

Failures in Fixed Partial Denture: A Review

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Abstract:- One of the most accepted and desired treatment option by patients is the rehabilitation performed using a fixed partial denture (FPD). However, it takes a long treatment time to complete the procedures and it generates high patient expectations. The practitioners must have a sound knowledge of diagnosis and treatment procedures in order to reduce the failure of fixed dental prosthesis. The ability of the clinician mind to be creative, advanced and original, paves the key to successful treatments and helps in handling the situations when met with a FPD failure. The most challenging situation for a dentist is to solve the problem in a most effective and economical way. Once the professional has the knowledge on the factors that create dissatisfaction or contribute to failures, they would get an idea to reduce the errors, thus enabling them to meet the patient requirements and helps them in creating more effective treatment planning. This paper demonstrates a summary of all the attainable sources from literatures and exhibits the factors influencing the failure of fixed partial dentures and how it can be managed.

I. INTRODUCTION

The Fixed prosthodontic treatment can offer an exceptional fulfilment to both patient and the dentist. However, to achieve such accomplishment, meticulous attention to every detail from initial patient interview, through the active treatment phase, to a planned schedule of follow-up care is required. Fixed prosthodontic failures can be frustrating and complex in terms of both diagnosis and treatment and may occur at any time.¹ Hence, it is important to have knowledge of the basic principles and ideals in crown and bridge prosthodontics, as well as technical procedures, is essential. If an operator learns from his own mistakes, however, and from those of others, his efforts may result in greater success. Experience is a good teacher, but this does not imply that years of doing something wrong should be considered years of experience. Fixed prosthodontic treatment can offer exceptional satisfaction for both patients as well as the dentist. FPD failure may occur at any point of time within diagnosis to treatment phase, this can be frustrating. There are certain objectives which a fixed prosthesis should achieve. Failing to succeed in these will lead to failures in fixed prosthodontic treatment.²

II. OBJECTIVES OF FIXED PROSTHODONTIC TREATMENT^{3,4}

- Preservation or improvement of related hard and soft tissue structures.
- Providing better oral function.
- Enhancing or restoring of aesthetics
- Confirming better retention, resistance and stability of restoration
- Presenting restoration with mechanical or structural integrity
- Providing comfortable treatment to patients
- Designing restorations for maximum longevity.

III. CLASSIFICATION FOR FAILURE OF FIXED PARTIAL DENTURE

A. Robert's Classification^{4,5,12}

- 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.

B. Barreto classification – 1984^{4,6,12}

- **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 undercut on the bonding surface cause porcelain to be dislodged.

C. Thayer classification – 1984^{4,7,12}

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

D. Selby classification – 1984 4,8,12➤ *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

E. Wise classification – 1999 4,9,12

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

F. Smith classification – 1985 4,10,12

- 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 colour
- Occlusal problems

G. John. F. Johnston classification – 1986 4,11,12➤ *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

H. Manappallil classification – 2008 3,4,12

- 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.

IV. MOST COMMON FAILURES IN FIXED PARTIAL DENTURE

A. Biological Failures➤ *Caries:*

Most common biologic failure.

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

Over extension of the margin causes resorption of the cement which close the space between the cast-teeth, this will result in plaque accumulation and periodontal issues. Short casting will leave rough cementum or dentin which cause collection of debris. Open margin allows the saliva and cariogenic organisms to penetrate between tooth and the restoration. Wearing of the cast will create resorption of cement and exposure of the tooth surface which later leads to caries. Other factors such as loosening of one of the retainers, Poor oral hygiene of the patient, using of wrong type of retainer can also result in dental caries. Dental caries is considered as one of the most common factors responsible for the failure of a cast restoration. Detection of caries can be very difficult especially in cases with full crown restoration. The caries is often diagnosed only after the involvement of irreversible pulpal damage, by that time, the disease may have progressed to a point where tooth extraction and fabrication of a new prosthesis becomes

unavoidable. It is very important to identify and deal with root cause of the problem before starting the repair or replacement.¹²

- **Treatment:**

- ✓ Maintenance of good oral hygiene, particularly in patients showing high caries index.
- ✓ Use of Fluoride mouth washes, dentifrices, professionally applied topical fluoride, proper diet plans, Antibacterial cements like (ZnPO₄) and antimicrobial agents (Consepsis) can aid in reducing the caries incidence.
- ✓ Restoring early caries lesions with a procedure also known as Conventional operative dentistry.

