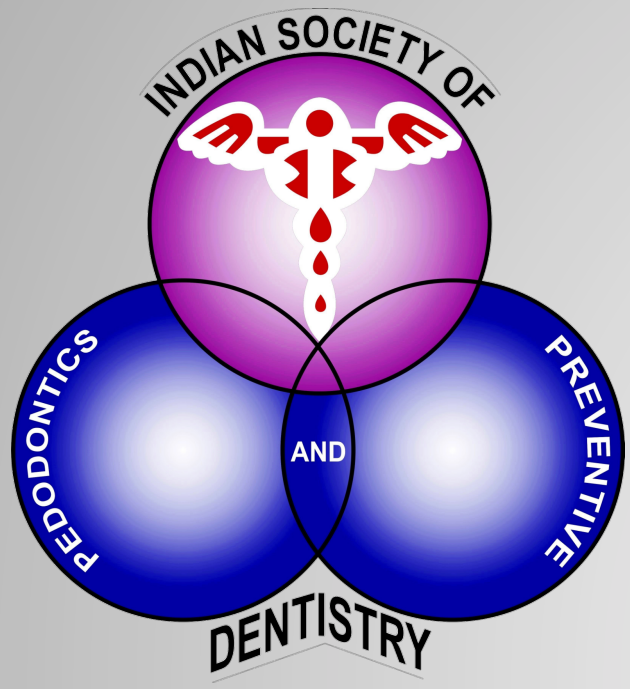
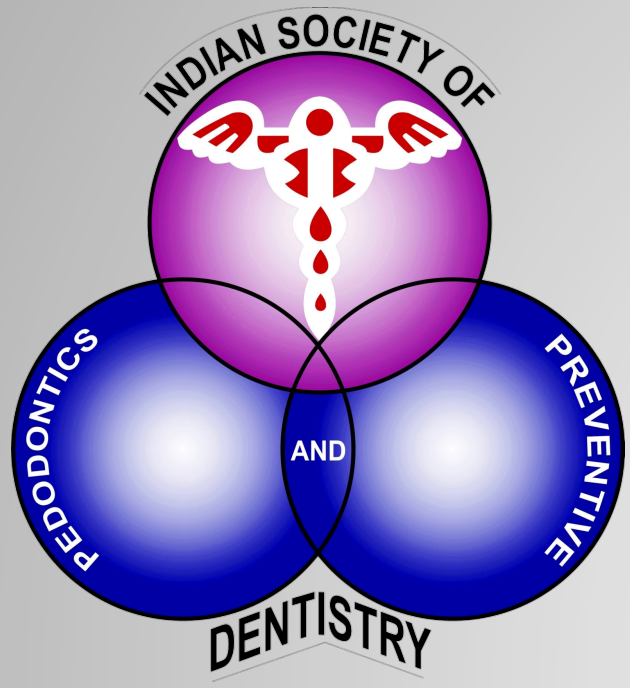
DR. HARSH VYAS

- Dr.Harsh Vyas completed his Masters in Pediatric Dentistry from Nair Hospital Dental College, Mumbai in 1992.
- He received the **ISPPD gold medal** in the subject of Pediatric Dentistry.
- He then started his private practice in 1994 located in South Bombay that is dedicated **exclusively to children.**
- Dr.Harsh is the **Head of Department of Pediatric Dentistry** at the SRCC Childrens Hospital Mumbai and also Consultant Pediatric Dentist at the prestigious Bombay Hospital & Medical Research Center and Saifee Hospital, Mumbai.
- He is a highly sought after speaker at various conferences for his clinically relevant lectures which are very informative wherein, he shares his expertise and discusses his own clinical cases.
- He has **lectured and conducted workshops** all over the country and abroad, at the University of Maryland Baltimore, Nationwide Children's Hospital Columbus USA, to name a few, on various topics of Pediatric Dentistry.
- For many years he has been a **"key opinion leader" for GC**-Japan, **Ultradent** - USA, and recently with **Nu Smile** -USA, for their zirconia crowns.
- Dr.Harsh Vyas has been a former Professor at KLES Dental College, Belgaum and Professor and HOD at Terna Dental College Mumbai.
- His approach and enthusiasm ensures that he continues to remain a student of the speciality of Pediatric Dentistry



RARE Summit



SEALANTS & DIRECT RESTORATIVES IN PAEDIATRIC DENTISTRY

INTRODUCTION

Prevalence of dental caries in India

A very extensive and comprehensive National Health Survey was conducted in 2004 throughout the entire country of India in order to ascertain the oral health status and prevalence of dental disease in representative age groups.

- **51.9% in 5 year-old children**
- **53.8% in 12 year-old children**
- **63.1% in 15 year-old teenagers**

High caries prevalence in the permanent dentition

Bali RK, Mathur VB, Talwar PP, Chanana HB. National Oral Health Survey & Fluoride Mapping, 2002-2003, India. Delhi: Dental Council of India; 2004

Global statistics

Untreated cavitated dentine carious lesions in permanent teeth remained the most prevalent health condition across the globe in 2010, affecting 2.4 billion people.

Kassebaum, N. J., Bernabe, E., Dahiya, M., Bhandari, B., Murray, C. J. L. & Marcenes, W. (2015) Global burden of untreated caries: a systematic review and metaregression. Journal of Dental Research 94, 650–658.

CHANGE IN TREATMENT APPROACH

- **"Risk based PREVENTION and patient centered DISEASE MANAGEMENT have been now recognized as the cornerstones of *modern caries management*.**

Fontana M, Wolff M. Translating the caries management paradigm into practice: challenges and opportunities. J Calif Dent Assoc. 2011;39(10):702-708.

IMPORTANCE OF PREVENTION

- The National Health and Nutrition Examination Survey (NHANES) 2011–2012 data showed that
  - 37% of children,aged 2–8 years old, were diagnosed with dental caries in primary teeth, and
  - 21% of children, aged 6–11, and
  - 58% of children, aged 12–19, were diagnosed with dental caries in their permanent teeth.

When comparing this data to the earlier survey of 1999–2004, an overall decline in the prevalence of caries in primary teeth and a slight decrease in the caries percentage in permanent teeth was noticed.

Dye, B.A.; Tan, S.; Smith, V.; Lewis, B.G.; Barker, L.K.; Thornton-Evans, G.; Eke, P.I.; Beltran-Aguilar, E.D.; Horowitz, A.M.; Li, C.H. Trends in oral health status: United States, 1988–1994 and 1999–2004. Vital Health Stat. 2007, 11, 1–92.

Dye, B.A.; Thornton-Evans, G.; Li, X.; Iafolla, T.J. Dental caries and sealant prevalence in children and adolescents in the United States, 2011–2012. NCHS Data Br. 2015, 191, 1–8.

- **It was found that the greatest decrease in caries was among smooth surfaces rather than pits and fissures.**

- **Pit and fissure caries accounts for about 90%of the caries of permanent posterior teeth and 44% of caries in the primary teeth in children and adolescents.**

- Dye, B.A.; Tan, S.; Smith, V.; Lewis, B.G.; Barker, L.K.; Thornton-Evans, G.; Eke, P.I.; Beltran-Aguilar, E.D.; Horowitz, A.M.; Li, C.H. Trends in oral health status: United States, 1988–1994 and 1999–2004. Vital Health Stat. 2007, 11, 1–92.

- Dye, B.A.; Thornton-Evans, G.; Li, X.; Iafolla, T.J. Dental caries and sealant prevalence in children and adolescents in the United States, 2011–2012. NCHS Data Br. 2015, 191, 1–8.

PIT AND FISSURE SEALANTS

- It involves the sealing of pits and fissures on caries susceptible teeth.
- It forms a micromechanically bonded protective layer that acts as a barrier keeps bacteria away from their source of nutrients
  - which prevents pit and fissure caries (primary prevention)
  - and stalls progression of incipient caries (secondary prevention)

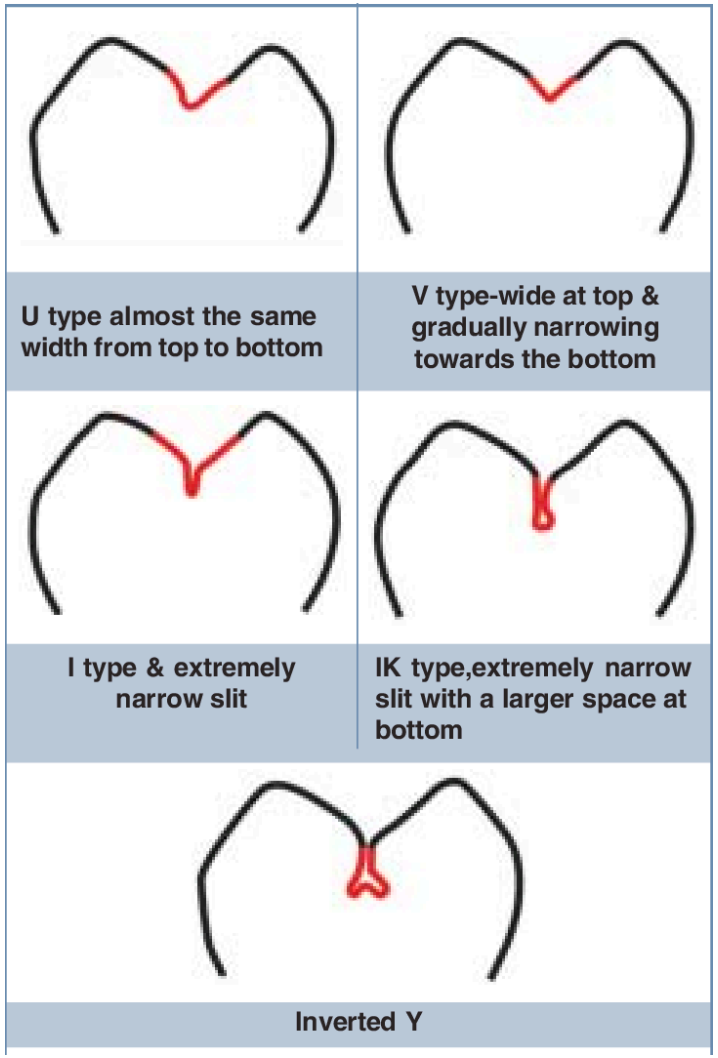
RATIONALE FOR PLACEMENT IN PERMANENT MOLARS

- Incomplete post-eruptive maturation and the presence of narrow and deep fissures increases caries susceptibility of occlusal surfaces of permanent molars
- Dental plaque can mature undisturbed in the pits and fissures of teeth during eruption
- Fluorides are more effective in preventing caries on smooth surfaces

Cvikl, B., Moritz, A., & Bekes, K. (2018). Pit and Fissure Sealants-A Comprehensive Review. *Dentistry journal*, *6*(2), 18. https://doi.org/10.3390/dj6020018

TYPES OF FISSURES (NAGANO,1961)

Prevalence-34%
Self-cleansing
Non-invasive technique



Prevalence-14%
Self-cleansing
Non-invasive technique

Prevalence-19%
Susceptible to caries
Invasive technique

Prevalence-26%
Susceptible to caries
Invasive technique

Prevalence-5-10%
Susceptible to caries
Invasive technique

Nagano T. Relation between the form of pit and fissure and the primary lesion of caries. Dent Astr 1961;6:426.

