# A COMPARATIVE EVALUATION OF THE EFFECT OF SODIUM HYPOCHLORITE ON THE SHEAR BOND STRENGTH OF DIFFERENT BONDING SYSTEMS: AN IN-VITRO STUDY.

DISSERTATION

Submitted to the

BABU BANARASI DAS UNIVERSITY, LUCKNOW, UTTAR PRADESH

In the partial fulfillment of the requirement for the degree

of

MASTER OF DENTAL SURGERY

In the subject of

CONSERVATIVE DENTISTRY & E[illegible]ODONTICS

Submitted by

DR. RAHUL SHARMA

Under the guidance of

DR. TANU TEWARI

DEPARTMENT OF CONSERVATIVE DENTISTRY & ENDODONTICS

BABU BANARASI DAS COLLEGE OF DENTAL SCIENCES, LUCKNOW.

Batch: 2019-2022 Enrollment No. 11903222220

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## DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation entitled **"A COMPARATIVE EVALUATION OF THE EFFECT OF SODIUM HYPOCHLORITE ON THE SHEAR BOND STRENGTH OF DIFFERENT BONDING SYSTEMS:AN IN-VITRO STUDY: An in-vitro study"** is a bonafide and genuine research work carried out by me under the guidance of **Dr. Tanu Tewari**, Reader, Department of Conservative Dentistry & Endodontics, Babu Banarasi Das College of Dental Sciences, Babu Banarasi Das University, Lucknow, Uttar Pradesh.

Rahul

Signature of the Candidate

**Dr. Rahul Sharma**

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# Acknowledgement

## *ACKNOWLEDGEMENT*

*The most important function of education at any level is to develop the personality of the individual and the significance of his life to himself and to others."*

*At the very start, I bow my head to the* ***Almighty GOD****, who blessed me with his worthy blessings, bestowed me with his kind grace, provided me with necessary strength, courage and good health to reach this stage and made it possible to bring out this manuscript.*

*Words cannot describe my emotions for my beloved Parents* ***Mr. Vishambhar Nath Tehria & Mrs. Shardha Tehria*** *who have been my pillars of strength throughout my life. I owe them everything for all the sacrifices, undying support and relentless prayers throughout my educational tenure.*

*A very special thanks to my big brothers who were always there to help* ***Mr. Arun Tehria, Mr. Vivek Tehria.***

*I would thank my beloved brothers,* ***Mr. Rajesh Tehria, Mr. Chotu tehria, Mr. Sonu Tehria & also thank my beloved sister, Ms. Saumya Tehria****, who always stood by me in times of joy and distress and have given me the strength to face the world.*

*It is a profound sense of gratitude that I express my thankfulness to my mentor and Guide,* ***Dr. Tanu Tewari, MDS, Reader, Department of Conservative Dentistry and Endodontics, Babu Banarasi Das College of Dental Sciences, Lucknow,*** *who has been a constant source of inspiration and encouragement to me. The present work bears at every stage the interest of his wise, logical suggestions and meticulous attention to details, which has helped me in bringing this dissertation to its ultimate goal. Without his expert guidance this project would have been buried in complicated jargon.*

## *ACKNOWLEDGEMENT*

*I am deeply indebted to respected* ***Dean and Professor and Head of the Department, Dr. B. Rajkumar, Babu Banarasi Das College of Dental Sciences, Lucknow****, for his constant support, caring attitude and advice that has helped me to carry out this work, his vast knowledge and ability to achieve excellence has proved to be very valuable throughout.*

*I'm deeply indebted to my Co-Guide* ***Dr. Pragyan Paliwal, MDS, Senior Lecturer, Babu Banarasi Das College of Dental Sciences, Lucknow,*** *for his priceless suggestions, constant counselling and affectionate attitude that helped me in preparing this thesis with ease. Without his sharp eyes for details and practical knowledge, this thesis would not have seen the light of the day.*

*I would like to extend my sincere thanks to* ***Dr. Vishesh Gupta, MDS, Reader, Babu Banarasi Das College of Dental Sciences, Lucknow*** *for all the much needed constructive criticism, along with the ingenious suggestions to overcome them.*

*I would like to express my gratitude to* ***Dr. Akanksha Bhatt, Ph.D, MDS, Reader, Babu Banarasi Das College of Dental Sciences, Lucknow*** *for extending all cooperation everlasting guidance, constant help and advice when need arose, and for being there when I needed her help.*

*I'm extremely grateful to* ***Dr. Sandeep Dubey, MDS, Reader, Babu Banarasi Das College of Dental Sciences, Lucknow*** *for the invaluable suggestions & unparalleled knowledge in this very topic of my dissertation.*

*I am truly grateful to* ***Dr. Tarun Saxena, Dr. Palak Singh, Dr. Jaya Singh, Dr. Rita Gupta & Dr. Ananya Rawat, MDS, Senior Lecturer, Babu Banarasi Das College of Dental Sciences, Lucknow*** *for their unwavering help & support in the*

*completion of my dissertation, not just as a teacher, but also as a senior & friend throughout my PG life.*

*With deep sense of gratitude, I acknowledge my revered teacher* ***Dr. Amit Nigam, Lecturer, Babu Banarasi Das College of Dental Sciences, Lucknow*** *for his encouragement and guiding wisdom which many a times supported my sagging spirits.*

*Very special thanks to our beloved teacher* ***Dr. Lalit Chandra Boruah,*** *who laid the very foundation of our post-graduate life in our department.*

*I would like to thank my colleagues* ***Dr. Divya, Dr. Ananya Jain, Dr. Chris Cherian Geogi, Dr. Aarushi Shekhar & Dr. Prachi Mishra*** *for their valuable suggestions and support.*

*I wish my sincere thanks to my super seniors* ***Dr. Swikriti Agarwal, Dr. Gitanjali Singh*** *& my seniors* ***Dr. Sankalp Nigam, Dr. Dibyajit Sur, Dr. Vandana Shukla,*** *who have been a great source of inspiration and encouragement to me.I would like to special thank my junior* ***Dr. Shalu Shukla.***

*I would like to thank my juniors,* ***Dr. Atul Krishnan, Dr. Laxmi Pandey, Dr. Richu Raju, Dr. Ricku Matthew, Dr. Aishwarya Sudha, Dr. Rimjhim Singh, Dr. Shivani Agrawal, Dr. Aayush Poddar, Dr. Satyam Kashyap, Dr. Priyanka Mahajan, Dr. Anuja Kaushik*** *for all their help & support.*

*Getting through my dissertation required more than academic support & I have to thank* ***Dr. Akanksha Tehria,*** *my beloved wife for listening to & at times, having to tolerate me over the past few years. I am truly grateful for your unflinching faith in my abilities & in the blessings of the Almighty. Thank you for being my Google and providing me will all the help that was possible. This was not possible without you.*

## *ACKNOWLEDGEMENT*

*I wish to thank my friends who have been my motivators since UG days,* ***Dr. Sunil Fauzder, Dr. Shweta Singh, Dr. Jyoti Agrawal, Dr. Rahul Samadiya, Dr. Jasbinder Singh, Dr. Sangeeta Sharma, Dr. Girish Sharma*** *for always having faith in me & my abilities.*

*I would like to acknowledge the support of the non-teaching staff of our department* ***Mr. Parshuram, Mr. Vaibhav,*** *I would also like to acknowledge college management staff* ***Mrs. Priyanka, Mrs. Succhi, Mr. Santosh, Mr. Girish & Mr. Saurabh*** *for their support.*

*I beg forgiveness from those, whose names I have inadvertently missed but they should find solace that their knowledge has been extended to others by way of this thesis.*

*Above all I bow my head in gratitude to the almighty and ever loving* ***GOD*** *for bestowing his blessings on me, & rest my work on his feet.*

***OM NAMAH SHIVAAY***

***Dr. Rahul Sharma***

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## LIST OF ABBREVIATIONS

| ABBREVIATION | FULL FORM |
|---|---|
| NaOCl | Sodium Hypochlorite |
| SBS | Shear Bond Strength |
| CIPET | Central Institute of Petrochemicals Engineering & Technology |
| MPa | MegaPascals |
| ANOVA | Analysis of Variance |
| SPSS | Statistical Package fo Social Sciences |
| HEMA | Hydroxyethylmethacrylate |
| IUTM | Instron Universal Testing Machine |
| SSSEA | single-step self-etch adhesive, |
| CHP | Cross-head Speed |
| DBA | Dentin Bonding Agents |
| SF | shear force |

# ABSTRACT

# ABSTRACT

The aim of this study was to evaluate dentin shear bond strength with and without sodium hypochlorite (NaOCL) application using different adhesive systems.

Sixty recently extracted premolar teeth were then sectioned horizontally using a carborandum disc.At the level of the cemento enamel junction to expose the dentin surface. The cut surfaces were finished using silicone carbide paper to create a flat surface. The teeth were then mounted in custom made acrylic moulds. All teeth were divided in to 3 contaning 20 sample each (A (One coat Bond 7.0),B (Tetric+ N Bond universal), C (Prime & Bond universal) respectively, which further divided into 2 subgroups (ie.A1,A2,B1,B2,C1,C2) containing 10 sample each group. For Group A1 B1 C1 respective bonding agents were directly applied to the dentin surface. All the adhesive systems were applied according to the manufacturer instructions, except 5%NaOC1 solution treated for 2 min in Group-A2,Group-B2 and Group-C2. After curing of respective adhesives in each group, Transparent Plastic mould having 4mm internal diameter and 4 height were placed over dentin surface. Composite was used to fill the ring in increments. The resin increments were light cured for 40s each and the samples were stored at $370^{0}$C in distilled water for 24hrs and submitted for shear bond strength (SBS) testing with across head speed of 1mm/min by using Universal Testing Machine. The data was analysed by ANOVA, SHAPIRO – Wilktest and Post hoc analysis was done using Tukey's HSD tests ($p < 0.05$). There was significant difference between groups with or without treatment of NaOCL in Prime and Bond NT groups but not in One Coat Bond7.0.and Tetric + N-Bond Universal groups.

The mean average values of Load at break(Newton) and SBS (MPa) in MEAN±SD were: G-A1 (118.±9.4) ,(8.54±059), G-A2 (167.±13.3), (12.62±054),G –

B1(101±8.11), (7.61±0.47), G-B2 (151.±11.05), (11.45±0.68), G-C1(139.31.±10.69), (10.62±0.21), G-C2 (206.±16.63), (16.07±0.35).

In this study it was found that the dentin shear bond strength of Prime and Bond universal increased after 5% Sodium hypochlorite application while that of One Coat Bond 7.0 and Tetric N Bond universal decreased after Sodium hypochlorite application. However this being an in-vitro study, more in--vivo studies have to be carried out using several dentin bonding agents to understand the effectiveness of NaOCL on etched dentin and subsequently its effect on dentin shear bond strength

**Keywords:** Prime and Bond Universal, One Coat Bond 7.0,Tetric N-bond Universal Sodium hypochlorite, Shear bond strength, Dentin, Universal Testing Machine.

