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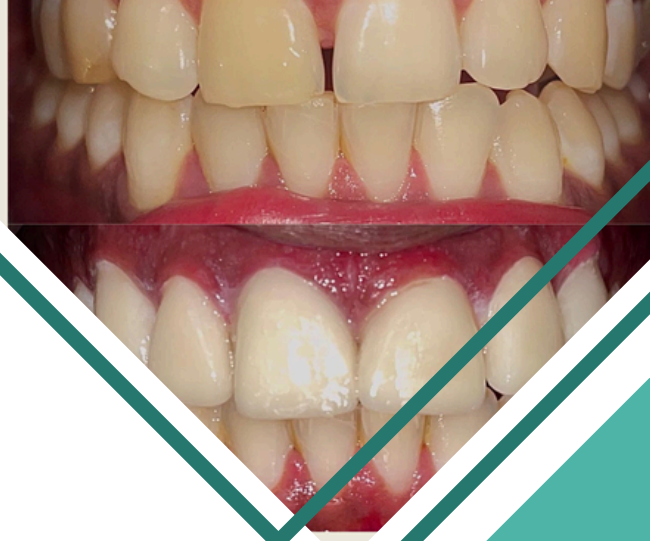

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Volume 2

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EDITORS DESK

Greetings!

It gives me immense pleasure in sharing this issue of Journal of Restorative Dentistry and Endodontics, an official publication of Association of Conservative Dentistry and Endodontics of Karnataka

This journal serves as an excellent platform to share scientific knowledge, research work and unique cases in our speciality by post graduate students, academicians, and specialists. The editorial board anticipates in showcasing the remarkable advancements across various domains within our speciality.

I hereby welcome everyone in our speciality to utilise this opportunity and provide manuscripts to raise the standards of our journal

Dr. Srirekha. A

ORIGINAL RESEARCH

FLEXURAL PROPERTIES OF BIOACTIVE BULK FILL AND CONVENTIONAL BULK FILL COMPOSITE RESIN AFTER SOLVENT STORAGE: A COMPARATIVE IN VITRO STUDY

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ABSTRACT:

Context: Bulk fill composites are widely used to restore posterior tooth. Bioactive bulk fill composites are recent advancement in these materials.

Aims: To compare the flexural properties of newer bioactive bulk fill composite with a standard bulk fill composite, conditioned in different mediums.

Methods and Material: Sixty rectangular shaped (2mm height,2mm width,12mm length) specimens were fabricated from both bioactive bulk fill composite resin (Group I) and conventional bulk fill packable composite resin (Group Ⅱ) using a customized metal mould. The specimens was light polymerized through the glass slide with two overlapping irradiations of 10 seconds each using a calibrated curing light. The specimens were removed from their molds and any minor material excess, or ‘‘fins,’’ was gently removed by using a 600-grit silicone carbide paper. Any defective specimens were replaced. The specimens of Group IA & IIA were kept in artificial saliva and Group IB & IIB in 0.02 N citric acid solutions in a glass container and stored in the incubator at 37°C and 100% relative humidity for seven days.

Results: No significant difference was noted between bioactive bulk fill composite resin compared to conventional bulk fill packable composite after stored in different solvents. Samples stored in citric acid showed the least flexural properties than samples stored in artificial saliva ($p<0.01$).

Conclusions: Within the limitation of the study, it can be concluded that both bioactive bulk fill composite and conventional bulk fill composite showed no significant difference in flexural properties after stored in artificial saliva and 0.02N citric acid. Use of solvents like citric acid significantly reduced the flexural properties of both bioactive bulk fill composite resin and conventional bulk fill packable composite resin.

Key-words: Bioactive bulk fill composite, Conventional bulk fill composite, Flexural strength, Flexural modulus, Citric acid, Solvents.

INTRODUCTION:

Bulk-fill resin-based composites were introduced in an effort to reduce placement times by laying the components in increments of up to 4 or 5 mm thick and curing them all at once.[1,2] According to studies bulk fill materials are comparable to or superior to conventional composite resins.[3,5,12] Recently bioactive bulk-fill composite has been introduced with improved mechanical properties.[2] Flexural strengths has been used to examine the brittle fracture in composite restorative materials intended to be used in stress-bearing areas, such as class I, II, and IV cavities.[6]

Citric acid is a food-simulating chemical that can weaken and dissolve matrices, harm fillers, induce debonding, and cause leaching, reducing the durability and duration of restorations.[3]

SAMPLE PREPARATION:

Sixty rectangular shaped (2mm height,2mm width,12mm length) specimens were fabricated from each material using a customized metal mould. Excess material was removed by compressing the moulds between mylar strips with glass slides. The top surface of the specimens was light polymerized through the glass slide with two overlapping irradiations of 10 seconds each using a calibrated LED curing light (blue phase c8). The glass slide was removed, and the specimens were light cured for another 10 seconds. The mylar strips were subsequently discarded, and the composite beams were removed from their moulds. Any minor material excess, or ''fins,'' was gently removed by using a 600-grit silicone carbide paper. The composite specimens were visually examined with naked eye holding the specimens within hands for the presence of voids, and any defective specimens were replaced.

Conditioning mediums and time

The specimens were randomly divided into two subgroups

A- Artificial saliva

B- 0.02N citric acid

The specimens were subsequently kept in respective solutions for seven days in lightproof container with distilled water and stored in the incubator at 37°C and 100% relative humidity.

Preparation of conditioning mediums

Preparation of 0.02N citric acid

To prepare 0.02 N citric acid ,1.2808 gm of anhydrous citric acid mixed with one-liter distilled water.

Flexural testing

A three-point bending test seven days after solvent storage, using a universal testing machine at a crosshead speed of 0.5mm/min was performed on all specimens until fracture.

Flexural strength

The specimens were aligned such that the load would be applied at the centre. The maximum load exerted on the specimens was recorded, and flexural strength FS, in megapascals (MPa), was calculated using the following equation:

$FS= 3PL /2BH^2$

where P is the maximum load exerted on the specimen in newtons, L is the distance between the supports in millimeters (10 mm), B is the width of the specimen in millimeters, and H is the height of the specimen in millimeters

Flexural modulus

Flexural modulus, FM, in MPa, was calculated using the following equation:

$FM= (F/ D) (L^3/ 4BH^3)$

L is the distance between the supports in millimeters (10 mm), B is the width of the specimen in millimeters, and H is the height of the specimen in millimeters.

RESULTS:

The statistical calculations were performed using the software SPSS for windows (statistical Presentation System Software, SPSS Inc.) version 22.0

The following statistical methods were employed in the present study

- Descriptive statistics including percentage, mean, and standard deviation.
- Level of significance: 0.05
- Kruskal Wallis Test
- Dunn's post hoc Test

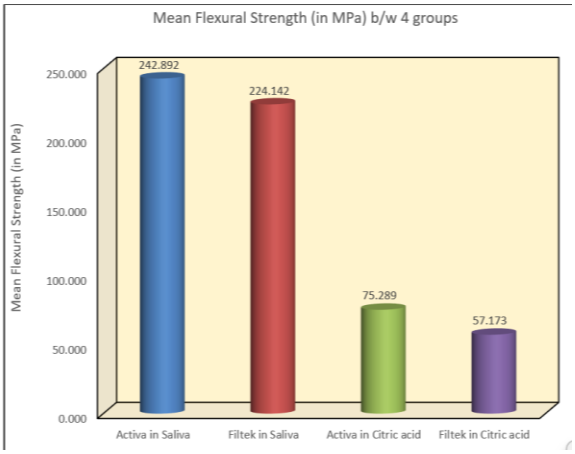
  Multiple comparisons between groups revealed that the Group IA showed significantly higher mean flexural strength as compared to Group IB & Group IIB and the difference was statistically significant at $p<0.001$. This was then followed next by Group IIA showing significantly higher mean flexural strength as compared to Group IB & & Group IIB the difference was statistically significant at $p<0.001$. However, no significant difference was noted between Group IA & Group IIA and also between Group IB and Group IIB.