EVOLUTION OF SEALANTS

Placement of dental cement in pits and fissures to prevent caries

– Wilson, 1865

Insertion of small restorations in deep pits and fissures before carious lesions had the opportunity todevelop: “prophylactic odontomy”.

- Hyatt, 1923

Deep fissures could be broadened with a large round bur to make the occlusal areas more self cleansing:“fissure eradication”.

-Bodecker, 1929

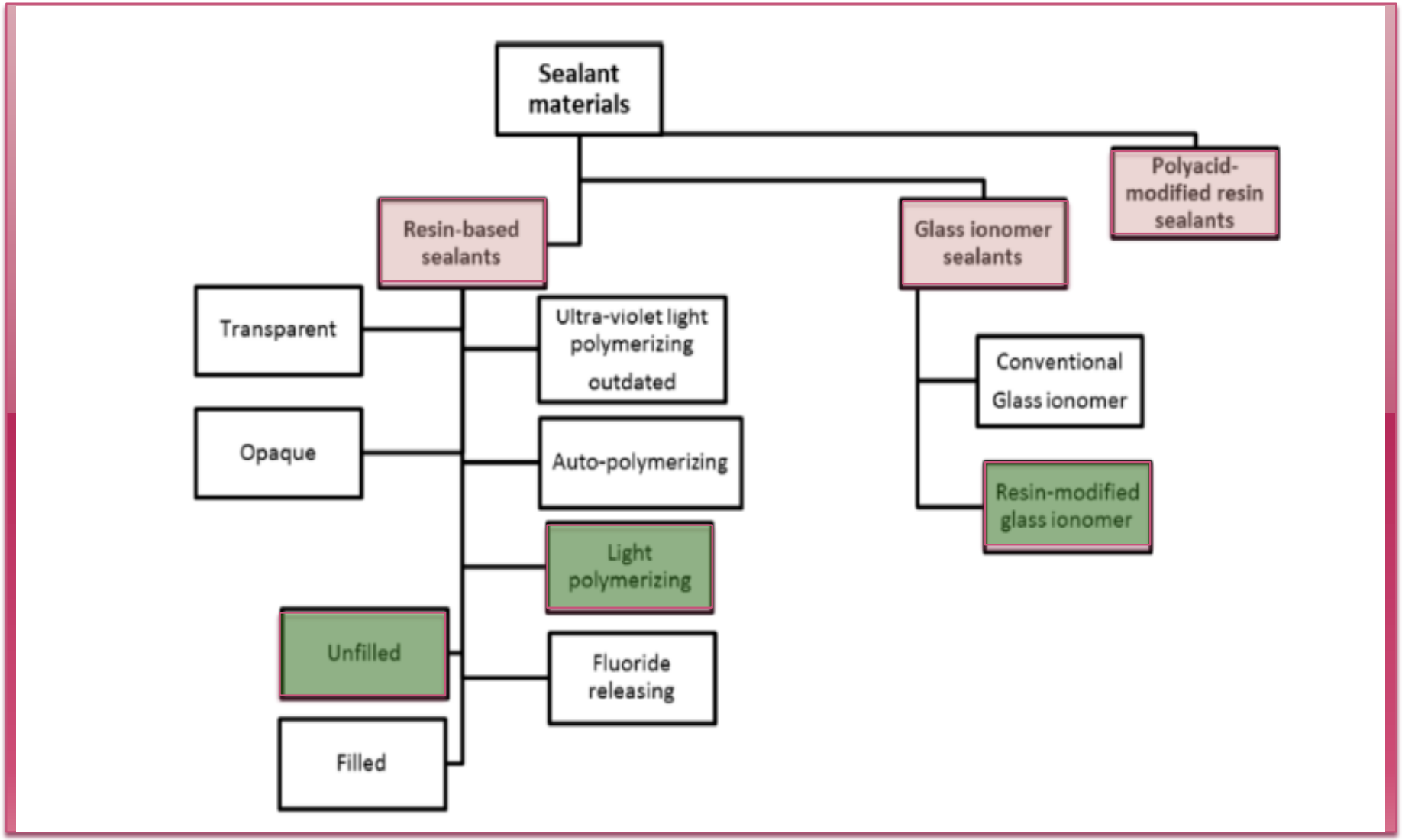
Attempted either to seal or to make the fissures more resistant to caries with the use of topical zin chloride, potassium ferrocyanide, ammonical silver nitrate

- Ast, 1950

Use of acid to etch the enamel surface prior to the application of acrylic resin

- Bunocore,1955

CLASSIFICATION OF SEALANTS



DO WE SEAL ALL FISSURES ?

- **"U" or shallow "V" shaped fissures that are self-cleansing may not be sealed provided:**
  - ✓ Child is caries free
  - ✓ Child has received systemic fluoride
  - ✓ Good oral health
  - ✓ Regular brushing habits
  - ✓ Biannual check-ups

Beauchamp.J. Evidence-Based Clinical Recommendations for the Use of Pit-and-Fissure Sealants JADA. 2008; VoL 139(3): 257 – 268

DO WE SEAL ALL FISSURES ?

Loesche and Straffon found that the average *S. mutans* representation in fissures

- **of high caries-active subjects of 5 to 12 years of age was nearly 25%**
- **whereas the average proportion in low caries-active subjects was just 0.1%.**

HIGH CARIES RISK → SEAL EVEN SELF-CLEANSING FISSURES

Loesche WJ, Straffon LH. Longitudinal investigation of the role of Streptococcus mutans in human fissure decay. Infect Immun. 1979;26:498–50

DO WE SEAL ALL FISSURES ?

- Teeth that are partially erupted or with the peri-coronal flap present must not be sealed

- In partially erupted hypoplastic molars or teeth showing pre-eruptive caries, a Glass Ionomer Sealant may be used.

Azarpazhooh A, Main PA. Pit and fissure sealants in the prevention of dental caries in children and adolescents: a systematic review. J Can Dent Assoc. 2008;74(2):171-177.

EVIDENCE ON EFFECTIVENESS OF SEALANTS

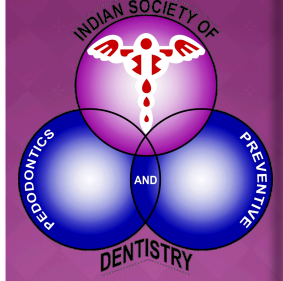
Resin-based sealants applied on occlusal surfaces of permanent molars are effective for preventing caries in children and adolescents.

Resin-based sealants reduced caries by between 11% and 51% compared to no sealant, when measured at 24 months. Similar benefit was seen at timepoints up to 48 months; after longer follow-up, the quantity and quality of evidence was reduced.

Ahovuo-Saloranta A, Forss H, Walsh T, Nordblad A, Mäkelä M, Worthington HV. Pit and fissure sealants for preventing dental decay in permanent teeth. Cochrane Database of Systematic Reviews 2017, Issue 7. Art. No.: CD001830.

Moderate-quality evidence suggested that participants who received sealants had a reduced risk of developing carious lesions in occlusal surfaces of permanent molars compared with those who did not receive sealants after 7 or more years of follow-up.

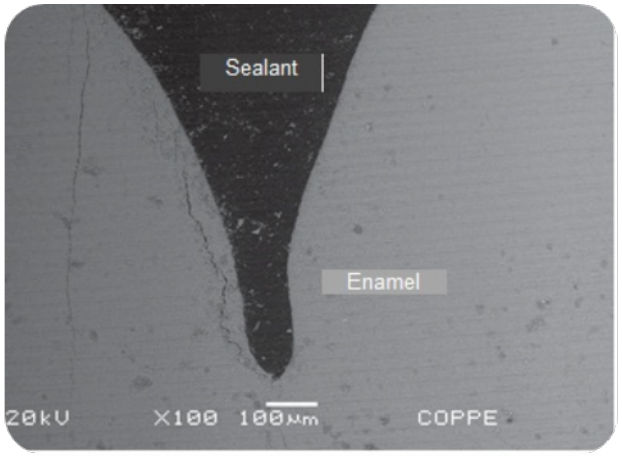
Wright.J. Sealants for preventing and arresting pit-and-fissure occlusal caries in primary and permanent molars. JADA. Vol147 (8): 631 - 645.e18



HOW LONG CAN A SEALANT LAST ?

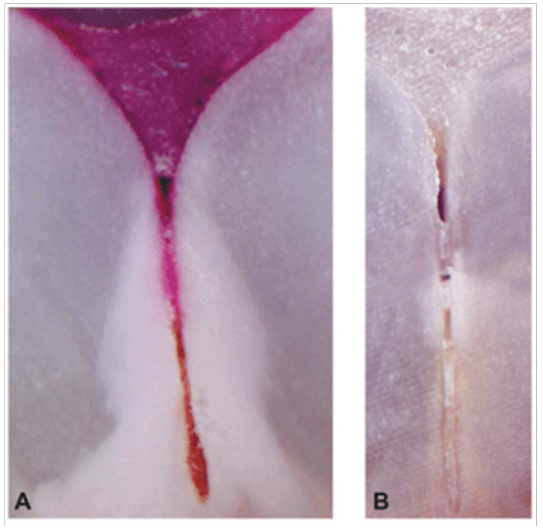
Longevity of a sealant depends on

- Penetration and adaptation of resin in to the fissure.
- Good adhesion
- Flowability of material / Viscosity



More viscous ➡ Lesser penetration

⬆ Filler loading ⟺ ⬆ Viscosity



Irinoda Y, Matsumura Y, Kito H, Nakano T, Toyama T, Nakagaki H, et al. Effect of sealant viscosity on the penetration of resin into etched human enamel. Oper Dent. 2000;25:274–82.