# Introduction

# INTRODUCTION

Increased demand for esthetic restorations in dentistry has led to the development of more advanced dentin bonding systems. Dentin bonding system that are available in the market dentin adhesives include three-steps, two-steps and one-step depending on the method of incorporation of the three main constituents of etching, priming and bonding.[1,2]

A recent revolutionary advancement in dentin bonding agents is the use of acidic adhesives enabling simultaneous application of acid, primer and bonding agent all together in the 6th and 7th generation bonding systems.[3]

The development of dental resin based composite restorative materials, started in the late 1950s and early 1960s by Bowen [4,5,6].Composites are presently the most popular tooth colored materials [7].Composite restorative materials consist of a continuous polymeric or resin matrix in which inorganic filler is dispersed.[8]

Post endodontic restoration is required for all teeth that undergo root canal treatment. One of the most common steps involved in root canal treatment is root canal irrigation. The irrigating solutions that are used have been found to alter the bond strength of the restoration the reason being that these solution when come in contact with the coronal dentin alters its structure thus affecting the bond strength and the sealing ability of the restoration material.

The most common endodontic irrigant used is sodium hypochlorite (NaOCl) because of its, excellent physiological properties such as its antibacterial action & tissue dissolution property [9]. Sodium hypochlorite is a non specific proteolytic agent that has a unique, capacity to dissolve organic components of the smear layer for better penetration of the irrigants into dentinal tubules thus aiding in complete disinfection

of the canal [10]. Although, the effect of NaOCl on dentin is not exactly know, it has been found that but sodium hypochlorite breaks down into sodium chloride and oxygen molecules, and these oxygen molecules act as strong inhibitors for polymerization of resin material.[11]

Phosphoric acid is commonly used to etch hard tooth tissues in attempts to improve adhesives infiltration and retention. Infiltrating the etched and partially demineralized dentin surface with adhesives containing hydrophilic adhesive resin monomers is considered essential for improving bonding at the resin/tissue interface [12]. Micromechanical interlocking of polymerized resins within the network of exposed collagen fibrils resulted in the formation of the "hybrid layer.[13]

This demineralized dentin surface sometimes presents several characteristics that were thought to play a negative role in dentin adhesion:

1. After conditioning dentin with acidic agents, the dense web of collagen fibrils becomes a low energy surface substrate.[14]

2. During acid etching, collagen fibrils undergo structural changes that affect the extent of resin infiltration[15]. Although collapse and shrinkage of collagen fibrils are minimized in the presence of water, reexpansion of a collapsed demineralized collagen matrix remains a considerable problem with bonding to dentin.[16,17,18]

3. Part of acid demineralized dentin collagen remains in a destabilized state that is susceptible to hydrolysis and enzymatic degradation.[19,20,21,22]

4. Incomplete resin infiltration within the demineralized dentin results in a weak collagen-rich zone susceptible to microleakage or nanoleakage.[23,24,25]

Removal of the collagen fibrils with a deproteinizing agent such as sodium hypochlorite (NaOCl) may facilitate the infiltration of adhesive resins into a dentin

substrate [26,27]. Depending on the specific composition of each dentin adhesive, application of NaOCl may either increase or decrease the dentin bond strengths.[28,29,30]

Hence, this has been undertaken that to compare and evaluate the effect of NaOCl on the shear bond strength of different bonding systems available.

# Aims and Objectives

## AIM:

To evaluate and compare the effect of sodium hypochlorite on the shear bond strength of different bonding systems: an in- vitro study.

## OBJECTIVES:

1. To evaluate the effect of 5% sodium hypochlorite on shear bond strength of One coat bond (7.0).
2. To evaluate the effect 5% sodium hypochlorite on shear bond strength of Tetric + N- bond universal.
3. To evaluate the effect of 5% sodium hypochlorite on shear bond strength of Prime & bond universal.
4. To compare the effect of 5% sodium hypochlorite on shear bond of One coat bond (7.0) , Tetric + N-bond universal and Prime & bond universal bonding agent.

# Review of Literature

## REVIEW OF LITERATURES

1. **Inaba D, Ruben J, Takagi O, Arends J. (1996)**[31] investigated the influence of organic material removal from artificial dentine lesions by means of NaOCl pretreatment on subsequent remineralization with and without fluoride. They concluded that the remineralization showed that pretreatment with a 10% NaOCl solution for 2 min, increased lesion remineralization. After NaOCl treatment, the amount of accumulated mineral increased by about 27% without F in the remineralization solution, and by about 4% with 10 ppm in solution. The removal of organic materials from dentine lesions is an interesting approach to enhance remineralization.

2. **Vargas M A, Cobb D S, Armstrong S R (1997)**[32] evaluated the effect of a 2-minute exposure of 5% NaOCI following acid conditioning of the dentin on the shear bond strength for two adhesive systems and to examine the ultra structure of the resin dentin interface under SEM. They concluded that A 2-minute exposure of dentin .to 5% NaOCI following acid conditioning of the dentin had no significant effect on the dentin shear bond strength for Scotchbond Multi-Purpose, but significantly increased the bond strength of All-Bond 2 specimens. The interfacial structure of the dentin to resin bond for two dentin treatments and two adhesive systems was studied morphologically under the scanning electron microscope.

3. **Roberts H W, Karpay R I, Mills S E, (2000)**[33] evaluated the effect of four proposed antimicrobial agents used in dental unit waterlines on dentin bond strength. The authors used a fifth-generation dentin-bonding agent to bond composite cylinders to molar dentin surfaces.. They proposed antimicrobial agents reduced dentin bond

strength. Proposed waterline treatment regimens of a diluted mouthrinse and chlorhexidine significantly reduced dentin bond strength compared with sodium hypochlorite and citric acid regimens.

4. **Perdiga J, Lopes M, Geraldeli S, Lopes G C, Godoy F G (2000)**[34] determined the effect of a commercial 10% NaOCl gel on the dentin shear bond strengths and HL ultra-morphology of two simplified dentin adhesives.They results showed that the increase in the NaOCl application time resulted in a progressive decrease in shear bond strengths for both dentin adhesives. For Single Bond, the application of AD Gel for 60 s resulted in a reduction of bond strengths to 38% of that obtained for the control. For Prime &Bond NT, the mean bond strength obtained when AD Gel was applied for 60 s was 31% of that obtained for the control. The integrity of the collagen fibrils left exposed upon acid-etching plays a major role in the mechanism of adhesion of the specific adhesive systems tested in this study. The intermingling of the adhesive monomers with the filigree of collagen fibers or HL should still be considered the paramount dentin bonding mechanism.

5. **Osorio R, Ceballos L, Tay F, A Miguel, V Cabrerizo, T Manuel (2001)**[35] evaluated the effect of sodium hypochlorite (NaOCl) treatment on dentin bonding by means of contact angle (CA), shear bond strength (SBS), and microleakage (ML) measurements. Ultrastructure and nanoleakage (NL) of the interfaces were examined by transmission electron microscopy (TEM). For CA, SBS, and TEM evaluation, human molars were sectioned to expose dentin surfaces and were either acid-etched (35% H3PO4) or further treated with 5% NaOCl for 2 min before the application of Single Bond adhesive. The results showed that CA values decreased after acid etching and even more after NaOCl treatment. NaOCl treatment produced lower SBS than

acid-etched dentin. Both ML values and NL manifestations were similar for NaOCl-treated and acid-etched dentin. NaOCl did not completely remove the collagen matrix. NL was manifested along the base of hybrid layers and within the polyalkenoic acid copolymer in both groups. Adverse chemical interactions could have occurred between the remnant collagen matrix and/or mineralized dentin after NaOCl treatment. There is no additional advantage in using NaOCl treatment with this adhesive.

6. **Castro A K B B B D, Amaral C M, Ambrosano G M B, Pimenta L A F (2002)**[36] determined the effect of 10% NaOCl-gel on the dentin shear bond strengths (SBS) of three hydrophilic adhesive systems. One-hundred and twenty bovine incisors were mounted, polished with 320 to 600 - grit Al2O3 paper and randomly divided in 6 groups (n=15): G1 - Single Bond applied according to manufacturer's instructions; G2 – 10% NaOCl gel + Single Bond; G3 - Prime & Bond 2.1 used according to manufacturer's instructions; G4- 10% NaOCl gel + Prime & Bond 2.1; G5 - Gluma One Bond used according manufacturer's instructions; G6- 10% NaOCl-gel + Gluma One Bond. They concluded that Collagen removal significantly increased the SBS of Gluma One Bond, but did not affect the SBS values of the other adhesives. The influence of 10% NaOCl gel in bond strength values may be dependent on the adhesive systems applied.

7. **Sung EC, Tai ET, Chen T, Caputo AA (2002)**[37] evaluated the effect of irrigation solution of different purity levels on the shear bond strength of a hybrid composite to dentin. The effect of irrigation solution on shear bond strength of various dentin bonding agent to a single composite were determined in vitro and it was concluded

that the bond strength to dentin of a hybrid composite irrigated with sodium hypochlorite was dependent on the dentin bonding agent used.

8. **Pecora N, Yaman P, Dennison J, Herrero A (2002)**[38] evaluated the shear bond strength of 3 single –bottle adhesives with their multistep counterparts. They concluded all bonding agents tested resulted in higher mean shear bond strengths when tested with the ultradent testing device compared with the unrestricted knife. The single-step bonding agents exhibited men bond strengths comparable to their multistep counterparts.

9. **Gomez N U, Reis A, Carrilho M R D O, Loguercio A D, Filho L E R(2003)**[39] evaluated the bond strength to superficial (SU) and deep (D) dentin, accessed via apical (DA) or occlusal (DO), using One-Step adhesive system applied according to the manufacturer's instructions (C) or following deproteinization with 10% sodium hypochlorite (H) for 60s, after acid etching. They concluded that: 1) bond strength values were higher in superficial dentin, 2) no difference was found between the two deep substrate preparations, and 3) the application of sodium hypochlorite following dentin acid etching may reduce bond strengths.

10. **Ozturk B, and Ozer F (2004)**[40] evaluated the effects of 5% NaOCl on bond strengths of four bonding systems— Clearfil SE Bond, Prompt L-Pop, Prime&Bond NT, and Scotchbond Multi Purpose Plus—to pulp chamber mesial walls. In general, NaOCl application decreased the bond strength values of the bonding agents. Both Clearfil SE Bond and Prompt L-Pop without NaOCl showed higher bond strength values than the other bonding groups. In NaOCl-applied groups, Clearfil SE Bond had the highest bond strength. They concluded that self-etching bonding systems are more

successful than the other systems in bonding to pulp chamber dentinal wall and that NaOCl reduces bond strength.

