Assessment of Restorative Skills for Amalgam Restoration

Jagruti Nanda[1], Lora Mishra[2]

[1]Intern, [2]Professor, Department of Conservative Dentistry and Endodontics, Institute of Dental Sciences, Siksha 'O' Anusandhan (Deemed to be University), Bhubaneswar, Odisha

Abstract

Dental treatment procedures are mostly governed by factors such as biocompatibility of restorative materials, patients demand for esthetics and conservative approach for the minimal loss of tooth structure. GV Black followed 'EXTENTION FOR PREVENTION' for restorative treatment which follows classical cavity forms and principles which almost remained unchanged and unchallenged for 50years using amalgam. Though it required uniform depth, ease of manipulation and excessive tooth structure damage for proper retention of it. The support from clinical observation of success and failures of different restorations has presented with the concept of new designs. This article reviews the literature on assessing and evaluation of amalgam restoration. Information on the characteristic material, its rate of progress with time and its nature of the association. Mainly focusing on the relationship between the deterioration of amalgam restoration and risk of secondary caries.

Keywords: *Caries, Creep, Silver Amalgam, Tarnish, Restoration.*

Introduction

The restorative dentistry is provided with a wide range of material to store any derangements of a lesion in hard tooth substance. The success and failure of restoration depend on the degree of involvement, the skill of operator and properties and limitations of materials and technique. The purpose is to determine the quality of amalgam fillings and its longevity. The ability of the amalgam restoration to withstand the masticatory forces mainly depends on the distribution of internal stresses and the design of the cavity.[1] The most straight forward method would be restoring a tooth with amalgam material and subjecting the same tooth with forces of similar nature and magnitude to that present during mastication. It can be anticipated that the precision of this technique would be affected by morphologic differences between the duplication of cavity design and variation of the strength of condensed amalgam. The average lifespan of an amalgam restoration is 10-15 years of correct manipulation. Amalgam has been ubiquitously believed to be restorative material of choice for small and large cavities. Despite the use of composite resins with advanced esthetics, amalgam is considered as the restoration of choice for elaborate posterior tooth preparation due to its longevity and ease of use and low cost.[2] According to Healey and Philip, mainly the failure of amalgam restoration occurs due to 56% inadequate cavity preparation and 42% due to faulty manipulation. Many investigators have reported the need for frequent and possible premature replacement of amalgam restoration. Despite continuous preventive programs and the development of better materials, the replacement rate has remained unchanged. The physical properties are generally appraised as adequate for a dental restorative material.[11] The assessment methodology used for cavity preparation must be valid, reliable, and reproducible. The performance of amalgam may be influenced by several factors including its composition, manipulation, presence of moisture, use of varnish and cavity designs.[3]

Corresponding Author:
Lora Mishra
Professor, Department of Conservative Dentistry and Endodontics, Institute of Dental Sciences, Siksha 'O' Anusandhan (Deemed to be University), Bhubaneswar, Odisha
e-mail: loramishra@soa.ac.in

Table 1. Criteria for A Successful & Method of Assessing a Restoration Clinically

Criteria for A Successful Restoration Assessment	1. Stop of original insult and its further recurrence 2. Restoration of function/mastication 3. Restoration of esthetics 4. Absence of recurrent caries 5. Marginal accuracy and adaptation 6. Patient comfort and satisfaction
Method of Assessing a Restoration Clinically	1. Marginal Ditching 2. Isthmus fracture 3. Tooth fracture 4. Excessive Discoloration 5. Post Restoration Hypersensitivity 6. Gingival & Periodontal Affections 7. Improper Anatomical Contour 8. Improper Proximal Contact 9. Improper Occlusal Contact 10. Overhangs

Marginal Degradation (Ditching): The breaking of a thin edge of a restoration creating an irregular V-shaped creviceis known as Marginal degradation, ditching or crevicing. This is the most common mode of clinical observation. They are also called as Dyscrasia. Most commonly seen on cavosurface margins. Buccal end of proximal marginal ridge more prone to ditching.

Diagnosis: Either visual/tactile, Amalgam-Enamel interface if evaluated with an explorer or probe, Margins into which the probe penetrates are referred to as open or defects.[4]

Causes: Depletion of support at margin, Voids, Excess Mercury.[4]

Depletion of support at the margin: Amalgam with its property of low tensile strength and low shear strength makes it a brittle material. So, there should be enough of the tooth structure to support it. It may be dueto lack of support or insufficient bulk of the material at margins due to beveling of the occlusal outline.[4]

Voids: The presence of voids in the amalgam cause decreased density and strength of it. They are usually localized. Voids may be due to: Corrosion, Dry mix, Inadequate condensation, Moisture contamination of amalgam

Excess Mercury: Excess Mercury in amalgam decreases its strength. It occurs due to improper proportioning of alloy/mercury ratio, under trituration, inadequate condensation force.[4]

Isthmus Fracture: The occlusal and auxiliary portion of a cavity has the narrowest junction called as the Isthmus. There should be a state of balance between the external and the intrinsic tensile stresses at the isthmus area.

