

Clinical Failure and its management in fixed partial denture: A Systemic Review

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Abstract

Fixed prosthetic dentistry encompasses those procedures designed to enhance & improve the facial form, mastication and appearance of maxillofacial region. But there are several factors which responsible for failure in fixed partial denture can be divided into biological, mechanical and esthetics. The present review of literature is concluded how to assess factor responsible for failure of fixed partial denture and how to fix these problems.

Keywords: Prosthesis failure, fixed partial denture failure, Biological failure, Mechanical failure, Esthetic Failure

Introduction

An objective evaluation of an existing restoration is necessary before coming to a conclusion that it is defective and requires either repair or replacement. What

constitutes a failure? Are failures absolute or are there degree of failures? There are, of course, minor failure, which are a matter of opinion and could possibly left without immediate repair or replacement, and there are obvious failures where repair or replacement is essential to avoid further damage to the dentition.

Restoring and replacing of teeth with FPDs represents an important treatment procedure in dental practice, mainly because of the continuing high prevalence of caries and periodontal diseases in the adult and geriatric populations.[1] Further it is impossible to say how long a tooth with crown or bridge should last, failure may occur at any time. Loss of vitality, for instance may occur years after cementing a bridge and may be the end result of chronic inflammation and degenerating pulp beneath an

otherwise intact bridge. If cement seal and the underneath abutment are intact, successful endodontic treatment may be carried out through the occlusal surface of the retainer without removing the bridge.

Reasons of failure can be caries, uncemented restoration, over-contoured restoration, poor occlusal plane, periodontal disease, periapical involvement, failed post retained crowns, poor esthetics, crown perforation and defective margins of restorations.[1] Knowledge regarding the clinical complications that can occur in fixed prosthodontics enhances the clinician's ability to complete a thorough diagnosis and to develop the most appropriate treatment plan.[2] It provides realistic expectations to patients and to plan the time intervals needed for post-treatment care.[3]

Therefore, it is important to be aware of obvious and subtle indications of prosthesis failure and to have a thorough working knowledge of the procedures that are necessary to remedy the solution.

Reason for failure of fixed partial denture:

The causes of FPD failures were summarized as early as in 1920 when Tinker wrote [4] - "Chief among the causes for such disappointing results has been:

First: Faulty, and in some cases, no attempt at diagnosis and prognosis.

Second: Failure to remove foci of infection in attention to treatment and care of the investing tissues and mouth sanitation.

Third: Disregard for tooth form

Fourth: Absence of proper embrasures

Fifth: Inter proximal spaces

Sixth: Faulty occlusion and articulation.

Classification for failure of fixed partial denture:

Robert's [5] Classification

- 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.

Lombardi [6] classification of esthetic errors

1. Inharmonious dentofacial ratio
 - Shade disharmony
 - Compositional incompatibility
 - Static prosthesis in dynamic mouth
 - Inharmonious strength or weakness of dental composition compared to background features
 - Weak mouth with strong face
 - Strong mouth with weak face.
2. Intrinsic dental disharmony
 - Space allocation errors
 - Inadequate vertical space allocation
 - Excessive vertical space allocation
 - Excessive horizontal space allocation
 - Structural line errors
 - Elevated occlusal plane
 - Occlusal plane drops down posteriorly
 - Asymmetrical occlusal plane.
3. Unnatural lines
 - Reverse smiling line
 - Unnatural axial inclination
 - Cusp less posterior teeth
 - Gradation errors
 - Age-sex personality disharmony.
4. Single-line errors
 - Vertical deviation
 - Horizontal deviation

- Line conflict.
5. Imbalance
- Midline error
 - Imbalance of directions
 - Artifact error
 - Diastema error.

Barreto [7] classification – 1984

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

Thayer [8] classification – 1984

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

Selby [9] 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

Wise [10] classification – 1999

1. General pathosis
2. Periodontal problems
3. Caries
4. Pulpal changes
5. Erosion
6. Cracked teeth
7. Subpontic inflammation
8. Temporomandibular joint disorders
9. Occlusal problems.

Smith [11] classification – 1985

1. Loss of retention
2. Mechanical failures of crown and bridge components
3. Changes on abutment tooth
4. Design failures
5. Inadequate clinical or laboratory technique
 - a. Marginal deficiencies
 - b. Defects
 - c. Poor shape and color
6. Occlusal problems

John. F. Johnston [12] 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 & over glazing
- Dark space in cervical third
- Failure of translucency
- Improper contouring
- Discoloration of facing.

Facing failures

Manappallil [13] 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.

