

Fixed Partial Denture Failures – A Review

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Publication Date: 2025/06/14

Abstract: Rehabilitation with a fixed partial denture (FPD) is one of the most frequent and desired treatment options across patients. Both the patient and the dentist could experience substantial joy from fixed prosthodontic therapy. From the first patient consultation through the active treatment phase to a planned follow-up care regimen, every detail must be carefully considered in order to achieve fixed prosthodontic success. The key to successful treatments and how to handle situations when faced with an FPD failure is the clinician's capacity for creativity, innovation, and originality. For a dentist, finding the most efficient and cost-effective solution to a problem is the most difficult scenario. Professionals that are aware of the elements that lead to failures or cause unhappiness will be able to meet patient needs and develop more effective treatment plans by reducing errors. This study presents an overview of all available research sources and illustrates the causes of fixed partial denture failure as well as management strategies.

Keywords: *Fixed Partial Denture Failures, Systematic Review.*

How to Site: Dr. Abhilash; Dr. Arunachalam Sudheer; Dr. Susmita Mondal; Dr. Priya; (2025) Fixed Partial Denture Failures – A Review. International Journal of Innovative Science and Research Technology, 10(6), 504-512. <https://doi.org/10.38124/ijisrt/25jun427>

I. INTRODUCTION

Fixed prosthodontic therapy can provide outstanding satisfaction for both the patient and the dentist. But to accomplish this, careful attention to every detail is needed, starting with the initial patient interview and continuing during the active treatment phase and ending with a scheduled follow-up care programme. ¹Because caries and periodontal disorders are still quite common in adult and elderly populations, replacing and restoring teeth with FPDs is a significant therapy technique in dentistry. In terms of diagnosis and treatment, fixed prosthodontic failures can be annoying and complicated, and they can happen at any time.¹

There are numerous possibilities for the fixed prosthesis to fail. The causes of failure can be separated into three categories: aesthetic, mechanical, and biological. Clinicians have a more direct influence on mechanical failures. Biological issues are more difficult to manage and sometimes have nothing to do with the prosthesis or treatment. Caries, uncemented restorations, over-contoured restorations, poor occlusal planes, periodontal disease, periapical involvement, failed post-retained crowns, poor aesthetics, crown perforations, and improper restoration margins are some of the causes of failure.

The abilities of the physician to do an in-depth diagnostic evaluation and develop the most effective treatment strategy improved by knowledge of the clinical issues that can arise in fixed prosthodontics. It assists with planning the time intervals required for post-treatment care and offers patients realistic goals.²

II. CLASSIFICATION SYSTEM FOR FAILURES IN TOOTH-SUPPORTED FIXED PARTIAL DENTURE

Tinker³ was the first one to summarize the causes of FPD failures as early as in 1920.

➤ *Chief Among the Causes for such Disappointing Results were:*

- First: Faulty or no attempt at diagnosis and prognosis.
- Second: Failure to remove foci of infection.
- Third: Disregard for tooth form.
- Fourth: Absence of proper embrasures.
- Fifth: Interproximal spaces.
- Sixth: Faulty occlusion and articulation.

➤ *Robert's⁴ classification: 1970*

- Cementation failure.
- Mechanical breakdown.
- Flexion, tearing, or fracture of the gold.
- Solder joint failure.
- Pontic fracture.
- Bonded porcelain failure.
- Gingival irritation or recession.
- Periodontal breakdown.
- Caries.
- Necrosis of the pulp.

➤ *Barreto⁵ classification: 1984*

- Biologic – caries, fractures, and generalized periodontal disturbances.
- Esthetics – shapes, contours, and surface characteristics.
- Biophysical – physical properties and chemical composition of porcelain and metal.
- Biomechanical – faulty designs, misplaced finish lines, rough or sharp surfaces, and undercuts on the bonding surface cause porcelain to be dislodged.

➤ *Thayer⁴ classification – 1984*

- Caries.
- Cement failures.
- Preparation fractures and acrylic veneer wear/loss.
- Porcelain fractures.
- Solder joint or major connector failure.
- Periodontal involvement.

