PIT AND FISSURE SEALANTS

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INTRODUCTION

Pit and fissure sealants
**DEFINITIONS:**

- **Pit:** is defined as small pin point depression located at the junction of developmental grooves or at terminals of those grooves.

- **Fissure:** is defined as deep clefts between adjoining cusps. They provide areas for retention of caries producing agents.

- **Pit and Fissure Sealant:** is used to describe a material that is introduced into the occlusal pit and fissure of caries susceptible teeth, thus forming a micromechanically–bonded, protective layer cutting access of caries producing bacteria from their source of nutrients.
Sealants protect the chewing surfaces!

Fluoride protects the smooth surfaces!
INEFFECTIVENESS OF FLUORIDE:

Systemic fluoride ingestion - selective benefit on smooth surface caries

Thus, in fluoridated community - in smooth surface caries, relative in PF caries

Ingestion of fluorides in pre eruptive phase: enhances coalescence of occlusal PF and reduces steepness of cuspal inclines: in PF caries

SEALANTS + FLUORIDE = MAXIMUM PROTECTION AGAINST CAVITIES
EFFECTIVENESS OF SEALANTS:

- Conservative preventive measure

- When utilized in conjunction with water fluoridation, its effectiveness increases by 20%

- 100% effective in protecting tooth surface

- Retention varies for sealant coverage:
  - 96% after 1 yr.
  - 82% after 5 yrs
  - 57% after 10 yrs
  - 52% after 15 yrs

(JCPD Vol. 6: no.3: 2005)
HOW DO SEALANTS WORK ???

Keep substrates out of pits, fissures and grooves

Create an anaerobic environment - eliminate the aerobic bacteria and other decaying matter residing in this area of the tooth.
MICROFLORA OF PIT AND FISSURES —

- **Cocci** constitute – 75% to 95% of microorganisms

- **S. Sanguis** – Predominant viable microorganisms

- **S. Mutans and Lactobacilli** –
  - low in newly formed plaque in fissures
  - over time

- **Fusiforms, Spirillae and Spirochaetes** are absent
PLAQUE COMPOSITION IN FISSURES:

- Fissures contain microorganisms and food particles.
- Limited morphological types occur in fissure.
- Palisading and branching filaments are absent within fissures but may colonize at orifice.
- Empty ghost-like cell wall structures intermingle with viable cells in some areas.
CLASSIFICATION OF SEALANTS –

BASED ON GENERATION –

A. First generation sealants:
   - polymerized by UV-light at a wavelength 356 μm.
   - disad.: -Excessive absorption and incomplete polymerization of sealant at its depth.
     - variable output intensity
     - output not uniform

B. Second generation Sealants/Self curing resins
   - Based on catalyst – accelerator system
   - Most are unfilled.
     - May be transparent, tinted or opaque by inclusion of white pigment or a tint for better visualization.
       eg. Concise [3M] white sealant system, Delton.
C. Third generation sealants:
- Light cured by visible light at wavelength 430 nm-490 nm.
- May be classified as filled or unfilled, and with or without tint or opaquer.
- Most of the unfilled resins are colored white.
- Filled resins are either clear, yellowish white or tan

PERFORM BETTER THAN SELF CURE RESINS

D. Fourth generation sealants:
- Are those containing fluorides.
Fluoride is added to unpolymerized resin in form of soluble salt
- Releases fluoride for extended period: 24 hrs. to 30 days

An organic fluoride compound is chemically bound to resin
- An ion from saliva diffused into resin, exchanged with fluoride ion – which then is diffused out and is released

FLUORIDE REPLACED RATHER THAN LOST
BASED ON FILLER CONTENT:

1. Unfilled [free of fillers]
   - flow is better
   - retention is more
   - abrade rapidly
     eg. Concise White

2. Filled
   - need for occlusal adjustments
   - more resistant to wear
     eg. Prisma shield
BASED ON TRANSLUCENCY:

1. CLEAR
   - Esthetic, but difficult to detect at recall examination.
   - Better flow than tinted or opaque
   - More easily appreciated by the patient.