11. **Vongphan N, Senawongse P, Somsiri W, Harnirattisai C (2005)**[41] determined the micro tensile bond strengths of total etching adhesive systems to pulpal chamber wall dentine after treated with various irrigants. They concluded that Sodium hypochlorite significantly reduced the bond strengths of the adhesive when a total-etching was applied. The application of sodium ascorbate on sodium hypochlorite treated dentine significantly improved the bond strengths.

12. **Manjunath MK, Vinutha M (2007)**[42] evaluated the effect of NaOCI on shear bond strength of two fifth generation single bottle adhesive agents on demineralized and remineralized dentin surfaces. They concluded that bond strength values to demineralised dentin surface both without and NaOCl application. Sodium hypochlorite is an effective deproteinizing agent and its application results in the formation of a reverse hybrid layer. This formed a more stable interface and would delay the process of hydrolytic degradation overtime.

13. **Cecchin D, Farina A P, Barbizam J V B, Paranho M P G, Carlini B (2011)**[43] evaluated the bond strength of a total-etching adhesive system to dentin irrigated with 1% sodium hypochlorite (NaOCl) and ethylene diamine tetraacetic acid 17% (EDTA). They concluded that the application of the NaOCl irrigating solution significantly decreased the bond strength values. The use of NaOCl followed by EDTA resulted in bond strength values not statistically different from control group.

14. **Chaharom M E E, Kahnamoii A M, Kimyai S and Moghaddam M H (2011)**[44] evaluated the effect of sodium hypochlorite (NaOCl) on the shear bond strength of

fifth and seventh –generation adhesive resins to coronal dentin. They concluded the use of NaOCl reduced the shear bond strength of fifth and seventh-generation adhesive resins to dentin and there was no difference in the shearing bond strength of both adhesive resins.

15. **Rosa A C M V, Goncalves M, Orsi IA, Miani P K (2011)**[45] evaluated the dentin shear bond strength of four adhesive systems (Adper Single Bond 2, Adper Prompt L-Pop, Magic Bond DE and Self Etch Bond) in regards to buccal and lingual surfaces and dentin depth. They concluded that bond strength is affected by adhesive and dentin depth. The dental adhesive systems had a significant influence on shear bond strength. The ASB2 demonstrated the highest mean values and the SEB had the lowest for all dentin depths evaluated. The dentin depth adversely affected the bonding mechanism. The dental surface did not affect shear bond strength at the dentin-resin interface.

16. **Aguilera F S, Osorio R, Osorio E, Moura P, Toledano M (2011)**[46] evaluated the effect of sodium hypochlorite (NaOCl) treatment on dentin bonding by means of shear bond strength (SBS) measurements when using Prime &Bond NT (PB NT) adhesive. They concluded that the use of 5% NaOCl for 2 min after dentin demineralization when PB NT was employed did not improve the bond strength to dentin, probably due to nanofiller content and/or oxidative changes on collagen-depleted dentin.

17. **Gowda L, Mohan Das U (2012)**[47] evaluated the efficacies of 1%, 2.5%, 5% and 10% NaOCl at 30, 60 and 120s on etched primary dentin. They concluded that the higher concentrations of NaOCl solutions (5% and 10%) produced significant changes in the etched primary dentin. The higher the concentration of the NaOCl solution, the lower

can be the time for the application of the solution for the complete removal of collagen fibrils.

18. **Dontula B S K, Nagaraj B, Danda N (2012)**[48] evaluated the effects of different concentrations of sodium hypochlorite applied for 30 seconds on acid etched dentin on the shear bond strengths of an acetone-based adhesive. 40 freshly extracted molars were used as specimens to evaluate shear bond strength of composite to sodium hypochlorite (NaOCl)-treated dentin using Prime and Bond NT dentin bonding agent after 10% NaOCl (Group I), 5% NaOCl (Group II), 2.5% NaOCl (Group III) and No NaOCl (Control) treatment. They concluded that Highest shear bond strength values were demonstrated by Group II i.e. 5% sodium hypochlorite treatment group. This could be because of partial decollagenation and formation of an optimum hybrid layer.

19. **Mathai V, Angelo MC, Jayakumar K, Babu KS (2013)**[49] evaluated dentin shear bond strength with and without sodium hypochlorite (NaOCL) application using three adhesive systems. It was found that the dentin shear bond strength of Prime and Bond NT (Acetone based) increased after Sodium hypochlorite application while that of Single Bond and Clearfil SE bond (Alcohol based) decreased after Sodium hypochlorite application.

20. **Mohanbabu V, Mala K, Priyadharshini I (2015)**[50] evaluated the importance of collagen fibrils in the adhesion of different self-etching adhesive materials to dentin. They concluded that the results revealed that the collagen fibrils are not required for adhesion and their removal improves the marginal seal of G-Bond, an acetone based dentin bonding system

21. **Afshar H, Nakhjavani Y B, Taban S R, Baniameri Z, Nahvi A (2015)**[51] conducted a study to check the push bond strength of a total etch and self- etch bonding system to intracanal dentin of primary anterior teeth. They concluded that all three bonding agents are recommended for use with composite posts in PAT. However, due to high technical sensitivity of the total etch system single or two- step self etch systems may be preferred for uncooperative children.

22. **Francescantonio M D, Nurrohman H, Takagaki T, Nikaido T, Tagami J, Giannini M (2015)**[52] evaluated the effects of 10% NaOCl gel application on the dentin bond strengths and morphology of resin-dentin interfaces formed by three adhesives. They concluded that 10% NaOCl changed the morphology of bonding interfaces and its use with etch- &-rinse adhesives reduced the dentin bond strength. Formation of ABRZ was material- dependent and the interface morphologies were different among the tested materials.

23. **Chandrashekhar S, Patil S, Abraham S, Mehta D,Chaudhari S, Shashidhar J (2018)**[53] evaluated the difference of shear bond strength to pulp chamber dentin treated with sodium thiosulfate and proanthocyanidin (PA). They concluded that the use of $Na_2S_2O_3$ and PA can significantly increase the bond strength of composite resin to NaOCl/EDTA-treated dentin, allowing adhesive restorations to be immediately applied after endodontic treatment.

24. **Ahmed AA, Hassan M M, Abdalla A I (2018)**[54] determined the dentin bonding ability of three new universal adhesive systems under different etching modes using microshear bond strength (μSBS). They results showed that the universal adhesives, Futurabond U and Tetric N-Bond Universal in total-etch mode showed significantly

higher μSBS values than in self-etch mode. Single Bond Universal did not show any significant difference in μSBS between the total-etch mode and self-etch mode. They concluded that Performance of universal adhesives was shown to be material-dependent. The results indicate that universal adhesives used on dentine performed better in total-etch mode than self-etch mode.

25. **Meshki R, Zarouni F, Sarikhani P (2019)[55]** evaluated the affect the dentin properties and bond strength to resin materials and the effect of sodium hypochlorite and sodium ascorbate on shear bond strength of composite to dentin of primary teeth. They concluded that sodium hypochlorite (5.25%) reduced the shear bond strength of composite to dentin and the used of 10% sodium ascorbate could compensate for the reduction of bond strength.

26. **Arslan S, Balkaya H, and Cakir N N (2019)[56]** evaluated the effect of etidronic acid on bond strength to coronal dentin. A total of 75 human mandibular molars were sectioned 3 mm below the occlusal surface and then randomly divided into five groups according to irrigation solution used ($n = 15$): Group 1: 5 ml 2.5% sodium hypochlorite (NaOCl) +5 ml distilled water; Group 2: 5 ml 2.5% NaOCl + 5 ml 17% ethylenediamine tetraacetic acid (EDTA); Group 3: 10 ml mixture of 5% NaOCl and 18% 1-hydroxyethylidene-1,1-bisphosphonate (HEBP); Group 4: 5 ml mixture of 5% NaOCl and 18% HEBP + 5 ml 17% EDTA; and Group 5: 5 ml mixture of 5% NaOCl and 18% HEBP + 5 ml distilled water.They concluded that HEBP adversely affected the bond strength of the tested adhesive to coronal dentin.

27. **Cardoso G C D, Nakanishi L, Isolan C P, Patrícia dos Santos Jardim P D S, R Moraes R R D (2019)[57]** evaluated the immediate and 6-month dentin bond strength

of universal adhesives used in etch-and-rinse or self-etch bonding strategies. The adhesives tested were Ambar Universal, G-Bond, Single Bond Universal, Tetric N-Bond Universal, and Ybond Universal. Gold standard adhesives (Scotchbond Multipurpose Plus and Clearfil SE Bond) were controls. Microtensile dentin bond strength (n=5 teeth), pH, and C=C conversion (n=3) were evaluated.. They concluded that the bonding performance of universal adhesives to dentin is material dependent. Most adhesives had stable dentin bonds with results comparable to the gold standard materials, particularly when applied in the self-etch mode. In general, it seems the use of universal adhesives in dentin should not be preceded by phosphoric acid etching.

28. **Chauhan U, Dewan R, Goyal N G (2020)**[58] evaluated and compared the shear bond strength of the fifth, sixth, seventh, and eighth generations of bonding agents. Forty freshly extracted premolars were selected and assigned into five groups: group I—fifth-generation bonding agent (Swiss TEC SL Bond), group II—sixth-generation bonding agent (One Coat), group III—seventh-generation bonding agent (One Coat 7.0), group IV—eighth-generation bonding agent (One Coat 7 Universal), and group V—control group. The results showed that maximum shear bond strength was found in the eighth generation of bonding agent followed by the fifth, seventh, and lastly, the sixth generation.

29. **Ganesh AS (2021)**[59] evaluated and compared the shear bond strength of composite resin to dentin using eighth generation dental adhesive (G Premio Bond) with fifth, sixth, and seventh generation dentin adhesives. That was the highest value of shear bond strength was obtained from G-Premio Bond (eighth generation) and concluded the G-Premio Bond (eighth generation) showed effective shear bond strength than other bonding agents.

30. **Nagpal R, Tewari S, Gupta R (2021)**[60] evaluated the effect of collagen removal and sodium ascorbate treatment of acid etched dentin on the microleakage and ultrastructure of resin-tooth interface under moist and dry conditions using an acetone-based 1 bottle adhesive system. The results showed that of the dye penetration were analyzed with Kruskal-Wallis non-parametric analysis followed by the Mann-Whitney U test at a significance level of $p$=0.05. After acid etching, the conventional acid etched groups and groups with NaOCl treatment demonstrated extensive leakage. Sodium ascorbate treatment of the NaOCl-treated dentin significantly reduced microleakage. No statistically significant difference between moist and dry bonding was observed in all groups. Although resin tag penetration improved in both the NaOCl-treated and NaOCl/ascorbate-treated groups, an absence of gap at the resin dentin interface was observed only for the NaOCl/ascorbate-treated groups.

# Materials and Methods

# MATERIALS & METHODOLOGY

The present in-vitro study was conducted in the Department of Conservative Dentistry and Endodontics, Babu Banarasi Das College of Dental Sciences, Lucknow in collaboration with CIPET, Lucknow.