➤ *Selby⁶ classification – 1984*• *Biologic:*

- ✓ Caries.
- ✓ Periodontal disease.
- ✓ Endodontic or periapical problems.

• *Mechanical:*

- ✓ Loss of retention.
- ✓ Fracture or loss of porcelain.
- ✓ Wear or loss of acrylic veneer.
- ✓ Wear or perforation of gold.
- ✓ Fracture of metal framework.
- ✓ Fracture of solder joints.
- ✓ Fracture of abutment tooth or root.
- ✓ Defective margins.
- ✓ Poor contour.
- ✓ Poor esthetics.

➤ *Smith classification⁴ – 1985:*

- Loss of retention.
- Mechanical failures of crown and bridge components.
- Changes on abutment tooth.
- Design failures.

- Inadequate clinical or laboratory technique.
- Marginal deficiencies.
- Defects.
- Poor shape and color.
- Occlusal problems.

➤ *John. F. Johnston^{7,8} classification: 1986*• *Biological failures:*

- ✓ Caries.
- ✓ Root caries.
- ✓ Periodontal disease.
- ✓ Occlusal problems.
- ✓ Gingival irritation.
- ✓ Gingival recession.
- ✓ Pulp and periapical health.
- ✓ Tooth perforation.

• *Mechanical failures:*

- ✓ Loss of retention.
- ✓ Cementation failure.
- ✓ Acrylic veneer wear or loss.
- ✓ Porcelain fracture.
- ✓ Metal-ceramic porcelain failures.
- ✓ Porcelain jacket crown failures.

• *Esthetic failures:*

- ✓ Improper shade selection.
- ✓ Excessive metal thickness and exposure.
- ✓ Thick opaque layer application overglazing.
- ✓ Dark space in cervical third.
- ✓ Failure of translucency.
- ✓ Improper contouring.
- ✓ Discoloration of facing.

➤ *Wise⁴ classification – 1999*

- General pathosis.
- Periodontal problems.
- Caries.
- Pulpal changes.
- Erosion.
- Cracked teeth.
- Subpontic inflammation.
- Temporomandibular joint disorders.
- Occlusal problems.

➤ *Facing failures*• *Manappalli^{9,10} classification – (2008)*

- ✓ Class I – Cause of failure is correctable without replacing restoration.
- ✓ Class II – Cause of failure is correctable without replacing restoration; however, supporting tooth structure or foundation requires repair or reconstruction.

- ✓ Class III – Failure requiring restoration replacement only. Supporting tooth structure and/or foundation acceptable.
- ✓ Class IV – Failure requiring restoration replacement in addition to repair or reconstruction of supporting tooth structure and/or foundation.
- ✓ Class V – Severe failure with loss of supporting tooth or inability to reconstruct using original tooth support. Fixed prosthodontic replacement remains possible through the use of other or additional support for redesigned restoration.
- ✓ Class VI – Severe failure with loss of supporting tooth or inability to reconstruct using original tooth support. Conventional fixed prosthodontic replacement is not possible.

III. OVERALL FIXED PARTIAL DENTURE FAILURES

➤ *Biological Failures:*

• *Caries¹¹:*

Dental caries is a common chronic infectious illness that gradually demineralises tooth structure by metabolising sugars to create acid. It is caused by tooth-adherent cariogenic bacteria, primarily *Streptococcus mutans*.

➤ *Findings:*

- Among the most frequent biologic malfunctions.
- The primary method of early detection is thorough probing of the tooth surfaces and prosthesis edges with a keen explorer.
- Caries on proximal surfaces can be found with the use of radiographs.

➤ *Causes¹¹:*

- Caries not being detected; caries not being completely removed; rough abutment finishing margins; subgingival marginal placement in inaccessible areas; overhanging margins; rough crown or bridge margins; overconformity of the cervical thirds of crowns or bridges, which inhibits physiologic cleaning by the tongue or muscles; marginal discrepancy; and thick cement space in margins, which causes cement dissolution.