FLEXURAL STRENGTH

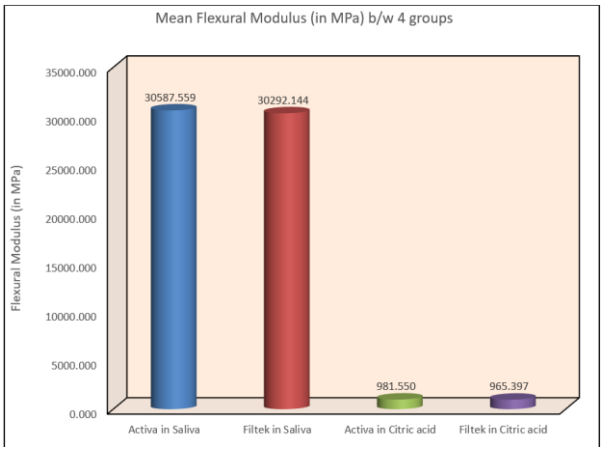
Multiple comparison of mean difference in Flexural Strength (in Mpa) between 4 groups using Dunn's post hoc Test					
(I) Groups	(J) Groups	Mean Diff. (I-J)	95% CI for the Diff.		p-value
			Lower	Upper	
Activa in Saliva	Filtek in Saliva	18.751	-19.185	56.686	0.67
	Activa in Citric acid	167.604	129.668	205.539	<0.001*
	Filtek in Citric acid	185.719	147.784	223.655	<0.001*
Filtek in Saliva	Activa in Citric acid	148.853	110.918	186.788	<0.001*
	Filtek in Citric acid	166.969	129.033	204.904	<0.001*
Activa in Citric acid	Filtek in Citric acid	18.116	-19.820	56.051	0.15

* - Statistically Significant

Table 1: **Multiple comparison of mean difference in Flexural Strength (in Mpa) between 4 groups using Dunn's post hoc Test**



Graph 1: Mean Flexural Strength between 4 groups



Graph 2: Mean Flexural Modulus between 4 groups.

Multiple comparison between groups revealed that the Group IA showed significantly higher mean flexural modulus as compared to Group IB & Group IIB and the difference was statistically significant at p<0.001. This was then followed next by Group IIA showing significantly higher mean flexural modulus as compared to Group IB & Group IIB and the difference was statistically significant at p<0.001. However, no significant difference was noted between Group IA & Group IIA and between Group IB and Group IIB.

FLEXURAL MODULUS

Multiple comparison of mean difference in Flexural Modulus (in Mpa) between 4 groups using Dunn's post hoc Test					
(I) Groups	(J) Groups	Mean Diff. (I-J)	95% CI for the Diff.		p-value
			Lower	Upper	
Activa in Saliva	Filtek in Saliva	295.415	-4960.989	5551.820	0.84
	Activa in Citric acid	29606.009	24349.605	34862.414	<0.001*
	Filtek in Citric acid	29622.163	24365.7582	34878.567	<0.001*
Filtek in Saliva	Activa in Citric acid	29310.594	24054.1899	34566.999	<0.001*
	Filtek in Citric acid	29326.747	24070.3431	34583.152	<0.001*
Activa in Citric acid	Filtek in Citric acid	16.153	-5240.251	5272.558	0.78

* - Statistically Significant

Table 2: **Multiple comparison of mean difference in Flexural Modulus (in Mpa) between 4 groups using Dunn's post hoc Test**

DISCUSSION:

The premise upon which the current investigation was built was that, under various storage conditions, the flexural characteristics of the two materials would not differ. There has been some debate over the mechanical characteristics of bulk-fill composite resin (BFCR).[1] While one study revealed mechanical qualities that were inferior to those of conventional, high-filled resin-based composites (RBCs),[3] another study obtained values that were comparable to those of conventional restorative materials.[4]

The bioactive bulk-fill composite resin used in this study is one of the first bioactive bulk fill composite resins to be used in dentistry. According to studies, this restorative material, which resembles composite resin, is strong and resistant to abrasive wear. It can also promote remineralization and the production of apatite, which may result in a marginal seal and higher adaption at the edge of restorations, which helps to lower microleakage and secondary caries.[23]

The bulk fill packable composite resin used in this study is one of the most popularly utilized bulk fill packable composite resins. It is a restorative material that is visible light activated and designed to make quick, simple repairs. Due to the use of a stress-relieving resin system and improved optical characteristics, the material can be deposited and cured up to a depth of 5mm.[1,2]

Different chemicals included in food can soften and dissolve RBC matrixes, debond, and leach fillers, reducing the durability and longevity of the restoration. By using dietary solvents like citric acid, it is possible to evaluate chemical affinity and the elution process of RBCs in short periods of time. The current solvents were selected either because they are chemical components of food, drink, and saliva. In an oral environment, the resin composites are intermittently or continuously exposed to chemical compositions of saliva, food, and drinks. And citric acid is a commonly used organic acid in foods. Many previous studies have shown that organic acids and their many derivatives and food-like fluids can cause softening of the resin matrix of the composite resin restorations.[14,16,25]

Prior to flexural testing, the RBCs underwent a continuous seven-day incubation in the different conditioning media at 37^0C. Since restorations only sometimes and briefly come into contact with foods and beverages intraorally, this conditioning period may seem excessively long. However, if food particles or

calculus accumulate at the edges or grooves of restorations, they may absorb chemicals, resulting in continuous exposure.[14,15]

Because polymer matrix saturation starts between seven and sixty days, the food-simulating solutions were submerged for seven days. However, a prior study found that a week was enough to show chemical changes in resin, indicating that the quality of the material may be affected.[27]

For flexural testing, the International Organization for Standardization (ISO) suggests using specimens that measure 25×2×2 mm.[18] The mesiodistal widths of molars are approximately 11 mm, and the cervico-incisial length of central incisors often does not surpass 13 mm, hence these ISO specimens are not clinically relevant. The 12-mm specimens used in the mini flexural test were chosen because of their superior efficiency, clinical applicability, and significant correlation to the ISO flexural test.[17]

When utilizing shorter specimens (10×2×2 mm) than those recommended by ISO 4049 (25×2×2 mm), Peutzfeldt & Asmussen (1991) discovered greater values of flexural strengths, which they attributed to the lower dimensions. In line with other authors, a more recent study testing three different specimen lengths for the flexural strength test (25×2×2 mm, 15×2×2 mm and 10×2×2mm) found no statistically significant difference between the lengths.[4]

Both materials showed significantly higher flexural strength after storing them in artificial saliva. Flexural strength was found to be decreased following storage in the artificial saliva in a previous study.[1] This may be due to changes in the content of the saliva that was used in their investigation. Additionally, to adjust the pH, hydrochloric acid was added to artificial saliva.

The mean flexural modulus for bioactive bulk fill composite in saliva (Group IA) was 30587.559 ± 7763.326, for conventional bulk fill packable composite in saliva (Group IIA) was 30292.144 ± 7610.722, for bioactive bulk fill composite in 0.02 N citric acid (Group IB) was 981.550 ± 149.635 & conventional bulk fill packable composite in 0.02N citric acid (Group IIB) was 965.397 ± 87.701(Table3, Graphs 2). Multiple comparison between groups revealed that the Group IA showed significantly higher mean flexural modulus as compared to Group IB & Group IIB and the difference was statistically significant at $p<0.001$. This was then followed next by Group IIA showing significantly higher mean flexural modulus as compared to Group IB & Group IIB and the difference was statistically significant at $p<0.001$. However, no significant difference was noted between Group IA & Group IIA and also between Group IB and Group IIB. This variation could be the result of modifications of the materials in composition as well as the form and size of the fillers.

Bioactive bulk fill composite resin used in this study is free of Bis-GMA, Bis-EMA, and TEGDMA and is composed of a mixture of diuretane and other methacrylates. The hydrophilic monomers bis-GMA, Bis-EMA, and TEGDMA may dissolve in water and absorb it and may contribute to the composite's decreased flexural strength. The conventional bulk fill composite's flexural characteristics are further decreased by the smaller, less transparent zirconia filler particles, which make the material more vulnerable to water attack.[16,27]

When storage environments were compared, conditioning in artificial saliva presented the highest flexural strength and modulus for both materials than in 0.02N citric acid. According to a prior study, the flexural values decreased after seven days of storage in 0.02N citric acid.[1] It is suggested that weak intraoral acids, including citric acid, can destroy the inorganic fillers in RBCs.[16] Exposure to organic acids, their many derivatives, and liquids that resemble food can cause the resin matrix of composite resin restorations to deteriorate. Water absorption, which softens the resin, and hydrolytic breakdown of the silane-filler-resin matrix bond are the two factors that induce this degradation.[15,16]

In various ways, the current study could be improved. The conditioning time could first be prolonged to ascertain the longer-term impact of the conditioning environment on flexural properties.[7,9] Due to the fact that dental RBCs are viscoelastic in nature and display both viscous and elastic characteristics when experiencing deformation, the static flexural testing that was performed in the current study cannot offer insights into the material structure. It is possible to conduct dynamic testing along with dynamic mechanical analysis to more accurately evaluate the RBCs' viscoelastic characteristics.[10] Furthermore, because dynamic testing is nondestructive, it allows for repeated testing of specimens over a longer time frame than static testing does.[11]

CONCLUSIONS:

Within the limitation of the study, it can be concluded that

- Solvent storage affected the flexural strength and modulus of both bioactive bulk fill composite and conventional bulk fill packable composites.
- Bioactive bulk fill composite and conventional bulk fill packable composites exhibited significantly high flexural strength and flexural modulus after storage in artificial saliva ($p<0.001$).
- Bioactive bulk fill composite and conventional bulk fill packable composites exhibited significantly lower flexural strength and flexural modulus after storage in 0.02N citric acid ($p<0.001$).
- On intergroup comparison both bioactive bulk fill composite and conventional bulk fill packable composites exhibited significantly lower flexural strength and flexural modulus on storage in 0.02N citric acid in comparison with artificial saliva ($p<0.001$).

