

Assessment and Management of Existing Direct Restorations with a Minimal Invasive Approach in Older Population

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ABSTRACT

We have an increasing older population with a reduced number of edentulism. This has led to an increased number of patients with complex restorations. Any failing restoration will require assessment and management, whilst considering their health conditions. The minimal intervention dentistry and operative procedures will help a general dental practitioner to provide ethical and least-invasive dentistry to the older population. It helps to avoid unnecessary tooth destruction and damage to dentine–pulp complex. It prevents iatrogenic damage to adjacent teeth and soft tissues. Minimal intervention dentistry reduces costs for the older population.

Clinical Relevance: The growing older population along with the rising restorative challenges of heavily restored dentition, occlusion, salivary dysfunction, disruptive behaviours, poor dexterity, poor compliance, high plaque levels, and financial constraints, if inevitable the operative procedure needs to be minimal to preserve tooth structure.

Keywords: Assessments, Indices, Minimal intervention.

I. INTRODUCTION

Restorations of teeth are the most effective way to prolong their function and lifespan. However, the materials used for restoration are subject to forces and elements that can damage their appearance or even fracture them. A waning filling is one that has undergone a biomechanical defect, which can cause immediate or subsequent clinical damage like microleakage, caries, or breakage of sealant. As a result, clinicians must assess and manage existing restorations with an approach that provides an effective restoration but avoids damage to the remaining tooth structure. This is very challenging in the older population, especially in heavily restored dentition.

The operative procedure needs to be minimal, if unavoidable, to preserve the life of natural dentition in older people considering reducing edentulism and the growing older population along with the ever-increasing restorative challenges of heavily restored dentition, occlusion, salivary dysfunction, disruptive behaviors, poor dexterity, poor compliance, high plaque levels, and financial constraints [1].

In the UK, number of those aged 65 years and over are growing faster than those under 65 years [2]. There are three segments of older people based on their age groups: young-old for those aged between 60-69 years, middle-old for those aged 70-79 years and, finally, very-old aged 80 years and over [3]. In addition to this, there is an increasing number of people in the above segments who have been able to maintain natural teeth. This trend was evident in the Adult Dental Health Survey of 2009, which highlighted that in 1978 about 50% of the people were edentate between the

age of 55-65 years, whereas, in 2009 this was just over 5% [4]. With this increasing population of older people of whom many are maintaining natural teeth is resulting in a growing need for their regular review and care.

The present older generation is better informed as they can easily access a variety of information on oral health. Moreover, they have a better-paying capacity and access to payment plans, which make expensive treatments affordable. They do not like replacement with dentures and are very proud they can save their teeth as compared to their ancestors. Sadly, they do not understand the concept of minimal invasive dentistry. They are not aware of the risks associated with restoration replacement, including progressive cavity enlargement, weakening of the restored tooth and repeated injury to the pulp, which is likely to increase the risk of irreversible pulpal damage that may require root canal treatment or extraction with replacement with dentures, bridges, or implants. Thereby, older patients' time and financial resources may not be used appropriately and wisely [5] – [8]. It has always been challenging to convince most of the older population for minimally invasive dentistry as they believe their broken tooth are only protected with a crown.

The decision-making process for effectively assessing a defective restoration and matching with the intervention criteria is difficult, since the evidence base is growing with varying point of views [9]. Variable factors of patient's age, caries risk, and the size as well as the location of the restoration determine intervention. Furthermore, patient can change dentist, which disrupts the treatment plan. Since the decision to intervene in existing restoration is subjective to clinician's knowledge, skills, and experience [10], [11].

Although Ryge & Snyder Index [12], classification by

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Hickel *et al.* [13] and the 5Rs system [14] are available to assess and intervene for failing restorations. However, it has been always challenging to provide restoration in the older population in a dental setting. Since chronic medical conditions can lead to physical infirmity and often associated medications can have a negative effect on the oral cavity, lastly, communication between patients and professionals can be affected by their hearing difficulties [15].

Age itself should not be a barrier to any form of dental treatment plan, rather the older population's needs and demands, along with his/her ability and compliance to undergo treatment should determine the most appropriate level of intervention for providing stability to their restored tooth [3]. The concept of minimal intervention dentistry has evolved with an increased understanding of the caries process and the development of adhesive restorative materials and Glass Ionomer cements [16]. This has helped in managing the older population dentition with minimal invasion. However, many clinicians in dental practice are not paid for minimal invasive dentistry. There is considerable confusion and disagreement regarding the management of failing restoration in older populations, therefore, Minimal dentistry needs to be incorporated in general practices, this will help dentists to accept and implement this in routine dentistry.