Clinically: Starts as a crack line. Then it propagates and widens upon masticatory forces, and fracture occurs. Hypersensitivity is a common occurrence with food impaction. Factors attributing to isthmus fracture, increase tensile stresses, inadequate resistance and retention form, irregular surface with discontinuities and excessive occlusal force.

Inadequate resistance and retention form: The restorations that are not adequately and not independently retained are easily and quickly broken down by the masticatory forces. So, restorations should have proper resistance and retention form. This is achieved by, flat pulpal floor, gingival floor perpendicular to the direction of the force, walls parallel to the direction of masticatory forces, cavo surface angle 90 degrees, proximal axial grooves, use of the effective adhesive system, use of threaded pins or amalgam pins.[5]

Irregular surface with discontinuities:

a. Poor polishing leaving the surface rough and full of pits

b. Over carving into deep grooves weakens the restoration by decreasing its bulk

c. Presence of internal voids

Excessive occlusal forces:

a. Biting on the restoration before the setting time

b. Under carving of the marginal ridge leading to premature contact

Decrease tensile strength:

a. Insufficient bulk of amalgam

b. Inherent weakness

c. Excess Mercury

d. Structural discontinuity

Insufficient Bulk of Amalgam: Amalgam being a brittle material have a low tensile strength and shear strength. The bulk of amalgam should be at least 1.5-2mm to have sufficient tensile strength. Insufficiency may be due to over carving or decreased cavity depth.[5]

Excess Mercury: This flaw of amalgam decreases the amount of gamma phase resulting in low strength of it, providing the maximum strength to the amalgam by increasing the gamma 2 phase, which is considered to be the weakest.

Structural Discontinuity: This occurs due to corrosion products, moisture contamination, dry mix and lack of condensation force.[5]

Tooth Fracture: Tooth fracture is the fracture of a cusp or ridge under functional forces due to lack of tensile strength to support the remaining tooth structure and much less able to reinforce weak cusp. The careful visual and tactile examination is done to locate the fracture line. This leads to the worst outcome if the restoration is extensive enough, leading to less support of the remaining structure.

It can be prevented by eliminating all undermined enamel as well as weak cusps and ridges.[7]

Excessive Discoloration: These are discolorated areas often seen through the enamel in teeth that have amalgam restorations. It occurs as a result of leaching of corrosive products of amalgam into dentinal tubules.

Clinically:

a. Tarnish- loss of surface lustre

b. Corrosion- the rough, pitted amalgam surface

c. Amalgam Blues- dark bluish discolouration

Tarnish: Formation of a surface film of discolouring oxides and sulfides leading to loss of amalgam lustre. Excess Mercury and moisture contamination enhance this.

Corrosion: It is the actual disintegration of the bulk of amalgam.

It is of two types:

Chemical Corrosion- due to ack of polishing and food stagnation leading to halogenation and sulfurization.

Electric Corrosion- due to two dissimilar or similar metallic restorations (old/new)[10]

Amalgam Tattoos/Blues: Amalgam hues appear through the enamel surfaces. Corrosive products which get entrapped within gingival tissue known individually as amalgam tattoo.

Causes:

a. Thin or undermined enamel

b. Penetration of metallic ions and corrosive product into dentinal tubules.

Post Restoration Hypersensitivity: Hypersensitivity is an amalgam restored tooth maybe because of stimulation of freshly exposed dentine by

a. Galvanic stimuli generated on immediate contact with opposing dissimilar metals.

b. Thermal stresses

c. Pressure or premature contact

d. Stimuli by fluids penetrating through leakage

Clinically appears as:

a. Severe pain after insertion of restoration indicating pulp involvement

b. Pain on hot/cold application

c. Pain on biting indicating premature contact or fractured restoration

d. Dull aching pain after restoration due to delayed expansion of it

Gingival & Periodontal Health: The interplay between the periodontics and restorative dentistry include margins of the restoration, crown contours, and the response of gingival tissue to restorative materials and preparations.

Clinically: Bleeding on probing, Discomfort, Food stagnation, Tooth mobility[7]

Factors: Gingival overhangs, thick subgingival margin, ragged cavity margins, sharp margin restoration, open contact.

Improper Anatomical Contour: Amalgam restoration should duplicate the normal anatomical contour of the teeth. Restoration impinging on the soft tissue has poor embrasure form and proximal contact preventing use of dental floss and are defective restoration. It should be correctly recontoured or replaced to maintain proper periodontal health. Over contoured proximal and facial and lingual surfaces impinge on the soft tissue and act as plaque trap.[9]

Improper Proximal Contact: The importance of proper contacts and contours of restoration is to enhance correct occlusion with sound periodontal

health while preventing gingival overhang. Matrixing is a vital step during placement of different restorations proximal contact are of an amalgam restoration against the adjacent tooth should be evaluated with a string of dental floss.[7] If the contact is open and is associated with poor interproximal tissue health and food impaction, the restoration is defective and should be replaced while tight contact between teeth results in the recorded degree of mobility of both restored and neighboring teeth.[9]