In the present study, 60 human mandibular premolars were taken into consideration after accomplishing the inclusion and exclusion criteria.

The following inclusion & exclusion criteria were set to select the teeth:

**INCLUSION CRITERIA;**

Non carious, sound and intact single rooted human premolar teeth were selected

**EXCLUSION CRITERIA;**

- Teeth with any crack caries or calcification.
- Teeth with any developmental anomaly.

Following materials and armamentarium were used:

## TABLE-1

## MATERIALS AND ARMAMENTARIUM USED

| S. No. | Material & Armamentarium | Manufacturer |
|---|---|---|
| 1. | Ultrasonic Scaler with tips | Coltene, (Switzerland) |
| 2. | Straight hand piece | Marathon, (Korea) |
| 3. | Diamond disc & Mandrel | Horico (Germany) |
| 4. | 5% Sodium hypochlorite (NaOCl) | Vishal, (India) |
| 5. | Micromotor and control box | Marathon, (Korea) |
| 6. | Measuring Scale (stainless steel),Divider, cotton and Glass jar | ---------- |
| 7. | 7th Generation of one coat 7.0 bond | Coltene Whaledent, (USA) |
| 8. | Tetric +N bond universal | Ivoclar Vivadent, (Schaan Liechtenstein) |
| 9. | Prime & Bond Universal | Dentsply, (Germany) |
| 10. | Applicator Tips | Dentsply, (Germany) |
| 11. | LED curing light | (Ivoclar Vivadent Blue phase N) |
| 12. | Composite instrument kit | GDC, India) |
| 13. | Silicone carbide paper) | Mohan Ltd, (India) |
| 14. | Cement Spatula | ---------- |
| 15. | Tweezer | GDC, (India) |
| 16. | Chip Blower | (R&D Impex International) |
| 17. | Petroleum jelly (Vaseline) | (United States) |
| 18. | Modelling wax | Shiva Products, (India) |

| | | |
|---|---|---|
| 19. | Tetric N- Ceram Composite | Ivoclar Vivadent, (Schaan Liechtenstein) |
| 20. | Pink Orthodontic resin | Pyrex (India), |
| 21. | Instron Universal Testing Machine | PTC/083/ME -Instron Industries, (USA) |

## TABLE-2

## DISTRIBUTION OF SAMPLES

| GROUPS | NO. OF SAMPLES | TEST BONDING AGENT |
|---|---|---|
| GROUP A1 | 10 | One Coat Bond (7.0) |
| GROUP A2 | 10 | One Coat Bond (7.0) with 5% Sodium Hypochlorite |
| GROUP B1 | 10 | Tetric +N -bond universal |
| GROUP B2 | 10 | Tetric +N -bond universal with 5% Sodium Hypochlorite |
| GROUP C1 | 10 | Prime & Bond Universal |
| GROUP C2 | 10 | Prime & Bond Universal with 5% Sodium Hypochlorite |

## METHODOLOGY

### PROCEDURAL FLOWCHART

Sixty single rooted freshly extracted human premolars extracted for Orthodontic/Periodontal reasons were obtained from the Department of Oral and Maxillofacial Surgery, BBDCODS, Lucknow after obtaning patient consent.

↓

Teeth were then cleaned for removal of any tissue remnants, plaque and calculus using an ultrasonic scaler and stored in distilled water.

↓

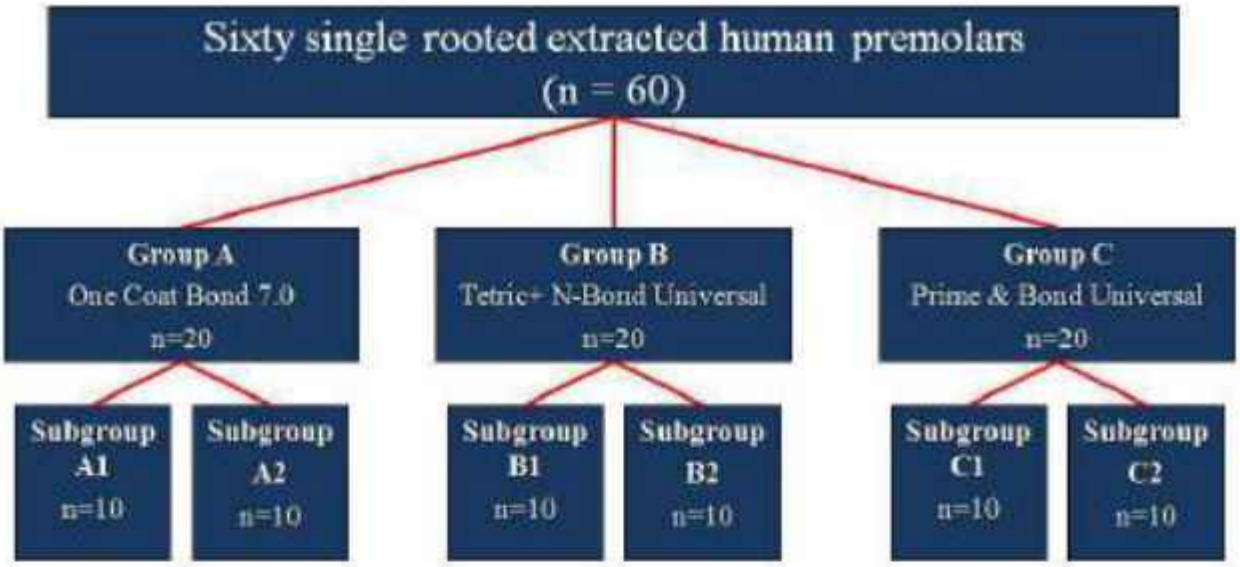
The teeth were then sectioned horizontally using a carborandum disc. At the level of the cementoenamel junction to expose the dentin surface.The cut surfaces were finished using silicone carbide paper to create a flat surface. The teeth were then mounted in custom made acrylic moulds (size12mm length, 16mm height and 10mm width).

↓

A Transparent Plastic mould with 4mm internal diameter and 4mm height was prepared which was further used to fill the selected composite resin on the prepared finished dentin surface of the samples.

↓

All teeth were divided into 3 groups containing 20 sample each (A,B and C respectively), which is further divided into 2 subgroups (ie. A1, A2; B1, B2; and C1, C2) containing 10 samples each.




For Group A1, B1, C1: respective bonding agents were directly applied to the dentin surfaces.

For Group A2, B2, C2: the dentin surface was exposed to 5% sodium hypochlorite for 2 mins and air dried. After which bonding agents of the respective groups were applied.

For Group A1 & A2- a layer of one coat bonding agent self etch was applied on the dentin surface using micro brush applicator and gently scrubbed for 20 seconds followed by applying gentle air stream to remove excess material and then light cured for 10 seconds using curing light.

For Group B1 & B2- a layer of Tetric +N bond universal adhesive bonding agent self etch was applied on the dentin surface using micro brush applicator and then gently scrubbed for 20 seconds followed by applying gentle air stream to remove excess material and then light cured for 10 seconds using curing light.

for Group C1 & C2- a layer of Prime & bond universal bonding agent self etch was applied on the dentin surface using micro brush applicator and gently scrubbed for 20 seconds followed by applying gentle air stream to remove excess material and then light cured for 10 seconds using curing light.

These restored specimens were subjected to shear bond strength test using Instron Universal Testing Machine. Samples were mounted horizontally on the machine platform and load was applied vertically at a cross head speed of 0.5 mm/min until the specimens fractured under stress load.

$$SBS = 4F / \pi d^2$$

Where, F is peak load at failure in newton (N), $d^2$ is the specimen surface area ($\pi$= 3.14, d=diameter of specimen in mm). The data was tabulated and statistically analyzed to compare the shear bond strength of the three tested groups.

The shear value (peak load at failure) was recorded for each sample. The shear bond strength (SBS) in megapascals (MPa) was calculated using formula:

## FIGURE- ARMAMANTERIUM

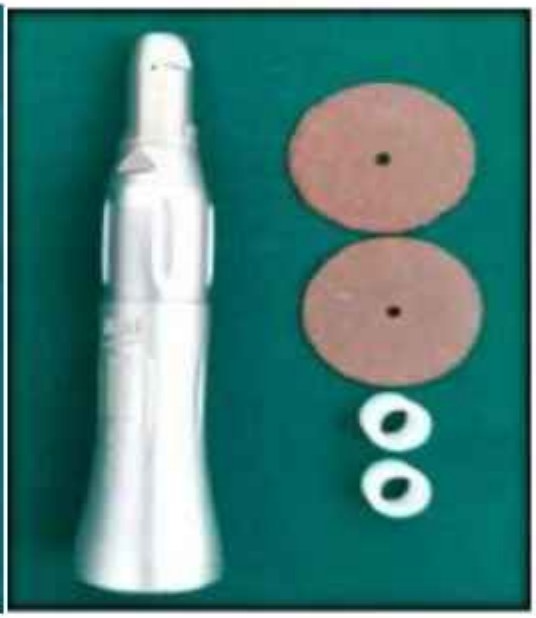
**(Fig-1)**

**Samples used in this study**

.

**(Fig-2)**

**Micromotor,straight hand piece corborundum disc teflon old(4x4mm)**



**(Fig-3)**

**Armamentarium for Sample preparation**

**(Fig-4)**

**Decoronation of samples**

**(Fig-5)**

**Resin block**

**(Fig-6)**

**Light cure units (Ivoclar vivadent blue phase N)**

(Fig-7)

Selfcure,Acrylic Resin,

(Fig- 8)

Composite Instruments

(Fig- 9)

Baseline, Dapendish, Cement Spatula

(Fig- 10)

**Sodium hypochlorite**


(Fig -11)

**Bonding Agents, Composite, Applicator Tips**

## GROUP A METHODOLOGY

(Fig–12)

**Disposal of One Coat Bond (7.0)**

(Fig-13)

**Application of 5% Sodium** hypochlorite

(Fig -14)

**Application of bonding agent**

(Fig -15)

**Light curing done for 10 secs**

(Fig -16)

**Placement of composite**

(Fig -17)

**Light curing done for 40 secs**

(Fig-18)

**Completed 20 samples group A1, A2 with composite flow**

## GROUP B METHODOLOGY

(Fig -19)

Disposal of Tetric$^{+}$ N-bond universal

.