This literature review is aimed to syntheses different ideas and concepts for the assessment and management of direct restoration through minimal invasive dentistry in the older population, minimal invasive dentistry in practice through case illustration and discussion, and to identify areas of further studies. However, the limitations of this review are firstly exclusion of atraumatic restorative treatment, and secondly, even though there is some discussion about dental materials in case discussion, this area has not been explored in detail.

II. IT HAS BEEN ALWAYS CHALLENGING WHETHER TO REPAIR OR REPLACE

Over a period, efforts have been made to establish easy and effective clinical indices that provide a framework to categorise the stage of a failing restoration, which can enable a clinician to determine its management options.

In 1971, the United States Public Health Service (USPHS) criteria by Cvar and Ryge, as cited by Ryge *et al.* [12], proposed five criteria for the assessment of direct restoration, alpha is for ideal restoration and Charlie for restoration which needs interventions. Bravo restoration has some changes from alpha but can be managed preventatively. However, this index was missing occlusion, sensitivity, fracture retention and surface texture.

In 1980, the above criteria were revised to modified United States Public Health Service (USPHS) criteria by Ryge & Snyder in Table I [12]. These criteria take into consideration occlusion, sensitivity, fracture retention and surface texture. Modified USPHS was created when there was more use of amalgam restoration, and the life span of composite filling was not known.

Hickel *et al.* [13] proposed a new index based on three categories:

- Aesthetics
- Functional
- Biological

TABLE I: A SUMMARY OF UNITED STATES PUBLIC HEALTH SERVICE (USPHS) CRITERIA BY RYGE & SNYDER. A CRITERIA FOR THE CLINICAL EVALUATION OF RESTORATIONS [12]

| Clinical characteristic | Alpha | Bravo | Charlie |
|-------------------------|---|--------------------------------|---------------------------|
| Marginal adaption (MA) | Probe does not catch or has one way catch | Probe falls into crevice | Dentine or base exposed |
| Anatomical form (A) | Contour follows tooth | Contour does not follow tooth | Overhang |
| Surface roughness (R) | No surface defects | Minimal surface defects | Severe surface defects |
| Marginal staining (MS) | No discoloration | <50% circumference discoloured | >50% discoloured |
| Occlusal contact (C) | Normal | Light | None |
| Lustre (L) | Shiny/enamel-like surface | Dull/opaque | Aesthetically displeasing |
| Secondary caries (SC) | No caries | N/A | Caries detected |

These categories were created to detect early weakening and failing restorations. 'Each category was divided into subcategories to allow for more detailed description and analysis. Each subcategory was scored according to a five-step grading of the restoration:

Score 1 – the restoration is excellent/fulfils all quality criteria.

Score 2 – the restoration is still highly acceptable, though one or more criteria deviate from the ideal (no risk of damage).

Score 3 – the restoration is sufficiently acceptable but with minor shortcomings.

Score 4 – the restoration is unacceptable but repairable.

Score 5 – the restoration must be replaced.

The final score in each category was the most severe score obtained among all subcategories [17, p. 2].

Since the approval of modified criteria by Hickel *et al.* by the Science Committee of the FDI World Dental Federation in 2010 [13], 'no update or further feedbacks have been published regarding their application in clinical studies' [17, p. 2]. Please refer to Table II.

If there is an early deterioration of the restoration, then prevention and monitoring need to be implemented. Nonetheless, if clinicians note restoration with deterioration, and localized failings through clinical examination or radiographic images, then it will be reasonable to initiate minimal invasive dentistry for restoration repair, to help save the tooth structure and keep the cost low to the patient [7], [18].

FDI [13] classification is more sensitive and judicial in its approach as well as defendable. However, these classifications are for the general population and not for older people. We need classifications with reliance on issues of dry mouth, oral hygiene, and amalgam, which affect treatment planning for this group.

In the UK and US dental health care, the option of restoration replacement is experienced by patients who change their dentists as opposed to those who remain committed to their dentist [1], [13], [19]. There are

possibilities for more treatments. The unnecessary damage, the tooth structure weakens due to enlargement in overtreatment of existing restoration can cause iatrogenic

