through theoretical learning and clinical exposure. Evaluating their understanding and preferences regarding pulp capping materials can help identify gaps in undergraduate training. This information can be useful for improving teaching methods and clinical practice. Therefore, this study was conducted to evaluate and compare the knowledge and clinical application of pulp capping techniques among dental students at different academic levels

MATERIALS AND METHODS

This cross sectional questionnaire based study was carried out among undergraduate dental students and dental interns. The study included a total of 194 participants. These participants consisted of third year students, final year students, and interns. Ethical approval was obtained before the start of the study. Informed consent was also taken from all participants prior to their involvement.

A structured questionnaire was prepared for data collection. The questions were framed based on available literature and expert opinion. A total of 19 multiple choice questions were designed using an online survey platform, Google Forms. The questionnaire link was shared with the participants through WhatsApp to ensure easy access and response.

The first section of the questionnaire consisted of six questions. These questions focused on the demographic details of the participants. Information regarding gender, age, and year of study was collected in this section. The second section of the questionnaire included fifteen questions. These questions assessed the participants' basic knowledge of pulp capping procedures. It also evaluated their preferences for pulp capping materials and haemostasis agents.

Additional questions were included to assess awareness regarding factors that influence the success of pulp capping treatment. Participants were also questioned about their knowledge of possible complications

related to pulp capping procedures. Criteria used by students to judge treatment outcome were also explored in this section.

The collected data were entered and analyzed using descriptive statistical methods. Comparison between different academic groups was performed using one way analysis of variance. Tukey's HSD post hoc test was used for multiple comparisons. Statistical significance was considered when the p value was less than 0.05. The questions asked are

1.Age

2.Email id

3.Gender

A. Male

B. Female

C.others

4.Year of study

A.I year

B.II year

C.III year

D.IV year

E. Interns

5. What is the primary goal of pulp capping?

A. Removal of the pulp

B. Preservation of pulp vitality

C. Strengthening enamel

D. Improving crown retention



6.. Which of the following is a direct pulp capping indication?

- A. Irreversible pulpitis
- B. Necrotic pulp
- C. Small mechanical pulp exposure
- D. Chronic periapical abscess

7. Which is most commonly used for indirect pulp capping?

- A. Calcium hydroxide
- B. Composite resin
- C. Amalgam
- D. Zinc phosphate

8. Which property is most essential in a pulp capping material?

- A. Aesthetics
- B. Biocompatibility
- C. Fluoride release
- D. Staining potential

9. Which material is considered the gold standard for pulp capping for many decades?

- A. MTA
- B. Calcium hydroxide
- C. Biodentine
- D. Zinc oxide eugenol

10. What is a major drawback of calcium hydroxide as a pulp capping material?

- A. Poor antibacterial property
- B. Long setting time
- C. Tunnel defects in dentin bridge
- D. Lack of radiopacity

11. Mineral Trioxide Aggregate (MTA) is preferred over calcium hydroxide because:

- A. It is cheaper
- B. It induces more predictable dentin bridge formation
- C. It sets instantly
- D. It has poor sealing ability

12. Biodentine differs from MTA primarily because:

- A. It is not bioactive
- B. It sets faster and is easier to handle
- C. It causes tissue irritation
- D. It is less biocompatible

13. Which pulp condition is most suitable for indirect pulp capping?

- A. Necrotic pulp
- B. Vital pulp with deep caries but no exposure
- C. Irreversible pulpitis
- D. Hyperplastic pulpitis

14. A successful pulp capping procedure depends most on:

- A. Operator speed
- B. Moisture contamination control
- C. Radiographic technique
- D. Tooth shade selection

15. What is the ideal time for performing direct pulp capping after pulp exposure?

- A. Immediately
- B. After 24 hours
- C. After 3 days
- D. After 1 week

16. Which of the following is a bioactive material?

- A. MTA
- B. Zinc oxide eugenol
- C. Amalgam
- D. Glass ionomer

17. Which of the following can lead to pulp capping failure?

- A. Bacterial contamination
- B. Adequate sealing
- C. Use of bioactive materials
- D. Moisture control

18. Which material shows the best sealing ability?

- A. Calcium hydroxide
- B. Biodentine
- C. MTA
- D. Zinc oxide eugenol

19. Which layer is preserved in indirect pulp capping?

- A. Necrotic dentin
- B. Affected dentin
- C. Caries-infected dentin
- D. Enamel prisms

SATISTICAL ANALYSIS

Data were analyzed using Microsoft Excel with Data Analysis ToolPak. Continuous variables (knowledge and clinical application scores) were assessed for normality and homogeneity of variance, then presented as means \pm standard deviations. Categorical variables are presented as frequencies and percentages. Descriptive statistics were calculated for all three academic groups. All questionnaire responses were complete with no missing data, and all 194 participants were included in the final analysis.