➤ *Management:*

- Restorative conservative techniques
- The preferred filler material for repairing marginal cavities is gold foil.
- Amalgam: the greatest substitute for gold foil filling.
- Composite: less attractive; recommended for caries restoration in the aesthetic zone.
- Glass Ionomer cement.

➤ *Preventive:*

- Dentifrices, mouth rinses, topical fluoride application.

➤ *Degeneration of the pulp:*

- Clinical characteristics include:
 - Pulpal sensitivity upon implantation.
 - Severe discomfort.
 - Radiographic anomalies were found in the periphery.

➤ *The following are the causes:*

- Prolonged preparation.
- Excessive heat production during preparation.
- Unnoticed pulp exposure.
- Pulp invading by 2° caries.

➤ *Prevention:*

- Applying a varnish or dentin bonding agent creates a strong barrier that shields the pulp beneath from the harmful effects of the cement and core components.

➤ *Management:*

- Use coolant in the airtor.
- Preparation that is conservative.
- Use the prosthesis's opening to access the hollow.
- Severe: FPD extraction followed by endodontic therapy and a new prosthesis
- If the retainer comes free during access opening or there are porcelain fractures, the prosthesis may need to be redone.
- There is no indication for indirect pulp capping.

➤ *Periodontal breakdown¹²:*

- Localised around the prosthesis, periodontal breakdown might be caused by a restoration that obstructs proper oral hygiene or by a lack of training in prosthesis care.

➤ *Clinical characteristics include¹³:*

- Periodontal pockets.
- Gingival pocket.
- Mobile abutment tooth.
- The involvement of furcation.

➤ *The Reasons include:*

- Inadequate marginal adaptation.
- Excessive flexion of the retainers' axial surfaces.
- Connectors that are too big, limiting the cervical embrasure space.
- A pontic that makes contact with an excessively extensive portion of the edentulous ridge.
- A prosthesis with uneven surfaces that encourage the buildup of plaque.

➤ *Place the final line¹⁴:*

- Equigingival vs Subgingival vs Supragingival.

➤ *Management options include:*

- Periodontal surgery.
- Scaling for less severe plaque.
- To fix the flaws, recontour or remake.
- The tooth may need to be extracted if the abutment teeth's prognosis has deteriorated more than that of the crown or bridge.

• *Occlusal Problems:*

- ✓ Occlusal wear facets.
- ✓ Too much tooth movement.
- ✓ Permanent pulpal injury.
- ✓ Soreness in the muscles.
- ✓ Breakdown of the periodontia.

➤ *Management:*

- To get rid of these interferences without causing irreversible harm, occlusal correction should be made.
- Excessive mobility combined with decreased bone support necessitates abutment tooth extraction.
- Endodontic therapy is required for irreversible pulpal damage.

• *Tooth perforation:*

- ✓ Incorrectly positioned pinholes or pins used with restorations that are pin-retained might lead the tooth to perforate laterally.
- ✓ The perforation's location are:
 - ✓ Pulp chamber.
 - ✓ Furcation region.
 - ✓ Extension into periodontal ligament.
 - ✓ Occlusal to periodontal ligament.

➤ *Management*

- The preparation was expanded to include the flaw.
- Surgery on the teeth.
- The projecting pin becomes smoother.
- The restoration was positioned in the perforated area.
- The tooth is removed.
- Endodontic therapy.

➤ *Mechanical Failures*

- Retention loss.
- Failure of the retainer, connector, and pontic.
- Perforation and occlusal wear.
- A fractured tooth.
- A break in porcelain.
- The failure of the cement.

➤ *Decrease in retention¹⁵*

- Caries.
- A larger taper.
- Misfit.

- Short clinical crown.
- Ineffective cementation.

➤ *Retention loss due to increased taper¹⁶*

- An increase in taper - 2.5 to 6.5 degrees is ideal.
- There are several elimination paths.