TABLE II: THE FDI CRITERIA WITH THEIR VARIOUS CATEGORIES AND THEIR GRADING [17, p. 3]

| FDI Criteria (modified in 2010) | | | | Correspondent USPHS Criteria | | |
|------------------------------------|---|---|--|--|---|---|
| Categories | Sub-Categories | Five Steps Grading | Two Steps Grading | Categories (modified) | Grading | |
| a) Aesthetic properties | 1. Surface luster | 1. Clinically excellent/very good | | <i>Surface texture</i> | Alpha (clinically ideal) | |
| | 2. Staining | | | Cavo-surface marginal discoloration | | |
| | a. <i>Surface</i> b. <i>Margin</i> | | | Colour match | | |
| | 3. Colour <i>match</i> and translucency | | | Anatomical Contour | | |
| | 4. <i>Esthetic anatomical form</i> | | | <i>Fracture, retention</i> | | |
| b) Functional properties | 5. Fracture of material and retention | 2. Clinically good (after correction very good) | Acceptable (1,2,3) | <i>Marginal integrity</i> | (showing minor deviation from the idea, nevertheless acceptable) (except for retention and secondary caries) | |
| | 6. Marginal adaptation | | | <i>Occlusion</i> | | |
| | 7. Wear | 3. Clinically sufficient/satisfactory (minor shortcomings with no adverse effects but not adjustable without damage to the tooth) | | - | | |
| | 8. Proximal anatomical form (contact point/food impact) | | | - | | |
| | 9. Radiographic examination (when applicable) | | | - | | |
| | 10. Patient's view | 4. Clinically unsatisfactory (repair for prophylactic reasons) | Not acceptable (4,5) | - | Charlie (should be replaced to avoid future damage) | |
| | 11. Postoperative (hyper- sensitivity) and tooth vitality | | | <i>Postoperative sensitivity</i> | | |
| | c) Biological properties | 12. Recurrence of caries, erosion, abfraction | 5. Satisfactory poor (replacement necessary) | | Secondary caries | Delta (requires immediate replacement) |
| | | 13. Tooth integrity (enamel cracks) | | | - | |
| | | 14. Periodontal response (always compared to a reference tooth) | | | - | |
| 15. Adjacent mucosa | | - | | | | |
| 16. Oral and general health | | - | | | | |

In Italics: the revisions of 2010, and the correspondence with the USPHS criteria, with their various criteria and their grading (In Italics: the modified USPHS).

cavities, loss of healthy tissue, and cause irreversible damage to pulp [7], [20], [21]. It leads to the inevitable restorative cycle [22]. There are a variety of consequences on dentition like the need for endodontics or early damage of the restored tooth, change in occlusion with chances of aesthetic needs, which can influence the quality of life of any individual [16]. The extent to which the number of patients receiving replacements for their failing tooth, based on different studies [8], could have been repaired reducing costs and extending its life.

The replacement of restoration always requires the removal of tooth structure. To increase the life of tooth repair is a better option than replacement. 'There is a 'demographic bubble' of patients now between 30 and 65 years who have retained much of their natural dentition but with high levels of dental disease treated by fillings and other restorations – a so-called 'heavy metal generation'' [23, p. 501]. It is coming up to 10 years since this study, and these patients are aging and their restorations will start failing, the clinicians will need to consider whether these restorations need to be repaired or replaced [23]. The last Cochrane review on the replacement versus repair of defective amalgam restorations in adults in permanent molar and premolar teeth seeks the need for randomized controlled trials to check outcomes of replacement versus repair with amalgam. Additionally, it identified the need for qualitative

views on pain, distress and anxiety, time, and costs. It also recognises the need for research and use of non-mercury-based materials as amalgam is being phased out [24].

Both indices have addressed technical excellence and have not considered factors like medical conditions, temperature changes, eating habits, oral hygiene, and habits. The indices of modified USPHS criteria by Ryge & Snyder are for amalgam restoration as the longevity of the composite was not known. The FDI [13] index was for amalgam and composite restoration. However, in both the indices material strength, wear resistance, and possibility of secondary caries were not taken into consideration.

Modified USPHS criteria by Ryge & Snyder do not have an intermediating rating for caries. It did not mention how to manage these restorations after assessing them. Clinicians used these criteria to either accept restoration as not requiring intervention with Alpha score or as unacceptable which would need treatment with a Charlie score. There was a lack of clarity about the nature of the treatment they could offer in the form of repair or replacement, it was open to individual practitioners' interpretation. Moreover, the number or percentage of Charlie's score to initiate replacement or change restoration is not clearly mentioned. On the other hand, FDI [13] scoring provides clarity to review and repair or replace restoration. Equally, these indices have not discussed the material to be used for repair

or replacement. Secondly, these indices are for the general population and not age-specific. Nonetheless, occlusion secondary caries and sensitivity have been taken into consideration.

III. CRITERIA FOR REPAIR OR REPLACEMENT OF RESTORATION

Banerjee and Watson [25] prepared criteria for assessing the extent of failing tooth restoration Table III.