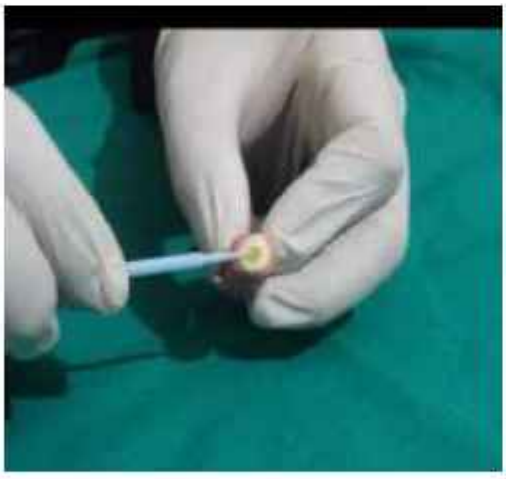
(Fig -20)

Application of 5% Sodium hypochlorite

(Fig -21)

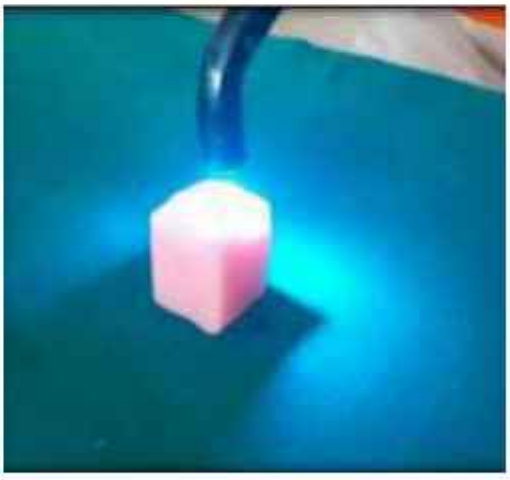
Application of bonding agent

.



(Fig -22)

light curing done for 10sec



(Fig -23)

Placement of composite

(Fig -24)

Light curing done for 40 secs

(Fig -25)

Completed 20 samples group B1, B2 with composite flow

## GROUP C METHODOLOGY

(Fig -26)

**Disposal of prime and bond universal**

(Fig -27)

**Application of 5% Sodium hypochlorite**

(Fig -28)

**Application of bonding agent**

(Fig -29)

**light curing done for 10secs**

(Fig -30)

**Placement of composite**

(Fig -31)

**Light curing done for 40 secs**

(Fig -32)

**Completed 20 samples group C1, C2 with composite flow**

(Fig -33)

**Universal testing machine (instron 3382)**


# Observations & Results

# OBSERVATIONS & RESULTS

The results obtained were tabulated. Descriptive and analytical statistics were done.The normality of data was analyzed by the Shapiro-Wilktest. As the datafollowed normal distribution the parametrictests were used to analyze the data. The one-way analysis of variance (ANOVA) testwas used to check mean differences amongthe groups. Post hoc analysis was done using Tukey's HSD test. The paired t-test was done to evaluate mean differences wherever appropriate.

**Software:** SPSS (Statistical Package for Social Sciences) Version 24.0 (IBM Corporation, Chicago, USA)

## Post hoc analysis

Post hoc ("after this" in Latin) tests are used to uncover specific differences between three or more group means when an analysis of variance (ANOVA) F test is significant.

## The P-value

The p value is calculated based on the Null distribution, which is a theatrical distribution of the test statistic when the null hypothesis is true. The commonly used null distributions.

**Interpretation of p-value**

The p-value indicates how probable the results are due to chance.

p=0.05 means that there is a 5% probability that the results are due to random chance.

p=0.001 means that the chances are only 1 in a thousand.

Statistical inferences indicating the strength of the evidence corresponding to different values of p are explained as under:

| Values of *p* | Inference |
|---|---|
| $p > 0.10$ | No evidence against the null hypothesis. |
| $0.05 < p < 0.10$ | Weak evidence against the null hypothesis |
| $0.01 < p < 0.05$ | Moderate evidence against the null hypothesis |
| $0.05 < p < 0.001$ | Good evidence against null hypothesis. |
| $0.001 < p < 0.01$ | Strong evidence against the null hypothesis |
| $p < 0.001$ | Very strong evidence against the null hypothesis |

**Table 3:** Comparison of shear bond strength among the three control groups

| Groups | N | Mean | S.D. | S.E. | 95% C.I. | Min. | Max | P-value[#] |
|---|---|---|---|---|---|---|---|---|
| Group I | 10 | 8.54 | 0.59 | 0.18 | 8.12-8.97 | 7.74 | 9.40 | <0.001[†] |
| Group II | 10 | 7.61 | 0.47 | 0.15 | 7.27-7.95 | 6.80 | 8.33 | |
| Group III | 10 | 10.92 | 0.21 | 0.06 | 10.77-11.07 | 10.61 | 11.30 | |

[#]P-value derived from one-way ANOVA test; [†]significant at $p < 0.05$

The shear bond strength among the three control groups were evaluated and compared. Analysis done by one-way ANOVA showed statistically significant differences ($p<0.001$) in the mean shear bond strength. The shear bond strength of group III – Prime and Bond Universal was the highest ($10.92 \pm 0.21$) followed by group I - One Coat Bond 7.0 ($8.54 \pm 0.59$) and group II – Tetric + N- Bond Universal ($7.61 \pm 0.47$).

**Table 4:** Post hoc pair wise comparison of shear bond strength among the three control groups

| Groups | M.D. | 95% C.I. | P-value* |
|---|---|---|---|
| Group I v/s Group II | 0.93 | 0.42-1.44 | <0.001† |
| Group I v/s Group III | -2.37 | -2.88--1.86 | <0.001† |
| Group II v/s Group III | -3.31 | -3.81--2.80 | <0.001† |

*P-value derived from Tukey's HSD post hoc test; †significant at $p < 0.05$

The post hoc pair wise comparative analysis also showed significant differences in mean shear bond strength among the three control groups. When group I was compared with group II, a mean difference of 0.93(95% C.I. 0.42-1.44) was found which was statistically significant (p<0.001). When group I was compared with group III, a mean difference of -2.37(95% C.I. -2.88--1.86) was found which was statistically significant (p<0.001). When group II was compared with group III, a mean difference of -3.31(95% C.I. -3.81--2.80) was found which was statistically significant (p<0.001).

**Table 5:** Comparison of shear bond strength among the three experimental groups

| Groups | N | Mean | S.D. | S.E. | 95% C.I. | Min. | Max | F-value | P-value* |
|---|---|---|---|---|---|---|---|---|---|
| Group I | 10 | 12.62 | 0.54 | 0.17 | 12.23-13.01 | 11.58 | 13.30 | 194.627 | <0.001† |
| Group II | 10 | 11.45 | 0.68 | 0.21 | 10.96-11.94 | 10.56 | 12.58 | | |
| Group III | 10 | 16.07 | 0.35 | 0.11 | 15.82-16.32 | 15.47 | 16.63 | | |

#P-value derived from one-way ANOVA test; †significant at p < 0.05

The shear bond strength was evaluated & compared among the three experimental groups. The analysis done by one-way ANOVA showed statistically significant differences (p<0.001) in the mean shear bond strength. The shear bond strength of group III – Prime and Bond Universal was the highest (16.07± 0.35) followed by group I -One Coat Bond 7.0 (12.62± 0.54) and group II – Tetric + N-Bond Universal (11.45± 0.68).

**Table 6:** Post hoc pair wise comparison of shear bond strength among the three experimental groups

| Groups | M.D. | 95% C.I. | P-value# |
|---|---|---|---|
| Group I v/s Group II | 1.16 | 0.56-1.77 | <0.001† |
| Group I v/s Group III | -3.45 | -4.05--2.84 | <0.001† |
| Group II v/s Group III | -4.62 | -5.22--4.01 | <0.001† |

#P-value derived from Tukey's HSD post hoc test; †significant at p < 0.05

The post hoc pair wise comparative analysis also showed significant differences in mean shear bond strength among the three experimental groups. When group I was compared with group II, a mean difference of 1.16(95% C.I. 0.56-1.77) was found which was statistically significant (p<0.001). When group I was compared with group III, a mean difference of -3.45(95% C.I. -4.05--2.84) was found which was statistically significant (p<0.001). When group II was compared with group III, a mean difference of -4.62(95% C.I. --5.22--4.01) was found which was statistically significant (p<0.001).

**Table 7:** Evaluation of the effect of 5% sodium hypochlorite on shear bond of One Coat

Bond7.0.

| Groups | N | Mean | S.D. | S.E. | M.D. | 95% C.I. | t-value | P-value[#] |
|---|---|---|---|---|---|---|---|---|
| Group I | 10 | 8.54 | 0.59 | 0.18 | -4.07 | -4.70--3.44 | -14.590 | <0.001[†] |
| Group III | 10 | 12.62 | 0.54 | 0.17 | | | | |

[#]P-value derived from paired t-test; [†]significant at $p < 0.05$

The effect of 5% sodium hypochlorite on shear bond of One Coat Bond 7.0 was also evaluated and analysed the paired t-test. A statistically significant difference ($p<0.001$)was found in their mean shear bond strengths. The mean shear bond strength of One Coat Bond 7.0 experimental group ($12.62 \pm 0.54$) was significantly more than the control group ($8.54\pm 0.59$).

**Table 8:** Evaluation of the effect of 5% sodium hypochlorite on shear bond of Tetric + N-Bond Universal

| Groups | N | Mean | S.D. | S.E. | M.D. | 95% C.I. | t-value | P-value[#] |
|---|---|---|---|---|---|---|---|---|
| Group I | 10 | 7.61 | 0.47 | 0.15 | -3.84 | -4.32--3.35 | -18.056 | <0.001[†] |
| Group III | 10 | 11.45 | 0.68 | 0.21 | | | | |

[#]P-value derived from paired t-test; [†]significant at $p < 0.05$

The evaluation of the effect of 5% sodium hypochlorite on shear bond of Tetric + N-Bond Universal was done. The analysis done by paired t-test showed statistically significant differences ($p<0.001$) in the mean shear bond strengths. The

mean shear bond strength of Tetric + N-Bond Universal experimental group (11.45 ± 0.68) was significantly more than the control group (7.61± 0.47).