➤ *Management*

- Proximal grooves are incorporated as part of management.
- More retentive grooves, which ought to run parallel to the insertion path.
- More pins.

➤ *Short clinical crown*

- Luting cements alone by themselves are insufficient.

➤ *The following are the Management Strategies*

- Crown lengthening technique.
- Sub-gingival margin.
- Additional proximal box and retentive grooves.
- Pin incorporation.
- Additional abutments.

➤ *Misfits*

- internal misfit, horizontal marginal misfit, overextended or underextended margins, and vertical marginal misfit.
- The following are the causes :- casting failures (nodules, fins), incorrect impression, wax pattern shrinkage, and firing shrinkage.

➤ *The following are Symptoms*

- A loose or dislodged crown.
- Discomfort or pain during chewing.
- Sensitivity to temperature changes.
- Sharp edges that irritate your gums or tongue.
- An unpleasant taste or bad breath.
- The **management** involves re-cementing, Modifications, Re-fabrication, Elimination and substitution.

➤ *Failed cementation¹⁷*• *Reasons*

- ✓ Cement type.
- ✓ Old cement, a long mixing period, a thin mix, cement hardening before sitting, inadequate isolation, partial removal of temporary cement, a thick cement gap, and insufficient pressure are some of the issues.

➤ *Detected by¹⁵*

- The patient's perception of looseness or sensitivity to temperature or sweets is one way to identify the loss of retention.

- A bad smell or flavor.
- By holding the retainers between the fingers and a curved explorer underneath the connector, the retainers are raised

and lowered (occlusocervically) in an attempt to remove the current prosthesis.