This summary has advised us to consider occlusion. However, they have not provided an approach based on the age of the patient, particularly for older people, but left it to the clinical judgment and consideration of radiographs.

Considerations need to be given if the patient is a regular attendee, maintains good oral hygiene, has good compliance and is dentally motivated, they are good contenders for repair of restorations [22]. On the other hand, patients who want minimum operative time, especially in the older population, because of their complex medical needs, and difficulty communicating and cooperating, are suitable for repair rather than replacement of restorations. Nevertheless, patients who are unwilling to accept repair as an alternative to replacement or are irregular attenders, have poor oral hygiene, lack compliance, and have a history of failure of previous repair are not good candidates for repair or restoration [24]. Additionally, for good outcomes in the absence of a definitive route to manage repair of restoration, it is best not to progress repair [24]. The role and experience of the clinician also play a critical role in making good decisions and achieving positive outcomes, as McAndrew et al. [26] demonstrated that training clinicians in the assessment and diagnosis of restoration failure increases the accuracy and predictability of decision-making and reduces the frequency of restoration replacement compared to a non-trained control group.

Repairing or replacement of restoration is challenging in older populations due to poor oral hygiene, which may result from reduced dexterity for brushing or the onset of secondary caries. Moreover, occlusion also plays a substantive role since life and quality of the repair or replacement of restoration is compromised with a heavily restored mouth along with physiological tooth surface loss.

IV. WHY REPAIR OR REPLACE RESTORATIONS?

Repair of restoration benefits to increase the life of tooth restoration by avoiding damage to the pulp. There are fewer chances of unfavorable iatrogenic damage to adjacent teeth and tissues. It reduces chair side time, and the procedure can be managed without local anesthesia [27]. In case of replacement, the older population would struggle with longer chair side time, as with their age and medical needs, they may not be able to sit longer or keep their mouth open for the procedure.

Replacement of restoration inclines towards restorative cycle which results in removing unnecessary and excessive quantities of natural tooth structure. It causes the weakening of the tooth and restoration complex [28], [29].

Therefore, Jokstad *et al.* [30] considered the importance

of asking the following risk assessment questions:

1. Is the remaining tooth integrity intact?
2. Is there a damage to the periodontal tissues?
3. Have the restoration inconsistencies placed natural tooth tissue at risk?
4. If the intervention will negatively affect (deteriorate

TABLE III: CAUSES OF RESTORATION FAILURE AND THE CRITERIA USED TO ASSESS THIS FAILURE, WITH CLINICAL COMMENTS [25, p. 168]

| <i>Restoration failure criteria</i> | <i>Causes and clinical comments</i> |
|-------------------------------------|--|
| Colour match (aesthetics) | <ul style="list-style-type: none"> • Important to get the patient's views, especially in the anterior aesthetic zone - they may or may not be concerned. Ability to manage patient expectations is important at the outset of any treatment offered • Underlying discoloration from stained dentine • Superficial discoloration from marginal/surface staining • Underlying discoloration from corrosion products (e.g., amalgam) • Aged tooth-coloured restorative materials become stained and discoloured due to water/food stain (tannin) absorption leading to a gradual change in optical properties |
| Marginal integrity | <ul style="list-style-type: none"> • Loss of margin integrity (allowing plaque stagnation) caused by: <ul style="list-style-type: none"> ◦ long-term creep/corrosion/ditching of amalgams ◦ margin shrinkage of resin composites/bonding agent ◦ margin dissolution/shrinkage (on desiccation) of glass ionomer cements ◦ margin chipping under occlusal loading due to poor restoration edge strength ◦ presence of ledges/overhangs, poor contour of margins • If the patient can keep the failed margin plaque and recurrent caries-free and it is not of aesthetic/functional concern, this partial loss of integrity may not be a strong indicator to repair/replace the restoration |
| Margin discoloration | <ul style="list-style-type: none"> • Micro-/macro-defects at the tooth– restoration interface will permit exogenous stain (e.g., food stains) to penetrate along the outer perimeter of the restoration as well as towards the pulp • Poor aesthetics • An indication of margin integrity failure? • Not necessarily an indication of secondary/recurrent caries/caries associated with restorations/sealants (CARS) |
| Loss of bulk integrity | <ul style="list-style-type: none"> • Restorations may be bulk fractured/partially or completely lost due to: <ul style="list-style-type: none"> ◦ heavy occlusal loading— inadequate occlusal assessment before restoring the tooth ◦ poor cavity design leading to weakened, thin-section restorations (especially for amalgams) ◦ poor bonding technique/contamination leading to an adhesive bond failure and lack of retention ◦ inadequate placement procedures (condensation technique/curing) causing intrinsic material structural weaknesses (e.g., voids, 'soggy bottom' in resin composites) • Patients will often complain of a 'hole in the tooth' where food debris is trapped - ↑ caries risk • Bulk loss of restoration or occlusal wear may affect the bite/occlusal scheme |

'It is vital to appreciate that multiple aetiologies of restoration failure are common and must be considered alongside the causes of tooth failure – the tooth-restoration complex' [25, p. 168].

or damage) restoration to an undesirable level even before the next appointment?