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ORIGINAL RESEARCH

EFFECT OF ADDITION OF 0.25% CHITOSAN NANOPARTICLES (CSN) TO NEOSPECTRA COMPOSITE, 8th GENERATION DBA & SDR ON BOND STRENGTH IN CLASS II RESTORATION

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ABSTRACT

Aim: The aim of the study is to evaluate the effect of addition of 0.25% Chitosan Nanoparticles (CSN) to neospectra composite, 8th generation dentin bonding agent & SDR on the bond strength in class II restoration in mandibular molars.

Materials and Methods: 60 mandibular teeth were cleaned and mounted in acrylic mould up to 2mm below CEJ & class II MO cavities were prepared .0.25% chitosan powder was added to 8th gen DBA, SDR & neospectra. The samples were then arbitrarily divided into six groups with 10 samples in each group.

Group 1: 8th gen DBA + neospectra, Group 2: 8th gen DBA +SDR+ neospectra, Group 3: 8th gen DBA with 0.25% chitosan + neospectra, Group 4: 8th gen DBA + neospectra with 0.25% chitosan, Group 5: 8th gen DBA with 0.25% chitosan + neospectra with 0.25% chitosan, Group 6: 8th gen DBA with 0.25% chitosan +SDR with 0.25% chitosan + neospectra with 0.25% chitosan. After restoration, bond strength was evaluated in each sample using a universal testing machine, and data collected were statistically analyzed by one-way analysis of variance and Post hoc Tukey tests ($P \leq 0.05$).

Results: Group 4: 8th gen DBA + neospectra with 0.25% chitosan showed significantly highest mean Bond Strength as compared to other study groups.

This was then followed with Group 2: 8th gen DBA +SDR+ neospectra & Group 3: 8th gen DBA with 0.25% chitosan + neospectra had the least bond strength.

Conclusion: Composite resin (neospectra) incorporated with CSN 0.25% increased the bond strength of class II restorations. Addition of a liner (SDR) has shown to positively influence the bond strength. Hence, it can be stated that 0.25% concentrations of CSN can be added to the composite resin to achieve good bond strength & improving longevity of the restoration.

Keywords: Chitosan nanoparticles; composite restoration; SDR; posterior restorations; bond strength

INTRODUCTION:

The longevity of composite restorations determines its success.[1] Posterior composites can produce predictable & effective restorations that resemble natural teeth. Consequently, there has been a noticeable increase in the use of posterior composites due to advancements in material physical qualities, dentin adherence, instruments and appropriate restorative procedures.[2]

Class II composite restorations are technique sensitive as they are prone to heavy occlusal forces.[1] For dental composite restorations in the anterior and posterior teeth, failure rates ranges from 0-45% / year. Restoration fracture, marginal defects, and secondary caries were the main causes of composite failure [3]. As a result, composite restorative materials require additional improvement.

Neo Spectra ST is a nanoceramic universal composite, used in both direct and indirect restorations resin & has unique (Sphere TEC) filler component system that combines spherical filler granules with an optimized resin matrix. It is longer-lasting, offers superior handling qualities, and good esthetics.[1]

SDR is a low viscosity bulk-fill resin composite based on stress-relieving resin technology. It is applied in 4 mm layers & filling the occlusal surface with a traditional resin composite. Urethane di-methacrylate (UDMA) modulator is used in SDR to control the polymerization reaction and produce a comparatively slow radical polymerization rate. The material's rheology may also contribute to its improved adaptation to the walls of cavities by preventing voids between the restoration and the tooth.[4]

The eighth generation of DBAs provides greater bond strength, longer shelf life, and enhanced stress absorption.[1] Tetric N-Bond Universal adhesives are considered "mild-etching" due to their low acidic monomer content. Its pH ranges between 2.5 and 3.0. Tetric N-Bond Universal's combination of characteristics enables it to consistently bridge the gap between the hydrophilic tooth substrate and the hydrophobic resin restorative.[5]

A naturally occurring polysaccharide, chitosan has become more and more popular in dentistry. It has strong chelating properties, high biocompatibility, and antibacterial activity against microorganisms. It promotes resin infiltration and the generation of the hybrid layer beneath composite restorations, as well as the biomimetic repair of enamel.[6] Chitosan nanoparticles (CSNs) added to DBAs enhances antibacterial and anti-inflammatory properties which protects the pulp.[7]

There are very few studies in which chitosan nanoparticles are incorporated into composite resins.

Hence, this study aims to evaluate the effect of addition of 0.25% Chitosan Nanoparticles (CSN) to neospectra composite, 8th generation dentin bonding agent & SDR on bond strength in class II restoration in mandibular molars.

MATERIALS AND METHODS:

MATERIALS

Eighth-generation DBA Tetric N-Bond Universal (Vivadent-Ivoclar, Schaan, Liechtenstein)
0.25% Chitosan nanoparticles
Etchant (37% ortho phosphoric acid)
NeoSpectra universal composite restorative material (Dentsply Sirona, USA)
SureFil SDR Flow Plus (Dentsply Sirona, USA) & CSN 0.25% (SRL Pvt. Ltd., Hyderabad, India)
Sixty human extracted maxillary molar
Ultrasonic Scalers
distilled water

Sixty human extracted mandibular molar teeth recently extracted for periodontal reasons were collected, cleaned with Ultrasonic Scalers (woodpecker piezo scaler UDS-J, China), and stored in distilled water for further use not more than a month.

Preparation of experimental materials

Neospectra + 0.25% Chitosan nanoparticles

About 1 mg of of composite & 1 mg chitosan powder components were weighed separately in a 1:1 ratio using an analytical balance (ACZET Model CZ 310, Ahmedabad, India) Mirani et al. [8] To incorporate nanoparticles within the composite resin, 1mg of CNS was mixed with 1 g of composite with a metal spatula on a glass plate. The manual mixing was performed for 1 min. The modified resin was protected from light inside a small, darkened box to prevent premature polymerization until placement within cavity.[17]

SDR + 0.25% Chitosan nanoparticles

About 1 mg of flowable composite (SDR) & 1 mg of chitosan powder were weighed in a 1:1 ratio & mixed according to Mirani et al [8]. The weighed 1mg CSN powder was mixed with 1 mg of SDR in a dark room using a spatula on a mixing pad & glass slab vibrator for 15 minutes. The resin composites were then returned to their opaque container.[18]

8th generation DBA + 0.25% Chitosan nanoparticles

To prepare the experimental DBA for CSN 0.25% groups, about 1 mg of chitosan powder was incorporated with 1 ml of bonding agent by vigorous mixing in a vortex, without exposure to the light according to de Carvalho Nunes et al. [9]

Specimen preparation

60 mandibular teeth were cleansed and mounted in acrylic mould up to 2mm below CEJ.

Class II MO cavities were prepared with standard dimensions of 2 mm pulpal depth ,1.5 mm of buccolingual width, and the gingival floor on the mesial side was prepared 1 mm above the CEJ with new straight fissured diamond point (Mani, India) & airotor (NSK Handpiece, UK).

The specimens were allotted into six groups:

Samples (n = 60) with (n =10) each group

Group 1: 8th gen DBA + neospectra

Group 2: 8th gen DBA +SDR+ neospectra

Group 3: 8th gen DBA with 0.25% chitosan + neospectra

Group 4: 8th gen DBA + neospectra with 0.25% chitosan

Group 5: 8th gen DBA with 0.25% chitosan + neospectra with 0.25% chitosan

Group 6: 8th gen DBA with 0.25% chitosan +SDR with 0.25% chitosan + neospectra with 0.25% chitosan

In specimens of Group 1, DBA was applied for 10 s, then air-dried and light-cured for 20 s followed by placement of Bioclear Matrix with retainer (Tacoma, USA) and stabilized for tight contact; followed by the placement of neospectra restorative material into the cavity by the incremental technique of 1 mm thickness and light-cured for 20 s.

In Group 2, DBA was applied for 10 s, then air-dried and light-cured for 20 s, SDR liner was placed light-cured for 20 s, followed by the placement of neospectra into the cavity and light-cured for 20 s.

In Groups 3, DBA modified with 0.25% CNS was applied for 10 s, then air-dried and light-cured for 20 s followed by the placement of neospectra restorative material into the cavity and light-cured for 20 s.

In Group 4, DBA was applied for 10 s, then air-dried and light-cured for 20 s, followed by the placement of neospectra modified with 0.25% CNS into the cavity and light-cured for 20 s.