FILLER LOADING OF DIFFERENT SEALANTS

Ultradent 53 % filled wt

Ivoclar 42% filled wt

Pulpdent 33% filled wt

3M Espe Unfilled wt

Helioseal® sealant 42% filled

FACTORS AFFECTING RETENTION OF SEALANTS

Tooth preparation

- **Cleaning fissures with pumice/polishing paste using prophy-brushes**

Historically advocated, but long- term studies show no difference in sealant retention with or without prophylaxis

Simonsen RJ. Retention and effectiveness of dental sealant after 15 years. J Am Dent Assoc, 1991; 122(11):34-42.

Garcia-Godoy F, Gwinnett AJ. An SEM study of fissure surfaces conditioned with a scraping technique. Clin Prev Dent, 1987; 9(4):9-13

FACTORS AFFECTING RETENTION OF SEALANTS

Tooth preparation

- **Sealant penetration and retention were improved by mechanical preparation in the deeper "Y" fissures with ¼ round burs or Fissurotomy Burs®**

A, Akbari M, Rezaeian M, Ansari G. Microleakage assessment of fissure sealant following fissurotomy bur or pumice prophylaxis use before etching. *Dent Res J (Isfahan)*. 2013;10(5):643-646

BONDING : TO IMPROVE RETENTION ?

- In deep fissures the presence of moisture residue is commonly seen. If dentin is exposed at the base of the fissure, dentinal fluids may leach out of the tubules. As resins are hydrophobic, it will not penetrate to the base of the fissure

- Bonding agents are hydrophilic and hence will improve wettability and penetration even in the presence of moisture.

- Also, bonding by itself improves retention and reduces microleakage when applied before placing a sealant.

A systematic review showed that the use of adhesive systems beneath fissure sealants can increase the retention of fissure sealants. Also, when adhesive systems areused with fissure sealants, etch-and-rinse systems are preferable

Bagherian A, Sarraf Shirazi A, Sadeghi R. Adhesive systems under fissure sealants: yes or no?: A systematic review and meta-analysis. *J Am Dent Assoc*. 2016;147(6):446-456.

SEALANT RETENTION

- Total Etch vs Self Etch

Self etch adhesives have reported lower enamel bond strengths as compared to that obtained with 35%phosphoric acid.

The Total etch systems are still considered the gold standard when it comes to enamel bond strengths

Aman N, Khan FR, Salim A, Farid H. A randomized control clinical trial of fissure sealant retention: Self etch adhesive versus total etch adhesive. J Conserv Dent 2015;18:20-4

ISOLATION

- **If the etched enamel gets exposed to salivary proteins for as little as 0.5 s, it can be contaminated If this occurs, re-etching is required.**

- **The use of a rubber dam is the ideal way to achieve optimum moisture control. The use of cotton rolls and a saliva ejector is also a valid option.**

Deery, C. Strong evidence for the effectiveness of resin based sealants. Evid. Based Dent. 2013, 14, 69–70.

- A systematic review has suggested that four-handed delivery, compared to two-handed delivery, increases sealant retention by 9% when other factors, such as the surface cleaning method, were controlled .

Griffin, S.O.; Jones, K.; Gray, S.K.; Malvitz, D.M.; Gooch, B.F. Exploring four-handed delivery and retention of resin-based sealants. J. Am. Dent. Assoc. 2008, 139, 281–289.

HYDROPHILIC SEALANTS

Embrace® Wet Bond

Ultraseal XT Hydro®

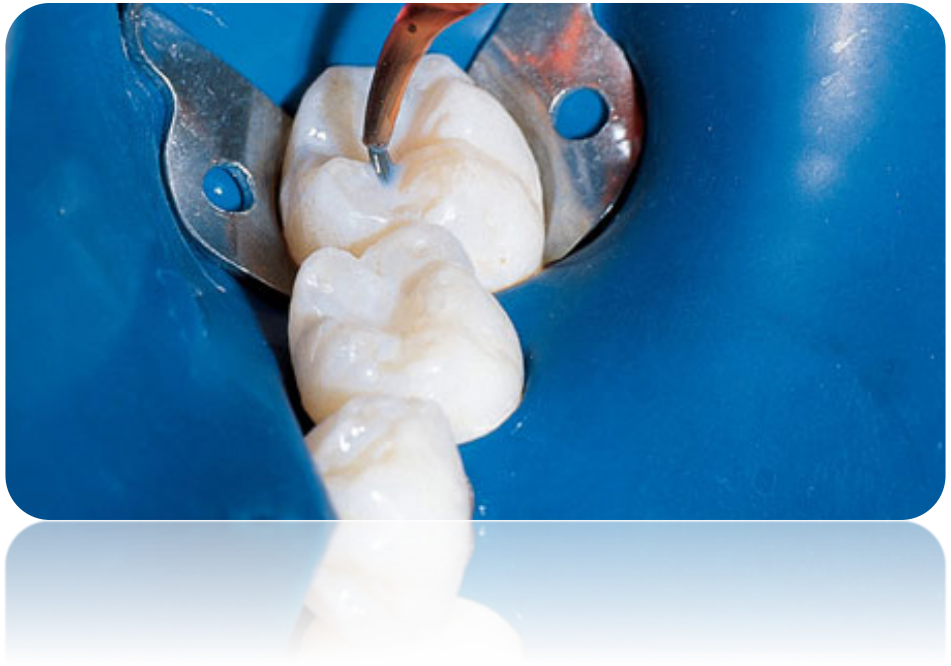
Hydrophilic nature of sealants allows resin penetration to base of fissure which may have moisture contamination

This eliminates the extra step of placing an intermediary layer of bonding

SEALING CARIES

- **Applying sealant over an incipient carious lesions is certainly justifiable.**

- **Studies indicate that there is no progression of the incipient caries below a well-placed sealant.**



FAILURE OF SEALANTS

Partial or complete loss of sealants is seen over 4-5 years.

Messer et al(1997) showed that, regardless of complete retention *caries experience* was low under partially retained sealants(5%) and completely retained sealants(1%) as compared to unsealed teeth.

Repairing a partially retained sealant is simple and effective

Messer LB, Calache H, Morgan MV. The retention of pit and fissure sealants placed in primary school children by Dental Health Services, Victoria. *Aust Dent J*. 1997;42(4):233-239.

COMPARING THE PERFORMANCE OF DIFFERENT SEALANTS

- Primed sealants had a 2-year pooled retention rate (RRE) of 43.2% which was significantly inferior to 80.8% of auto-polymerizing and 68.4% of light-polymerizing sealants.
- Fluoride-releasing and light-polymerizing sealants had the highest 3-year pooled RREs of 86.4and 83.1% respectively.

Kühnisch J, Bedir A, Lo YF, et al. Meta-analysis of the longevity of commonly used pit and fissure sealant materials. *Dent Mater*. 2020;36(5):e158-e168.

Resin versus GIC sealants

- A recent systematic review identified only 6 trials .
- Equivalent caries-preventive effects were observed at 6 months 12 months and 24 months.
- The 36-month data (not pooled) favoured resin-based sealants (RR 0.93, 95% CI 0.88-0.97, p = 0.002).

Yengopal V, Mickenautsch S. Resin-modified glass-ionomer cements versus resin-based materials as fissure sealants: a meta-analysis of clinical trials. European Archives of Paediatric Dentistry 2010; 11(1): 18-25

SEALANT PLACEMENT

EXPLAIN THE RATIONAL FOR USE OF PIT AND FISSURE SEALANTS. DISCUSS IN DETAIL THE RECENT DEVELOPMENTS IN RELATED MATERIALS AND TECHNIQUES. DISCUSS THE BENEFITS AND RISKS OF USING PIT AND FISSURE SEALANTS IN SCHOOL DENTAL HEALTH PROGRAMS. (LAQ)

- **Outline for the answer**

1) **Introduction:**

- Prevention is the cornerstone of modern pediatric dentistry
- Dr. G.V. Black himself was quoted saying that a time would come when dentists would be more engaged in practicing preventive rather than reparative dentistry. Perhaps this is that time and age.
- Statistics on global/ Indian statistics on prevalence of dental caries in children particularly pit and fissure caries
- Effect of dental caries in children on the quality of life
- Preventive dentistry more cost-effective than operative dentistry
- Currently preventive dentistry centred around topical fluorides and pit and fissure sealants.
- Topical fluoride effective in preventing caries on smooth surfaces. Is not as effective on occlusal surfaces
- Pit and fissure sealants are effective in preventing caries on occlusal surfaces.

- 2) Define pit and fissure sealants
- 3) History behind the development of sealants
- 4) Indications for pit and fissure sealants

5) Discuss how the eruption pattern/ factors and anatomy of permanent first molar makes it important to be sealed\

6) Discuss the classification of pit and fissures by Nugano,1961

7) Classification of different generation of sealants

8) Factors which affect sealant retention and longevity

- Tooth cleaning/ preparation
- Isolation
- Etching time
- Use of self-etch/ total etch
- Use of bonding agent
- Viscosity of sealant

9) Other factors such as use of air abrasion/ Lasers

10) Discuss different failures of sealants- Partial loss/ Complete loss and their role in leading to secondary caries

11)Placement of sealants over caries

12) Evidence on their effectiveness in different systematic reviews

13) Comparison between resin based and GIC sealants

14) Modifications in their use – Preventive resin restorations + Classification of PRR

15) Evidence on their survival rate

16) Role of sealants as a behaviour management tool

Published in final edited form as:
Health Aff (Millwood). 2016 December 01; 35(12): 2233–2240. doi:10.1377/hlthaff.2016.0839.