Clinicians must also consider the managing occlusion of the older population since heavily restored dentition options to repair or replace can alter their occlusion, thereby affecting other restorations. Therefore, we need more studies and trials to relate occlusion and the medical needs of the

older population to assess and manage failing restorations. This will help to manage a minimal invasive approach and will help to increase the longevity of the tooth.

V. MINIMALLY INVASIVE MANAGEMENT OF RESTORATIONS

The 5 Rs category approach focuses on minimally invasive non-operative management options for the failing tooth-restoration complexes as detailed in Table IV [14]:

A. Review

Patients who have good oral hygiene, without plaque and biofilm, are good candidates for monitoring restorations in the case of minor defects like surface roughness and irregularities. We need to measure the risks and benefits of the operative interventions. Patients' compliance and consent is very important. All management discussions need to be clearly documented along with a clinical picture to monitor and review restorations. Caries risk assessment and patients' preventive compliance are crucial. Recall of patient needs to be decided on their individual needs and directed by their commitment to home care protocols [14].

TABLE IV: THE MINIMALLY INVASIVE '5 Rs' CONCEPT TO MANAGE FAILING TOOTH-RESTORATION COMPLEXES [14, p. 419]

| | |
|---------------|--|
| Reviewing | The monitoring of minor defects, where there would be no clinical advantage to undertaking treatment |
| Refurbishment | The treatment of small defects presents in the restoration which require intervention to prevent further deterioration |
| Resealing | The application of sealant into a non-carious, defective marginal gap |
| Repair | The placement of additional restorative material to an existing restoration |
| Replacement | The removal and replacement of an entire restoration |

B. Refurbishment

If there are small defects that can retain plaque, there is a risk of secondary caries. It may be modified by smoothening, removal, or reshaping of marginal excess or surface material [14]. 'The aesthetic appearance of restorations may be improved by refurbishing techniques, such as polishing to increase their functional longevity' [14, p. 416].

C. Resealing

Sealant material can be placed into marginal defection and into the non-carious lesion to lower the risk of caries associated with restoration/sealant surface. There are a variety of materials available however material's ability to infiltrate and seal the marginal defect is important [14].

D. Repair

Repair is the addition of the same or different dental material to existing restoration. It may require adjustment or removal of defective parts of the tooth-restoration complex [14].

E. 5 Replacement

It is a complete removal of the existing restoration before the placement of a new restoration. Reasons for failure need

to be evaluated to modify cavity design to increase restoration retention and stability. According to patient risk assessment, all the management options require appropriate review intervals [14].

With the criteria for assessing the extent of failing tooth restoration in Table III [25, p. 168] and the '5R's concept' in Table IV [14, p. 419], it is easier to manage failed restorations. However, we need to consider additional factors like patients' age, oral hygiene, their understanding and compliance, health issues, and attendance. Secondly, we need due consideration to the choice of materials, as the longer the time required to do restoration less likely the patient's ability to cooperate. Since they may complain of discomfort with prolonged opening of the mouth or even develop temporomandibular joint (TMJ) problems. Older people also find it hard to accept the placement of rubber dams in their mouths. Apart from this, poor oral hygiene due to compromised dexterity increases the risk of secondary caries, which complicates the decision to manage failing restorations. Similarly, patients with dry mouth have an adverse effect on their oral hygiene, as this has increased the risk of caries. Therefore, it is difficult to reach a restoration option. We need more studies to incorporate these factors to help clinicians in deciding the best possible treatment option.

VI. DISCUSSION

Minimal invasive dentistry provides a pathway to manage failing restorations through repair or replacement of restorations. The indices and criteria have been applied in the two cases below to demonstrate their effectiveness and gaps, which can be bridged through further studies.

