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Research Article

Flaskless Curing of Acrylic Dentures by Microwave Energy

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Abstract

Heat cure poly methyl methacrylate (PMMA) is the most commonly used denture base resin despite having some short comings. Lengthy polymerization time being one of them and in order to overcome this fact microwave curing method was recommended. This technique needs a nonmetallic flask. The disadvantages of microwave processing related to the plastic flasks are their relatively high cost and their tendency to break down after processing several dentures. Packing pressure cannot exceed 1200 psi without danger of breaking the plastic flask. In order to overcome that short comings a new technique involved the use of conventional brass metal flask without the need of the plastic flask has been tried. It produced satisfactory dentures. The current technique is easy, reproducible, and economic one. The aim of this article was to describe this successful flask free technique for microwave processing of PMMA resins.

Keywords: *Metal Flask; Plastic Flask; Compression Molding; Microwave Polymerization; Heat Cure Poly Methyl Methacrylate*

Introduction

Traditionally, poly [methyl methacrylate] resin (PMMA) for denture bases has been compression molded in metallic flasks and polymerized with a water bath method but microwave energy polymerization, as first reported by Nishii, is an alternative method. In 1968 Kimura., *et al*. [1] reported that it was possible to cure acrylic resin in a very short time using the same technique introduced by Nichii [2]. In 1984 and 1985, the fiber reinforced flask was substituted for heavy brass flask and the water-bath curing task gave way to microwave ovens to be used for PMMA resin curing.

When compared to conventional water-bath heat curing, the microwave processing of dentures offers these advantages: 1) saving of time from several hours to few minutes [3], 2) cleaner curing as it does not need water [4], 3) better bond strength with acrylic teeth [5], 4) equal or better dimensional accuracy [6], and 5) more color stability under conditions of accelerated aging [7,8]. It can also be used successfully with metallic removable partial denture frameworks [9].

Microwave oven is a device, in which electromagnetic waves are produced by a generator called as magnetron, which is used to generate heat. Microwave radiation as high-frequency electromagnetic wave exerts its function by inducing frictional heating from its interaction with polar molecules. Water molecules are polar molecules with the hydrogen side of the molecule carrying a positive charge and the oxygen side of the molecule carrying a negative charge. When microwave radiation hits the water molecules, they oscillate between two and five billion times to align themselves with the fluctuating microwave. This rapid molecular rotation generates and uniformly distributes heat [10].

Methyl metacrylate monomer molecules are also polar molecules and microwave energy heats them similarly. This means that one end of each molecule has a slight positive charge while the other has a slight negative charge. In an electromagnetic field, which rapidly changes direction, polarized molecules are flipped over rapidly and generate heat due to molecular friction [11].

Metal flasks cannot be used for microwave processing of PMMA resin because the waves will be reflected on the surface of the flask and hence will not reach the packed acrylic resin. Therefore, the flask must be made of a microwave translucent material such as common resins, high resistance ceramics, or unbreakable glass [3]. A fiber-reinforced plastic denture flask system (U.S. Shizai Corp., Santa Monica, calif.) was developed and became commercially available in 1985. This system is made from glass fiber reinforced polyester resin and uses three polycarbon bolts to secure flask sections [12]. Another type was constructed from polyester thermoplastic resin where its sections were fixed by three conical stainless steel centering bolts, and corresponding nuts and washers [3]. Many authors tried other materials for constructing microwavable flasks, e.g. plain or fiber glass and dental stone reinforced heat cured PMMA resin [13,14], and polyvinyl chloride resin [15].

Despite the many advantages gained by the microwave processing of PMMA resins, most dental practitioners have not adopted it because of its drawbacks that are mostly related to the plastic flasks [13]. The disadvantages of microwave processing related to the plastic flasks are their relatively high cost and their tendency to break down after processing several dentures. The polycarbon bolts tend to break or the threads strip if tightened too firmly. Packing pressure cannot exceed 1200 psi without danger of breaking the plastic flask [4,14,16,17].

In order to overcome that curing of conventional heat cured acrylic resin (PMMA) by microwave energy with the use of conventional brass metal flask without the need of the plastic flask has been tried. It produced satisfactory dentures. The aim of this article was to describe this successful flask free technique for microwave processing of PMMA resins.

Procedure

The technique utilized the conventional compression molding facilities in preparing the mold, that is, the metal brass denture flask (Hanau Teledyne) with slight modification as follows:

1. The inner surfaces of metal brass flask were finished and polished with slight divergence toward the free surface, then coated with a thin layer of vaseline to prevent adherence of the investing material.

2. During flasking of the waxed-up denture together with two base plate rods (Base plate paraffin wax, GC Dental Industry Corp.), each one is 3 cm long, were embedded vertically to their half in the lower section of the flask (Figure 1).

3. Flasking, wax elimination, and mold seal application procedures were completed following the standard technique. The resulting grooves in place of the two base plate rods (Figure 2) were blocked temporarily with gauze (Figure 3).

4. Microwave curing resin (Acron MC, GC Dental Indiustry Corp) was proportioned according to manufacturer's directions, mixed, and packed into the mold under pressure of 3500 psi.

5. Trial closures were performed as usual but before the final closure process no polyethylene sheet was interposed between the major mold sections and the grooves were evacuated from the gauze and packed with cold cure resin (Acrostone Repair Denture Base Material, England) (Figure 4).