School-Based Dental Sealant Programs Prevent Cavities And Are Cost-Effective

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Christina Scherrer [professor],
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Paul M. Griffin [professor],
School of Industrial and Systems Engineering, Georgia Institute of Technology, in Atlanta

Kate Harris [health communications specialist], and
Center for Surveillance, Epidemiology, and Laboratory Services at the CDC

Sajal Chattopadhyay [economist]
Center for Surveillance, Epidemiology, and Laboratory Services at the CDC

Abstract

Untreated cavities can have far-reaching negative consequences for people's ability to eat, speak, and learn. By adolescence, 27 percent of low-income children in the United States will have untreated cavities. School-based sealant programs typically provide dental sealants (a protective coating that adheres to the surface of molars) at little or no cost to students attending schools in areas with low socioeconomic status. These programs have been shown to increase the number of students receiving sealants and to prevent cavities. We analyzed the cost-effectiveness of school sealant programs using data (from school programs in fourteen states between 2013 and 2014) on children's cavity risk, including the effects of untreated cavities on a child's quality of life. We found that providing sealants in school programs to 1,000 children would prevent 485 fillings and 1.59 disability-adjusted life-years. School-based sealant programs saved society money and remained cost-effective across a wide range of reasonable values.

Espinoza-Espinoza *et al. BMC Oral Health* (2019) 19:293
https://doi.org/10.1186/s12903-019-0990-3

BMC Oral Health

RESEARCH ARTICLE Open Access

The cost-utility of school-based first permanent molar sealants programs: a Markov model

Gerardo Espinoza-Espinoza[1,2], Gilda Corsini[3], Rubén Rojas[4], Rodrigo Mariño[5] and Carlos Zaror[6,7*]

Abstract

Background: Evidence of the cost-effectiveness of school-based first permanent molar sealants programs is not yet fully conclusive. The aim of this study was to determine the incremental cost-utility ratio (ICUR) of school-based prevention programs for the application of sealants in molars of schoolchildren compared with non-intervention.

Methods: A cost-utility analysis based on a Markov model was carried out using probability distribution. The utility was measured in quality-adjusted tooth years (QATY). The assessment was carried out from the public payer's perspective with a six-year time horizon. Costs and benefits were discounted at 3% per year. Only direct costs were evaluated, expressed in Chilean pesos (CLP) at 7th May at 2019 values (exchange rate USD = CLP 681.09). Univariate deterministic sensitivity analysis and probabilistic analysis were carried out.

Results: After a six-year follow up, the cost of sealing all first permanent molars was found to be higher than non-intervention, with a mean cost difference of USD 1.28 (CLP 875) per molar treated. The "seal all" strategy was more effective than non-intervention, generating 0.2 quality-adjusted tooth years more than non-intervention. The ICUR of the "seal all" strategy compared to non-intervention was USD 6.48 (CLP 4,412) per quality-adjusted tooth years. The sensitivity analysis showed that the increase in caries was the variable which most influenced the ICUR.

Conclusions: A school-based sealant program is a cost-effective measure in populations with a high prevalence of caries.

Keywords: Pit and fissure sealants, Dental caries, Prevention, Cost-effectiveness analysis

REFERENCE ARTICLES TO BE STUDIED:

I. Beauchamp.J. Evidence-Based Clinical Recommendations for the Use of Pit-and-Fissure SealantsJADA. 2008; VoL 139(3): 257 – 268

II. Azarpazhooh A, Main PA. Pit and fissure sealants in the prevention of dental caries in children and adolescents: a systematic review. J Can Dent Assoc. 2008;74(2):171-177

III. Ahovuo-Saloranta A, Forss H, Walsh T, Nordblad A, Mäkelä M, Worthington HV. Pit and fissure sealants for preventing dental decay in permanent teeth. Cochrane Database of Systematic Reviews 2017, Issue 7. Art. No.: CD001830.

IV. Simonsen RJ. Pit and fissure sealant: review of the literature. Pediatr Dent. 2002;24(5):393-414.

V. Simonsen RJ. Retention and effectiveness of dental sealant after 15 years. J Am Dent Assoc, 1991; 122(11):34-42

VI. Nagano T. Relation between the form of pit and fissure and the primary lesion of caries. Dent Astr 1961;6:426.

VII. Bromo, F & Guida, Andrea & Santoro, G & Peciarolo, M & Eramo, Stefano. (2011). Pit and fissure sealants: review of literature and application technique. Minerva stomatologica. 60. 529-41.

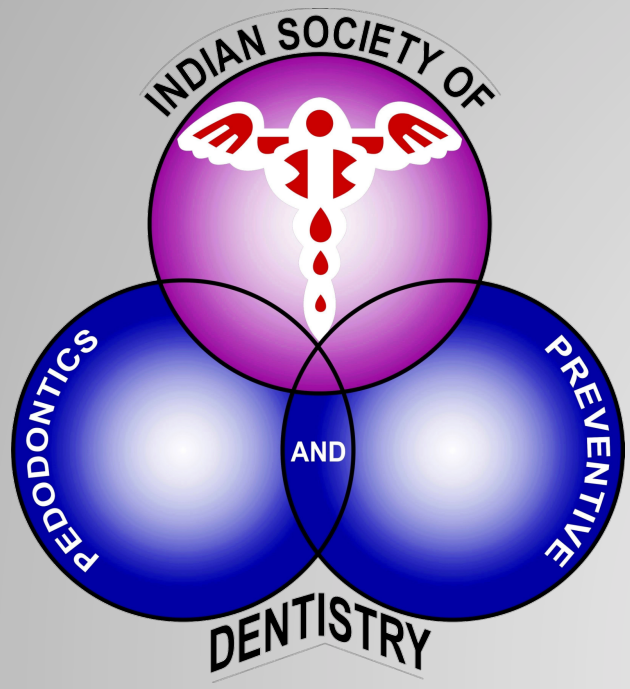
VIII. Bagherian A, Sarraf Shirazi A, Sadeghi R. Adhesive systems under fissure sealants: yes or no?: A systematic review and meta-analysis. J Am Dent Assoc. 2016;147(6):446-456

IX. Houpt M, Fukus A, Eidelman E. The preventive resin (composite resin/sealant) restoration: nine-year results. Quintessence Int. 1994;25(3):155-159.

X. Swift. J. Preventive resin restorations . JADA. 1987; Vol 114 (6) 819 – 821

XI. Simonsen, R.J. Conservation of tooth structure in restorative dentistry. Quintessence In t 16(1): 15-24, 198

XII. Naaman R, El-Housseiny AA, Alamoudi N. The Use of Pit and Fissure Sealants-A Literature Review. Dent J (Basel). 2017;5(4):34. Published 2017



PAEDIATRIC DIRECT RESTORATIVES

CURRENT TRENDS IN PAEDIATRIC RESTORATIVE DENTISTRY

- Radical change in philosophy in treatment of dental caries from an approach of " Can I save the tooth " to "Can I save the pulp"
- G.V. Black's philosophy – " Extension for prevention" to current philosophy " "Prevention of extension"
- Development of adhesive restorative materials
- Fluoride releasing materials
- Demand for esthetic restorative materials

Frencken JE, Peters MC, Manton DJ, Leal SC, Gordan VV, Eden E. Minimal intervention dentistry for managing dental caries - a review: report of a FDI task group. *Int Dent J*. 2012;62(5):223-243.

Burke FJ. From extension for prevention to prevention of extension: (minimal intervention dentistry). *Dent Update*. 2003;30(9):492-502.

CHANGING TECHNIQUES OF RESTORATIVE DENTISTRY

Complete caries excavation

Selective removal of carious tissue

Stepwise excavation

Partial excavation

Non restorative treatments

SMART Restorations

Schwendicke F, Frencken J, Innes N (eds): Caries Excavation: Evolution of Treating Cavitated Carious Lesions. Monogr Oral Sci. Basel, Karger, 2018, vol 27, pp 82–91

Alvear Fa B, Jew JA, Wong A, et al. Silver Modified Atraumatic Restorative Technique (SMART): an alternative caries prevention tool. *Stomatology Edu Journal*. 2016;3:243-248.

COMPARISON OF CARIES EXCAVATION TECHNIQUES

- **Stepwise caries removal resulted in a 56% reduction in incidence of pulp exposure. The mean incidence of pulp exposure was 34.7% in the complete caries removal group and 15.4% in the stepwise groups.**

- **Partial caries removal reduced incidence of pulp exposure by 77% compared to complete caries also based on moderate quality evidence. In these two studies the mean incidence of pulp exposure was 21.9% in the complete caries removal groups and 5% in the partial caries removal groups.**

- **No long-term studies done yet on the prognosis of SMART restorations.**

Ricketts D, Lamont T, Innes NP, Kidd E, Clarkson JE. Operative caries management in adults and children. *Cochrane Database Syst Rev*. 2013;(3):CD003808.

WHAT WOULD BE THE BEST RESTORATIVE MATERIAL ?

Is it the most durable restoration?

The most conservative?

The least technique sensitive?

Or the most esthetic?

Waggoner WF. Restoring primary anterior teeth: updated for 2014. *Pediatr Dent*. 2015;37(2):163-170.

