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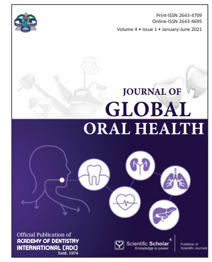

Opinion Piece Articles

Changing concepts and trends from dental amalgam to composites

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ABSTRACT

An increase in concern regarding the safety and inferior aesthetics of amalgam restorations in dentistry has resulted in a transition from amalgam to other alternative dental materials such as composite resins. This article would critically analyze both the materials and the need for this changeover by means of scientific literature.

Keywords: Changing concepts, Dental amalgam, Bulkfill composite, Composite

INTRODUCTION

Amalgam has always been the gold standard for an ideal restorative material right after gold restoration. It is considered as one of the most versatile restorative materials used in dentistry having served for over more than 165 years, despite the controversies.

The quality of dental amalgam is based on its cost, load bearing capacity and most of all its ability for long-term performance is what makes it unmatched by other dental restorative materials.[1]

Even though in recent years, it has been undergoing phase-out or phase-down stage, it's not likely to prevail beyond 2030 as a direct restorative material.[2,3] Long-term adhesion to enamel and dentin as well as the occlusal stability are key factors for its clinical success.[4] In prospective clinical literature, amalgam has been compared with composite for the annual failure rates (Manhart *et al*., 2004) even though studies reported better longevity of amalgam restorations when it was compared with composite restorations.

The restoration of minimally invasive restorations is not possible when amalgam is used, as it is based on the principle of "extension for prevention" and works on the principle of mechanical interlocking between the restoration and the tooth structure, which may no longer be considered in most clinical cases.[3]

Today, minimally invasive restorations are performed by the bonded resin-based composite restorations.[5-7] Resin-based composite restorations are influenced greatly by the operator and the reason for composite restorations to do better when compared to the amalgam restoration is its esthetic properties. Furthermore, amalgam had subjective concerns about the use of metal in the mouth, which was one of the major reasons for composite restoration in gaining popularity and its use in posterior teeth and slowly being replaced as a the primary choice for restoration.

Although it is esthetic, it has certain drawbacks, for instance, if there is compromise in adhesion it would lead to residual polymerization stresses, which, in turn, causes gap formation, leakage resulting in recurrent caries and may finally cause pulpal irritation and loss of retention.[8-10]

Composite resins in orthodontics have proven to be a versatile workhorse in various procedures claiming to have multiple uses. Some of the applications of the flowable restorative composites in orthodontics include: in cases of parafunctional habits such as tongue thrust, wherein the tongue spikes and cribs tip are covered with flowable composite to prevent trauma, reactivation of coil springs, molar stops, cantilever arches, and lingual retainers.[11]

Composites have also been found to have its use in periodontology for splinting of periodontally compromised teeth and traumatized teeth through extracoronal or intracoronal splinting.[12,13]

HISTORY OF DENTAL AMALGAM

Dental amalgam was first used by a Chinese called Su Kung in 659 AD. It was nearly 1000 year later that Johannes Stokers, a European municipal physician in Ulm, Germany, recommended amalgam as a dental filling material in 1528.[1] Later, Hen (1578) came up with a dental mixture in which 100 parts mercury with 45 parts silver and about 900 parts of tin was used. In 1877, Flagg caused the change in attitude of people toward the dental amalgams. He got the results of his laboratory tests with the 5-year clinical observation of new alloys which had 60% of silver and 40% of tin as major constituents and published in 1881.[1]

The universal acceptance of amalgam as a restorative material resulted from investigations of Black in 1895, 1896, and 1908 which was put forth by combining the principles of the cavity design with the help of an alloy with the composition of 68.5% silver, 25.5% tin, 5% gold, and 1% zinc.

Black brought amalgam into the mainstream. S.S. White manufactured the first ever alloy which was rich in silver in which the gold was replaced by the copper.[8,14]

In 1959, Dr. Wilmer brought a new concept in which he recommended a 1:1 ratio between mercury and alloy, by doing so he could lower the 8:5 ratio of mercury to alloy that others had been recommending.[10]

In the year 1962, a spherical-shaped particle dental alloy was introduced.[15] In 1963, a high copper dispersion alloy system came into existence which proved to be superior to its low copper counterpart.[16] Even though its performance was said to be the result of dispersion strengthening of the alloy, researchers later on discovered that the additional copper combined with the tin, creating a copper-tin phase that was more resistant to corrosion than the combination of tin-mercury (gamma-2) phase which was found in low copper alloys.