- *Pulp Degeneration*

- **Clinical features:**

Pulpal sensitivity, intense pain and radiolucency in the periapical region indicates pulp involvement.

During fixed Prosthodontic procedures, great care is required to avoid pulp injuries. The main reasons for this pulp injury are listed below:

- ✓ Heat generated during tooth preparation.
- ✓ Chemical irritation caused by some of the dental materials.
- ✓ Microorganisms.
- ✓ Recurrent caries.
- ✓ Over reduction of tooth structure without any provisional restorations.

All these can lead to irreversible pulpitis.

- **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 penetrating through the crown and making an access opening. After the completion of obturation, the hole created can be restored using gold foil, amalgam or cast metal inlay.^{12,13}

- *Periodontal Breakdown*

The periodontitis might be generalised or localised to a poorly fabricated design or maintained restoration. Early diagnosis of the attachment loss in periodontium and removing the factors responsible for it, can help in preventing further treatments. However, if the disease has advanced to a point where the prognosis is poor, then the crown or bridge, or the tooth itself may have to be removed.

- **Clinical features: -**

- ✓ Gingival recession,
- ✓ furcation involvement and pocket formation,
- ✓ mobility (secondary feature).

- **Treatment:**

- ✓ Proper instructions to maintain good oral hygiene
- ✓ scaling and proper plaque control is done in cases with mild attachment loss.

- ✓ In severe cases, treatments like flap surgery, bone grafts etc are done.

- *D.Occlusal Problems*

- **Clinical Features:**

- ✓ Large wear in facets, mobility, tender on percussion, open contacts, perforation, cusp fracture, tenderness of the masticatory muscles involved and widened periodontal ligament in radiographs.

- **Treatment:**

- ✓ Mobility caused by increased occlusal forces are checked using Fremitus test and occlusal adjustments are made.
- ✓ In cases with history of Trauma from occlusion on teeth which was formerly weakened by periodontal disease or long-term impact of occlusal loads on teeth with normal periodontium, may lead to mobility that can never be decreased or eliminated through adjustments in occlusion.
- ✓ Night guard or occlusal splint should be given to patients with history of bruxism/clenching. Articulated diagnostic casts should be remade at a regular period of time and compared with the previous records, so that, any occlusal changes can be checked and corrective treatment methods can be initiated at the right time.
- ✓ Selective reshaping of defective contacts and restoring or replacing teeth in a position favourable to accommodate occlusal load.^{12,13}

- *Tooth Perforations*

It is often possible to extend the tooth preparation in order to cover the perforation located occlusal to periodontal ligament. If the perforation is below periodontal ligament, then it is surgically exposed and then either a restoration is placed near the perforated area or its smoothed.

Extraction is done in cases where the site is inaccessible. Usually, these perforations are not obvious during initial stages of insertion of the prosthesis. It becomes noticeable only at a later stage.

B. Mechanical Failures

- *Loss of Retention*

Mostly due to the force and unequal occlusal loads on various parts of the bridge, loose retainers can lead to rapid destruction of the abutment core which is mainly made of dentin. Saliva, plaque accumulation and the pumping action of loose retainers are responsible for caries, eventually leading to rapid destruction of abutment teeth. Diagnostic test to detect a loose retainer includes, careful examination of bridge without drying the teeth and applying pressure on the bridge up and down in order to check the presence of small bubbles in the saliva near the margins of the retainers.

Some of the factors responsible for loss of retention are as follows:

- Deformation of the metal cast on the abutment teeth.
- Inadequate tooth preparation.
- Bad technique of cementation:

- Inadequate isolation.
- Poor mixing or using improper ratio.
- Not removing any remnants that interfere with retention.
- Movement of the patient during cementation.
- Solubility of the cement due to open margin or perforation in the bridge
- Caries which causes leakage at the margin.
- When only one retainer become loose without a cement seal, plaque gets deposited in the space between the retainer and the abutment tooth. This enables the caries to develop quickly across the whole of the dentine surface of the preparation.