Improper Occlusal Contact: Improper occlusal contact induces destructive effect on the restoration and the tooth due to excessive forces. Occlusal interferences or high points indicate defective restorative skill. It called a high filling when too much of restorative material projects out from the tooth cavity. Clinically tooth with the high dental filling will be sensitive to hot and cold changes and masticatory forces. Premature occlusal contacts appear as shiny spots on the surface or detected using occlusal markings/articulating papers. Correction of occlusal contact in centric and eccentric occlusion should be done. The restoration should be either replaced or adjusted.[9]

Overhangs: Amalgam overhangs are defined as an extension of the amalgam restoration beyond the confines of cavity preparation. Overhangs mainly the proximal ones, possess an obstacle for improper oral hygiene and food impaction, causing severe inflammation of adjacent soft tissues. They also decrease access to proximal cleansing devices. It is challenging to examine the overhanging restorations for a posterior tooth. Therefore, a bitewing radiograph is usually helpful. Overhanging restorations are one of the primary causes for the failure of the amalgam restoration. They are mostly iatrogenic caused by poor operator skill. It is advisable to replace the whole of faulty restoration rather than removing the overhang only.

Clinically:

a. Buccal, Lingual and occlusal overhangs seen visually

b. An explorer can be used for buccal, lingual, occlusal or proximal overhangs by tactile sensation.

c. Dental floss with threading which is passed proximally or proximal overhangs.

Recurrent Caries: Caries developed in a previously restored tooth is termed as recurrent caries. The term Secondary Caries is also given to it. It occurs on the marginal area of the restoration and is detected mainly by the radiographic method. Therefore, also called as marginal caries. The occlusal view is considered as the best view to visualize it.[1] A significantly higher proportion of Streptococcus mutants is found at the cavity margins. Once the restored tooth is diagnosed with recurrent caries, it should be replaced.[10]

Table 2. Causes of recurrent caries

Incomplete elimination of original lesion	a. Improper excavation of caries b. Improper evaluation of lesion
Improper outline form:	a. Leaving defective and retentive pits and fissure b. Leaving undermined enamel
Incorrect restoration	a. Lack of adaptation due to marginal leakage and moisture contamination b. Failure to restore proper anatomy, contact and contour c. Improper finishing of the restoration
Retention of bacteria plaque	a. Retentive pits and fissures b. Marginal overhangs c. Open interproximal contact d. Marginal ditching

Clinically: Carious lesion at the margin of the restoration or extending deeper underneath the restoration.

Conclusion

The article systematically analyzed the performance and clinical success of amalgam restorations. The assessment of the restorative material can be summarized

on the basis of the deterioration of the same. Many factors are leading to the deterioration, including the material, type of tooth, operator and manipulative forces. The deterioration continues with the time but at a decreasing it. Amalgam restorations reduce the need for mechanical retention, conservation of tooth structure, and reducing the effects of microleakage. Despite this, it can be considered the material of choice for more extensive restorations. However, there have been controversies and debate on the use of amalgam in dentistry due to potential release of Mercury and its adverse effect on health. This has led practitioners to explore other alternative restorative materials.

Ethical Permission: Approved

Funding: None

Conflict of Interests: None

References

1. Bharti R, Wadhwani KK, Tikku AP, Chandra A. Dental amalgam: An update. J Conserv Dent. 2010;13(4):204-208.
2. Jirau-Colón H, González-Parrilla L, Martinez-Jiménez J, Adam W, Jiménez-Velez B. Rethinking the Dental Amalgam Dilemma: An Integrated Toxicological Approach. Int J Environ Res Public Health. 2019;16(6):1036.
3. Rathore M, Singh A, Pant VA. The dental amalgam toxicity fear: a myth or actuality. Toxicol Int. 2012;19(2):81-88.
4. Kidd EA, Joyston-Bechal S, Beighton D. Marginal ditching and staining as a predictor of secondary caries around amalgam restorations: a clinical and microbiological study. J Dent Res. 1995;74(5):1206-1211.
5. Hayashi M, Wilson NH. Marginal deterioration as a predictor of failure of a posterior composite. Eur J Oral Sci. 2003;111(2):155-162.
6. Proussaefs P, Campagni W, Bernal G, Goodacre C, Kim J. The effectiveness of auxiliary features on a tooth preparation with inadequate resistance form. J Prosthet Dent. 2004; 91(1):33-41.
7. Mamoun JS, Napoletano D. Cracked tooth diagnosis and treatment: An alternative paradigm. Eur J Dent. 2015;9(2):293-303.
8. Chapple ILC, Mealey BL, Van Dyke TE, et al. Periodontal health and gingival diseases and conditions on an intact and a reduced periodontium: Consensus report of workgroup 1 of the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions. J Periodontol. 2018;89 Suppl 1:S74-S84.
9. McCall R, MacLennan G, Taylor M, et al. Anatomical contouring variability in thoracic organs at risk. Med Dosim. 2016;41(4):344-350.
10. Mjör IA. Clinical diagnosis of recurrent caries. J Am Dent Assoc. 2005;136(10):1426-1433.