Most common failure in fixed partial denture and its management [14]

Biological Failures

1) **Caries:** - Most common biologic failure.

Detected by:

- Visual examination (check for discoloration around margins)
- Comprehensive probing of margins.
- Radiographs for interproximal surfaces.

Treatment: - Meticulous oral hygiene especially in patients with high caries index. Fluoride mouth washes, dentifrices, professionally applied topical fluoride and diet counselling. Antibacterial cements (ZnPO₄) and anti-microbial agents (Consepsis) should be used to decrease the caries incidence. Conventional operative dentistry procedures to restore small lesions.

2) Pulp Degeneration

Clinical features: Pulpal sensitivity, intense pain, radiolucency in the periapical region, indicate pulpal involvement.

Treatment:-Use of varnishes and dentin bonding agents which forms an effective barrier and prevents underlying pulp from toxic effects of cement and core materials. Endodontic treatment of the involved tooth by making an access opening through the crown, once obturated the perforation can be restored with gold foil, amalgam or cast metal inlay.

3) Periodontal Breakdown

Clinical features: - Gingival recession, furcation involvement and pocket formation, mobility (secondary feature).

Treatment:-Proper oral hygiene instructions

- In cases of less severe breakdown treatment is done by scaling and proper plaque control.
- In more severe cases treatment involves flap surgery, bone grafts etc.

4) Occlusal Problems

Clinical Features:- Large wear facets, mobility, tender on percussion, open contacts, perforation, cusp fracture, tenderness of the masticatory muscles involved and in

radiographic examination widened periodontal ligament is seen.

Treatment: - Mobility due to increased occlusal forces should be tested by Fremitus test.

However trauma from occlusion on teeth previously weakened by periodontal disease or long term presence of occlusal forces on teeth with normal bone support can lead to mobility which cannot be reduced or eliminated through occlusal adjustments.

Patient with bruxism/clenching → a night guard, or an occlusal splint should be given.

Articulated diagnostic casts should be periodically remade and compared with previous records so that any occlusal changes can be monitored and corrective treatment initiated. Selective reshaping of defective contacts and restoring or replacing teeth in more favourable position to accommodate occlusal forces.

5) Tooth Perforations

If perforation located occlusal to periodontal ligament it is often possible to extend the tooth preparation to cover the defect.

If below periodontal ligament then periodontal ligament is surgically exposed and restorations smoothed or place a restoration in the perforated area.

If not accessible – extraction is done.

Usually these perforations are not obvious initially during insertion of prosthesis, becoming obvious only at a later stage.

Mechanical Failures

1) Loss of Retention

Mainly due to leverage and unequal occlusal loads on different parts of the bridge, loose retainers cause rapid destruction of the abutment core which is usually made of dentin without its protective enamel cover. Saliva and plaque and pumping action of loose retainer are

responsible for caries leading to rapid destruction of abutment teeth.

Treatment: - Re-cementation if there is no extensive damage provided cause can be identified and eliminated. If the failure is due to poor preparation of the abutment then provide additional retention by cross pinning, grooves, and boxes etc. although ideally it should be made more retentive by fabricating new prosthesis. A wisdom quota states that:

It is better for teeth to have no cover than loose cover.

2) Connector Failure/ Solder joint failure

Connector between an abutment retainer and a Pontic or between pontics can fracture under occlusal forces. Failure of both cast and soldered connection has been observed and generally caused by internal porosity that has weakened the metal.

Treatment: - Fracture connectors are difficult to detect in an abutment teeth with no mobility. Wedges are placed beneath the connector to separate the FPD components to conform diagnosis. Occasionally an inlay like dovetailed preparation can be developed in metal to span the fracture site and casting can be cemented to stabilize the prosthesis.

If this is not possible and remake cannot be rapidly accomplished, the Pontic should be removed by cutting through intact connector. A temporary removal partial denture can then be constructed to maintain existing space and satisfy esthetic requirements.

It is better whenever possible to join multiple unit bridges by solder joint in the middle of pontics before porcelain is added. This gives much larger surface area for the solder joint and it is also strengthened by porcelain covering.

3) Occlusal Wear and Perforation

Clinical features: Attrition of the opposing teeth, polished facets on the retainers/pontics, gingival recession or inflammation.

Treatment: - If perforation is detected early a gold/ amalgam restoration can be placed that seals the area and provide additional years of service. Other material are resin, composite, GIC. If perforation is over amalgam core, leave it untreated and check it periodically.

If metal surrounding perforation is extremely thin a new prosthesis should be fabricated.

If occlusal surfaces are covered with porcelain, wear of ceramic is usually not a problem instead the opposing natural teeth shows dramatic wear of enamel.