- **Treatment:**

Re-cementation of the prosthesis, if there is no extensive damage, provided, the cause is identified and eliminated.

Provide additional retention by cross pinning, grooves, and boxes etc, if the failure is due to poor preparation of the abutment. Ideally, in such cases, it should be made more retentive by fabricating anew prosthesis. A wisdom quote states that: "It is better for teeth to have no cover than loose cover".^{12,14,15}

➤ *Connector Failure/ Solder joint*

The connector between an abutment retainer and pontic or between two pontics can sometimes fracture under occlusal forces. This occurs mainly because of the defect in cast and soldered connection due to the weakening of metal caused by internal porosity.

Seldom a solder joint that appears to be sound, fails under occlusal loading. Given below are few factors responsible for the failure of solder joint:

- A flaw or inclusion in the solder itself.
- Failure to bond to surface of the metal.
- The solder joint not being sufficiently large for the conditions in which it is placed.

In cases of works such as metal-ceramic bridge, high restriction of the solder connectors, buccally, gingivally and incisally might lead to inadequate area resulting in solder failure. It is better to join multiple unit bridges by placing solder joints in the middle of pontics prior to the addition of porcelain, as it can be strengthened by the porcelain covering it. Unfortunately, there are no satisfactory intraoral repair methods, and it is impossible to re-solder once failed, hence the whole bridge has to be remade.

- **Treatment:**

Fracture connectors are very difficult to detect in an abutment tooth with zero mobility. In such cases, wedges are placed beneath the connector to separate the FPD components to conform the diagnosis.

Occasionally, an inlay like dovetailed preparation can be prepared in metal to extent the fracture site and casting can be cemented to stabilize the prosthesis. In cases where this is not possible, re-creation cannot be accomplished rapidly. The Pontic should be removed by cutting through intact connector. A temporary removal partial denture can

then be constructed in order to maintain the existing space and for maintaining aesthetics. Thus, it is always better to join multiple unit bridges by solder joint in the middle of pontics before porcelain is added. This provides greater surface area for the solder joint and greater strength is achieved by porcelain covering it.^{12,16}

➤ *Occlusal Wear and Perforation*

- **Clinical features:**

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

Inadequate occlusal preparation leads to reduced metal thickness and this in turn may cause perforation, which may occur during the finishing and polishing of restoration. Even in patient with normal attrition, the occlusal surfaces of teeth may wear down significantly over a lifetime. An appropriate restoration might help in repairing the perforations caused by normal wear which is spotted before any caries is detected.

- **Treatment:**

If perforation is detected at an early stage, a gold or amalgam restoration can be placed that seals the area and thus provide additional years of service. Other materials such as resin, composite, GIC can also be used. If perforation is noted over the amalgam core, leave it untreated and recall and check it periodically. A new prosthesis should be fabricated in cases where the metal surrounding perforation is extremely thin. If occlusal surfaces are covered with porcelain, then ceramic chip off will not be usually of concern. However, opposing natural teeth will be affected due to the wearing of enamel.^{12,15,16}

➤ *Tooth Fracture*

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

Fractures of the tooth may occur as a result of:

- Trauma.
- Recurrent caries.
- Removing the prosthesis intact with using large force.
- Tooth structure is thin, especially with pulp less teeth. Hence, they might require post and core.

- **Treatment:**

If defect is small it is restored with amalgam, gold foil or resin which may provide additional years of service even though this method is not ideal. If the defect is large, then a new prosthesis should be fabricated so that it covers the fracture area.

- **Root fractures:**

It's located below the alveolar bone; hence, the tooth must be extracted and then a new prosthesis can be fabricated. Occasionally, fracture terminates at or just below the alveolar bone, in such cases it might be possible to perform periodontal surgery, remove bone and expose the fracture site so that it can be incorporated by a new prosthesis.^{12,14,15}

➤ 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. At one-time pieces of porcelain fracturing off metal ceramic crowns, or the loss of the entire facing due to failure of metal- ceramic bond.