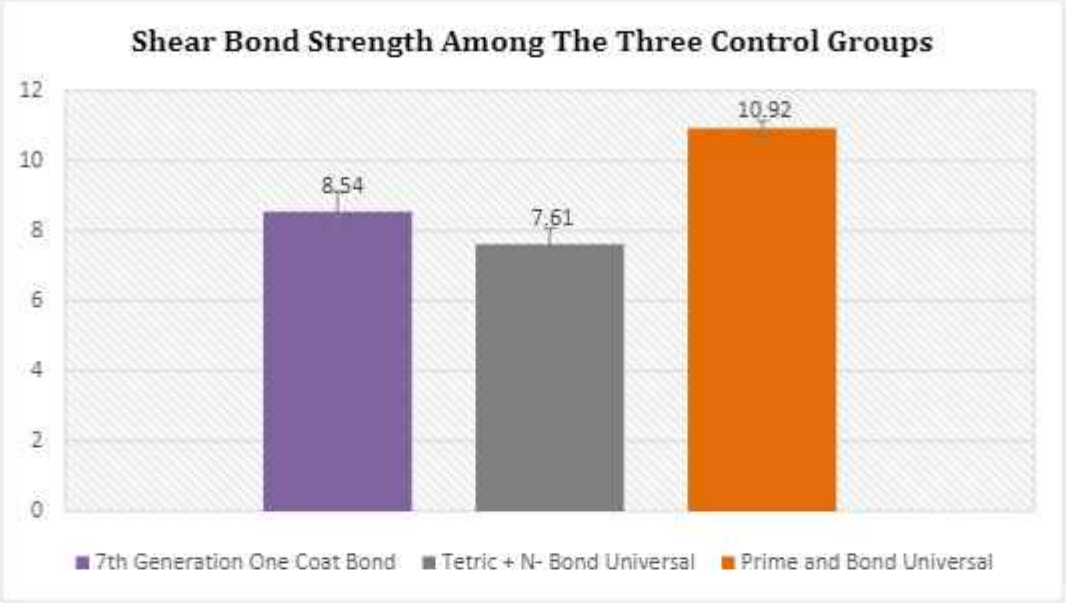
**Table 9:** Evaluation of the effect of 5% sodium hypochlorite on shear bond of Prime and Bond Universal

| Groups | N | Mean | S.D. | S.E. | M.D. | 95% C.I. | t-value | P-value[#] |
|---|---|---|---|---|---|---|---|---|
| Group I | 10 | 10.92 | 0.21 | 0.06 | -5.15 | -5.48--4.81 | -34.980 | <0.001[†] |
| Group III | 10 | 16.07 | 0.35 | 0.11 | | | | |

[#]P-value derived from paired t-test; [†]significant at $p < 0.05$

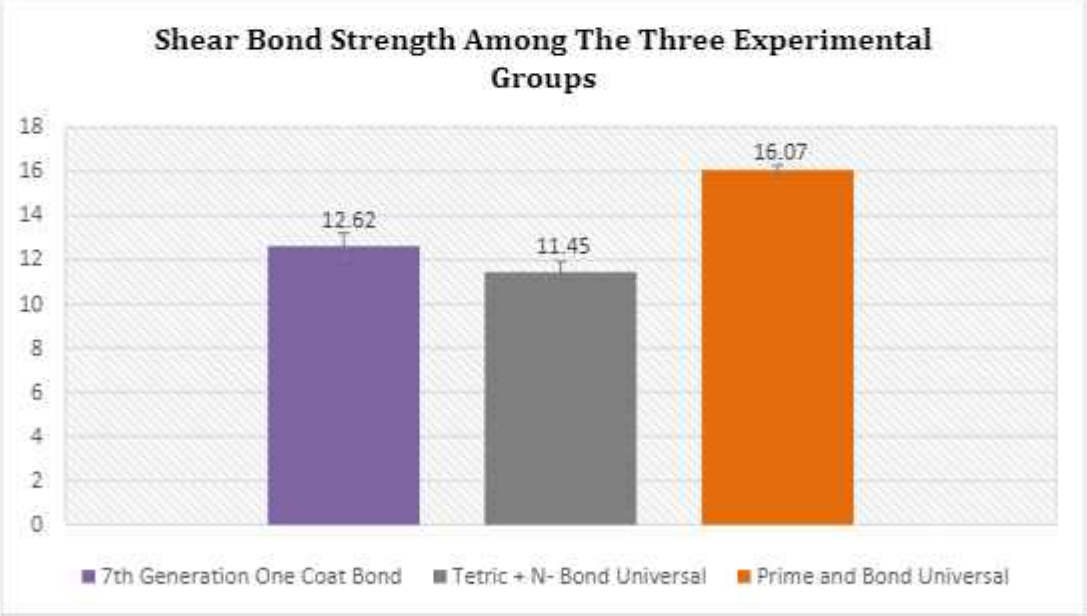
The evaluation of the effect of 5% sodium hypochlorite on shear bond of Prime and Bond Universal was done. The analysis done by paired t-test showed statistically significant differences ($p<0.001$) in mean shear bond strengths. The mean shear bond strength of Prime and Bond Universal experimental group (16.07 ± 0.35) was significantly more than the control group (10.92± 0.21).