In Group 5, DBA modified with 0.25% CNS was applied for 10 s, then air-dried and light-cured for 20 s, followed by the placement of neospectra modified with 0.25% CNS into the cavity and light-cured for 20 s.

In Group 6, DBA modified with 0.25% CNS was applied for 10 s, then air-dried and light-cured for 20 s, SDR liner modified with 0.25% CNS was placed light-cured for 20 s, followed by the placement of neospectra modified with 0.25% CNS into the cavity and light-cured for 20 s.

In all groups, finishing and polishing were performed using a composite polishing kit (Shofu, India). Following this, the specimens were stored in humid conditions for 24 hours.

Evaluation of bond strength

A reference point was marked on all specimens to guide the needle at the center of the tooth, specifically at the interface between the prepared cavity and the restoration. The specimens were placed under a universal test machine (Instron, USA) for bond strength. A needle consisting of a round cross-sectional area of 0.5 mm gauge, length of 1 mm, and radius curvature of 0.6 mm was inserted in each specimen at the speed of 1 mm/min until the restoration gets dislodged from the cavity, and data were recorded (fig)

Statistical analysis: Statistical Package for Social Sciences for Windows Version 22.0 Released 2013. Armonk, NY: IBM Corp., was used to perform statistical analyses.

The mean and standard deviation values were calculated and analyzed using the one-way analysis of variance and post hoc Tuckey tests ($P \leq 0.05$).

RESULTS:

One-way ANOVA Test showed the highest bond strength was obtained in Group 4 – (Neospectra+ 0.25% chitosan) group followed by Group 2(SDR + Neospectra group), Group 6(8th Gen DBA with 0.25% chitosan + SDR+ 0.25% chitosan), Group 1(Neospectra group), & Group 5(8th Gen DBA with 0.25% chitosan + Neospectra + 0.25% chitosan), with Group 3 (8th Gen DBA + 0.25% chitosan group) showing significantly least mean Bond Strength - (Table 1)

Based on multiple comparisons by post hoc Tukey test, statistical significance difference between all the groups ($P \leq 0.05$) (Table2)

Table1

Comparison of mean Bond Strength (in N) b/w 6 groups using One-way ANOVA Test						
Groups	N	Mean	SD	Min	Max	p-value
Group 1	10	223.50	5.62	215	231	<0.001*
Group 2	10	299.39	8.23	290	315	
Group 3	10	149.26	14.36	126	170	
Group 4	10	388.10	9.05	376	400	
Group 5	10	208.18	2.16	205	211	
Group 6	10	239.54	5.86	230	252	

* - Statistically Significant

Table2

Multiple comparison of mean difference in the Bond Strength b/w groups using Tukey's Post hoc Test					
			95% CI for the Diff.		
(I) Groups	(J) Groups	Mean Diff. (I-J)	Lower	Upper	p-value
Group 1	Group 2	-75.89	-87.03	-64.75	<0.001*
	Group 3	74.24	63.10	85.38	<0.001*
	Group 4	-164.60	-175.74	-153.46	<0.001*
	Group 5	15.32	4.18	26.46	0.002*
	Group 6	-16.04	-27.18	-4.90	0.001*
Group 2	Group 3	150.12	138.98	161.26	<0.001*
	Group 4	-88.72	-99.85	-77.58	<0.001*
	Group 5	91.21	80.07	102.35	<0.001*
	Group 6	59.84	48.70	70.98	<0.001*
Group 3	Group 4	-238.84	-249.98	-227.70	<0.001*
	Group 5	-58.91	-70.05	-47.77	<0.001*
	Group 6	-90.28	-101.42	-79.14	<0.001*
Group 4	Group 5	179.92	168.78	191.06	<0.001*
	Group 6	148.56	137.42	159.70	<0.001*
Group 5	Group 6	-31.37	-42.51	-20.23	<0.001*

* - Statistically Significant

DISCUSSION:

Researchers are constantly striving to enhance composite materials with new advances to address their drawbacks and improve their overall performance.[14]

In a study done by Kumagai et al concluded that the bulk-fill flowable composite SDR may improve the bond strength to the gingival walls of Class II MOD cavities.[10] In the present study incremental technique for restoration is followed to restore Class II MO cavities in groups 1,3,4 & 5 and in group 2 & 6 SDR liner was placed followed by incremental layering of nanocomposite.

Solomon *et al*. found that teeth restored with light-cured composite restoration with beta quartz insert showed significantly higher fracture resistance values of premolar teeth with class II preparations, compared to the group without beta quartz inserts. [15]

Agusnar et al showed that addition of 0.1% high molecular Chitosan to nanocomposite resins shows a better bond strength and less surface degradation when compared to the composite resin that is not infused with Chitosan. [16]

In a study conducted by Mohamed et al., to evaluate the effect of chitosan nanoparticles on microtensile strength of resin composite to dentin using self-etch adhesive after aging, it was found that the addition of 0.2% chitosan resulted in a statistically significant increase in bond strength compared to the use of 2.5% chitosan. Concluding that when the concentration of CSN increases the bond strength value decreases [6]

Hence in the present study, 0.25% CSN was incorporated into to 8th generation DBA, SDR liner & in composite resin to improve bond strength in class II cavities

The choice of adhesive material plays a crucial role in the quality and long-term success of composite restorations.

In a study done by Himali et al concluded that eighth-generation bonding agent modified with 7% arginine and 0.12% chitosan showed antibacterial efficacy against *S. mutans*. In addition to this, they also had higher tensile bond strength values as compared to unmodified adhesive. [11]

In the present study group 4 (Neospectra+ 0.25% chitosan) showed the best bond strength. In which 0.25% chitosan was added to neospectra. The significant increase in bond strength could be due to the Amine (NH2) and hydroxyl (OH) surface groups present in CCN promote the formation of several inter and intramolecular hydrogen bonds, which allows the embedding of nanoparticles used as a filler and increase the mechanical properties of nanocomposites[12]

This is in accordance with a study done by Halkai et al on different concentrations of CNS (0.25% & 2%) incorporated in composite resin and 8th generation DBA, it showed that when 0.25% CSN was incorporated into composite resin the bond strength increased & reduced bond strength was observed when CNS was incorporated in 8th generation DBA.[1]

In a study done by de Carvalho Nunes et al.to evaluate bond strength to dentin by adding 0.2% and 0.5% of CSN to total-etch and self-etch adhesives in class V cavities and concluded that chitosan incorporated composites have improved mechanical properties including bond strength with self and total-etch adhesives [9]. The results of the present study are in accordance with the above studies, showing that 0.25% chitosan nanoparticles added to composite increases the bond strength in class ii cavities.

The next highest bond strength was given by group 2 (8th gen DBA +SDR+ neospectra) where SDR was used as a liner below neospectra. The improvement in bond strength could be because it acts as a intermediate layer which absorbs stress and reduces polymerization shrinkage. Another reason could be, Urethane di-methacrylate (UDMA) modulator in SDR produces a comparatively slow radical polymerization rate, which reduces stress without lowering the conversion rate & permits a slower modulus development [4]

The present study is in accordance with the study done by Andre´ et al to test the effects of filling technique, cavity configuration and use of a low-viscosity composite liner influence resin bond strength to the dentin of class II cavities; and analyze the failure modes of fractured specimens. It concluded that bond strengths were not improved when a low-viscosity composite liner was applied, but it remarkably influenced the failure modes. Incremental techniques improved bond strength.[19] This may be due to decreased effectiveness of polymerization at the bottom of the cavity.[20]

Study done by Roulet et al SDR presented significantly higher μTBS values for bulk and incremental filling techniques in class MOD cavities [10]Group 6 (8th gen DBA with 0.25% chitosan +SDR with 0.25% chitosan + neospectra with 0.25% chitosan) showed minimal increase in bond strength when compared to Group 1 (Group 1: 8th gen DBA + neospectra) in when no CNS was added as incorporation of 0.25% chitosan into self-etch adhesive system negatively influences the bond strength.

In the present study, when 0.25% of chitosan added to DBA it has shown to decrease bond strength in group 6 ,5 &3, with group 3 being the least. It might be due to the physicochemical characteristics of the self-etch adhesive system used in this study, and are in accordance with Dacoreggio et al. Chitosan when added to the self-etch and total etch showed greater gelatinolytic activity & a reduction in the formation of dentin tags due to greater colloidal

stability. Both the self-etch and total etch strategy the Ch incorporation affected microtensile bond strength negatively, regardless of the application strategy. [12,13]

In a study done by Ahmed et al , incorporation of nanochitosan (0.5% and 1%) improved the universal adhesive microtensile bond strength and bond durability.[21]

Hence the present study suggests that incorporating CSN into composite resin and liner could be a promising approach to address some of the limitations of traditional composite restorations, such as polymerization shrinkage, bond strength, and susceptibility to secondary caries. Further *in vivo* and *in vitro* studies would be valuable to validate these findings and explore the potential benefits of CSN-enhanced composite restorations in clinical practice.