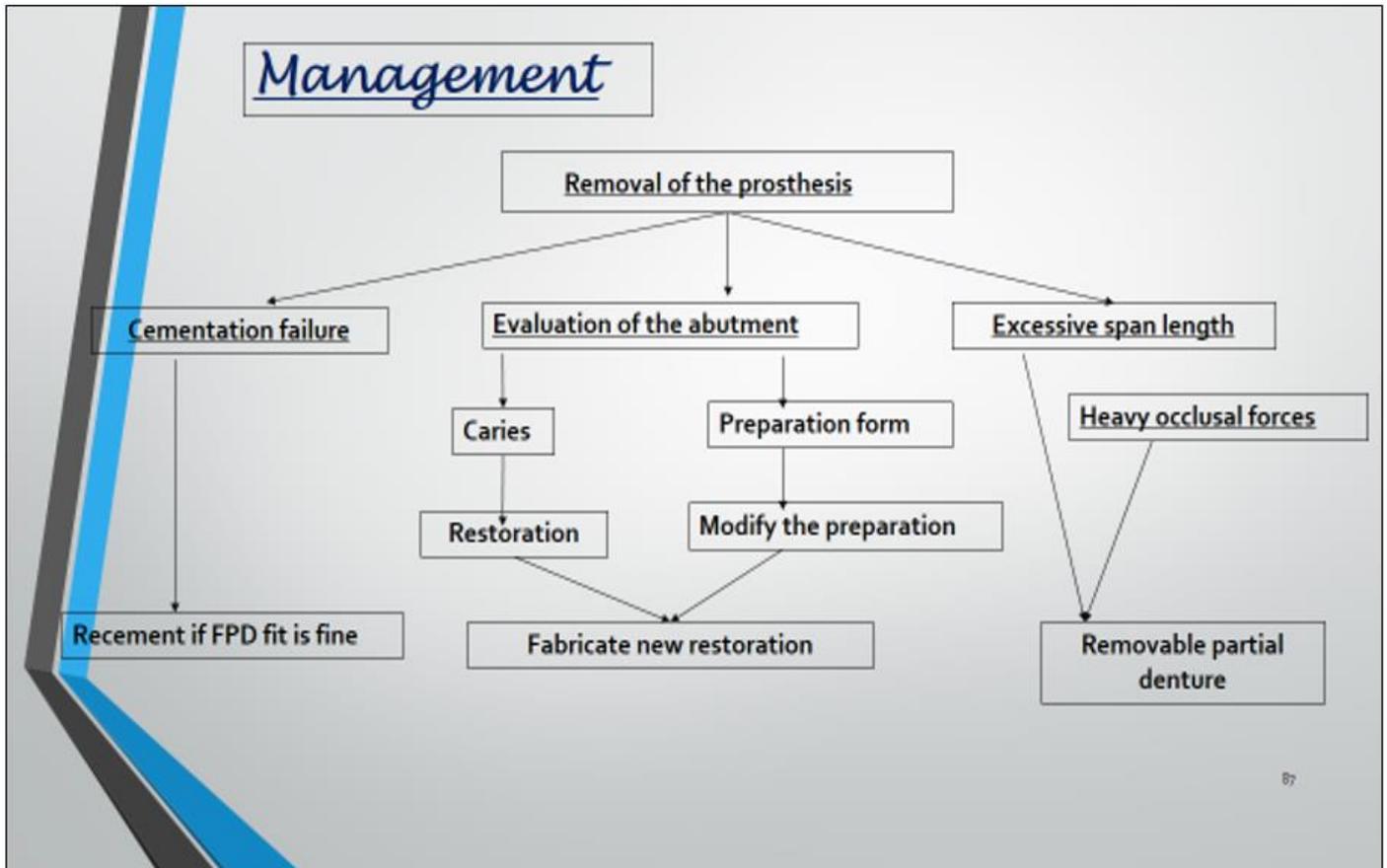


Fig 1 Management of Failed Cementation.

IV. FAILURES OF RETAINERS¹⁸

➤ Perforation

• Reasons

- ✓ Not enough occlusal reduction.
- ✓ High spots in the opposing dentition; inadequate occlusal material; and contaminated metal.
- ✓ Porosity in metalworking.
- ✓ Ineffective routines.

➤ Management

• Small Cracks/Holes:

✓ Resin/Composite Repair:

If the hole is tiny, a dentist may fix it with composite material or resin that matches the color of the tooth.

➤ Reshaping and Smoothing:

To repair the damaged area, the crown may occasionally need to be reshaped and smoothed.

• Bigger Cracks/Holes:

✓ Crown Replacement

The entire crown may need to be replaced with a new PFM crown or possibly another kind of crown if the damage is severe or the crown is weak.

➤ The marginal discrepancy

• Reasons:

- ✓ Margin selection.
- ✓ Inadequate planning and improper margin establishment.
- ✓ Inappropriate retraction of the gingiva.
- ✓ Choosing the material for the impression.
- ✓ Material shrinkage (condensation silicone) or Material distortion (alginate).
- ✓ The impression contains voids.
- ✓ A delayed die material pour.
- ✓ Wax patterns at the edges are distorted.
- ✓ Inadequate metal flow.
- ✓ Metal shrinkage.
- ✓ Nodules in the coping's inner side and edges.

➤ Faced with failure Fracture¹⁹:

- Inadequate metal framework; insufficient mechanical retention.

- Malocclusion, micro-leakage between the metal and the face, improper fusing process, excessive oxide layer deposition, and deformation of the framework metal are some of the issues.

➤ *Discolouration*

- Absorption of food colouring additives via microcracks or microleakage in metal and facing interfaces.
- Absorption of oral fluids.
- Tarnish of the facing and underlying metal.
- Microcracks brought on by malocclusion.

➤ *Facial wear can be caused by:*

- Poor fusing technique.
- Deep bite.
- Inadequate brushing and flossing practices.
- Parafunctional habits.

➤ *Management*

- The desired consistent veneer thickness is 1.2 mm. The wax is then cut back to a predetermined depth.
- The metal surfaces that are going to be veneered ought to be pit-free and smooth. Surface imperfections result in partial wetting by the porcelain slurry, which creates voids at the P-M contact, weakens the connection, and ultimately causes mechanical failure.
- Veneering surfaces with sharp angles should be rounded to reduce stress concentrations that could lead to mechanical failure.
- Where the external metal porcelain connectors are located. It is necessary to position occlusal centric contacts at least 1.5 mm distant from the junction.