- Inadequate thickness of metal.
- Excessive thickness of porcelain contributes to inadequate support predisposes to eventual fracture. This is often true in the cervical portion of a pontic.
- The metal surfaces to be veneered not smooth and not free of surface pits or irregularities will cause incomplete wetting by the porcelain slurry, leading to voids at the porcelain metal interface that reduce bond strength and increase the possibility of mechanical failure.
- Sharp angles on the veneering area must be avoided, they produce increased stress concentrations that could cause mechanical failure.
- Excessive occlusal function or trauma.
- Improper laboratory procedures.^{12,17}
- **All Porcelain Crown or Bridge Fracture:** Sometimes, stresses are developed within porcelain jacket crowns due to the contraction on cooling after the firing cycle. If the crown is subjected to sufficient force, these stresses may produce failure. These stresses are focused around sharp internal angle of fit surface, so it should be rounded.

If the fracture is caused due to history of trauma, and if the restoration had served successfully for some time, it is better to replace it with another all-ceramic restoration.

If the failure occurs during normal function, then it's better to replace it with metal ceramic.

- **Treatment:** Best treatment option is fabrication of new prosthesis. Resin materials are often used to rebuild the porcelain form in areas where the fracture has occurred. A relatively good colour matches can routinely be achieved. Major drawback is the lack of longevity and discoloration. The light cure composite can also be used. Silane coupling agents or 4 Meta should be utilised to enable bonding with acrylic or composite restoration. However, the strength of the joint reduces with temperature change and prolong water storage. Retention is mainly through mechanical means; therefore, it cannot be used in areas with high occlusal force. In cases where fracture is caused due to heavy occlusal loads, contact should be avoided at the metal ceramic junction and it should be at least 1.5mm away from the junction. A more permanent repair is possible only when adequate metal thickness is available.

The following Steps are involved, First, the residual porcelain is removed. several pin holes (4 to 5) are then drilled to depth of 2mm is then created and an impression is made. A pin retained metal casting 0.2 to 0.3 mm thick is made out of a metal ceramic alloy to fit over the exposed metal framework. Porcelain is fused to the pin retained casting in order to establish a normal form.

Followed by cementation of casting in position. In cases where there is risk of pontic area flexing, porcelain should be carried on to the lingual area of the pontic to harden them further.

- **Sleeve crown:** It is often possible to repair than replace the entire unit, when a considerable share of porcelain is lost from the labial or incisal surface of a retainer or pontic. The porcelain facing is detached along 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, meanwhile if the damaged unit is retainer and underlying pulp has to be considered, extra care is required in order to avoid any damage to the abutment teeth. The most common mistake in this procedure is removal of inadequate amount of porcelain and metal. Further, An impression is made of this and 2 adjacent units. The technician is then instructed to fabricate metal ceramic crown that will have just two surfaces instead of the usual four surfaces.

This sleeve crown is then cemented in normal way. The new sleeve crown will feel slightly bulky, if inadequate amount of porcelain is removed from the original unit.

- **Distortion:** Distortion of all metal bridges may occur, for ex. If the hygienic pontics are made too thin or if a bridge is removed using extreme force. In such cases, bridge has to be remade.

In metal ceramic bridges, distortion of the framework can occur during function or as a result of trauma. It occurs mostly in cases where the framework is too small in cross section for the length of span and the material used.^{12,17}

V. DESIGN FAILURES

A. Abutment preparation

Inadequate crown preparation is a common cause of failures:

Taper of preparation when it exceeds 20° (ideal 5° – 10°) can cause failure through retention loss.

Incorrect path of insertion leading to the poor seating of final restoration. Inadequate marginal reduction can result in an over built crown which in turn produce a plaque retention area at the margin.

The unrounded external angles of crown preparation result in: insufficient flow of the die stone materials into the sharp angles of the impression, creating bubbles.

The sharp edges may get damaged at the wax up stage. Investment material may not flow sufficiently into the wax pattern. It may be difficult to remove the entire investment materials from sharp internal angles without damaging the casting. Cement will flow less readily around sharp angles, increasing the likelihood of unnecessary thick cement layer at the margins.