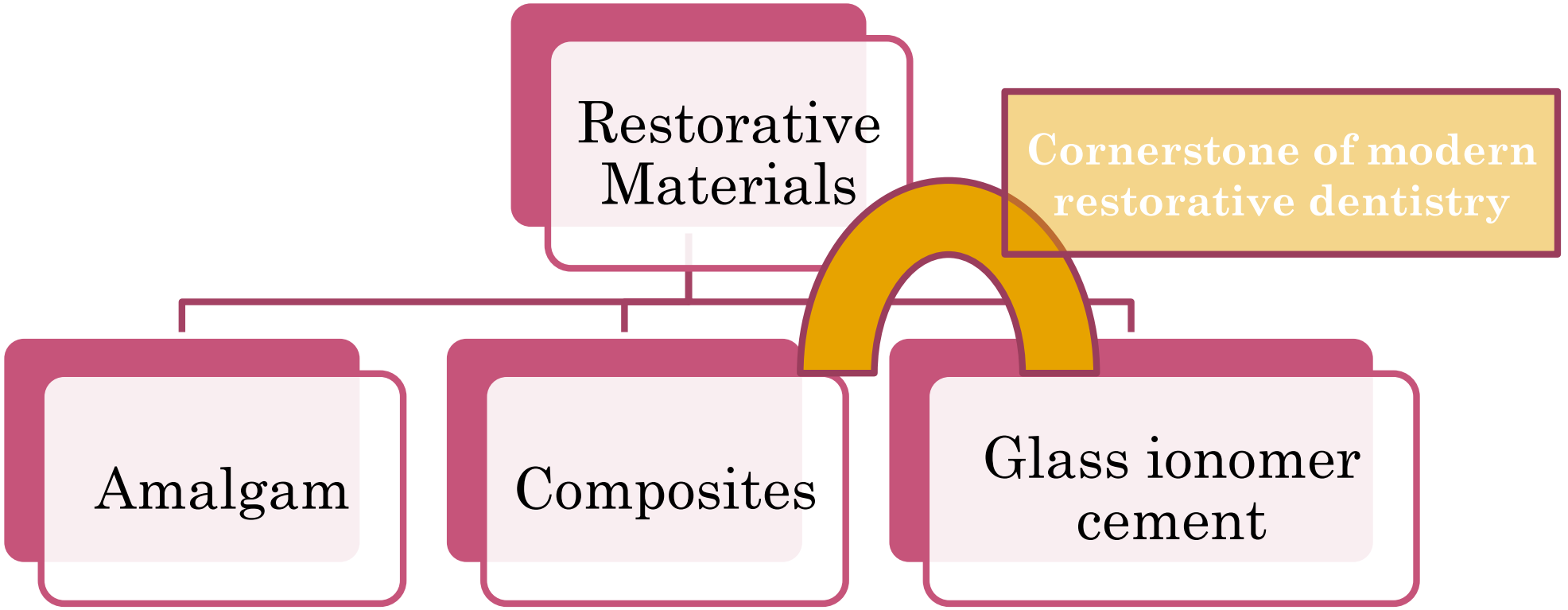
The answer is based on the following :

1) **Tooth to be restored**
2) **Extent of carious involvement**
3) **C- factor effect**
4) **Caries risk of the child**
5) **Age of the child**
6) **Cooperation of the child**

Choice of Restorative Material

Technique of Restoration

With change in techniques, the restorative materials used have changed too…

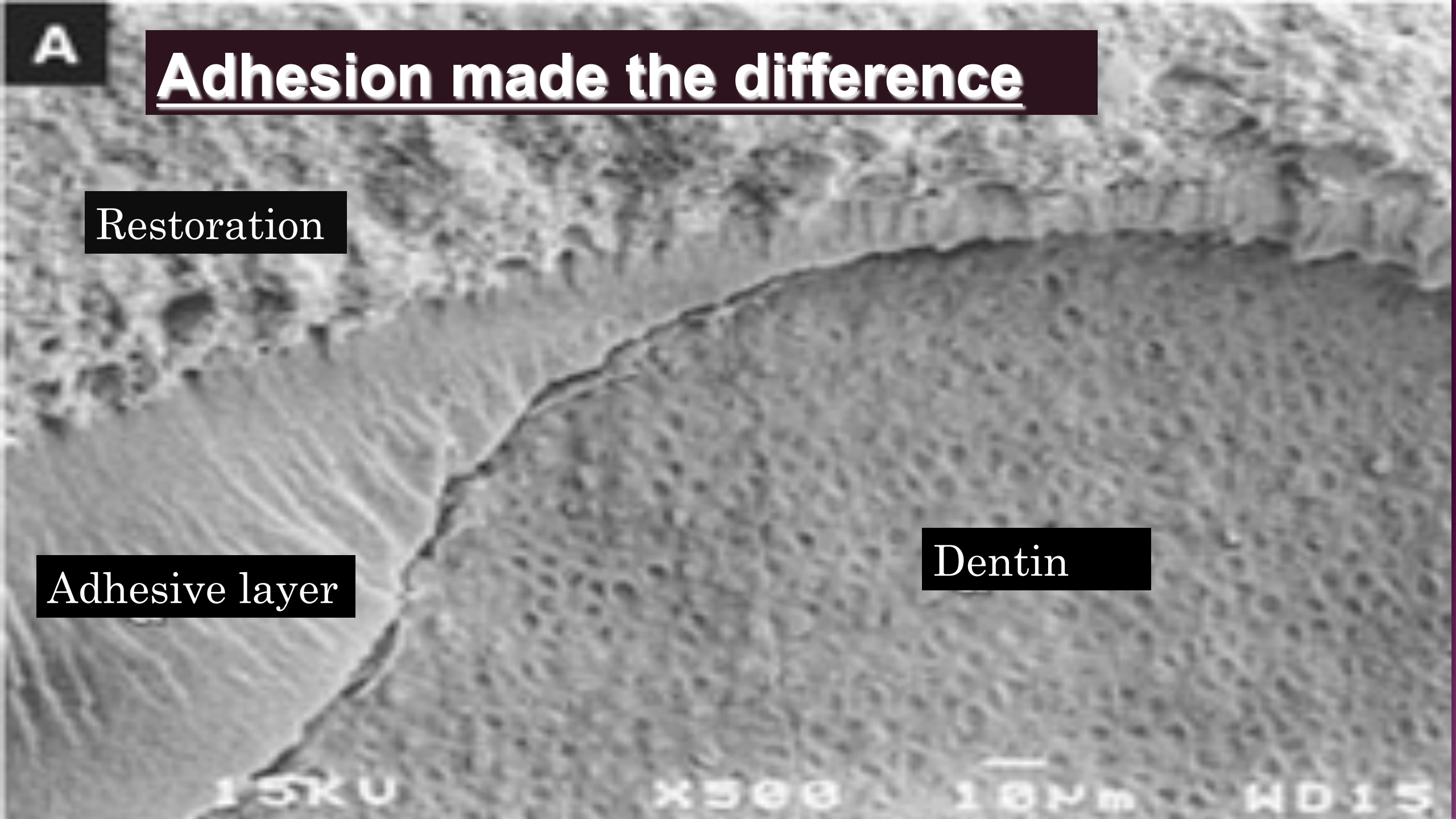


AMALGAM

- **Silver amalgam has been used for restoring teeth for over 150 years and was used extensively in pediatric dentistry.**

- **Currently being phased out due:**
  - ✓ **Development of tooth coloured adhesive restorative materials with improved physical and handling characteristics**
  - ✓ **Concerns on mercury toxicity by inhalation and ingestion**
  - ✓ **Requirement of removal of extensive tooth structure in primary teeth for attaining an adequate resistance and retention form**
  - ✓ **Non aesthetic appearance**

Fuks, Anna B.. "The use of amalgam in pediatric dentistry." (2002).


A
Adhesion made the difference
Restoration
Adhesive layer
Dentin
15KV X500 10μm WD15

PEDIATRIC DENTISTRY V 37 / NO 2 MAR / APR 15

Conference Paper

Restoring Primary Anterior Teeth: Updated for 2014

William F. Waggoner, DDS, MS*

It is the contention of the present paper's author that pediatric dentists will continue to see an increased demand among parents for ever-improving esthetic solutions to repairing their children's teeth in both anterior and posterior regions of the mouth.

Waggoner WF. Restoring primary anterior teeth: updated for 2014. *Pediatr Dent*. 2015;37(2):163-170.

ADHESIVE / AESTHETIC RESTORATIONS

GLASS IONOMERS:

One of the first active restorative materials to be discovered

Advantages	Disadvantages
Chemical bonding to tooth structure	Poor wear resistance
Fluoride releasing and recharging ability	Brittle, Prone to fracture
Ability to bond to arrested dentin	Does not command set unless it is an RMGIC
Biomimetic material, as its modulus of thermal expansion matches that of dentin	Sensitive to moisture in early stages of setting
Bulk-filled	Shade matching is not possible

Kuhn E, Chibinski AC, Reis A, Wambier DS. The role of glass ionomer cement on the remineralization of infected dentin: an in vivo study. *Pediatr Dent*. 2014;36(4):E118-E124.

Maclean and Kent. Textbook of Glass Ionomer. Quintessence Publishing

Vaderhobli, Ram M. Advances in Dental Materials.Dental Clinics, Volume 55, Issue 3, 619 - 625

MODIFICATIONS TO IMPROVE MECHANICAL PROPERTIES

1. Reinforced GIC's – To improve compressive strength

- Cermet
- Metal reinforced
- Resin modified
- Fibre reinforced
- Nano modified resin glass ionomer cement

2. Easily Mixable GIC's

-Capsulated GIC

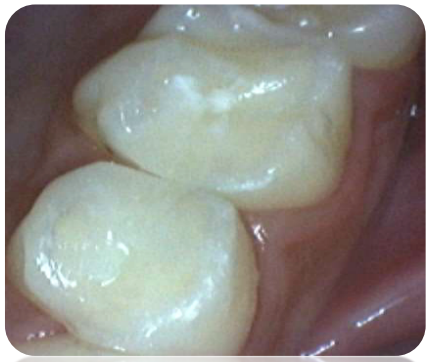
-Paste-Paste systems

3. Highly viscous GIC

RMGIC VS CONVENTIONAL GIC IN PRIMARY MOLARS

The **cumulative success rate of the RMGIC (Vitremer) restorations was 94% and that of the conventional GIC (Fuji II) restorations was 81%. The difference is statistically significant.**

The risk of a failed restoration was more than five times higher with conventional GIC than with RMGIC as the restorative material.



Hübel S, Mejàre I. Conventional versus resin-modified glass-ionomer cement for Class II restorations in primary molars. A 3-year clinical study. *Int J Paediatr Dent*. 2003;13(1):2-8.

RMGIC VS CONVENTIONAL GIC IN PRIMARY MOLARS

- A 8 year follow-up study RMGIC and GIC showed similar cariostatic effects on restored teeth and adjacent tooth surfaces,

- RMGIC should be preferred for class II restorations in the primary dentition, and class III/V restorations should be made in GIC due to enhanced longevity.

Qvist V, Manscher E, Teglers PT. Resin-modified and conventional glass ionomer restorations in primary teeth: 8-year results. Journal of Dentistry. 2004 May;32(4): 285-294.