4) Tooth Fracture

a) Coronal fracture: - Coronal tooth fracture can be dramatic, resulting in considerable loss of tooth structure or minor with little significant damage.

Treatment: - If defect is small it is restored with amalgam, gold foil or resin which may provide additional years of service even though not ideal. If defect is big/ large a new prosthesis is fabricated so that it encompasses the fracture area.

b) Root fractures: - **Located** well below alveolar bone so the tooth must be extracted and new prosthesis fabricated. Occasionally fracture terminates at or just below the alveolar bone, in such cases it may be possible to perform periodontal surgery, remove bone and expose the fracture site so that it can be encompassed by new prosthesis.

5) Porcelain fracture:

Fracture occurs with both metal ceramic and all ceramic restoration. Majority of metal ceramic fracture can be attributed to improper design of metal framework or problems related to occlusion. All ceramics most commonly fail because of deficiencies in tooth preparation / due to heavy occlusal load.

Treatment:

- 1) Best method is fabrication of new prosthesis
- 2) Resin materials are often used to rebuild the porcelain form in area where fracture has

occurred, adequate to good color matches can routinely be achieved. Drawback is lack of longevity and discoloration. (Even light cure composite can be used). Silane coupling agents or 4 Meta should be used to promote bonding with acrylic or composite. But strength of the joint diminishes with changes in temperature and prolong water storage.

Retention is mainly through mechanical means, therefore not used in areas of heavy occlusal force.

- 3) If fracture is due to heavy occlusal forces, the contact should be avoided at the metal ceramic junction and it should be at least 1.5mm away from the junction.
- 4) A more permanent repair is possible when adequate metal thickness is available. Steps involved are,
 - a) Remove remaining porcelain
 - b) Drill several pin holes (4 to 5) to depth of 2mm and make impression.
 - c) Creating pin retained metal casting 0.2 to 0.3 mm thick out of a metal ceramic alloy to fit over exposed metal framework.
 - d) Fusion of porcelain to the pin retained casting and establish normal form.
 - e) Cementation of casting in position.
- 5) If there is any risk of pontic area flexing, porcelain should be carried on to the lingual side of the pontic to stiffen them further.
- 6) Sleeve crown: When a considerable portion of porcelain is lost from labial/ incisal surface of a retainer or pontic it is often possible to repair than replace the entire unit.

The porcelain facing is removed with some of the underlying metal from the labial surface. Porcelain as

well as metal are removed from incisal third of the palatal surface. This is simple procedure when damaged unit is pontic, but when the unit is retainer and underlying pulp has to be considered, caution is necessary to avoid damage to the abutment teeth. Common mistake is removal of too little porcelain and metal.

An impression is taken of this and 2 adjacent units. The technician is then asked to make metal ceramic crown that will have two surfaces instead of usual four. This sleeve crown is then cemented in usual way. If too little porcelain is removed from original unit, the new sleeve crown will feel slightly bulky.

Esthetic Failures

Ceramic restoration more often fail esthetically than biologically/ mechanically.

a) Color Mismatch

Main reason reported by dental laboratories is poor color match. This could be the result of;

- Inability to match the patient natural teeth with available porcelain colors.
- Shade selection may have been inadequate.
- Metamerism also leads to poor color match.
- Insufficient tooth reduction / failure to properly apply and fire the porcelain may have created a restoration that does not match the shade guide or surrounding teeth.

b) Facing failures

Re-cementation of loose facing in metal ceramic bridges is simple process, but when fracture has occurred, a facing repair is indicated if prosthesis is otherwise satisfactory.

A new facing can be ground to fit the prosthesis if the particular type of facing is still available. The adaptation of new facing is done on trial and error basis and often does not yield the ideal fit.

c) Esthetic failure

It can also occur due to incorrect form or framework design that displays metal. In addition natural teeth undergo color changes that do not occur in porcelain, so that unacceptable color match is caused over the years.

Conclusion

Well organized and efficient post-operative care is the chief mechanism of success of FPD. A restoration that is cemented, forgotten and ignored is likely to fail, regardless of how skillfully it was designed and executed. Common complication after completion of active phase of treatment include caries, periodontal failure, endodontic failure, loose retainers, and porcelain and root fractures.

If possible dentist should be anticipate long-term prognosis and treatment needs of the patient and attempt to design the treatment plan accordingly. On occasion FPD's can be designed so that future treatment can be simplified. However it is not possible even for most experienced clinician to anticipate every contingency and complication. The patient must understand the limitation of fixed prosthodontics before treatment begins.

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