B. Inadequate bridge Designs:

Designing of the bridges is a difficult task. It is neither a precise science nor a creative form of art. It requires good knowledge and experienced judgment, which take years to accumulate. Design Failures can be classified as follows:

➤ **Under-prescribed bridges.**

These include designs that are unstable or have too few abutment teeth for ex: a cantilever bridge carrying pontics that cover too long span, or a fixed-movable bridge where again the span is too long, or where abutment teeth with too little support has selected.

➤ **Over-prescribed bridges:**

The dentists sometimes include more abutment teeth than are necessary retainer which fails:

The 1st lower premolar might be included as well as the 2nd premolar 2nd molar in a bridge to replace the lower 1st molar, this is not necessary. Upper canines and both premolars on each side are replacing the four incisors. As well as being destructive, or this gives rise to unnecessary practical difficulties in making bridge. The retainers themselves may be over prescribed with complete crowns being used where partial crowns or intra-coronal retainers would have been quite adequate, or metal-ceramic crowns might be used where all metal crowns would have been sufficient.^{12,15}

VI. INADEQUATE CLINICAL OR LABORATORY TECHNIQUE

It is helpfully to allocate problems in the construction of crowns and bridges to one of three groups: a) Minor problems to be noted and monitored but where on action is needed, b) the type of inadequacies that can be corrected in site, and c) those that cannot be corrected.

A. Marginal Deficiencies:➤ **Positive Ledge (Overhang):**

A positive ledge is an excess of crown material protruding beyond the margin of the preparation. These are more common with porcelain than any other margins. This easy to recognize and correct before the crown is cemented. other-wise, the restoration can cause disturbances.

➤ **B-Negative ledge**

This is caused by the deficiency of crown material. This leaves the margin of the preparation exposed but with no major gaps between the crown and the teeth. It is a common fault, particularly in restoration with metal margins. It is difficult or impossible to correct it at the try in stage.

➤ **Causes:**

- The impression did not give a clear enough indication of the margin of the preparation.
- The die was over-trimmed, leading to under-extension of the retainer.
- The die was not separated.

It is possible to adjust the tooth surface of the crown at the supragingival margin or if its at the margin. Subgingival

margin can be adjusted with a pointed stone, although this will cause gingival damage. However, best solution is to remake the restoration.^{12,15}

B. Marginal discrepancy

Fitness is the gap present between the crown and the margins prepared. four possible causes of improper fitness includes the following: a) The crown or retainer did not fit and the gap was present at try-in (this happens due to the faulty waxing or improper impression .b) in cases where the fitting of crown or retainer was intact until try-in , improper fitness can be due to the hydrostatic pressure built during the time of cementation of the cement, particularly if the cement was beginning to set resulting incomplete seating. c) in cases with mobile bridge or splint abutment, the cement might have depressed the mobile tooth in its socket more than the other abutment teeth, thus leaving the gap. d) in cases where gap was absent at the time of cementation but developed following the loss of cement at the margin, a crevice might have been created by the combination of erosion, abrasion and possibly caries. In such cases the only option is to remove the bridge, restore the gap with a suitable restoration or leave it alone and observe it periodically.^{12,15}

C. Poor shape or color (esthetic problems):

A common fault in tooth preparation for crowns in upper central incisor is removal of inadequate material from the buccal or incisal third of the preparation. These result in either a crown which is too thin, leading to the visibility of the opaque core material, or a bulbous crown. Insufficient thickness of porcelain in cases where lot of adjustment is done, the incisal shade of porcelain will be ground away and it affects the aesthetics' stone should be held perpendicular to the junction or else the metal particles may contaminate the porcelain. In the absence of embrasures, the teeth get easily notes as artificial. Extremely glazed anterior teeth will look unnatural. Inaccurate shade selection can also create aesthetic problems.