One-way analysis of variance (ANOVA) was conducted to compare mean scores across the three academic levels, with assumptions of independence, normality, and homogeneity of variance verified prior to analysis. Effect size was estimated using eta-squared (η^2). Following a statistically significant ANOVA result ($p < 0.05$), Tukey's Honestly Significant Difference (HSD) post-hoc test was performed to identify specific pairwise differences while controlling for family-wise error rate. Mean differences with 95% confidence intervals and HSD critical values are reported for all pairwise comparisons (final year vs. third year; intern vs. third year; final year vs. intern). All statistical tests were two-tailed with significance level set at $\alpha = 0.05$. Results are reported in accordance with STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines for cross-sectional studies

RESULT

Participants

A total of 194 dental students participated in this questionnaire-based survey on material preference and clinical application of pulp capping. The participants comprised 64 (33.0%) third-year students, 96 (49.5%) final-year students, and 34 (17.5%) interns. All distributed questionnaires were completed and included in the final analysis, yielding a 100% response rate.

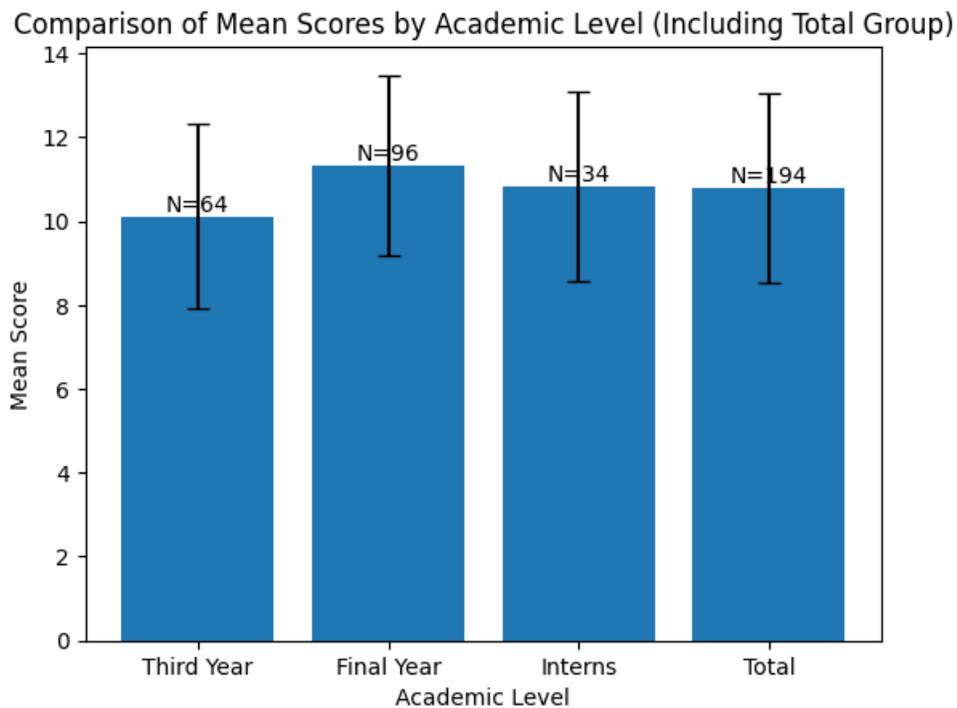
Descriptive Data

Knowledge Scores by Academic Level

Table 1 presents the descriptive statistics of pulp capping knowledge and clinical application scores across the three academic levels. Final-year students demonstrated the highest mean score ($M = 11.33$, $SD = 2.15$), followed by interns ($M = 10.82$, $SD = 2.46$) and third-year students ($M = 10.11$, $SD = 2.20$).

Academic level	N	Mean	SD	Variance
third year	64	10.11	2.20	4.86
final year	96	11.33	2.15	4.62
interns	34	10.82	2.26	6.03
TOTAL	194	10.79	2.25	5.08

Table 1. Descriptive Statistics of Scores by Academic Level *SD = Standard Deviation;



Comparison of Knowledge Scores Across Academic Levels

A one-way analysis of variance (ANOVA) was conducted to examine differences in pulp capping knowledge and clinical application scores among the three academic levels. The assumption of homogeneity of variances was met (Levene's test: $F = [\text{insert value}]$, $p = [\text{insert value}]$).