NANOGLASS IONOMERS

- **The incorporation of nanoparticles (the average particle size of glass ionomer particles were around 10-20μm) into glass powder of glass ionomers led to wider particle size distribution, which resulted in higher mechanical values.**

- **However current studies comparing these to RMGIC have shown conflicting results. No real evidence at present to indicate their superiority.**

Najeeb S, Khurshid Z, Zafar MS, et al. Modifications in Glass Ionomer Cements: Nano-Sized Fillers and Bioactive Nanoceramics. *Int J Mol Sci*. 2016;17(7):1134.

GIC AS A SMART MATERIAL ?

- The adjective “smart” implies that these materials are able to sense changes in their environments and then respond to these changes in predetermined manners
- Normally, the fluoride release in products is seen as a high initial fluoride release followed by a gradual decrease over a period.
- In the long term, the fluoride re-released after recharging may be much more important than the initial ‘burst’ which is sustained only for ashort time.
- The smart behavior of materials containing GIC salt phases is attributed to their property of getting “recharged” when the material is bathed in a high concentration of or mouth rinse fluoride as may occur in toothpaste or mouthrinse.

McCabe JF, Yan Z, Al Naimi OT, Mahmoud G, Rolland SL. Smart materials in dentistry – Future prospects. Dent Mater J 2009;28:37-43.

GIC AS A SMART MATERIAL?

- A systematic review showed that the secondary caries rate of the occlusal restorations was not different among the restorative materials (odds ratio, 1.2; 95% confidence interval, 0.5-3.1) in primary molars.

- For occluso-proximal analysis, GIC was associated significantly with better ability to prevent caries lesions (odds ratio, 1.7; 95% confidence interval, 1.2-2.5).

- Thus due to its fluoride release, GIC may be a better restorative material for proximal lesions where stainless steel crowns are not indicated.

Raggio DP, Tedesco TK, Calvo AF, Braga MM. Do glass ionomer cements prevent caries lesions in margins of restorations in primary teeth?: A systematic review and meta-analysis. *J Am Dent Assoc.* 2016;147(3):177-185

NEWER ADVANCES IN GIC

- Varnish XT (3M ESPE Dental Products, St Paul, MN, USA) is a newly developed resin-modified glass ionomer material that releases fluoride, calcium, and phosphate.

- It is currently used as a site-specific, light-cured durable coating that provides an immediate layer of protection to relieve dentinal hypersensitivity through occluding the dentinal tubules.

- Useful material choice in cervical lesions

Vaderhobli, Ram M. Advances in Dental Materials.Dental Clinics, Volume 55, Issue 3, 619 - 625

BIOACTIVE GI LUTING CEMENTS

BIOACTIVE GLASS

Glass– ionomer cements have also been formulated with bioactive glass to cap dentin for reduced hypersensitivity .

- One interesting example among them was to incorporate bioactive glass into commercial GICs for enhanced bioactivity .
- The results are very encouraging.
- However, the authors also pointed out that introducing bioactive glass into GICs dramatically compromised the mechanical strengths of GICs, which has somehow disappointed the researchers.

Yli-Urpo H, Lassila LVJ, Narhi TO, Vallittu PK. Compressive strength and surface characterization of glass ionomer cements modified by particles of bioactive glass. Dent Mater 2005; 21: 201–209

BIOACTIVE GLASS

Another study showed that that a newer formulation containing a modified polyacid water, Fuji II LC filler, and bioactive glass S53P4 to form resin-modified glass–ionomer cement had

- **strengths comparable to original commercial Fuji II LC cement**
- **also allowed the cement to help mineralize the dentin.**

Xie D, Zhao J, Weng Y, Park J-G, Jiang H, Platt JA. Bioactive glass–ionomer cement with potential therapeutic function to dentin capping mineralization. Eur J Oral Sci 2008; 116: 479–487

DENTAL COMPOSITES

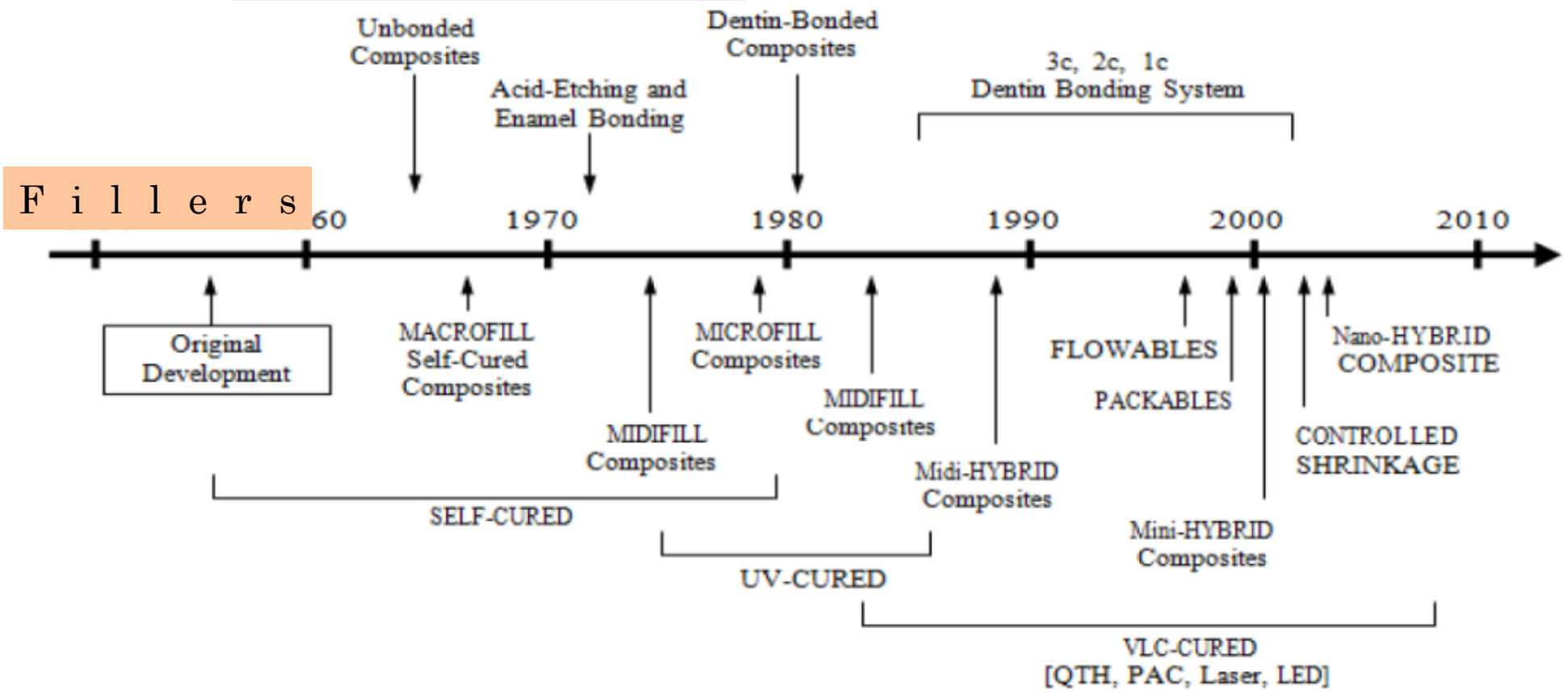
- Composite restorative materials represent one of the many successes of modern biomaterials research, since they replace biological tissue in both appearance and function.

- At least half of posterior direct restoration placements now rely on composite materials

Sadowsky SJ (2006). An overview of treatment considerations for esthetic restorations: a review of the literature. *J Prosthet Dent* 96:433-442.

Adhesives

Fillers



Curing methods

EVOLUTION OF COMPOSITES

ADVANTAGES OF COMPOSITES

- Micromechanical bonding to tooth structure
- Most aesthetic restorations due to shade matching
- Superior compressive strength and surface properties compared to GIC
- Superior polishing and finishing properties
- Commands set

DISADVANTAGES

- Adequate moisture control needed
- Technique sensitive
- Longer operating time as an incremental technique needed while restoring
- Polymerisation shrinkage
- Prone to insufficient depth of cure
- Non fluoride releasing

Ultimately, these shortcomings reduce a restoration's lifetime and represent the driving force for improvement in dental composites.

Cramer NB, Stansbury JW, Bowman CN. Recent advances and developments in composite dental restorative materials. J Dent Res. 2011;90(4):402-416. 3

CURRENT FOCUS

Bis-GMA

- High viscosity- leading to handling uses

Bis-GMA+ TEGDMA

- Helps to reduce viscosity
- Causes: Reduced mechanical properties/ Water sorption/ Poor colour stability

Bis-EMA

- Lowers viscosity
- Lower water sorption
- Lowers polymerisation shrinkage

Used in most commercial products

UDMA

- Higher viscosity than TEGDMA and Bis-EMS
- 100 times lower viscosity than Bis-GMA
- Greater fracture toughness than Bis-GMA

Pratap B, Gupta RK, Bhardwaj B, Nag M. Resin based restorative dental materials: characteristics and future perspectives. *Jpn Dent Sci Rev.* 2019;55(1):126-138. doi:10.1016/j.jdsr.2019.09.004.

