

Evolution of Denture Repair and a Review of New Era

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Introduction

Recurrent fracture of the denture base commonly occurs which represents annoyance for the clinician, and is time-consuming. A satisfactory denture repair material should match the color of the denture base and restores its original strength. Numerous researches investigated different repair materials, reinforcement, repair surface design, and surface treatment to improve the repair strength and avoid recurrent fracture of the denture base [1].

For more than 60 years auto-polymerized acrylic resin (PMMA) (AP), has been the most commonly used repair material. It is the most popular method because it allows for a simple and quick repair. However, its main drawback is low strength [2]. To overcome the drawbacks of AP acrylic resin several materials were suggested for denture repair such as; heat polymerized (HP), Microwave (MW), or light polymerized resins (VLP) [3]. Repair using HP resins reported the best results followed by MW. Unfortunately, reheating during polymerization limits its use as it results in denture distortion [4]. In addition to repair material, the repair surface design is also important as it influences the bonding strength. Among butt, round, bevel, rabbet, inverse rabbet, inverse and knife edge joints, the bevel joint demonstrated the highest mechanical property in addition to its easy clinical application [5]. Moreover, the 45-degree bevel increases the interfacial bond area and shifts the interfacial stress pattern more toward a shear stress and away from the more damaging tensile stress [1].

Recurrent fracture of the repaired denture frequently occurs due to poor bonding strength between denture base resin and repair resin [6] therefore repair surface

treatment was suggested. The interface between the denture base resin and repair resin is usually the weakest point of denture repair. To overcome this problem, several attempts have been made to increase the bond strength by surface modification using chemical or mechanical treatment. Chemical solvents (acetone, methylene chloride, monomer, or chloroform) are used to prepare the repair surfaces and change the topography to achieve good surface adhesion and improve shear bond strength [6]. Generally, roughening the repair surfaces is an acceptable idea to improve repair strength. Surface treatment using abrasive air blasting (alumina or silica air-abrasion) and plasma irradiation treatment resulted in a significant improvement in the repair strength while no effect with sandpaper abrasion was observed [7,8]. With ageing procedures, the repair strength increases after immersion in simulated oral fluid. This increase is proportional with time, attaining final strength within 24 hours and attainment extreme strength between 1 day and 1 week. For that reason, after the laboratory procedure is completed repaired dentures are ideally immersed in water and should not be delivered to the patient before 24 hours [9]. As thermocycling affected bond strengths of AP to denture base resin, it was found that surface treatment enhanced the resistance to debonding AP bonded to denture base resin [10].

In addition to aforementioned factors, repair material reinforcement is considered an important factor for denture repair. Early metal wire and fibers (glass, nylon, aramid, ultra-high modulus polyethylene, etc.) were used to reinforce the repair material [11]. However, its application and use are still limited to in vitro research area. One of the drawbacks of reinforcement is the weak

adhesion between resin matrix and reinforcement material which weaken the material rather than strengthening it. Therefore, treatment of reinforcement material with saline coupling agent increases the bond strength between reinforcement material and resin subsequently improves the repair strength [7].

Nowadays nanotechnology invaded this field improving the properties of denture repair. Recently, it was found that the addition of zirconia nanoparticles significantly improves the repair strength. Obvious enhancement in the repair strength was found with the addition of nanoparticles, depending on the application and manipulation [1,12]. Further investigation on different types of nanoparticles and their effects are recommended. Finally, it could be concluded that the most important factors affecting repair strength are reinforcement materials and surface treatment in addition to repair material, repair method, and surface design. Although, several studies were conducted on denture repair to improve repair strength, still the conventional method (AP) is the dominant method. Most of the researches done in this area were in vitro studies. Therefore, our recommendations are to investigate all these ideas especially nanoparticles reinforcement in vivo and then clinical application otherwise, what are the benefits of these researches.

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