The problem in waxing that may create a problem on the final restoration such as:

- When the wax pattern is left out of the die, distortion can occur due to stresses that accumulate in the wax as a result of the heating and manipulation of the wax during fabrication.
- Wax pattern should be over sized slightly mesiodistally, finishing and polishing without creating an open contact in the finished restoration
- Most common error relating to axial contour is the creation of bulge or excessive convexity resulting in accumulation of food debris plaque causing gingival inflammation, which is encouraged rather than prevented.
- At the margin finishing stage, approaching the finishing line on the die with sharp instrument that can remove die material can cause the final restoration to not fit on the tooth prepared as the margin is a critical area of any wax pattern.
- Any roughness in the wax near the margin may lead to plaque, irritation and inflammation of adjacent gingival tissues.^{12,18}

D. Poor Investing and Casting Procedures:

Vacuum mixing of investment materials is highly recommended for obtaining consistent results in casting and to avoid surface defects, especially while using phosphate bonded investment.

Inaccuracy in casting can be due to the cooling and reheating of the investment as the refractory and binder will not revert to their original forms. This leads to inadequate expansion and cracking of the investment. Excessive burn out temperature can lead to increased surface roughness on casting. Alloys from different manufacturers when mixed, even if they are of similar materials may lead to defect in the casting. Over heated or otherwise abused alloys as well as grinding and old restorations are returned to the manufacturer as scrap rather than reusing them.

E. Defects in the casting:**➤ Nodules:**

Bubbles of the gas get trapped between the wax pattern and the investment and produces nodules on the casting surface. Imperfect casting occurs if the gas trapped are large or situated in a margin incomplete casting may result.

➤ Fins:

Are created by the cracks in the investment filled with molten metal. These cracks occur mainly due to the following reason

- Weak mix of investment (high water \ powder ratio)
- Excessive casting force.
- Steam generated from the rapid heating.
- Reheating invested pattern.
- Improperly situated pattern (too close to the periphery of the casting ring).
- Premature rough handling of the ring after investing

➤ Incompleteness:

- Incomplete casting can occur if the area of wax is too thin (less than 0.3 mm) (veneering surface of a metal ceramic restoration).
- Insufficient heating of the metal.
- Imperfect wax elimination.
- Excessive cooling (freezing) of the mold.
- Insufficient casting force.
- Not enough metal, or metal spillage.

➤ Voids or porosity:

Voids may be caused by the debris trapped in the mold, commonly a particle of the investment. A well waxed small sprue can be used to prevent them.

➤ Porosity resulting from:

Solidification shrinkage occurs if the metal in the sprue solidifies before that in the mold, as may happen when a sprue is too narrow, too long, or incorrectly located or a large casting is made in absence a chill vent. Gases may dissolve in the molten alloy during melting leave porosity defects. Back pressure porosity may be caused by air pressure in the mold as the molten metal enters.^{12,16,17}

VII. AESTHETIC FAILURES

Ceramic restoration more often fails aesthetically than biologically/ mechanically.

A. Colour Mismatch

Main reason reported by dental laboratories is poor shade match.

This could be as a result of either the inability to match the patient natural teeth with available porcelain colours or inadequate shade selection. Metamerism also leads to poor colour match.

Another reason can be insufficient tooth reduction or the failure to properly apply and fire the porcelain, leading to a restoration that does not match the shade guide or surrounding teeth.^{12,18}

B. Facing failures

Re-cementation of loose facing in metal ceramic bridges is a 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.^{15,19}

C. Esthetic failure

It can occur either due to incorrect form or framework design that displays metal or due to change in the shade of the adjacent natural teeth caused by factors like staining or aging, the ceramic restorations may appear less appealing after few years.¹⁹

VIII. CONCLUSION

The replacement of teeth using crown and bridge is a very common procedure for many dental practitioners. The chief mechanism for the success of FPD is well organized and efficient post-operative care is. Regardless of being skillfully designed and executed, a restoration that is cemented, forgotten and ignored is likely to fail, after completion of active phase of treatment, some of the most common complications include caries, periodontal failure, endodontic failure, loose retainers, porcelain fracture and root fractures. The Fixed prostheses will provide expected function, aesthetics and value for money, if it is properly planned and implemented. However, they are more likely to fail early and create irreversible damage to the teeth and supporting periodontium, when done poorly. Thorough diagnosis, assessment and technical skills are crucial when dealing with failed or failing fixed restorations.

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