**Graph 1:** Comparison of shear bond strength among the three control groups



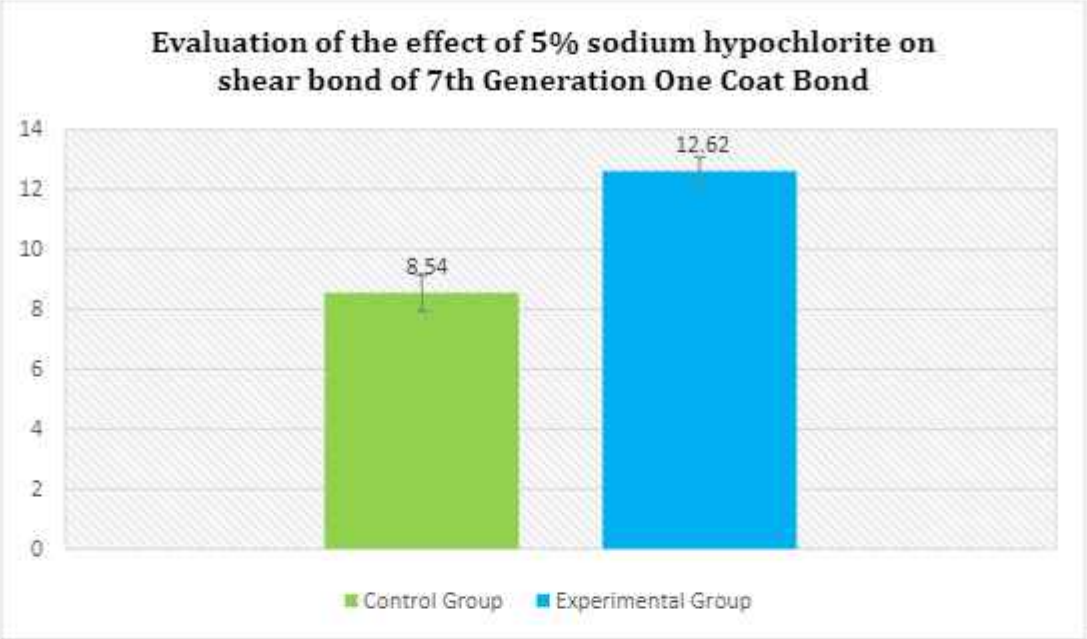

**Note:** The error bar represents standard deviation

**Graph 2:** Comparison of shear bond strength among the three experimental groups



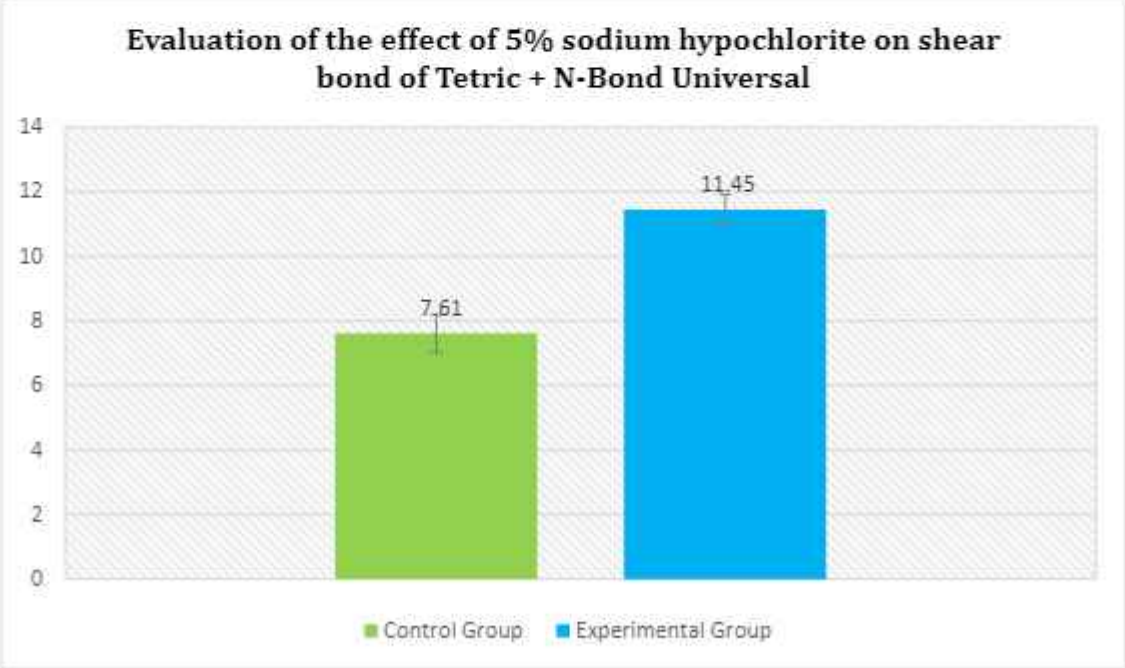

**Note:** The error bar represents standard deviation

**Graph 3:** Evaluation of the effect of 5% sodium hypochlorite on shear bond of 7th Generation One Coat Bond



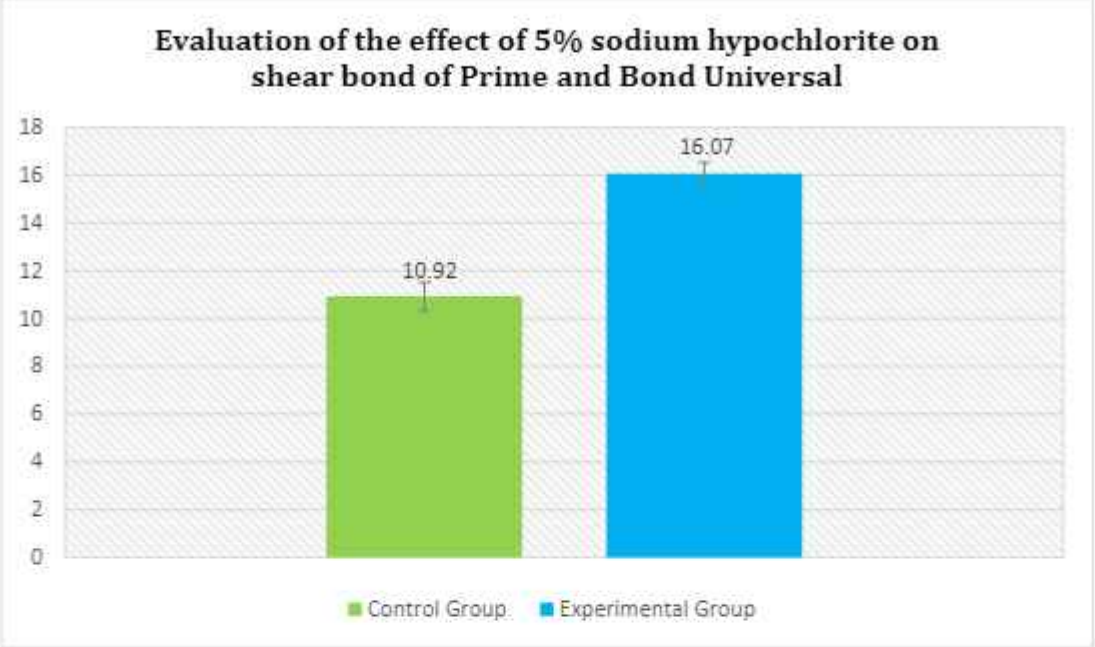

**Note:** The error bar represents standard deviation

**Graph 4:** Evaluation of the effect of 5% sodium hypochlorite on shear bond of Tetric + N-Bond Universal



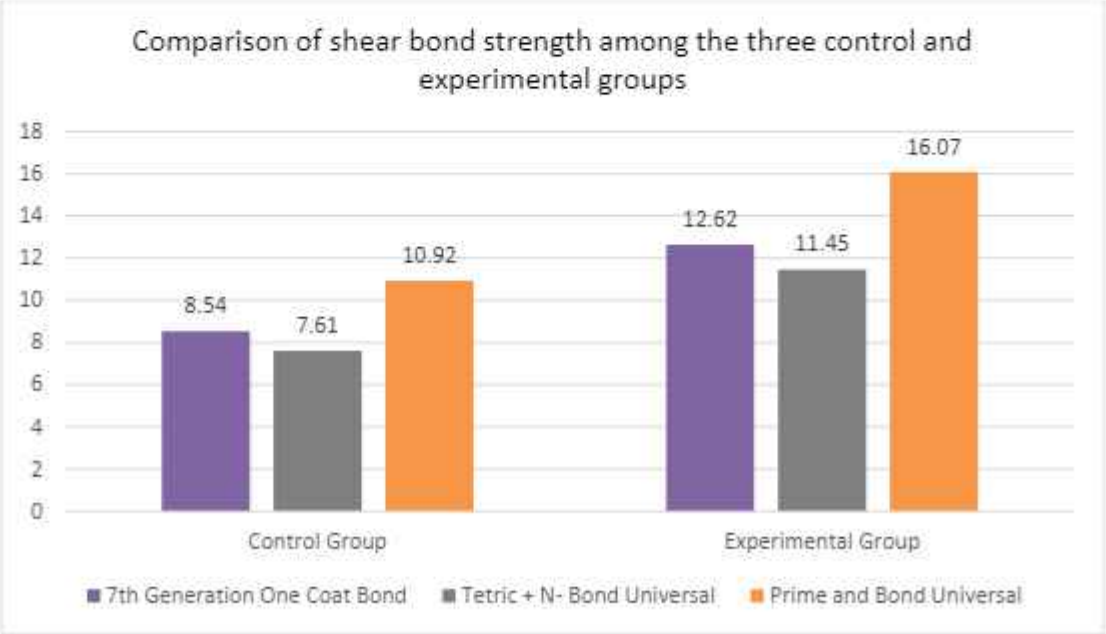

**Note:** The error bar represents standard deviation

**Graph 5:** Evaluation of the effect of 5% sodium hypochlorite on shear bond of Prime and Bond Universal

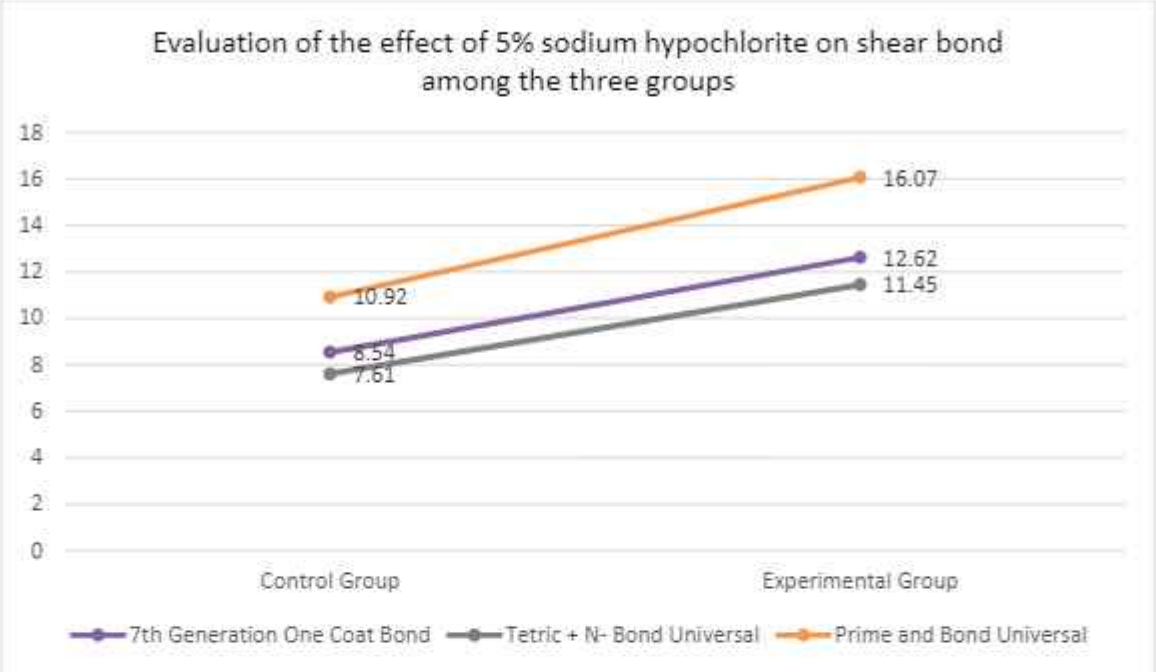



**Note:** The error bar represents standard deviation

**Graph 6:** Comparison of shear bond strength among the three control and experimental groups



**Graph 7:** Evaluation of the effect of 5% sodium hypochlorite on shear bond among the three groups



# Discussion

# DISCUSSION

The present in-vitro study was conducted in the Department of Conservative Dentistry and Endodontics, Babu Banarasi Das College of Dental Sciences, Lucknow in collaboration with CIPET, Lucknow.

The aim of this study was to evaluate & compare the effect of sodium hypochlorite on the shear bond strength of different bonding systems.

In the present study, 60 human mandibular premolars were taken into consideration after accomplishing the inclusion and exclusion criteria.

An intact coronal seal is important for successful endodontic therapy. However, coronal dentin is subjected to various medicaments, irrigants, which have different surface tensions, wettability, and different mechanism of action. Factors with such regional differences in dentin structure make bonding difficult.[61,62]

Asthana G et al the zone in which resin of adhesive system micromechanically interlocks with dentinal collegen is 'HYBRID LAYER'[63]

The hybrid layer disappeared and no erosion lesion was found at the interface after 5% NaOCl. The hybridization produced by etch-and-rinse adhesives is not a uniform layer, especially with respect to the existence of nano spaces within the hybrid layer, which correspond to dentin etched without monomer infiltration and filled with water or organic solvents[64]. When 5% NaOCl was applied to etched dentin, the exposed collagen fibrils were removed and the adhesives were unable to penetrate into underlying dentin, which resulted in no hybrid layer formation[65,67]. However, it was possible to note that there was a good contact without gaps between adhesives and dentin.

Formation of hybrid layer in integral part of dentin bonding. The quality of hybrid layer formed decides the strength of resin dentin interface the thicker and more uniform hybrid better is the bond strength, the uniformity in the formation of hybrid is also important. A uniform hybrid layer is seen with total etch technique where as the hybrid layer formed with self etch technique is less uniform and discontinuous with lots of debris.[63]

Adhesion is defined as the mechanism that bonds two materials in intimate contact across an interface. The key element for adhesion is the intimacy of the bond that develops between the adhesive and the substrate. While effective adhesion to enamel is achieved with relative ease, adhesion to dentin poses a difficult challenge. This is partly due to the biological characteristics of dentin, namely its high organic content, its tubular structure, and the presence of the dentin smear layer that forms immediately after cavity preparation[68,69] . Thus for effective bonding smear layer can be totally removed as in total etch technique or it can be modified as in self etch technique which leads to hybridization at resin-dentine interface by a molecular level mixture of adhesive polymers and dentinal hard tissues[70]. Thus a new type of single-step self-etch adhesive that is categorizedas "universal" or "multi-mode". These bonding systems can be used use both with and without acid pretreatment of enamel surfaces. In order to overcome the lower bond strength to enamel reported for self-etch adhesive systems, universal adhesives can be used with either etch-and-rinse or self-etch approaches.[71]

In the present study one coat bond 7.0, Tetric + N- bond and Prime & bond universal was applied to exposed dentin of freshly extracted premolar teeth.

one coat bond 7.0 dentin bonding agent is 7th generation requires one step, where as dual require two steps. Prime & bond universal 8th generation dentin bonding agent single dose system containing naofillers 20nm have been introduced in an attempt to increase bond strength.[63]

**Dr.Asthana G et al** ,the advantages 8th generation dentin bonding agent that is prime & bond universal is All-in-one adhesives, user-friendly in that fewer steps are required for the bonding Protocol and no rinsing is required. This is in favour of this study. [63]

One Coat 7.0 (seventh-generation bonding agent) performed better than the sixth-generation bonding agent. Fewer components save time and minimize confusion and no reapplication or waiting period is required. One Coat 7.0's special formulation demineralizes the dentin and enamel surfaces, thus solubilizing the smear layer without ever removing it from the open tubules. The end result is a low gap formation, which prevents microleakage. This study showed that One Coat 7.0 showed very low bond strength in comparison with the other bonding agents.[72]

Acc to Sri Ganesh A the seventh generation one bottle dentin bonding agent contains 2 hydroxyethyl methacrylate (HEMA) monomer which is absent in the eighth generation These Hydrophilic monomers produce a tough,highly cross-linked polymer network. HEMA attracts water, causing water sorption, hydrolytic degradation, nano leakage, and decrease in bond strength.[73]

One-step self-etch adhesive also called "all-in-one" adhesive, which contains an acid, primer, and adhesive components in one solution, allows one-step application only. Over the last few years, these adhesive systems have become increasingly

popular[74,75,76]. Furthermore, some studies exhibited less sensitivity with self-etch adhesives,as etch and rinse step is eliminated[77]. Thus, a new type of single-step self-etch adhesive, categorized as "universal" or "multi-mode" has been recently introduced for patient care. These adhesive systems are recommended by dental manufacturers for use both with and without acid pretreatment of enamel surfaces.[77]

Acc to Sri Ganesh A among the current generation of self etch adhesives the manufacturers have so thought to eliminate the etching step or to include it chemically in one of the other steps. A new, simplified adhesive system has been introduced, that is the seventh generation adhesive. Just as the Fifth generation bonding agents made a leap from previous multi component systems to a rational and easy to use single bottle system, the seventh generation simplifies the multitude of sixth generation materials into a single component, single bottle system.[73]