A. Case 1

A 69-year-old female came with a broken amalgam restoration on UR6 (Figs. 1 and 2). There was no pain or discomfort. The patient was concerned that her tooth along with the remaining restoration would break and she would lose the tooth eventually. Options were discussed either no treatment, repair with composite or amalgam, composite or on-lay (e max, Zirconia, or gold) as 2/3 of the tooth was restored. The patient was made aware that there are chances of fracture of repaired restoration with amalgam or composite. However, the patient was interested in repair with composite. She is not aware of grinding teeth. The patient is medically fit and well. She has good oral hygiene. No concern was identified through risk assessment (Table V). No interferences were noted during occlusal analysis (Fig. 3, a).

Assessment of restoration with Modified criteria by USPHS by Ryge and Snyder [12], The FDI Hickel indices [13] and the 5Rs system [14] helped us to decide on management broken restoration (Table VI-IX).

According to USPHS by Ryge and Snyder our option would have been to monitor this filling, as caries risk was low due to good oral hygiene. The FDI Hickel index highlights a notable enamel and dentine fracture and damaged marginal quality and retention, the patient is concerned about tooth integrity, therefore clinically it is

unsatisfactory. Therefore, a repair for prophylactic reasons is required using 5Rs. However, other issues were not covered through these indices, like the heavily restored dentition which has implications on occlusion and choice of dental material.

TABLE V: RISK ASSESSMENT OF RESTORATION

| <i>Risk</i> | <i>High/Medium/Low</i> |
|---------------|------------------------|
| Caries | Low |
| Periodontitis | Low |
| NCTTL | High |
| Oral cancer | Low |

TABLE VI: CLINICAL ASSESSMENT BASED ON USPHS CRITERIA BY RYGE AND SNYDER [12]

| <i>Clinical characteristic</i> | <i>UR6</i> |
|--------------------------------|------------|
| MA | C |
| A | B |
| R | B |
| MS | B |
| C | A |
| L | B |
| SC | A |
| OVERALL | B |

TABLE VII: AESTHETIC CRITERIA FOR ASSESSMENT OF EXISTING RESTORATION

| | <i>UR6</i> |
|----------------------------------|------------|
| Surface luster | N/a |
| Surface staining | 3 |
| Color stability and translucency | N/A |
| Anatomical form | 3 |

TABLE VIII: FUNCTIONAL CRITERIA FOR THE ASSESSMENT OF EXISTING RESTORATION

| | <i>UR6</i> |
|---|------------|
| Fracture and retention | 1 |
| Marginal adaptation | 2 |
| Wear | 3 |
| Contact point and food trapping | 2 |
| Radiographic examination (where applicable) | 1 |
| Patients view | 4 |

TABLE IX: BIOLOGICAL ASSESSMENT OF EXISTING RESTORATION

| | <i>UR6</i> |
|---|------------|
| Post operative (hyper) sensitivity/tooth vitality | 1 |
| Recurrent pathology (e.g., secondary caries /NCTTL) | 1 |
| Tooth integrity | 1 |
| Periodontal response | 2 |
| Adjacent mucosa | 1 |
| Oral and general health | 1 |

There were different materials available to repair [14]:

- Amalgam to amalgam
- Amalgam to composite
- Amalgam to GIC/RMCIC.

We decided to repair filling with a composite to save the tooth from secondary caries and further fracture. The decision to use composite was because the restoration fracture was very small, and it was difficult to have macro mechanical retention. Secondly, the patient wanted a composite filling. Resin composite repair of amalgam restorations is a suitable method providing the appropriate protocol is followed [31]. Improved bond strengths have been reported between resin composite and amalgam, with more predictable bonding and less microleakage between the repair-tooth interface and repair-restoration interface compared with an amalgam repair [32], [33].



Fig. 1. UR6 Mesio-palatal cusp broken.

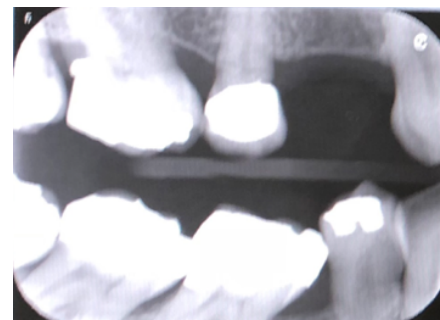


Fig. 2. Bite-wing Right Side.

Micromechanical retention was achieved with a tapered coarse diamond bur. Tooth was isolated with PFET tape (Fig. 4). Selective etch technique was used. UR6 enamel was etched with 37% phosphoric acid (3 m) for 20 seconds and scotch bond (3 m) adhesive was applied for 20 seconds by rubbing and then cured for 10 seconds. The type of adhesive has also been shown to influence the microleakage with etch and rinse adhesives (Types 1 and 2; 4th and 5th generation) performing better than self-etching primer adhesives (Types 3 and 4; 6th and 7th generation) [34]. Vitre bond lining was applied to decrease sensitivity. The tooth was repaired with Filtek XTE (3 m), A3 shade with 2mm increments. The composite was polished with a Diatech kit. Occlusion was checked with 40-micron articulation papers (Fig. 3.b), achieving the result (Fig. 5).