The ANOVA revealed a statistically significant difference in mean scores among the three groups, $F(2, 191) = 5.82$, $p = 0.004$, $\eta^2 = 0.057$. This indicates that academic level accounted for approximately 5.7% of the variance in pulp capping knowledge and clinical application scores.

source of variation	SS	DF	MS	F	p- value	F crit
between groups	57.54	2	28.77	5.82	0.004**	3.04
within groups	944.51	191	4.95	-	-	-
TOTAL	1002.05	193	-	-	-	-

Table 2. One-Way ANOVA Results between third/final/intern students ** $p < 0.01$;

SS = Sum of Squares; df = degrees of freedom; MS = Mean Square

Post-hoc Pairwise Comparisons

Following the significant ANOVA result, Tukey's Honestly Significant Difference (HSD) post-hoc test was conducted to identify specific group differences. The results are presented in Table 3

comparison	mean difference	95% CI*	HSD critical value	p-value	significant
final year vs third year	1.22	[0.38,2.06]	0.84	0.003**	yes
interns vs third year	0.71	[-0.43,1.85]	1.13	0.296	no
final year vs interns	0.51	[-0.56,1.58]	1.06	0.551	no

Table 3. Tukey's HSD Post-hoc Test Results *CI = Confidence Interval; **p < 0.01

The post-hoc analysis revealed that final-year students scored significantly higher than third-year students (mean difference = 1.22, 95% CI [0.38, 2.06], p = 0.003). No statistically significant differences were observed between interns and third-year students (mean difference = 0.71, p = 0.296) or between final-year students and interns (mean difference = 0.51, p = 0.551). Academic level significantly influenced knowledge and clinical application scores regarding pulp capping (p = 0.004). Final-year students demonstrated significantly superior knowledge compared to third-year students, with an average improvement of 1.22 points. Academic level accounted for 5.7% of the total variance in scores, suggesting that other factors beyond academic progression may influence pulp capping knowledge and clinical application.

DISCUSSION

This questionnaire-based survey evaluated dental students' knowledge, material preference, and clinical application of pulp capping procedures at different stages of academic training. The results revealed a significant variation in knowledge and clinical application scores among third-year students, final-year students, and interns, indicating that academic advancement has a measurable influence on students' understanding of vital pulp therapy

Final-year students demonstrated significantly higher scores than third-year students, which may be attributed to increased theoretical instruction and greater clinical exposure during the advanced years of

undergraduate training. As students progress through the curriculum, they encounter a wider range of clinical situations involving deep caries and pulp exposure. This repeated exposure, combined with supervised clinical practice, likely enhances their comprehension of case selection, material choice, and procedural accuracy, resulting in improved performance.

However, interns did not exhibit a statistically significant increase in scores compared to final-year students. Although internship involves extensive clinical practice, the lack of structured academic teaching during this period may limit further improvement in conceptual understanding. This finding suggests that clinical experience alone may not be sufficient to strengthen knowledge of pulp capping procedures without continuous academic guidance and reinforcement

The relatively small effect size observed in this study indicates that academic level explains only a limited portion of the variability in students' knowledge and clinical application. This suggests the influence of other contributing factors, such as individual learning styles, quality of clinical supervision, exposure to contemporary materials, and access to evidence-based educational resources. Students who actively engage in self-directed learning or receive consistent mentoring may demonstrate better understanding regardless of their academic year.

Material selection plays a critical role in the success of pulp capping procedures. While calcium hydroxide remains a commonly taught material due to its historical success in stimulating reparative dentin formation, newer calcium silicate-based materials such as mineral trioxide aggregate and Biodentine offer superior biocompatibility, sealing ability, and more predictable clinical outcomes. Awareness and appropriate use of these newer materials appear to improve with advancing academic level, likely due to increased exposure through lectures, demonstrations, and clinical discussions.

The findings of this study align with previous research indicating that knowledge of conservative dental procedures improves with academic progression. Nevertheless, the limited improvement observed during internship highlights the importance of continued academic engagement beyond the undergraduate years. Structured refresher courses, case-based learning, and evidence-based teaching during internship may further enhance students' clinical reasoning and decision-making skills. Despite its strengths, including

complete participation and representation of multiple academic levels, this study has certain limitations. The reliance on self-reported questionnaire responses may not fully reflect actual clinical competence. Additionally, as the study was conducted within a single institution, the findings may not be universally generalizable. Future multicenter studies incorporating objective clinical assessments could provide deeper insight into dental proficiency in pulp capping procedures.