FILLER PARTICLE SIZE

Traditional composites (8-12 um)

Microfilled composites (0.04um)

Hybrid composites (0.01um)

High fracture toughness
Poor surface finish

Poor fracture toughness
Good surface finish

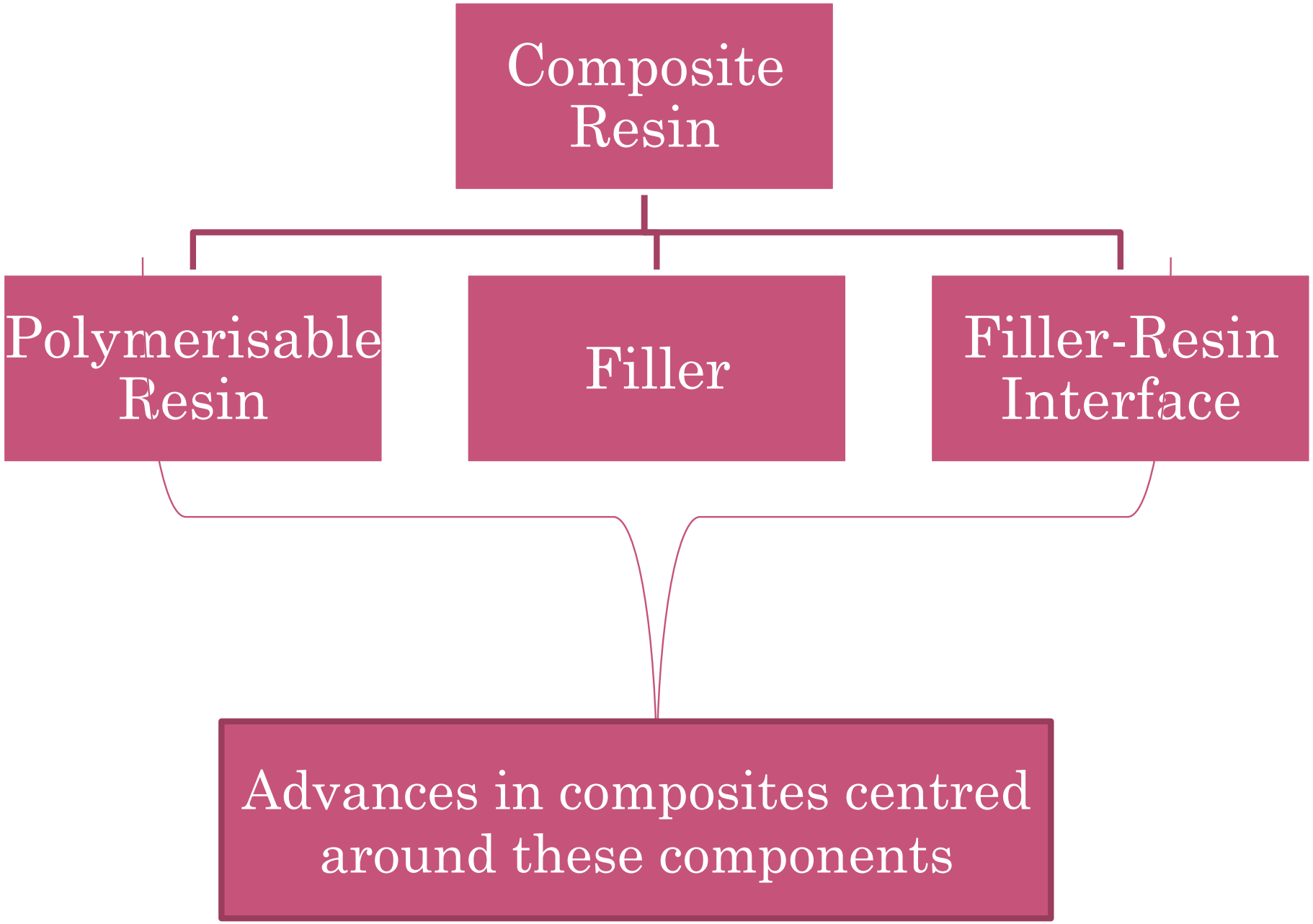
Combination of the two

Nanocomposites (40-50 nm)

NANOCOMPOSITES

- Nanofillers in resin composites were found to be more effective at
  - reducing polymerisation shrinkage,
  - decreasing wear, and
  - improving a material's mechanical properties compared with micro- and macrofillers .
  - They have superior esthetic properties with high polish retention
  - These have very good handling properties that allow for optimal placement and contouring

Rybachuk AV, Cekman IS. Nanotechnology and nanoparticles in dentistry. Pharmocol Pharm 2009;1:18-21.


Composite Resin
Polymerisable Resin
Filler
Filler-Resin Interface
Advances in composites centred around these components

BULK FILL COMPOSITES

- In the past decade, bulk-fill composite resins have been launched in the dental market as a new restorative concept. According to the manufacturers, the bulk-fill com-posite resins are restorative materials that can be inserted in increments of up to 4 mm in thickness without compromising conversion or mechanical properties at this depth.

- Helps reduce operating time and time for which isolation needs to be maintained. Particularly useful in pediatric patients

- Available as : Flowable/ Low viscosity

  High viscosity

- **A recent systematic review showed that the bulk-fill composite resins showed less shrinkage, polymerization stress, cusp deflection and microhardness than conventional composites, while both materials presented similar marginal quality, flexural strength and fracture strength.**

- **SureFill SDR Flow, Dentsply, Filtek Bulk Fill Flowable, 3M/ESPE**

Cidreira Boaro LC, Pereira Lopes D, de Souza ASC, et al. Clinical performance and chemical-physical properties of bulk fill composites resin -a systematic review and meta-analysis. *Dent Mater*. 2019;35(10):e249-e264.

SELF HEALING COMPOSITES

- Mastication forces and thermal stresses form micro-cracks and leads to failure of dental composites.
- To repair the developed cracks, self-healing characteristic of various polymers have been utilized in recent years.
- These self-healing materials are capable of repairing the crack and hence dental material regains its load bearing capabilities.
- Generally, microencapsulation of the self-healing liquid in composites has been used to provide self-healing characteristics to them. In case of crack or damage at the site of restoration, microcapsules after rupture, releases the healing liquid which flows into the cracks and gets polymerized due to catalyst to repair the crack by filling the crack together.

White SR, Sottos NR, Geubelle PH, Moore JS, Kessler MR, Sriram SR, et al. Autonomic healing of polymer composites. Nature 2001;409:794–7.[76]

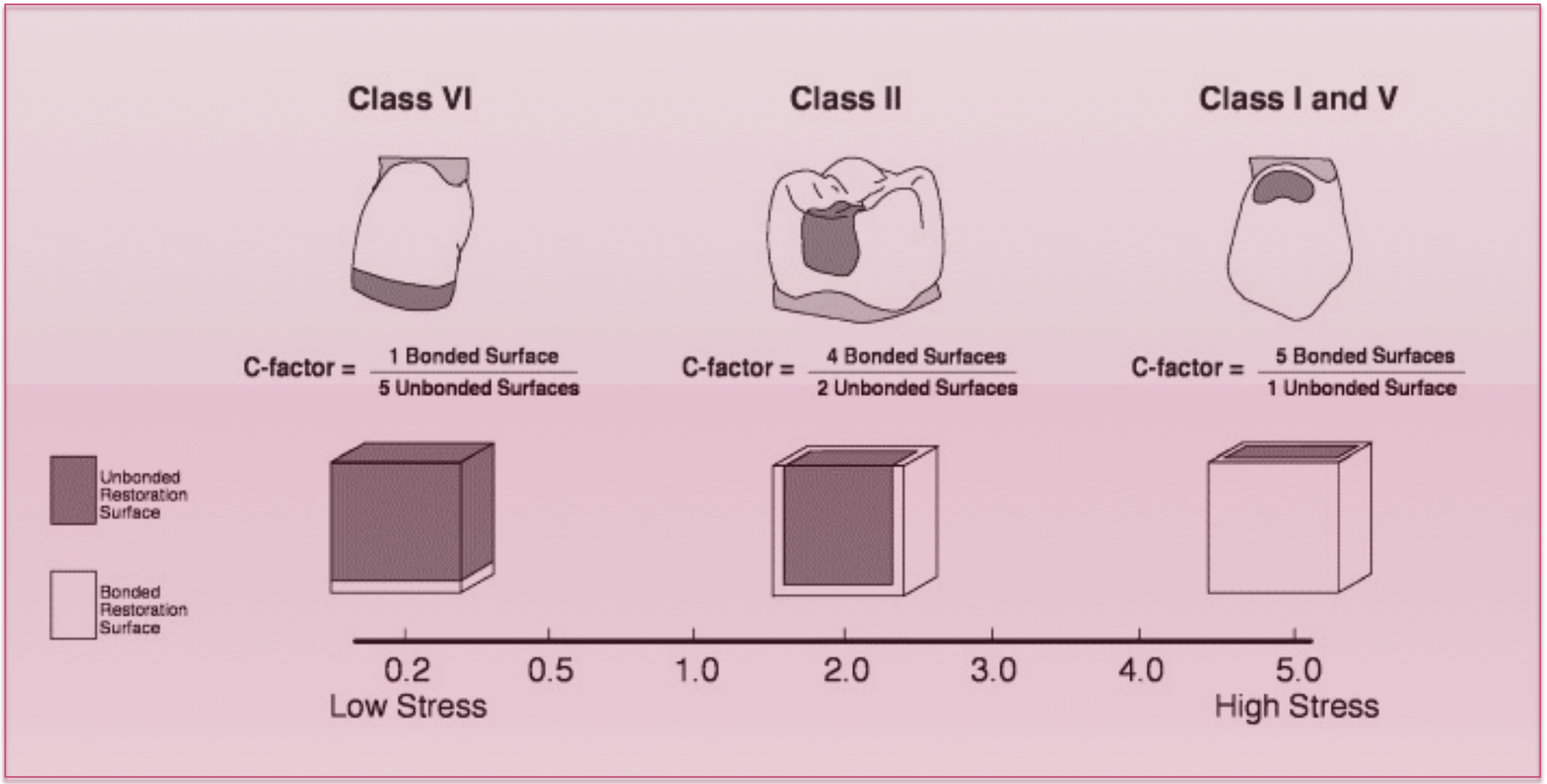
Wertzberger BE, Steere JT, Pfeifer RM, Nensel MA, Latta MA, Gross SM. Physicalcharacterization of a self-healing dental restorative material. J Appl Polym Sci2010;118:428–34.