NaOCl is a non-specific proteolytic agent that effectively removes organic compounds at room temperature. Tanaka *et al*. demonstrated that the use of NaOCl for surface treatment of etched dentin enhanced the shear bond strengths of dentin bonding agents to dentin.[78] Saboia *et al*. reported that NaOCl enhances the bond strengths of acetone-based adhesives while ethanol based adhesives exhibited a significant reduction in bond strengths[79]. NaOCl deproteinization increases the surface roughness of dentin and its wettability. It exposes a labyrinth of lateral, secondary tubules, which allows good mechanical retention. This substrate is also rich in exposed hydroxyapatite crystals and may result in a stable interface over time[80]. Inai *et al*. have reported that acetone containing adhesives interact strongly with a treated dentinal surface that has a high mineral content.[81]

Although 2.5% NaOCl is equivalent to 5% NaOCl in its collagen dissolving ability, it may be inferred that the application time may not have been adequate to produce high shear bond strengths. The shorter application time may have caused insufficient deproteinization of dentin. Hence, it may be hypothesized that a longer application time would be beneficial while using a 2.5% solution of NaOCl. 5% NaOCl applied for 2min shows the highest shear bond strengths in this study. Earlier studies by Vargas MA *et al*[82]. and Perdigao *et al*[83]. using 5% NaOCl for deproteinization reported the absence of hybrid layer following bonding when the application time ranged from 1 to 2 minutes. However, in the present study, the application time was only 2min. It may be therefore hypothesized that, by reducing the application time of 5% NaOCl, complete deproteinization of the etched dentin does not occur. There may be partial decollagenation of the dentin with remnants of collagen fibrils in the deeper portion of the etched dentin[84] . Probably 5% NaOCl treatment for 2min seconds may have retained some remnants of collagen fibrils which could enhance the intermingling of adhesive monomers with the filigree of collagen fibrils, thus forming an optimum hybrid layer. For the control group, decreased shear bond strengths was obtained. Probable reason for this could be due to the presence of a thick unsupported collagen layer not properly infiltrated by the adhesive resin.[84]

In the present study one coat bond 7.0, Tetric + N- bond and Prime & bond universal was applied to exposed dentin of freshly extracted premolar teeth. The study shows that the bond strength values for Prime & Bond universal was higher after NaOCl treatment while the bond strength values of One coat Bond 7.0 and Tetric+ N bond universal decreased following NaOCl treatment.[85]

Acc to Mathai V et al, the positive effect of NaOCl on bond strength of Prime and Bond universal may be explained by the higher diffusibility of acetone as well as its higher capacity to displace the water. Furthermore, removing collagen could improve the contact of adhesive and hydroxyapatite crystals by enhancing the dentin permeability. In the case of One coat bond (7.0) and Tetric+ N bond universal, as these adhesive systems diffuses more slowly than acetone based systems, this short dwell time is insufficient to permit a full diffusion of the monomer in to the substrate.[85]

Among all six groups taken in this study Prime & bond universal dentin bonding agent has the highest shear bond strength.

Acc to Sri Ganesh A the Prime & bond contain methacryloyloxyethyl trimellitic acid which is used as adhesion promoting monomer in G-premio bond.Adhesive is acetone is used as solvent which prevents the esterification of carboxylic acid groups, thereby which improv the demineralization and enhancing wetting. Acc to Joseph *et al*. it contain nano sized cross-linking silica fillers which the increased the bond strength.[73]

Acc to Mathai V et al Prime & bond Universal after NaoCl treatment has higher bond strength because of diffusibilty of acetone and higher capacity to displace water. Removing collagen enhance dentin permeability.[85]

**Paliyatharsi K et al** the forces acting on the teeth have their own stress pattern and every location on a tooth has a special stress behavior. In this study shear bond strength was taken as in posterior teeth the junction between clinical crown androot

bears shear components of stress, together with tension on the loading side and compression on non-loading side during excursive mandibular movements. The process of mastication is basically related to the shearing phenomenon and the true nature of the adhesive strength of materials at the tooth and restoration interface is described as by the shearbond strength (SBS). SBS test is the most common method to evaluate bond strength, as testing in shear mode is more clinically relevant and relatively simple, reproducible, and widely accepted test.[86]

In the present study samples were subjected to SBS test using Instron Universal Testing Machine (Model 3382, Instron (CIPET) following the 2003 ISO technical specification 11405 at a cross-head speed of 0.5 mm/min until the specimens fractured under stress load. The shear force was applied perpendicular to the tooth surface, to evaluate the shear bond strengths of composite resin to dentin using the different dentin bonding agents.[86]

# Conclusion

# CONCLUSION

The present in vitro study titled "A comparative evaluation of the effect of sodium hypochlorite on the shear bond strength of different bonding systems" aimed to evaluate and compare the effect of sodium hypochlorite on the shear bond strength of different bonding systems: One coat bond (7.0), Tetric + N- bond universal, Prime & bond universal.

With in the parameters of the present study it can be concluded that Prime and bond showed the maximum shear bond strength as compare to One coat bond (7.0), Tetric + N- bond universal. One coat bond showed the least shear bond strength.

When One coat bond (7.0), Tetric + N- bond universal, Prime & bond universal after NaoCl treatment, Prime and bond Universal after NaOCl treatment showed the maximum shear bond strength, One coat bond 7.0 after NaOCl showed the least shear bond strength.

It can be concluded from the results of this study that among all six groups the dentin shear bond strength of Prime and Bond universal (Acetone based) increased after Sodium hypochlorite application while that of One coat bond 7.0 and Tetric + N-bond universal (Ethanol based) decreased after Sodium hypochlorite application. However this being an in vitro study, it cannot mimic the in-vivo conditions. There is a requirement of more clinical trials using several dentin bonding agents to understand the effectiveness of Sodium hypochlorite on etched dentin and subsequently its effect on dentin shear bond strength

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# Annexures

Babu Banarasi Das University
Babu Banarasi Das College of Dental Sciences,
BBD City, Faizabad Road, Lucknow – 226028 (INDIA)

Dr. Lakshmi Bala
[illegible] Biochemistry and
[illegible] Institutional Ethics Committee

**Communication of the Decision of the VIII[th] Institutional Ethics Sub-Committee**

IEC Code: 12 **BBDCODS/03/2020**

**Title of the Project:** A Comparative Evaluation of Effect of Sodium Hypochlorite on Shear Bond Strength of different Bonding Systems An In-Vitro Study.

**Principal Investigator:** Dr. Rahul Sharma **Department:** Conservative Dentistry & Endodontics

**Name and Address of the Institution:** BBD College of Dental Sciences Lucknow.

**Type of Submission:** New, MDS Project Protocol

Dear Dr. Rahul Sharma,

The Institutional Ethics Sub-Committee meeting comprising following four members was held on 18[th] March, 2020.

| | | |
|---|---|---|
| 1. | Dr. Lakshmi Bala<br>Member Secretary | Prof. and Head, Department of Biochemistry, BBDCODS, Lucknow |
| 2. | Dr. Amrit Tandan<br>Member | Prof. & Head, Department of Prosthodontics and Crown & Bridge, BBDCODS, Lucknow |
| 3. | Dr. Sahana S.<br>Member | Reader, Deparment of Public Health Dentistry, BBDCODS, Lucknow |
| 4. | Dr. Sumalatha M.N.<br>Member | Reader, Department of Oral Medicine & Radiology, BBDCODS, Lucknow |

The committee reviewed and discussed your submitted documents of the current MDS Project Protocol in the meeting.

The comments were communicated to PI thereafter it was revised.

**Decisions: The committee approved the above protocol from ethics point of view.**

Forwarded by:

Lakshmi Bala 18/03/20

**(Dr. Lakshmi Bala)**
Member-Secretary
IEC

Member-Secretary
Institutional Ethics Committee
BBD College of Dental Sciences
BBD University
Faizabad Road, Lucknow-226028

**(Dr. B. Rajkumar)**
Principal
BBDCODS

# BABU BANARASI DAS COLLEGE OF DENTAL SCIENCES (FACULTY OF BBD UNIVERSITY), LUCKNOW

## INSTITUTIONAL RESEARCH COMMITTEE APPROVAL

The project titled **"A Comparative Evaluation of Effect of Sodium Hypochlorite on Shear Bond Strength of different Bonding Systems An In-Vitro Study"** submitted by **Dr Rahul Sharma** Post graduate student from the **Department of Conservative Dentistry and Endodontics** as part of MDS Curriculum for the academic year 2019-2022 with the accompanying proforma was reviewed by the Institutional Research Committee present on **19th December 2019** at BBDCODS.

The Committee has granted approval on the scientific content of the project. The proposal may now be reviewed by the Institutional Ethics Committee for granting ethical approval.

**Prof. Vandana A Pant**
Co-Chairperson

**Prof. B. Rajkumar**
Chairperson

Received
Dr.
Rahul Sharma
19/12/19

सिपेट : इंस्टीट्यूट ऑफ पेट्रोकेमिकल्स टेक्नोलॉजी (आई.पी.टी.)
रसायन एवं पेट्रोरसायन विभाग,
रसायन एवं उर्वरक मंत्रालय, भारत सरकार
बी-२७, अमौसी इन्डस्ट्रियल एरिया, लखनऊ-२२६ ००८
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**CIPET/Cons.-36/2021-22/1531** **Date:- 01.12.2021**

**TO WHOM IT MAY CONCERN**

This is to certify that Dr. Rahul Sharma Post Graduate Student, Department of Conservative Dentistry and Endodontics, Babu Banarasi Das College of Dental Sciences, B.B.D. University, Lucknow. Got research samples tested under my guidance for his thesis entitled:-

"A comparative evaluation of effect of Sodium Hypochlorite on shear bond Strength of different bonding system: An In-vitro Study". At Central Instiute of Petrochemical Engineering & Tehnology (CIPET), Lucknow.

I wish him all the success in his life.

**AUTHORIZED SIGNATORY**
Vivek Kumar
Quality Manager

Curiginal

## Document Information

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|---|---|
| Analyzed document | intro n discussion.docx (D153935121) |
| Submitted | 2022-04-07T14:16:00.0000000 |
| Submitted by | Vishesh Gupta |
| Submitter email | drvisheshgupta.bbdu@gmail.com |
| Similarity | 9% |
| Analysis address | drvisheshgupta.bbdu.u@analysis.urkund.com |

## Sources included in the report

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| W | URL: https://en.wikipedia.org/wiki/Dentine_bonding_agents<br>Fetched: 2020-05-02T15:45:15.0700000 | 1 |
| W | URL: http://www.medicinaoral.com/odo/volumenes/v9i7/jcedv9i7p892.pdf<br>Fetched: 2022-04-07T14:18:02.7030000 | 2 |
| W | URL: https://pocketdentistry.com/new-developments-in-dental-adhesion/<br>Fetched: 2022-04-07T12:21:47.5430000 | 1 |
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