2. TINTED / OPAQUE
   - Can be easily identified
     - COLOURED
   - Easy to see during placement
   - Easy to see during recall check up
Pit and fissure sealants

**BASED ON CURING:**

1. **AUTOPOLYMERIZING**
   - Better retention 88%
   - Sets by exothermic reaction

2. **LIGHT CURE**
   - 75% retentive
MATERIALS USED AS PIT AND FISSURE SEALANTS

- DEVELOPMENT OF CYANOACRYLATES: polymerized to hard but brittle polymers
  - Disad: bond to unetched enamel is poor
  - Material sticks to skin
  - Mechanical durability poor
  - Biodegradable
  - Hydrolysis of cyanoacrylates to toxic materials

- Recent cyanoacrylates – butyl and isobutyl esters

- Cyanoacrylates mixed with fluoride containing fillers are also available
Pit and fissure sealants

- POLYURETHANES:
  - Di-isocyanate + high mol. wt glycol
  - Urethane prepolymer
  - High mol. wt elastomer

- Adhesion of these polyurethanes to enamel is not satisfactory

- Eg. EPOXYLITE 9070, ELMEX PROTECTOR

- Disad: poor mechanical properties
  low oral durability
• **Enamite** – utilizes methyl methacrylate -poly methyl methacrylate initiated by butyl boron

• **BOWEN**: INTRODUCED BIS-GMA-SEALANT OF CHOICE

• Addition of BIS-PHENOL A and GLYCIDYL METHACRYLATE BIS-GMA

• In 1972, Nuva-Seal was the first successful commercial sealant to be used.

• Hydroxyl group in BIS-GMA is responsible for viscosity

• Some of these contain fillers, which makes it desirable to classify the commercial products into filled and unfilled sealants.

• The fillers make the sealant more resistant to abrasion
RATIONALE FOR USE OF SEALANTS-

- Safe, effective and underused in preventing PF caries on at-risk surfaces. Effectiveness-increased by follow up

- Benefit increased by placement on high risk surfaces or surfaces that already exhibit incipient carious lesions

- Best evaluation of risk-made by experienced clinician

- Sealant benefit-exist in any tooth with pit and fissure
Sealant placement- careful cleaning without removing any enamel

Placement of low viscosity, hydrophilic material under sealant- enhances retention and effectiveness

GIC is shown to be ineffective as PFS

Awareness- new preventive methods effective against PF caries.
• Diagnosis-based on tactile evaluation with an explorer and visual assessment of the enamel appearance

• Clinical examination varies highly from one practitioner to another - owing to the size and shape of the explorer tip, the force applied, and the judgment of the examiner.

• Radiographic evaluation of occlusal surfaces - minimal diagnostic value
INDICATIONS:

– RISK-BASED SEALANT TREATMENT

- Possibility of adequate isolation
- Questionable enamel caries in PF
- Xerostomia
- Patients undergoing orthodontic treatment
- Deep pits and fissures
CONTRAINDICATIONS:

- Posterior teeth that have shallow or well coalesced fissures
- Low caries risk (PF that remained caries free > 4 yrs)
- Rampant caries
- Teeth with proximal decay or occlusal caries involving dentine
- Allergy to methacrylate
- Semi-erupted teeth
REQUIREMENTS FOR OCCLUSAL SEALANTS:

- Non-toxic and non-irritating to tissues.
- Adhere to the tooth as a thin layer and for an extended period of time.
- The consistency and viscosity permit flow and penetration easily into small areas.
- Mechanical, compressive, and tensile properties of the material - sufficient to withstand mastication and resist wear.
• Water absorption - low, thus - resistance to displacement and discoloration.

• Should be able to be seen during application and at recall appointments

• Low solubility in oral fluids.