CONCLUSION:

Composite resin (neospectra) incorporated with 0.25% CSN increased the bond strength of class II restorations. Further addition of a liner (SDR) has shown to positively influence the bond strength.

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REVIEW ARTICLE

Applications of Micro CT in Conservative Dentistry and Endodontics

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ABSTRACT

Micro-CT, a three-dimensional imaging technique, captures images from multiple perspectives around an object's axis. It has proven indispensable in both operative dentistry and endodontics research. Given that research forms the cornerstone of clinical practice, conducting studies with accurate and up-to-date methodologies is crucial. This overview outlines the myriad uses of micro-CT in operative dentistry and endodontics research. Its ability to generate high-resolution 3D images without sample slicing reduces manual labor and eliminates potential errors associated with such methods. The review seeks to guide researchers in understanding the scope and potential applications of micro-CT methodology.

KEYWORDS: Three-Dimensional, Imaging, X-Ray microtomography, Dental Materials, Preventive Dentistry

INTRODUCTION

Computed tomography was developed in the year 1970, by Allan Cormack and Godfrey Hounsfield, as a 3-dimensional(3D) imaging method that involves obtaining X-ray projection images from many angles of view around an axis through an object.[1] Around a decade later, Jim Elliott developed micro-computed tomography (µCT) in the 1980s which has been in use in experimental endodontic studies since 1999.[2] Micro CT can directly analyze a wide range of specimens, including materials such as ceramics, polymers, biomaterial scaffolds, and mineralized tissues. The Micro CT method seldom requires sample preparation and allows for the imaging of samples in their natural form without the requirement for sectioning, which may lead to artifacts or the loss of material.[3] It is also possible to tilt, rotate and enlarge the regions of interest in the image. All of these features can be beneficial to clinicians or researchers since they can gain a better knowledge of dental anatomy or study samples. This technique has the potential to be a great tool, not only for clinical research but for educational applications as well.

The basic Micro-CT set up consists of various equipments comprising of an X-ray tube, a filter and collimator, a computer-controlled electric motor, a CCD camera for translating X-ray image data, an image intensifier apparatus, a specimen platform, and a computer.[4] in vivo and ex vivo scans are the two types of micro-CT scans which can be obtained. In in vivo scans, an object is placed on a stationary platform while the X-ray tube and X-ray detector rotate around it. However, for ex vivo scanning, an object is placed on a rotating platform while the X-ray tube and the X-ray detector remain fixed.[5] Lead shielding is used during the reconstruction of 3D images to protect operators during the procedure. Micro-CT systems have a much better spatial resolution and diagnostic accuracy compared to clinical CT. The sample can be thoroughly examined in three-dimensions utilizing MCT and mathematical modeling. After the serial reconstruction, the object's axial cross sections and a creation of a 3D object's realistic perspective with the ability to "cut" and "rotate" the object model may be seen on the screen. From the results, it is possible to reconstruct 3D objects with the use of an external software. [1]

Despite its many advantages in comparison with other methods, micro-CT also has some constraints.[6] It is a non-destructive approach when compared to microscopic methods as the internal properties of the same sample can be tested multiple times, as they remain intact. Multiple scanning and image processing is also possible with more precise measurements. Sample preparation is relatively easy for micro-CT unlike other destructive methods.[7] Some limitations of micro-CT include time consuming scanning and reconstruction procedures, expensive setup, and the necessity of computer expertise. Data acquisition is also difficult as it is necessary to store and retrieve large volume files. The radiation dose of micro-CT scans is believed to induce changes in biological pathways which may impact analysis on live specimens. The high radiation dose contraindicates its use in clinical settings even though these changes are not lethal. There are some recent studies where certain experimental animals have been studied under micro-CT without any significant radiological damage.[8] The areas of implementation of micro-CT currently are mainly in the fields of biomedical, bioengineering, and tissue engineering. This review article aimed to focus on the applications of micro-CT in conservative, diagnostic, restorative and endodontic research. This review is divided into two distinct parts expanding upon the endodontic and operative applications of micro-CT as seen in Figure 1.

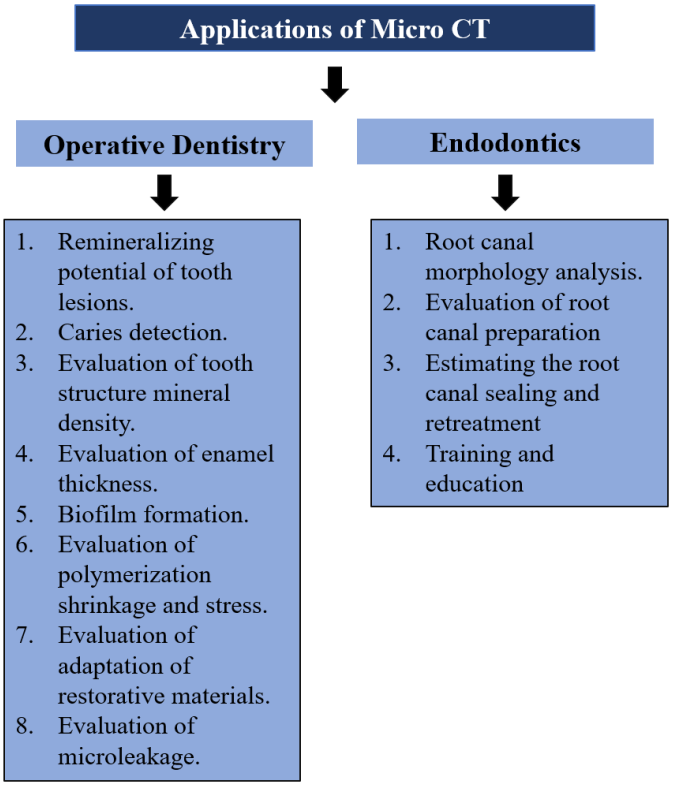

Figure 1: Applications of Micro CT in the dental field.

I. Applications in Conservative Dentistry:

a) Remineralizing potential of teeth

Various indirect methods have been used in studies to analyze and measure the mineral content of dental tissues and structures, including microhardness, nanoindentation and optical coherence tomography. transverse microradiography and micro-CT are direct methods of measuring mineral content. Micro-CT has the advantage of being nondestructive compared to the time-consuming and destructive transverse microradiography. The use of Micro-CT for quantitative research on dental hard tissues, has been found to have use in evaluating mineral loss [9] and the depth of lesions[10]. The mineral density profiles provide authors with an insight into mineral distribution and alterations in the mineral content of dental mineralized tissues.[11,12]

b) Caries detection

Proximal caries diagnoses are mostly carried out using visual examination and bitewing radiographs. Other caries detection techniques in use are the DIAGNOdent Pen and the CarieScan PRO.[13] Histological slicing is not always

suitable due to the destructive nature of the procedure, leading to loss of some specimen parts.[14] The micro-CT in contrast does not alter the specimens and can evaluate multiple dental sections together.[15] However, this is not yet feasible in routine practice due to lengthy scanning, reconstruction and measurement time, as well as the high radiation dose.

c) Mineral density evaluation

The mineral density primarily dictates the mechanical characteristics of both enamel and dentin. While previous studies have explored the mechanical attributes of specific tooth regions, there's a necessity to analyze the complete tooth structure, spanning from the crown to the apex, as a macrostructure, focusing on its mechanical aspects. [16] The mineral density of permanent enamel diminishes gradually toward the cementoenamel junction for each tooth, while in permanent teeth, the mineral density of dentin is consistently lower compared to the density distribution of enamel across all regions. [17]

d) Thickness evaluation

Enamel thickness is considered crucial for understanding occlusal loading patterns and for identifying chronic conditions like metabolic disorders or developmental defects in human evolutionary studies. Various techniques are available for assessing enamel thickness, with the most prevalent involving the creation of physical tooth sections. However, the destructive nature of this method, particularly when dealing with rare or extinct fossil specimens, appears impractical. [18] Micro-CT offers superior sensitivity for measuring tooth tissue thickness without harming specimens. Additionally, it enables the determination of enamel, dentin, and pulp volumes. Some research has utilized this technique to measure prosthesis and cement space thickness at various locations. [19]

e) Biofilm evaluation

Bacterial biofilms are predominantly found in dental and periodontal infections and utilizing micro-computed tomography (micro-CT) to characterize this biological structure provides valuable insights for clinical and research purposes. A technique has been devised to discern materials with low X-ray absorption, which was effectively employed to detect artificial dental biofilms formed around tooth surfaces. Dual-energy micro-CT can discern subtle variations in the attenuation coefficient by utilizing two sets of images acquired at different input energies.[20]