TOXICITY BY DENTAL AMALGAMS

The use of mercury in tooth fillings amounts to roughly about 10% of the total global mercury consumption, thus making the field of dentistry to be the largest consumer of mercury in the world.[17]

In the U.S. alone, up to 32 tons were being used per year.[2] Shortly behind the USA, the dental use of mercury was done by the European Union being the second largest consumer mounting about 20–25%, although countries such as Norway, Denmark, and Sweden had already recommend banning the use of mercury in dental amalgams.[17]

Mercury being the principal component in a dental amalgam, may lead to a well-known toxicity because of its high affinity toward proteins and amino acids.[18] *In vitro* experiments have been performed which proved that the elemental mercury is 10 times more toxic than lead on neurons (Pb). Tissues of liver, kidney, and central nervous system (CNS) are at high risk as they are the primary targets for bioaccumulation.[19-22] In correlation of the oral cavity to the brain, the mercury penetrates and gets deposited in organs and affecting the CNS. Experiments using rats were done, which showed the immediate consequence of mercury release into the brain.[23,24]

Even though dental mercury amalgam has been used for more than 165 years, their safety and risks have never been challenged as it should have been. Under the Federal Food, Drug, and Cosmetics Act (FDA) in the year of 1976, the US Government had given instruction to FDA to assess the safety of medical and dental devices and asked them to place a premarket approval of safety for any device which was intended to be implanted in the human body.[25] However, amalgam was exempted from this process by the FDA.[26]

In the year 1991, the World Health Organization (WHO) had confirmed that the dental amalgam was the biggest source of mercury exposure due to the fact that the people with restorations in them had mercury levels significantly higher.[27] Autopsy studies confirmed that dental amalgam had been the main source of mercury in human tissues which was responsible for at least roughly about 60–95% of mercury deposits.[14] It should be obvious and very clear that there are health hazards pertaining to mercury amalgam.

The dental amalgam dilemma is based purely on the inherent toxicity of mercury at different levels in the human body. The bulk of the presented data which have been gathered has been centering on the toxic effects of mercury and its derivatives.

Mercury toxicity may even lead to different pathological anomalies and to understand the full extent of the damage it causes we need to understand it at the molecular level and its toxicity should be addressed from that level. Our integrated approach should be focused on a complete toxicity picture of the mercury which is a constituent in dental amalgam.

The wide range of toxicological factors includes molecular mechanisms, genetic susceptibility, and gene regulation.

COMPOSITE RESTORATION

Composite resins are in trend and seem to be dentists' favorite choice for the restorative materials as they offer astonishing esthetic potential and acceptable longevity when it is compared to its predecessor. Furthermore, the cost has been drastically lowered for the treatment of both anterior and posterior teeth.[28-31]

For the placement of composite restorations, there is very minimally invasive or no preparation at all during replacement of decayed or missing dental hard tissues which give rise to the new concept called bio-esthetics. It is a known fact that all composite resins shrink during polymerization which ultimately leads to adhesive and cohesive failure. This presents major challenges during the process of placement and curing, but they are avoidable but either placing the material in the incremental placement or by the use of the newer material called the "Bulk Fill."[32-37]

INCREMENTAL TECHNIQUES FOR DIRECT COMPOSITE RESTORATION

When posterior composites restoration is being carried out, the restoration should be placed in small increments as recommended by the manufacturer so as to reduce shrinkage stress after curing is done.

When anterior composite restorations are carried out, the placement of composite restoration in increments not only aids to prevent the effects of polymerization shrinkage stress but also helps to prevent errors in the final result of restorations which are too translucent or opaque. So to ensure esthetically pleasing results, incremental layering technique is standardized and reproducible with much better results.

BULK FILL

Bulk fill, flowable, and packable composites have made many clinicians life easier by allowing restoration as thick as 4 mm bulk placement in one layer; in most cases, however, it is necessary to cover them with a 2 mm layer of conventional resin composite.

Bonded resin composites and especially bulk fill composites represent a true substitute due to their faster application because the fundamental difference between amalgam and resin composite is the latter's sensitivity to contamination with saliva or blood.[14,24] Therefore, a desperate need still exists for easy-to-use amalgam substitutes, that is, other than bonded resin composites.[28] Simplification and reduction of technique sensitive tooth color materials emerged after the introduction of classic amalgam alternatives such as glass ionomers, glass hybrids, and resin-modified glass ionomer cements. Class II fatigue loading design in terms of marginal quality, wear behavior, and fracture resistance are the characters which separated composite restorations from other restorations in the market.

Ideal requirement of the restoration materials

One of the prime GOALS for the clinician should BE TO ACHIEVE tight marginal seal to prevent irreversible consequences of gap formation because once it occurs, it is not reversible, even if restorative material companies claim to prevent demineralization along the cavity margins.[15-19]

Despite several developments in the field of adhesives, 100% gap-free margin is not realistically achievable. For a long time, multistep adhesives have been repeatedly reported to provide clinically proven, successful, durable adhesion to enamel and dentin[4,14,38] while simplified adhesives performed worse *in vitro* and *in vivo*.[14,38] Although the latest generation of universal adhesives seems to have disproven the claim that simplification always reduces performance, a certain amount of technique sensitivity is still involved, albeit reduced, when teeth are bonded with adhesives of all kinds.[4,14,20]

Simplifications of resin composite materials have been less frequently reported during the last decade in adhesive dentistry. There has definitely been improvement in the field of polymerization shrinkage and wear resistance, but a meticulous incremental layering technique was mandatory to meet for effective long-term sealing of resin composite restoration margins.[23]

CONCLUSION

Direct composite restorations are slowly replacing the age-old restorative material (dental amalgam) and giving way to numerous possibilities in dental practice. The methods and process are becoming more clinician friendly and its clinician duty to keep himself updated to the knowledge of the materials used for the betterment of the patient.

Declaration of consent patient

Patient's consent not required as there are no patients in this study.

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Conflicts of interest

There are no conflicts of interest.

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