In summary, the results emphasize the need for a balanced integration of theoretical knowledge and clinical training throughout dental education. Strengthening undergraduate instruction, promoting awareness of modern pulp capping materials, and ensuring ongoing academic support during internship may help improve clinical competence and support effective decision-making in vital pulp therapy

CONCLUSION

Academic progression plays an important role in building dental students' knowledge and clinical use of pulp capping procedures. Final year students showed a much better understanding when compared to third year students. This difference may be linked to increased clinical exposure and repeated learning during the later years of training.

The findings of this study highlight the need to include evidence based teaching methods throughout undergraduate dental education. Regular clinical exposure and guided learning are important to improve confidence and skills in pulp capping procedures. Strengthening both theory and clinical practice during all academic years can help students develop better competence in managing vital pulp therapy.

REFERENCES

1. Bergenholtz G, Cox CF. Pulp capping—A critical review. *Endod Dent Traumatol.* 2006;22(2):69–79.
2. Fuks AB. Pulp therapy for the primary and young permanent dentition. *Dent Clin North Am.* 2000;44(5):791–813.
3. Bogen G, Kim JS, Bakland LK. Direct pulp capping with mineral trioxide aggregate: an observational study. *J Endod.* 2008;34(3):258–263.
4. Tronstad L. Reaction of the exposed pulp to calcium hydroxide. *J Endod.* 1979;5(11):313–319.
5. Parirokh M, Torabinejad M. Mineral trioxide aggregate: a comprehensive literature review—Part I. *J Endod.* 2010;36(1):16–27.
6. Nowicka A, Lipski M, Parafiniuk M, et al. Response of human dental pulp to capped exposures with calcium hydroxide and MTA. *J Endod.* 2007;33(3):273–277.
7. Camilleri J. Investigation of Biodentine as dentine replacement material. *Int Endod J.* 2014;47(2):101–115.

8. Koutroulis A, Kuehne SA, Cooper PR, et al. The effects of pulp capping materials on pulp vitality. *Int Endod J.* 2016;49(8):740–748.
9. Hilton TJ, Ferracane JL, Mancl L. Comparison of pulp capping materials. *J Am Dent Assoc.* 2013;144(10):1187–1197.
10. Schwendicke F, Brouwer F, Schwendicke A, Paris S. Different materials for direct pulp capping: a meta-analysis. *J Endod.* 2016;42(9):1412–1419.
11. Marković D, Petrović B, Perić T. Knowledge of pulp therapy among dental students. *Eur J Dent Educ.* 2017;21(2):e11–e15.
12. Al-Zyoud W, Al-Hourani Z, Al-Omiri M. Dental students' attitudes toward pulp capping materials. *J Oral Sci.* 2015;57(3):227–232.
13. Almutairi AF, AlEnezi S, Almutairi A. Knowledge and preference of pulp capping materials among dental students. *Saudi Dent J.* 2019;31(4):495–501.
14. Mohan M, Reddy S, Ramachandra PK. Awareness of Biodentine among dental students. *J Clin Diagn Res.* 2018;12(5):ZC48–ZC52.
15. Manabe A, Itoh K, Wakumoto S. Hard tissue formation by calcium hydroxide and MTA. *Dent Mater J.* 2002;21(4):347–355.
16. Gandolfi MG, Siboni F, Prati C. Properties of calcium silicate cements. *J Endod.* 2010;36(6):1059–1063.
17. Camilleri J, Sorrentino F, Damidot D. Investigation of hydration of Biodentine. *Dent Mater.* 2014;30(10):1001–1009.
18. Dammaschke T, Leidinger J, Schäfer E. Long-term evaluation of direct pulp capping. *Int Endod J.* 2011;44(12):1177–1185.
19. Iwamoto M, Tsurumachi T, Saito T. Clinical evaluation of pulp capping. *Oper Dent.* 2012;37(5):458–465.
20. Aguilar P, Linsuwanont P. Vital pulp therapy in vital permanent teeth. *J Endod.* 2011;37(6):581–587.
21. Lenzi TL, Soares FZM, Rocha RO. Student perception of pulp capping materials. *J Dent Educ.* 2016;80(4):476–483.