f) Polymerization shrinkage evaluation

Composite resins have emerged as the primary choice for restorative material, driven by rising aesthetic expectations, surpassing amalgam for direct restorations. Nonetheless, these materials undergo polymerization shrinkage, which exerts significant stress on the marginal integrity of the restorations, leading to detachment from the tooth and the formation of gaps. Current methods for assessing polymerization shrinkage typically gauge both linear and volumetric alterations.[21] Micro-CT can be utilized to gather real 3D data from the cavity during polymerization as it is a non- contact technique. Certain studies have utilized a superimposition tool to assess volume alterations of composite resin pre- and post-curing using a light-curing unit.[22] In certain studies, polymerization shrinkage was assessed via micro-CT by determining the ratio between the overall volume of the composite resin prior to curing and its volume after curing.[23]

g) Evaluation of internal and marginal adaptation

Voids, gaps, bubbles, and other imperfections have the potential to diminish the mechanical characteristics of materials based on resin. [24] Imperfections can compromise the performance of restorations under repetitive stress and diminish the durability of the restorative material, even if it possesses suitable mechanical properties initially, ultimately resulting in clinical failure. [25] The formation of voids may arise due to factors such as the material's viscosity, the size of the applicator tip, and the entrapment of air between layers of resin composite during the incremental technique. [26] Additionally, some researchers have explored the internal and marginal fit following the curing of various adhesive restorative materials. [25] As the efficacy of ceramic restorations hinges on both margin sealing and the thickness of the adhesive cement, they evaluated the internal fit and marginal adaptation of inlays crafted using different computer-aided design software's. [27,28]

h) Evaluation of microleakage

Structural flaws at the bonding interface, alongside polymerization shrinkage, contribute to the disruption of marginal adaptation, increasing the risk of postoperative sensitivity and recurrent caries.[1] Several in vitro techniques have been proposed to visualize and quantify microleakage, however, these methods have limitations.[4] Micro-CT offers precise analysis without the need to section samples, thanks to X-rays' ability to penetrate them.

Moreover, regardless of the sample's shape or dimensions, micro-CT enables dependable and consistent examination of its internal features. [29]

II. Applications in Endodontics

a) Analysis of root canal structure

Root canal shapes can be assessed qualitatively and quantitatively through micro-CT. Distinguishing between the external and internal structure of a tooth is facilitated by the capacity to render dental hard tissues transparent, while the pulp chamber and root canal system appear opaque in three-dimensional morphological assessments of the root canal system. [30] It was possible to measure the pulp chamber's overall areas, the volume ratio at the level of the pulp horn, the pulpal floor, and the root canal orifice diameters on the buccal and lingual sides.[31] Certain research findings revealed that triangulation techniques could be employed to understand the surface characteristics and volumes of individual root canals, while model-independent methodologies could be utilized to assess canal diameters and configurations. [32] For clinicians, curved canals pose a substantial problem since they add on the potential of iatrogenic mistakes such as ledge formation, perforation, and transportation. [33,34]

Recent micro-CT investigations have evaluated 3D canal curvature by intersecting points of the minor and major axes of the canal cross in each slice using Kappa software (Custom made software designed by JK Lee, V works program, Germany). [35] The precise measurements of canal curvature in mandibular molars made using MCT showed that the curvatures were larger in the MB canal than in the mesiolingual. They were most prominent in the apical and coronal regions, and straight in the mid root area of the mandibular molar's mesial root. [35] Some investigations gave a thorough and precise description of the root canal curvatures present in maxillary first molars. [36] The P (palatal) canals have the least root canal curvatures, whereas the MB canals have the most prominent root canal curvatures. The apical third of the curvatures increases, especially in the MB (mesiobuccal) and DB (distobuccal) canals, and the curvatures in the apical third rise with the presence of accessory canals.

Clinically, it is difficult to access the middle mesial root canals because of where their orifices are located. If untreated, these canals could harbour germs, jeopardize the effectiveness of the therapy, and cause persistent apical periodontitis.[37] Previous studies showed that the use of MCT technology ensured a good visibility of additional canals that were consistently smaller than the major canals at each level. [38,39] Furthermore, the creation of more accurate and comprehensive 3D models of the root canal region was made possible by the ability of MCT devices to acquire imaging projections with a wider degree rotation of the specimen (360°) than the CBCT unit (200°). [40] 7.7% of mandibular molars were discovered to have three canals along any position of the mesial root, which is higher than the previously reported percentage (2.3%). [41] To boost the success rate of nonsurgical endodontic procedures, these results together with a 3D image of the mesial root canal aid in the identification of additional canals and their root canal preparation.

b) Evaluation of access cavity

Preserving dentin during access cavity preparation offers benefits such as maintaining the structural integrity of the tooth. [42] Multiple micro-CT studies have assisted in evaluating the difference in dentin loss between traditional and conservative methods of access opening. [43-45]

c) Evaluation of root canal preparation

MCT scans of teeth performed pre- and post instrumentation help in quantitative assessment of the remaining unprepared surface area and the associated morphological changes. The color mapping technique further aids in the spatial location of potentially infected dentin and its successful removal after instrumentation.[46] Micro- CT testing, has shown that current biomechanical preparation methods and instruments leave 10%–50% of unprepared areas in root canals that are narrow or circular, and these percentages tend to increase in canals that are oval shaped or flattened.[47] Because apical canal diameters vary greatly and are occasionally incompatible with the dimensions of currently available tools, unprepared walls are very common. When the root canal is enlarged, following excessive dentin removal, the tooth structure is weakened, and transportation of the canal is a crucial metric to assess.[48] Using Micro-CT, the center of gravity in each canal cross-section was connected with a hypothetical line (z-axis), passing along the root length; by correlating the data collected before treatment and after preparing the canal. Then, comparison of the separation between the center of gravity at each level of the root canal, is made, and mean transportation may be computed.[49] The smallest dimensions of canal widths were recorded as a measure of canal narrowness, which is significant in selecting the initial apical file size for preparing the apical third area. MCT has

established itself as the standard technique for the evaluation of accumulated hard tissue debris (AHTD) into the abnormalities of the root canal system, permitting a longitudinal observation of the same specimen during numerous experimental procedures.[50]

d) Estimating the root canal sealing and retreatment

Numerous techniques, including confocal laser scanning and stereomicroscopy, which require cutting the samples into sections before analysis, have been utilized to assess the quality of root canal sealing. However, MCT is currently the most effective tool for studying microleakage in vitro and has the advantages of being quick, precise, and nondestructive. This method has also been used to evaluate the amount of sealing material reaching the isthmus regions and branching.[51] These areas can be visualized with varying intensities of sealer, gutta-percha into different colors by processing pictures obtained with µCT on the computer.[52] Calculations can be made to determine the volume of voids and gaps in the root canal. The investigations involve void and gap demarcation in the 2D slices, followed by image reconstruction in three dimensions.

e) Training and education

In the realm of endodontics, educational practice is critical. Given that it can produce accurate, helpful images of tooth anatomy, MCT is an effective technique for endodontic experiments. It has the potential to be an effective research tool since it may assist researchers and clinicians in learning more about dental anatomy in obtaining better preclinical training in the core endodontic therapy approaches. The use of MCT for teaching preclinical students about tooth morphology and endodontic operations has the potential to be beneficial.[53] The 3D graphics assist students in visualizing and comprehending the results of root canal preparation and obturation. It was thought to be useful for inexperienced students to evaluate endodontic therapy.[54]

CONCLUSION:

- While micro-CT is not presently applicable for clinical use, it has emerged as a potent research instrument over the past decade due to its ability to offer a non-invasive, reproducible, and precise method for qualitatively and quantitatively evaluating teeth and dental materials.
- Nevertheless, the drawbacks of micro-CT, such as its high expense, lengthy scanning and reconstruction periods, and the substantial file sizes, constrain its widespread utilization.
- With the development of small animal imaging, future research should focus on overcoming the mentioned limitations and enable design of devices capable of in vivo 3D imaging in clinical dentistry.

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CASE REPORT

Minimally invasive esthetic treatment options for discoloured teeth- A Case Series

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ABSTRACT

Aesthetics has become a major concern for young as well as old patients and pose a treatment challenge to dentists. Teeth discoloration is common in the general population that can occur as localized or as generalized condition. Enamel discoloration is caused by hypermineralization, hypomineralization or staining. Many treatment options have been introduced for the restoration of such defects and a few are still being evaluated in order to ensure an efficient treatment with minimal chair time and cost effectiveness. For superficial enamel stains or defects, Enamel Microabrasion (EM) is preferred. It is a conservative procedure used to remove superficial enamel discolourations. Bleaching and macroabrasion as well as direct or indirect veneers are other microinvasive treatment procedures. Any combination of treatment also can be done. Identifying the type of discolourations that can be treated with various microinvasive treatment is critical to achieve a favourable outcome. This article describes the treatment with enamel micro and macro abrasion and direct and indirect veneers to achieve successful esthetic outcome.