➤ *Pontic Failure*

The following are factors that cause pontic failure²⁰

- *Pontic space:*
- ✓ ↓ M-D → tiny, unsightly pontic → ↑ food trap → challenging to clean.
- *The contour of the residual ridge:*
- ✓ Severe resorption resulting in lengthy pontics and aesthetic failure
- ✓ Ridge augmentation is taken into consideration.
- *A biological perspective:*
- ✓ The ease with which tooth plaque can be removed.
- ✓ Pontic ridge contact
- ✓ Pontic gingival surface (mucosal contact)
- ✓ Contact between mucosa
- ✓ Contact between non-mucosa

➤ *Pontic content*

- Sturdiness and strength to resist occlusal forces.
- Good aesthetics.

➤ *Biocompatibility:*

Better glassed porcelain.

➤ *The forces that occlude:*

- ↓ occlusal table width B-L → abutment tooth force

➤ *Metal substructure compromised:*

- Because of the opposing tooth's supra-eruption, there is an occlusal-cervical void.
- ↓ space mesiodistally as a result of neighboring teeth moving or drifting.

➤ *Connector Failure²¹*

➤ *Cause*

- ✓ Too thin metal.
- ✓ Occlusal load.
- ✓ Internal porosity.
- ✓ Solder failure to adhere to metal.
- ✓ Incorrect metal flow : solder must have a minimum width of 0.25 mm.

➤ *Recommended Dimensions*

- Molars : 4*4mm
- Anterior : 3*3 mm.

➤ *Preventive Measures*

- Sufficient bulk of metal.
- Proper height and width.

➤ *Management²²*

- As soon as possible, the prosthesis should be taken out and replaced.
- To stabilize the prosthesis, a casting can be cemented in place, and an inlay, similar to a dovetailed preparation, can be created in the metal to span the fracture location.
- To preserve the existing space and meet aesthetic standards, prosthetics can be taken out by cutting through the undamaged connectors and replacing them with a temporary, detachable partial denture.
- Before adding porcelain, link several unit bridges together with a solder junction in the center of the pontics.
- This increases the solder joint's surface area and strengthens it with the porcelain covering.

➤ *Occlusal Wear*²³

- The following factors may contribute to a faster occlusal wear of a prosthesis are high chewing forces, Parafunctional habits, Thin metal, Cast perforation → leaking → cavities → failure of the prosthesis.

- Occlusal wear caused by porcelain against metallic restorations or natural teeth.
- Clinical characteristics include attrition and inadequate occlusal clearance, facets are present.

➤ *Management*

Table 1 Management of Occlusal Wear.

Perforation detected early	Gold or amalgam restoration
Perforation over amalgam core	Left untreated , checked periodically
Metal surrounding perforation is extremely thin	New prosthesis
Parafunctional habits	Metal occlusal
Severe perforation	Replace crown, occlusion assessed

V. **TOOTH FRACTURE**²⁴

➤ *Coronal fracture*

• *Causes*

- ✓ Too much tooth preparation, which leaves the tooth with too little structure to withstand occlusal stresses.
- ✓ The existence of eccentric or interfering centric occlusal contacts.
- ✓ High occlusal forces applied to a restoration that has been appropriately adjusted.
- ✓ Making an effort to sit firmly on a prosthesis that does not fit well.
- ✓ A concrete bridge unseated incorrectly.

- ✓ Around inlays and partial veneer crowns, due to the tooth structure becoming more brittle with age.

➤ *Radicular fractures*²⁵

• *The following are the causes*

- ✓ Trauma.
- ✓ Forceful seating of a post and core.
- ✓ Making an effort to seat a post and core that don't fit properly.
- ✓ Fractures that happen while receiving endodontic therapy.