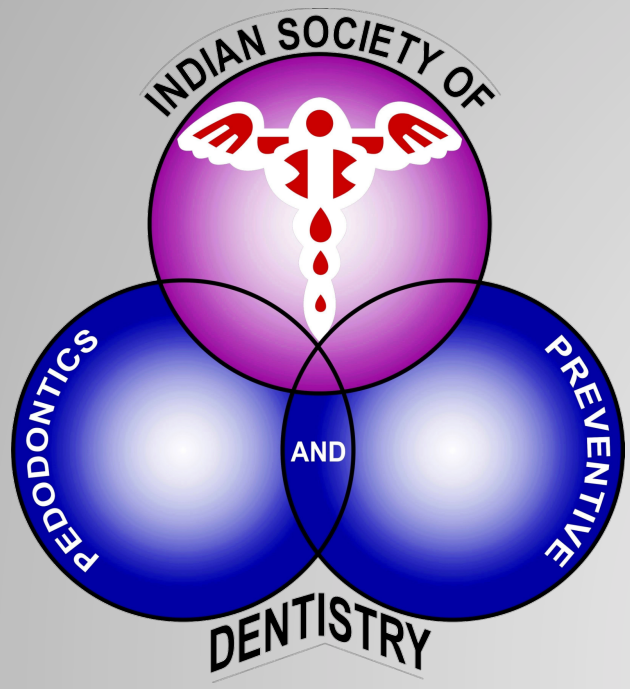
ANTI-BACTERIAL COMPOSITES

- Composites obtain antibacterial properties in two ways.
- In the first method, they are formed with the addition into the resin matrix of chlorhexidine which shows an effect by expression from the filling material.
- In the second method, they are produced with the expression of antibacterial agents remaining fixed in the resin matrix. For this purpose the monomer, 12-methacryloyloxydodecyl-pyridinium bromide (MDPB) was developed which does not allow bacteria production or the accumulation of bacterial plaque on the material

Saku S, Kotake H, Scougall-Vilchis RJ, et al. Antibacterial activity of composite resin with glass-ionomer filler particules. Dent Mater. 2010;29:193–8.

C- FACTOR


Class VI
Class II
Class I and V
C-factor = 1 Bonded Surface / 5 Unbonded Surfaces
C-factor = 4 Bonded Surfaces / 2 Unbonded Surfaces
C-factor = 5 Bonded Surfaces / 1 Unbonded Surface
Unbonded Restoration Surface
Bonded Restoration Surface
0.2
0.5
1.0
2.0
3.0
4.0
5.0
Low Stress
High Stress



RESTORATIVE TECHNIQUES

PREVENTIVE RESIN RESTORATIONS

- Preventive resin restoration is the conservative answer to the "extension for prevention" philosophy of Class I cavity preparation
- They have excellent long-term results after 9 year follow-up studies.

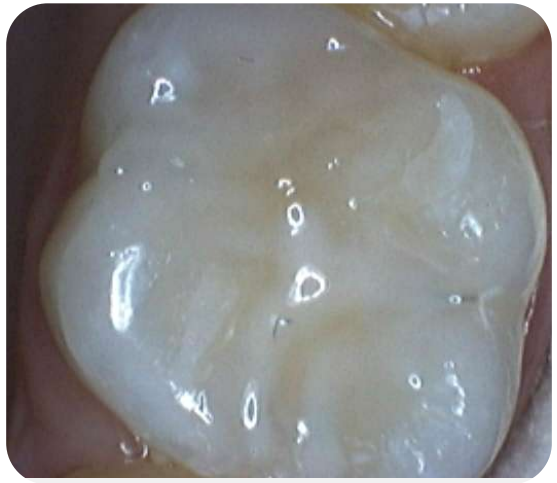
Houpt M, Fukus A, Eidelman E. The preventive resin (composite resin/sealant) restoration: nine-year results. Quintessence Int. 1994;25(3):155-159.

Swift. J. Preventive resin restorations . JADA. 1987; Vol 114 (6) 819 - 821

PREVENTIVE RESIN RESTORATIONS

A PRR restores the isolated carious pits and fissures with Resin or Glass Ionomer and simultaneously prevents caries in remaining unaffected pits and fissures by sealing them.

FLOWABLE PLACED IN DISTAL FISSURE

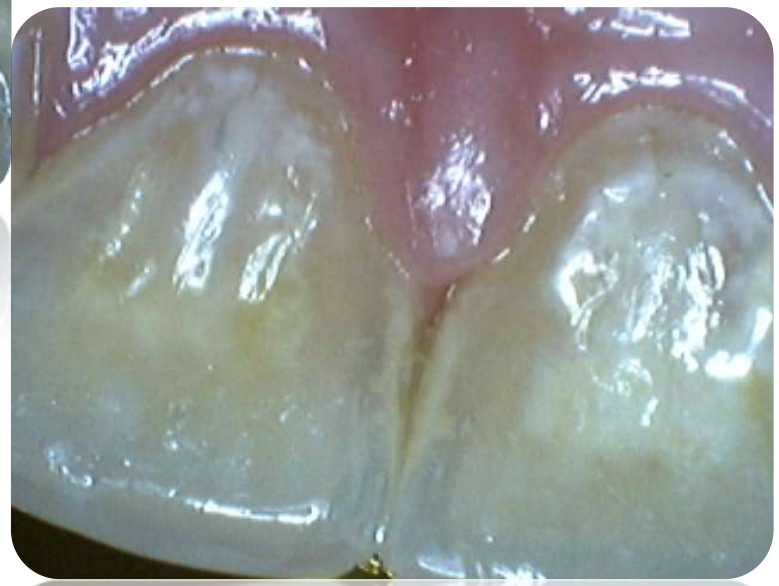


DISTAL FISSURE RESTORED WITH COMPOSITE

Simonsen, R.J. Conservation of tooth structure in restorative dentistry. Quintessence In t 16(1): 15-24, 198

PREVENTIVE RESIN RESTORATIONS

LINGUAL PITS AND FISSURES



FISSURES RESTORED WITH SEALANT AND FLOWABLE

PREVENTIVE RESIN RESTORATIONS

HYPOPLASTIC MOLAR

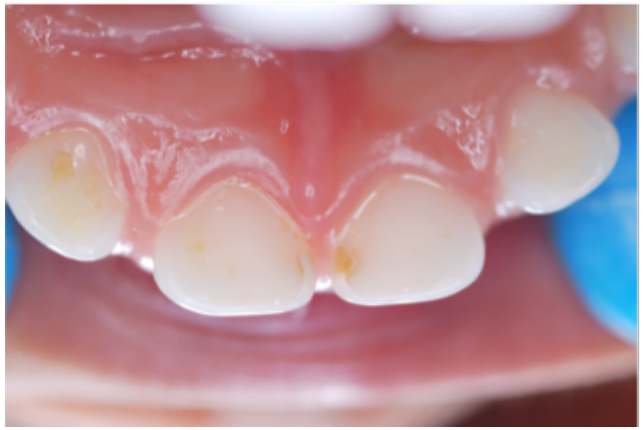
FISSURES AND RESTORATION COVERED WITH SEALANT

RESTORATION WITH GLASS IONOMER

RESTORED WITH COMPOSITE RESIN

REMAINING FISSURES SEALED

ANTERIOR PROXIMAL SURFACE RESTORATIONS



Conventional ‘slot’ with short bevel

ANTERIOR PROXIMAL SURFACE RESTORATIONS

Labial ‘dovetail’ to increase retention

LONGEVITY OF POSTERIOR RESTORATIONS IN PRIMARY MOLARS

A study evaluated different posterior restorations (class I, class II restorations and crowns) with different materials (amalgam, compomer, composite, glass ionomer cement, stainless steel crown) placed in primary teeth by reporting different outcomes measures (survival rate, success rate, annual failure rate).

Lowest Failure Rate : Composite (1.7-12.9%)

Highest Failure Rate: Metal reinforced GIC (10-29.9%)

What are the changing trends in pediatric restorative dentistry? Discuss recent advances in the materials used and anti-cariogenic properties of materials

1) Introduction

- Change in philosophy of treatment over time with dramatic improvements in understanding of the caries , diagnostic aids and restorative materials
- Earlier only solution was extractions
- With discovery of LA and radiography- root canal treatments was discovered
- Today's philosophy is Can I save the pulp
- G.V.Black suggested earlier an ' Extension of Prevention philosophy'
- Today we have shifted to ' Prevention of extension philosophy'
- Development of adhesive dentistry
- Understanding of the role of fluoride releasing materials
- Demand for esthetics from parents

2) Describe concept of infected/ affected/ arrested dentin and active carious lesions

3) Current minimally invasive caries excavation techniques and evidence based studies

4)Discuss ideal characteristics of a restorative material and factors affecting its choice

5)Current available restorative materials

6) Shortcomings of amalgam

7) GIC

-history of development/ generations/ advantages/ disadvantages/ recommendations for use/ classifications/ recent advances/ evidence on its success rate

8)Composites

history of development/ generations/ advantages/ disadvantages/ recommendations for use/ classifications/ recent advances/ evidence on its success rate

REFERENCES

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3. Ricketts D, Lamont T, Innes NP, Kidd E, Clarkson JE. Operative caries management in adults and children. Cochrane Database Syst Rev. 2013;(3):CD003808.
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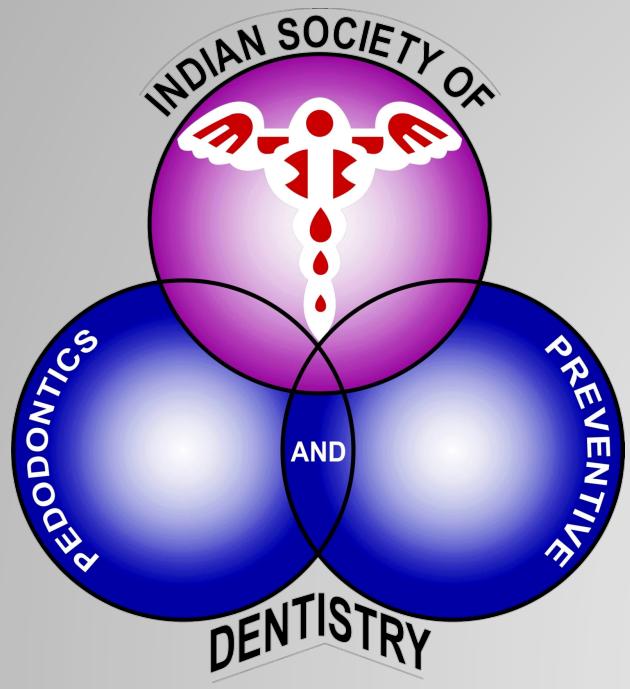
12. Cidreira Boaro LC, Pereira Lopes D, de Souza ASC, et al. Clinical performance and chemical-physical properties of bulk fill composites resin -a systematic review and meta-analysis. *Dent Mater*. 2019;35(10):e249-e264



THANK YOU