Fig. 3(a). Occlusion before the treatment.



Fig. 3(b). Occlusion after the treatment.



Fig. 4. UR6 Isolated with PFET tap for moisture control.



Fig. 5. UR6 MP cusp repaired with composite.

B. Case 2

A 69-year-old male attended for exam. He had a broken amalgam filling in LL6, with no pain or discomfort (Fig. 7 and 8, a). The patient was not keen on the repair or replacement of restoration for LL6 and LL7. LL7 distal was very difficult to repair or replace because of a change of occlusion. There was no space for restoration in LL7 and the tooth was asymptomatic. This tooth was kept under review.

Tables XI–XIV are based on Modified criteria by USPHS by Ryge and Snyder [12], The FDI Hickel indices [13], and 5Rs system [14] for restorative assessment, which clinically considers aesthetic, functional, and biological aspects of existing restoration.

According to USPHS by Ryge and Synder's score for LL6 is Charlie as there are severe surface defects. Although caries risk was low due to good oral hygiene, we cannot leave failing restoration as it has a high risk of secondary caries. The FDI Hickel index highlights a notable enamel and dentine fracture, damaged marginal adaptation, proximal anatomical form damage, and tooth integrity, although the patient was not keen on repair the tooth was clinically poor. Therefore, a replacement is necessary using the 5Rs. The patient is medically fit and well. No risk was identified in the assessment. According to the Hickel index filling is loose and in situ, so a complete replacement was required. The mean annual failure rates for posterior stress-bearing amalgam restorations were 3.0% and 2.2% for equivalent resin composites. The reasons for failure are secondary caries, fracture, marginal deficiencies, wear, and post-operative sensitivity [35]. Posterior restorations are more prone to fracture due to fracture lines in the enamel and heavy restorations [25].

It was diagnosed that the patient had occlusal interferences on the distobuccal and distolingual cusp of LL6. The patient was provided with options for amalgam, composite, on-lay (e max, zirconia, gold), and crown (Nonprecious metal, e max or zirconia and gold). However, the patient was advised that composite filling would provide micro mechanical retention.

TABLE X: RISK ASSESSMENT OF RESTORATION

| <i>Risk</i> | <i>High/Medium/Low</i> |
|---------------|------------------------|
| Caries | Low |
| Periodontitis | Low |
| NCTTL | Moderate |
| Oral cancer | Low |

TABLE XI: CLINICAL ASSESSMENT BASED ON USPHS CRITERIA BY RYGE AND SNYDER [12]

| <i>Clinical characteristic</i> | <i>LL6</i> |
|--------------------------------|------------|
| MA | C |
| A | B |
| R | C |
| MS | C |
| C | C |
| L | C |
| SC | A |
| Overall | C |

TABLE XII: AESTHETIC CRITERIA FOR ASSESSMENT OF EXISTING RESTORATION

| | <i>LL6</i> |
|----------------------------------|------------|
| Surface luster | N/A |
| Surface staining | 3 |
| Color stability and translucency | N/A |
| Anatomical form | 5 |

TABLE XIII: FUNCTIONAL CRITERIA FOR THE ASSESSMENT OF EXISTING RESTORATION

| | <i>LL6</i> |
|---|------------|
| Fracture and retention | 5 |
| Marginal adaptation | 5 |
| Wear | 5 |
| Contact point and food trapping | 5 |
| Radiographic examination (where applicable) | 1 |
| Patients view | 4 |

TABLE XIV: BIOLOGICAL ASSESSMENT OF EXISTING RESTORATION

| | <i>LL6</i> |
|---|------------|
| Post operative (hyper) sensitivity/tooth vitality | 1 |
| Recurrent pathology (e.g., secondary caries /NCTTL) | 1 |
| Tooth integrity | 5 |
| Periodontal response | 5 |
| Adjacent mucosa | 1 |
| Oral and general health | 1 |



Fig. 7. IOPA of LL6.