➤ *Management*

Table 2 Management of Tooth Fracture.

Extraction → new prosthesis	Extraction → new prosthesis
Questionable integrity of remaining tooth structure	New prosthesis fabricated encompassing the fractured area.
Large coronal fracture around partial coverage retainers	Pin retained restoration to serve as core and provide support and retention Full coverage restorations
	↓
Fracture causes exposure of pulp	Endodontic treatment along with post and core
Abutment tooth fracture under full coverage restoration → horizontally at the level of finish line	Removal of prosthesis → endodontic treatment → post and core → new prosthesis.
Root fracture	Extraction → new prosthesis

VI. **PORCELAIN FRACTURE**²⁶

➤ *Causes include*

- Sharp angles and excessively rough, and uneven sections above the veneering area in the framework design, Concentration sites of stress, Propagation of cracks, Ceramic fracture,
- For the same reason, metal perforations may also result in failure.
- Excessively thin metal casting (less than 0.2 mm) causes flexure and fracture.
- Restorations with facial veneers make central occlusal contact on or close to the metal-ceramic junction.

➤ *Occlusion*

- The opposing teeth make deflective contact due to heavy occlusal forces, parafunctional habits, eccentric or central occlusal interferences, and incorrect occlusal sides.

➤ *Metal handling procedures*^{27,28} :-

• *Metal contamination* :-

- ✓ When porcelain is applied improperly, it can cause bubbles to form at the metal-ceramic junction, which can lead to tension and cracks.
- ✓ Additionally, excessive oxide formation on the alloy surface can cause porcelain to separate from the metal.

➤ *Preparation, Impression and Insertion*

- Undercut tooth preparation → prosthesis binding → fracture.
- Overextension of thin metal feather edge finish lines might bind on teeth and cause fractures.
- The impression fails to capture the finish line.

➤ *Management*

- Repair of Fractured Metal-Ceramic Restoration²⁶

➤ *All ceramic porcelain failures*^{28,29}

- The following are the causes :-
- Inadequate tooth preparation.
- High occlusal forces.
- Vertical fractures.
- Tapered finish line, which places the restoration on a sloping surface and allows forces to try to expand it, which porcelain is unable to withstand.
- Vertical fracture due to stress concentration caused by sharp line angles and incisal edges.
- A round preparation form with insufficient rotational force resistance that can fracture vertically.

➤ *Management*

- All ceramic fractures can be repaired: -
- Silane coupling agent for porcelain repair kit: 4 methacryloxyethyltrimellitic anhydride (4META).
- Early failure without laboratory or clinical flaws: Metal ceramic because to excessive occlusal pressures.

VII. ESTHETIC FAILURES

Inadequate tooth reduction, improper porcelain application or firing, improper framework design that exposes metal, color changes in natural teeth, and improper marginal fit¹⁴, metamerism all falls under esthetic failures.

➤ *Post failure :-*

- *Causes :-*

There may be carious lesions, tooth fractures, loss of retention, or apical abscesses.

VIII. CONCLUSION

Fixed Partial Dentures (FPDs) effectively restore missing teeth, improving function and aesthetics, but their longevity depends on addressing key failure risks. **Biological failures** (e.g., secondary caries, periodontal disease), **Mechanical issues** (fractures, porcelain chipping), and **Technical errors** (poor fit, cementation) are common culprits. Failure can lead to clinical complications, functional impairments, and patient distress.

➤ *Preventive strategies include*

- Rigorous patient selection (avoiding high-risk cases like bruxism or poor hygiene).
- Precise treatment planning (abutment assessment, digital diagnostics).
- High-quality materials (zirconia, CAD/CAM-fabricated frameworks).
- Patient education on maintenance (cleaning under pontics, regular check-ups).

Future advancements like biomimetic materials, adhesive technologies, and digital dentistry (3D printing, intraoral scans) promise enhanced durability. While FPDs remain a reliable option, their success hinges on clinical expertise, patient compliance, and technological integration to minimize failures and ensure long-term outcomes.

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