• Cariostatic action
TYPES OF OCCLUSAL FISSURES:

- **V** – Wide at top and gradually narrowing towards the bottom (34%)

- **U** – Almost same width from top to bottom (14%)

- **Κ** – Hourglass, extremely narrow slit associated with a large space at the bottom (26%).

- **λ** – Inverted Y, bifurcating at the bottom (7%).

- **I** – Extremely narrow slit (19%).
Pit and fissure sealants
MORPHOLOGY OF SURFACES WITH PITS AND FISSURES:

- Caries in PF- related to form and depth of these P and F

- Two main type of pits and fissures are usually described

  1) Shallow, wide v-shaped fissures-self cleansing and CARIES RESISTANT

  2) Deep, narrow I-shaped fissures-constricted and resemble bottle neck. May have different branches- CARIES SUSCEPTIBLE

- PF vary in shape- 0.1 mm wide.
Fissure contains an organic plug composed of reduced enamel epithelium, microorganisms forming dental plaque and oral debris.

Fissure provides a niche for plaque accumulation.

Morphology of occlusal surfaces varies from one tooth to another:

1) Premolar — prominent primary fissure with 3 or 4 pits

2) Molar — as many as 10 separate pits may be present in primary, secondary and supplemental fissures.

Dental caries in fissures:
Enamel rods flare laterally in bottom of PF

Caries occur

Follow direction of enamel rods

Triangular lesion with base toward DEJ

Greater no. of dentinal tubules involved

- Pit and fissure caries (occlusal surfaces) involve greater cavitation than proximal lesions
First evidence of lesion formation occurs at orifice of fissure- two independent bilateral lesions

Depth of fissure walls become involved

Coalescence of two independent lesions into single, contiguous lesion

Once caries involves dentin-progress is enhanced

Cavitation of fissure-loss of mineral and structural support

Clinically detectable lesion
TECHNIQUE FOR SEALANT APPLICATION –

- PREPARATION OF TOOTH
- ISOLATION
- DRYING THE TOOTH
- ETCHING OF TOOTH SURFACE
- RINSING AND DRYING OF TOOTH
- PLACEMENT AND POLYMERIZATION OF SEALANT
- OCCLUSAL EVALUATION
Tooth preparation:

- Earlier - cleaning enamel surface with pumice mixture using rotary brush
- By patient - Direct bristles of dry brush in PF
- Use of explorer
- Use of Prophy-Jet: air polishing system
- Air abrasion system with 50 um alumina
- Mechanical preparation of fissure with tapered fissure diamond bur - retention
• **Isolation of teeth:**

  **SALIVA CONTAMINATION AVOIDED TO PREVENT REMINERALIZATION OF ETCHED SURFACES**

- **Acc to Ferguson and Ripa** – rubber dam isolation provides better retention rates for UV-light activated sealants

- **Use of cotton rolls** – when using autopolymerized resins

- **Rubber dam isolation** - used when a quadrant is to be isolated
• **Etching:**

  - **Applied using** – small sponge, cotton pellet or brush may be used

  - **Etchant available as** – liquid, gel or semi-gel form

  **“SKIPPING EFFECT”- USE OF GEL ETCHANT**

  - **Concentration used** – 30 – 40%

  - **Technique of application** : continuous but gentle dabbing or agitation of sol on enamel surface
    - **Rubbing**
Site of application – 2/3 rd way up cuspal slopes
Etch approx. 2 mm on either side of an exposed groove

Primary enamel has prismless structure – but it is not found on occlusal surface

Shorter etching time for primary molars - ↓ chances of contamination, during etching (acceptable for 3-4 yr old children)

Etching time has no effect on sealant retention
ZONES OF ETCHING

- NARROW ZONE OF ENAMEL/ETCHED ZONE – 10µ deep that is lost by etching

- QUALITATIVE POROUS ZONE – 20µ deep, rendered porous- as seen in polarizing microscope

- QUANTITATIVE POROUS ZONE/DEEPER ZONE – 20µ thick – indistinguishable from sound enamel, but is slightly porous due to acid
Washing and drying:

- **REMOVE ALL ACID AND REACTIONARY PRECIPITATES**

- Rinse with water for 10-20 seconds and dried for additional 10 sec

- Water under pressure in air-water spray + high power evacuation

- Evacuator tip placed above/adjacent the tooth and water directed to the tip

- 20 sec/tooth OR 30 sec/quadrant
• If contamination occurs . . . .