Key words: Discolourations; Enamel microabrasion; Enamel; Esthetic treatment; Fluorosis.

INTRODUCTION:

Teeth discoloration can affect an attractive smile on one tooth or all of the teeth. Isolated areas of yellow, brown or white patches are also common on an otherwise uniform surface. To address these unsightly situations, better materials and methods for masking the discolouration have been proposed.[1]The exogenous stains could have an extrinsic genesis, such as caused by tobacco use, food dyes, dental calculus buildup or plaque formation. Intrinsic etiology may be congenital (dentinogenesis imperfecta, dental fluorosis) or acquired (tetracycline staining).

Abrasive chemical treatments and ceramic veneers are two possible treatment options, depending on how severe the enamel stains are. Economic difficulties have affected patients' decisions on treatment options, even in spite of the growing demand for flawless smiles. Modest methods are centered on less expensive and time-consuming procedures like bleaching, treatments with micro and macro abrasion and composite resins. For superficial enamel stains or defects, enamel macroabrasion followed by microabrasion is preferred. Abrading the enamel surface using a fine diamond or carbide finishing bur is called macroabrasion.[3]

A conservative technique for improving discolorations restricted to the superficial layer of enamel is enamel microabrasion. Depending on the amount of acid concentration and applications, the enamel microabrasion causes a 25–200 µm loss of enamel structure.[4] By rubbing a gel containing an acid and an abrasive substance, microabrasion eliminates the stains that are trapped in the porous surface enamel layer.

The use of various acids to remove enamel stains was introduced in 1916. At first, 36% hydrochloric acid was used which was later modified as 18% hydrochloric acid due to the harmful effects of the concentrated acid. Later in 1970s, McClosky and Theodre Croll introduced the mechanical application of the acid for 20-30 sec per teeth.[3]

Murrin et al. (1982) suggested the use of pumice in combination with 36% hydrochloric acid as an abrasive agent. The resulting slurry was applied using a rubber cup. To make the process safer, Croll et al. suggested using the same combination but adding 18% hydrochloric acid.[3]

The first line of treatment for intrinsic dental enamel discoloration is minimally invasive procedures like microabrasion and teeth whitening.[5] When the stains are a little deeper, it may be essential to associate indirect ceramic veneers or restorative operations with micro- and macroabrasion in order to achieve good aesthetics.[6]

COMMERCIALLY AVAILABLE PRODUCTS

Product name	Manufacturer	Composition
Prema Compound	Premier Dental Company, Philadelphia, PA, United States	10% hydrochloric acid
Opalustre	Ultradent Products Inc., South Jordan, UT, United States	6.6% hydrochloric acid

Table 1: Commercially available products with manufacturers name and their composition

CASE REPORT

CASE 1: MICROABRASION TECHNIQUE AS A STAND ALONE TREATMENT

A 24-year-old female patient reported with the complaint of discoloured teeth in the upper front teeth. On examination, mild superficial enamel stains on the anterior teeth were observed. According to Deans Fluorosis Index, score of 2 was given. Diagnosis was mild fluorosis (Figure1: a, b, c) and treatment plan of oral prophylaxis followed by micro abrasion technique was implemented.

After rubber dam placement, a rubber cup (OpalCups, Ultradent) was used to compress the paste, Opalustre (Ultradent) using a low speed micromotor (500 rpm) and moderate pressure for 60 seconds followed by intermittent rinsing and inspection. (Figure 1: d, e, f). It was repeated twice till satisfactory results were obtained.

After removing the rubber dam, the teeth were polished with a composite polishing kit. The patient was satisfied with the final result. (Figure: g, h, i)

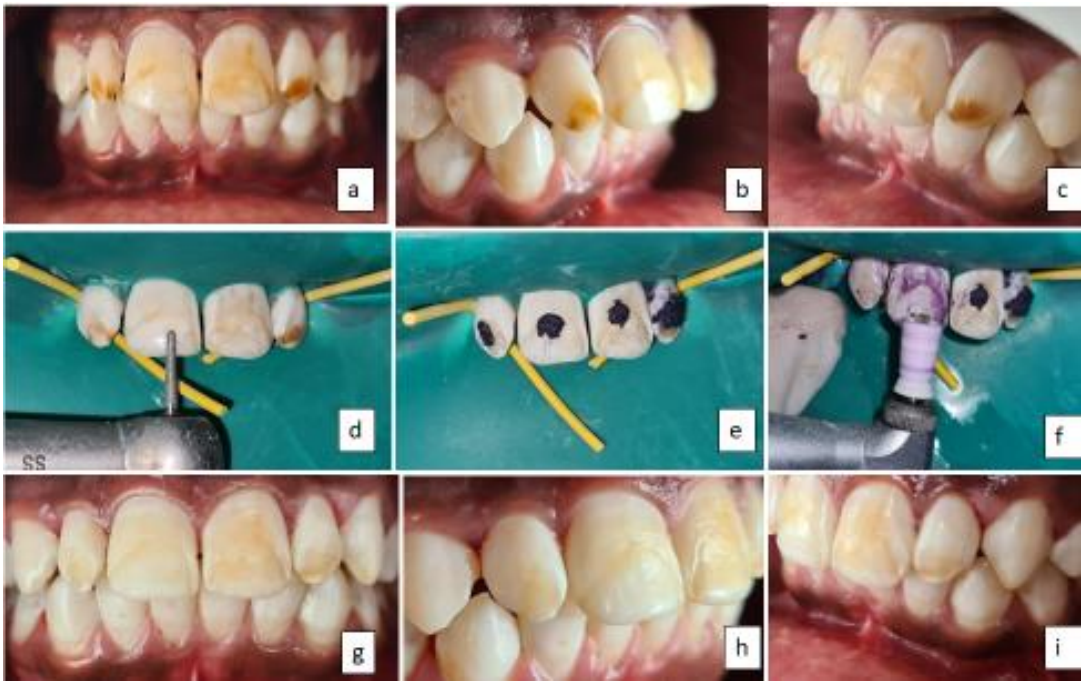

Figure 1(a, b, c) Preoperative view- Fluorosis stains in maxillary anterior teeth. (d) Macroabrasion using fine diamond (e, f) Microabrasion process using Opalustre and rubber cups. (g, h, i) Postoperative view

CASE 2: MICRO MACRO ABRASION FOLLOWED BY DIRECT COMPOSITE VENEERING

A 45-year-old female patient reported to the department with the chief complaint of discoloured upper front teeth (Figure 2a). According to Dean's index score 3 was given. Moderate fluorosis was diagnosed and treatment plan included oral prophylaxis, removal of stains using micro/ macro abrasion technique followed by direct composite veneering to bring back the contour of the teeth.

After rubber dam isolation (Figure 2b), macroabrasion was done to reduce the darker areas (Figure 2c) followed by use of microabrasion using opalustre on the surface of the teeth using rubber cups (Figure 2d and 2e). After micro macroabrasion, the patient was not satisfied with the results hence the treatment was proceeded for composite veneering with respect to 11,12,21,22. (Fig 2.g, h, i, j, k, l). The postoperative view is shown in the Figure 2(n)