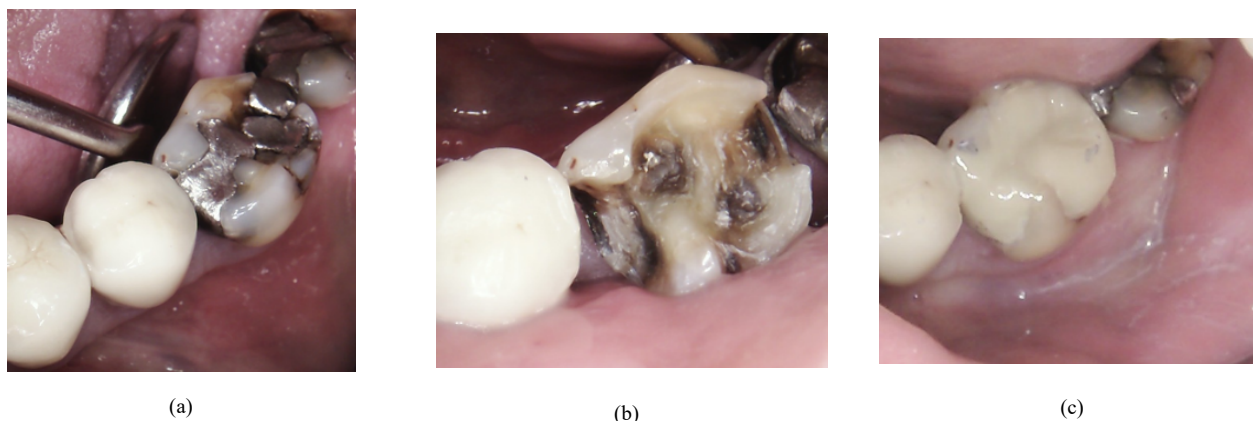


Fig. 8. (a) LL6 broken DOB amalgam. (b). LL6 broken filling removed with a diamond bur.(c). LL6 composite filling with Filtek.

We had decided to replace the old broken amalgam filling with a composite because of occlusion instability. There are multifactorial reasons to replace or repair a defective restoration. It depends on the secondary caries and the extent of the tooth-restoration complex either lost or present. The outcome of the repair is unpredictable due to the type and bonding of the material. Moreover, occlusion plays a major role in the success or failure of a filling [14]. As the patient's mouth is heavily restored, it was difficult to repair because of the risk of fracture of restoration.

Caries were removed with course round diamond bur and rose head bur (Fig. 8, b). Selective etch technique was used. LL6 enamel was etched with 37% phosphoric acid (3 m) for 20 seconds and scotch bond (3 m) adhesive was applied for 20 seconds by rubbing and then cured for 10 seconds. The tooth was filled with Filtek XTE (3 m) A3 shade with 2 mm increments (Fig. 8, c).

In essence, these indices enabled decisions for managing these failing restorations. However, factors like xerostomia, heavily restored dentition, low motivation, and periodontal disease need to be considered in the indices. There was a lack of evidence to support a decision on the use of the material in case 1 amalgam, GIC, or even RMGIC could have been used. Although, there are studies on the use of different materials and techniques [1]. We do not have studies that merge these issues to inform decisions and treatment plans for the older population. Minimal-invasive dentistry is the best option for these situations however clinicians do not have a clear understanding and inadvertently opt for indirect restorations. Learnings from such studies need to be incorporated as part of key learnings and continuing professional development for the clinicians to ensure that the failing restorations are identified at an early stage, which will help in managing them through a minimally invasive approach.

VII. CONCLUSIONS

The indices to assess failing restoration based on USPHS by Ryge and Synder, FDI Hickel, and 5Rs for the management of such restorations are effective tools. However, they have not taken into consideration the older population and other factors related to them like their medical history, occlusal stresses, oral habits, temperature changes, oral hygiene, attenders, and eating habits. They are helpful in assessing broken restoration and treating them,

accordingly, not merely based on their age. We need more studies and trials on the older population to adapt these indices according to the needs of the older population. A thorough assessment with these indices and minimally invasive dentistry will help to prevent damage to the tooth structure whilst repairing or replacing existing restoration/s.

Further studies and trials on the choice of materials are also required. As for strength and aesthetics GIC/RMGIC are not good materials, they do work effectively for minimal invasive dentistry, but we need a good choice of material for the older population. The repair approach needs to be used in the older population wherever possible; it is in the interest of the patients: ethically, aesthetically, physically, and financially.

Minimal invasive dentistry helps to provide the older population with both aesthetics and function in their dentition. We need longer studies and trials to elucidate effective evidence for minimally invasive dentistry in the older population. These studies should consider factors like the reason for failing restoration, material, occlusion, and time to avoid recurrent fracture of repaired restoration, as there is a cost involved in the form of material, time, and professional expertise. These approaches will reduce pressure on the patients and the clinicians.

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CONFLICT OF INTEREST

The authors declare that they do not have any conflict of interest.

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