- If cotton rolls are being used - replaced after becoming saturated during etching and washing

- If sal cont. does occur – re-etching for 10 sec before washing once again

- If etched enamel is exposed to sal for 1 to 60 sec → re-etching

- Minimal sal exposure for less than 10 sec → immediate washing performed
Use of dentin bonding agents.

Feigal et al--- hydrophilic bonding materials, may, when applied under sealant, minimize the bond strength normally lost -- when a sealant is applied in a moist environment.
### TECH. FOR SEALANT APPLICATION

- **Bonding agent** under sealant on wet contamination -

- **Bonding agent** used without contamination –

- It also reduces microleakage

- **In primary teeth**- use of sealants in moisture contaminated areas gave better results than sealant alone on non-contaminated areas

### SYMON PROPOSED :

- **Single bottle agents**- protect sealant survival :
  - Yield half the usual risk of failure for occ sealants
  - Yield 1/3 the risk of failure for buccal/lingual sealants
Sealant application --

- Sealant applied with disposable bristle brush

- For autopolymerizing resins – cover etched areas on each tooth as quickly as possible with sealant and then bulk can be added

- For light curing resins – no mixing necessary and hence reduced bubbles

- Sealant applied should be –
  - too much
  - thick

Thus total time for sealant application should take 3 1/2 min
**Adjustment and recall** –

- Surface wiped off to remove surface film – inspection of surface

- Occlusion checked with articulating papers

- Occlusal interferences removed
  - Filled sealants adjusted with green stone

- Sealants should be evaluated every 6 mnths
  - Bite-wing RG: detect caries progression under sealants
LAST STEP OF SEALANT APPLICATION INVOLVES EDUCATION OF PATIENT AND THE PARENTS ABOUT THE IMPORTANCE OF PERIODIC RE-EVALUATION OF THE SEALANTS.
# TOOTH ORIENTED INDICATIONS AND CONTRAINDICATIONS FOR USE OF PFS

<table>
<thead>
<tr>
<th>SURFACE DIAGNOSIS</th>
<th>CLINICAL CONSIDERATIONS</th>
<th>DO SEAL</th>
<th>DO NOT SEAL</th>
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</thead>
<tbody>
<tr>
<td>CARIOUS</td>
<td>1. Occlusal anatomy</td>
<td>1. If FFS separated by transverse ridge-sound FFS</td>
<td>1. Carious FFS</td>
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</tbody>
</table>
LOSS OF SEALANT

Pit and fissure sealants
Inadvertent placement over carious sites:

- Not recommended over detectable carious lesion - unless marginal integrity can be maintained

- According to some studies - reduction in viable organisms cultured from sealed fissures

- Inactivity was also seen by - lack of RG progression observed over time

- **SOME BACTERIA REMAIN VIABLE AND PRESUMABLY RETAIN THEIR POTENTIAL FOR PATHOGENICITY**
# POTENTIAL PROBLEMS AND ITS SOLUTIONS IN SEALANT PLACEMENT