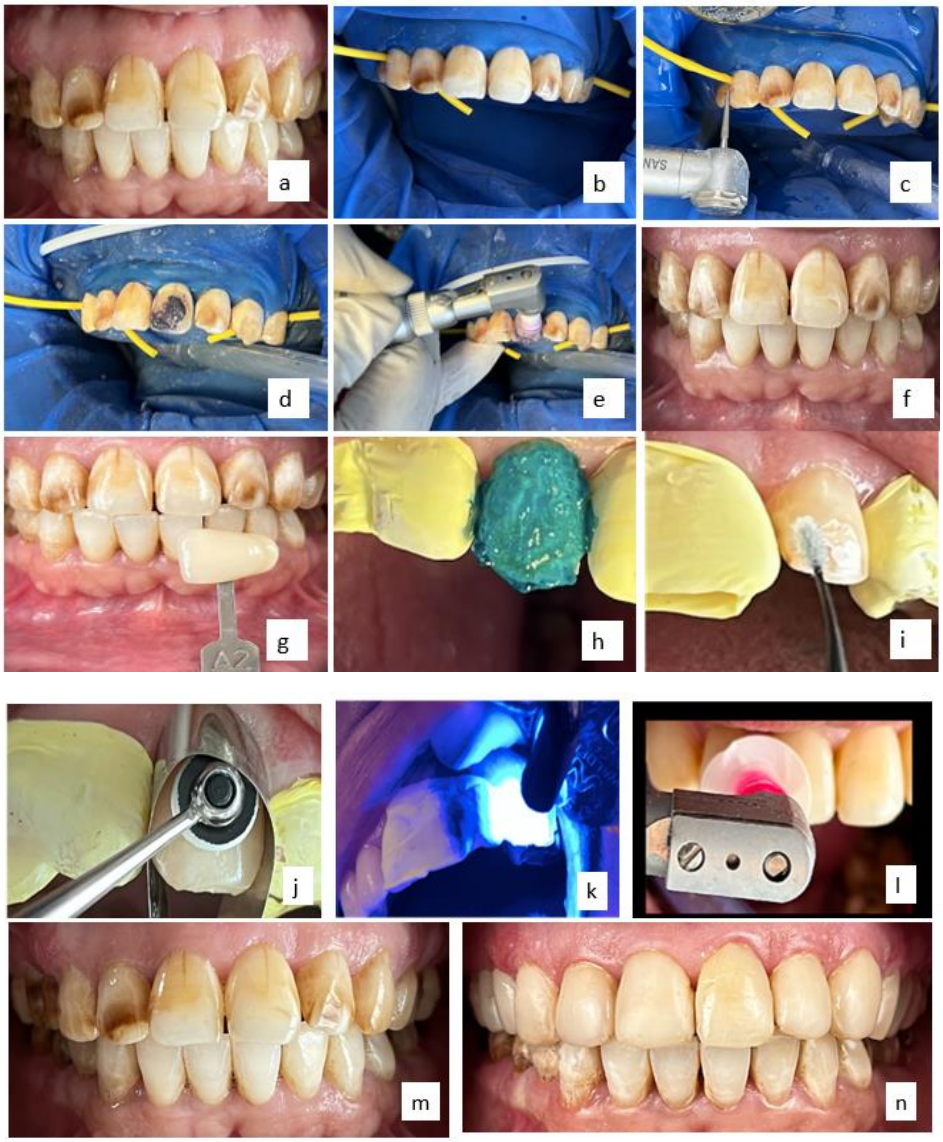

Figure 2(a)Preoperative view: Moderate fluorosis (b)rubber dam isolation (c) In the darker areas macroabrasion was done with a tapered finishing-diamond bur.(d)&(e) microabrasion using opalustre(f) post macromicroabrasion (g) shade selection for composite veneering (h) etching (i) bonding (j) layering of composite(k) light curing (l) finishing and polishing (m)&(n)preoperative and postoperative view. (Acknowledgement: Dr Prerana Choudhury)

CASE 3: INDIRECT CERAMIC VENEERS

A 18 year old patient reported with the chief complaint of discoloured front teeth. According to Dean's index, score 4 was given due to the severe pitting and brown stains. Treatment plan was oral prophylaxis, removal of stains using micro and macro abrasion technique followed by indirect ceramic veneers. After micro macro abrasion, there was a slight reduction in the stump shade (figure 3b). The treatment was further proceeded for indirect ceramic veneers (IPS emax veneers). After preparation and try in of the fabricated veneers, the cementation was carried out. The postoperative view is shown in figure 3e.

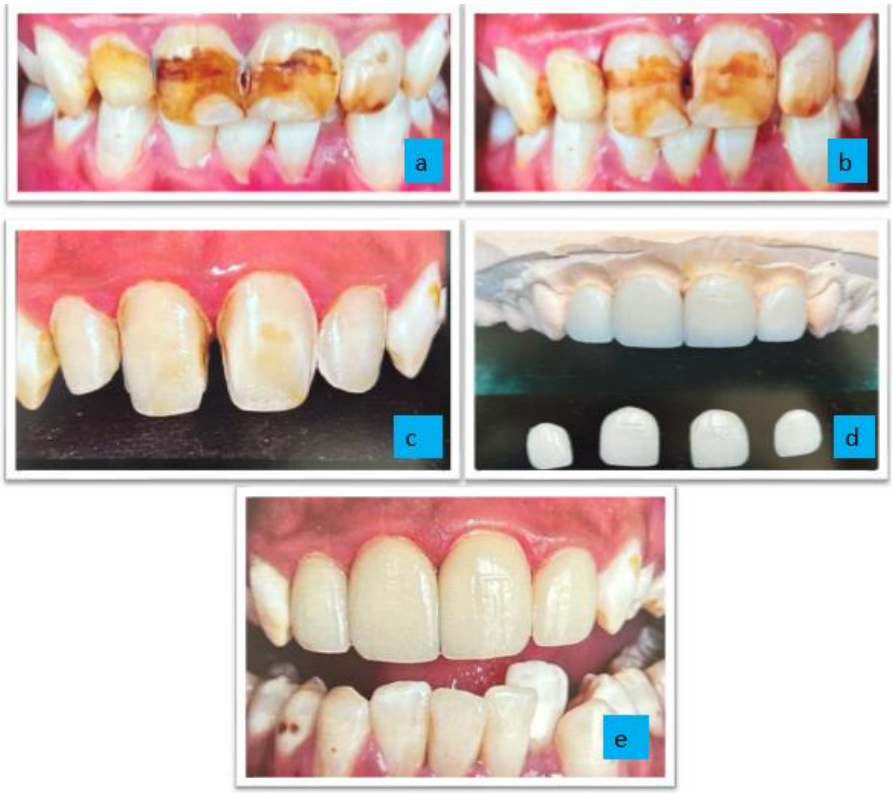

Figure 3 (a) Preoperative view: Severe fluorosis (b) Reduction in the value of stump shade after micro and macro abrasion (c) Preparation for veneers followed by shade selection (d) Fabrication of e max veneers (e) Postoperative view after the cementation of veneers.

DISCUSSION:

It is appreciated by individuals of all ages and genders, the significance of a gorgeous smile. Patients may experience psychological effects as well as social difficulties from unattractive teeth. Enamel microabrasion is considered useful when there are stains in the outer layer of the enamel. Knowing the extent of enamel stains is critical while managing fluorosis. The most important factors for the success of enamel microabrasion are the location and depth of the enamel stain or defect. An LED or light curing unit positioned in the palatal or lingual surface of the tooth can help the clinician to examine the extent of enamel stain. This can be used to estimate the lesion depth, as a darker color indicates deeper staining. The number of clinical applications vary according to the severity of stains.[7] Proper patient selection and effective rubber dam isolation are essential for a successful treatment outcome. The initial application of the fine-tapered diamond bur (macroabrasion) allows decreased number of applications of the microabrasive product.

Patients whose teeth have undergone enamel microabrasion have smooth, prism-free enamel with a gradually increasing glossy surface. The term "abrosion effect" refers to this combination of erosion and abrasion that can occur when minerals become compacted as a result of the microbrasive action on dental enamel. The demineralization resistance of enamel treated with microabrasion method is higher than that of untreated enamel surfaces.[8] Furthermore, Streptococcus mutans was shown to colonize enamel that has been microabraded less frequently.[9] Micro abrasion greatly improved the appearance of mildly fluorosed teeth but only slightly improved severely fluorosed teeth.[10] It is important to recognize that different crown regions have varying levels of enamel thickness when evaluating stained teeth for resin-based composite repair, bleaching, and enamel microabrasion. This results in increased opacity as one moves closer to the gingival edge and increased translucency in the incisal third of an anterior tooth.

This case series highlights three case reports of fluorosis condition where microabrasion was done. In case 1 of mild fluorosis, microabrasion was done and the results were satisfying for the patient. This case depicts that macro abrasion followed by micro abrasion can be used as a standalone treatment protocol for achieving good esthetic results. The patient was educated about further definitive treatment options like veneering which can be done in the future for a promising result.

In case 2, which was a case of moderate fluorosis, macro abrasion followed by microabrasion was done as a first line of treatment. There was a reduction in the stump shade but the results were not satisfactory. The patient was advised about minimally invasive treatments like direct composite or indirect ceramic veneers. The patient opted for direct composite veneering due to financial constraints. The esthetic results were acceptable and the doors are always open for indirect ceramic veneers.

In case 3, a case of severe fluorosis with brownish stains and pitting, the definitive treatment option given was indirect veneers. Macro abrasion followed by microabrasion helped only in reducing the stump shade. The patient was ready to proceed for the indirect veneers. The outcome was highly satisfactory and fulfilled the patient's esthetic demands.

CONCLUSION:

Enamel microabrasion and macroabrasion offer excellent results for patients with mild to moderate fluorosis. They are safe, conservative and atraumatic treatment options for removing superficial enamel stains and defects. They can be adjuncts to additional esthetic procedures
like bleaching and composite or ceramic veneers.

PATIENT PERSPECTIVE

All the patients discussed in this case series were satisfied with the treatment provided.

INFORMED CONSENT

Consent was taken from all the patients prior to the treatment initiation.

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Nil

CONFLICTS OF INTEREST

There are no conflicts of interest

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