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>ITS SOLUTION</th>
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<tbody>
<tr>
<td>1. Air bubbles- present under/bet sealants</td>
<td>Sealant should be ground to expose bubble- refill with same sealant material</td>
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<td>2. Porosities in sealant</td>
<td>Reapply sealant</td>
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<tr>
<td>3. Loss of sealant</td>
<td>Reapply sealant- they are not permanent Some protection provided even when they are lost- due to sealant present in microporosities created by etching</td>
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<td>4. Decay present under sealant</td>
<td>If excessive- remove sealant and place restoration or PRR If minute decay left- not a problem, as it creates an environment in which bact wont thrive</td>
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<td>CHILDREN</td>
<td>RISK FACTORS</td>
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<td>-------------------------------------------------------------------------------</td>
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<tr>
<td>1. LOW RISK</td>
<td>• No new/incipient caries in past year</td>
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<td></td>
<td>• Good oral hygiene</td>
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<td></td>
<td>• Regular dental visits</td>
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<tr>
<td>2. MODERATE RISK</td>
<td>One new, incipient/recurrent caries in past year</td>
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<td></td>
<td>Deep PF</td>
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<td></td>
<td>High familial caries experience</td>
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<td>Early childhood caries</td>
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<td>Frequent sugar exposure</td>
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<td></td>
<td>Decreased salivary flow</td>
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<td></td>
<td>Compromised oral hygiene</td>
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<tr>
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<td>Irregular dental visits</td>
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<td>Inadequate fluoride exposure</td>
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<tr>
<td>3. HIGH RISK</td>
<td>Two or more new or recurrent carious lesions in past year</td>
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<td></td>
<td>Deep PF</td>
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<td></td>
<td>Sibling or parents with high caries rate</td>
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<td></td>
<td>History of pit and fissure caries</td>
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<tr>
<td></td>
<td>Early childhood caries</td>
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<tr>
<td></td>
<td>Frequent sugar exposures</td>
</tr>
<tr>
<td></td>
<td>Decreased salivary flow</td>
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PREVENTIVE RESIN RESTORATIONS (P RR)—FISSURE SEALANT OR SEALANT RESTORATION

- It is a natural extension of Pit and Fissure sealants.

- INDICATIONS
  - Tooth can be isolated.
  - No, or only minimal pit and fissure staining
  - Minimal “catches” in the grooves, or areas with distinct incipient enamel caries.
  - No evidence of radiographic caries.
Three types of PRR – based on extent and depth of carious lesion as determined by exploratory preparation.

- **TYPE A**: suspicious PF where caries removal limited to enamel
- **TYPE B**: incipient lesion in dentin that is small and confined
- **TYPE C**: is characterized for greater exploratory preparation in dentin
<table>
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<tr>
<th>TYPE OF SEALANT RESTORATION</th>
<th>INDICATIONS</th>
</tr>
</thead>
</table>
| 1. Sealant alone             | Decalcified fissure  
  No RG involvement of dentin  
  Less than 2 other carious lesions in mouth |
| 2. Composite + Sealant       | More than 2 other carious lesions in mouth  
  Lesion confined to dentin |
| 3. GIC + Sealant            | Cavity in dentin but confined  
  Margins not in occlusal contact |
| 4. Laminate restoration      | Lesion in dentin and lateral spread along DEJ  
  Cavity margins in occlusal contact |
| 5. Amalgam restoration       | Large radiolucency in dentin  
  Significant lateral spread of caries |
• RECENT ADVANCES:

• Use of **surfactant containing etchant** – lower surface tension and contact angle

• Use of argon laser for polymerization

• Use of Er: YAG laser

• Carbon dioxide conditioning

• Use of DIAGNOdent – detection of caries under pit and fissures
REFERENCES

• Fundamentals of paediatric dent.- R.MATHEWSON

• Dentistry for child and adolescent – Mc DONALD

• Pediatric dentistry – STEWART

• Textbook of pedodontics – SHOBHA TANDON

• Pediatric dentistry: infancy through adolescence- PINKHAM

• T.B of pediatric dent. – BRAHAM MORRIS

• Cariology – NEWBRUN

• Pit and fissure sealants: review of literature (pediatric dentistry 2002)