6. The flask mold sections were properly oriented and placed in the bench press till hardening of the cold cure resin. The hardened cold cure will fasten the stone mold sections and permit retrieval of the whole stone mold (Figure 5) to become metal free for microwave curing.

7. The locked stone mold was placed inside a microwave oven (EM-M 553 T, Sanyo Electric Co, Ltd., Osaka, Japan) (Figure 6) and irradiated using the following cycle: 13 minutes on low power at 90 watts, 1.2 minutes on high power at 500 watts, and then bench cool for 30 minutes [16].

8. After curing, denture is retrieved from stone mold (Figure 7) and finished and polished (Figure 8) and delivered to the patient.

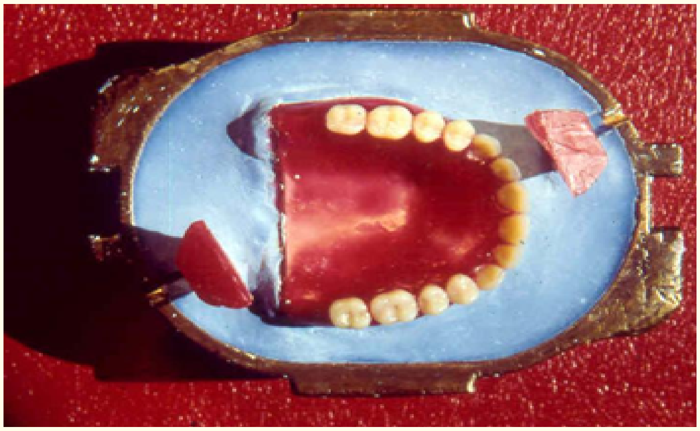

Figure 1: *Waxed up denture is flasked together with the two base plate wax rods.*

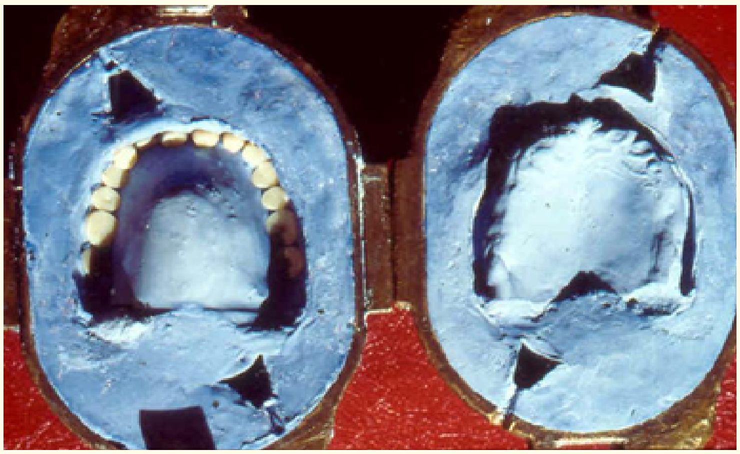

Figure 2: *Holes in place of the two base plate rods.*

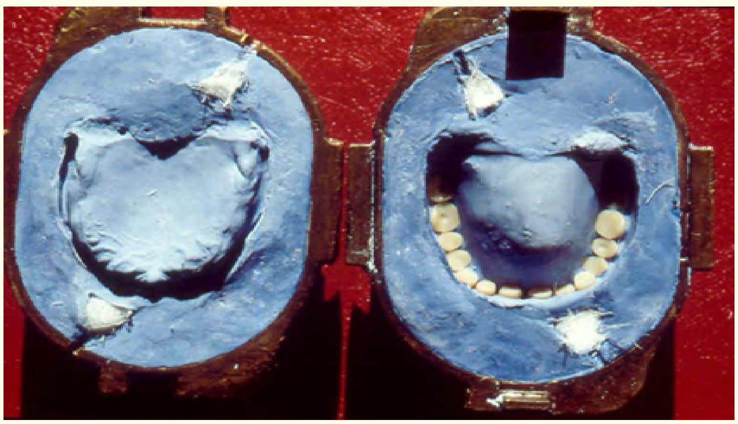

Figure 3: *The grooves in place of the two base plate rods are temporary packed with guaze.*

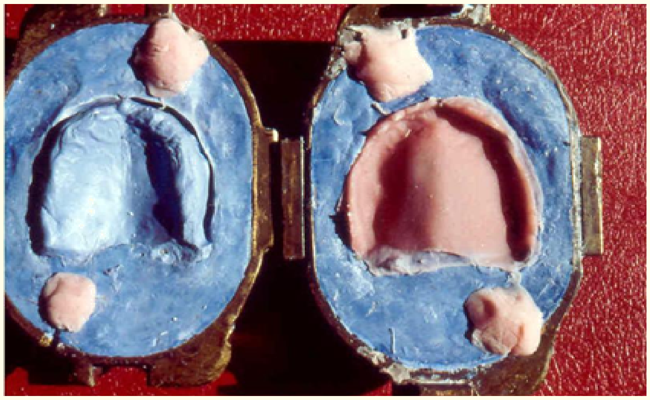

Figure 4: *The grooves in place of the two base plate rods are packed with self-cure after final trial closure.*

Figure 5: *Retrieved stone mold from metal brass flask ready for microwave curing.*

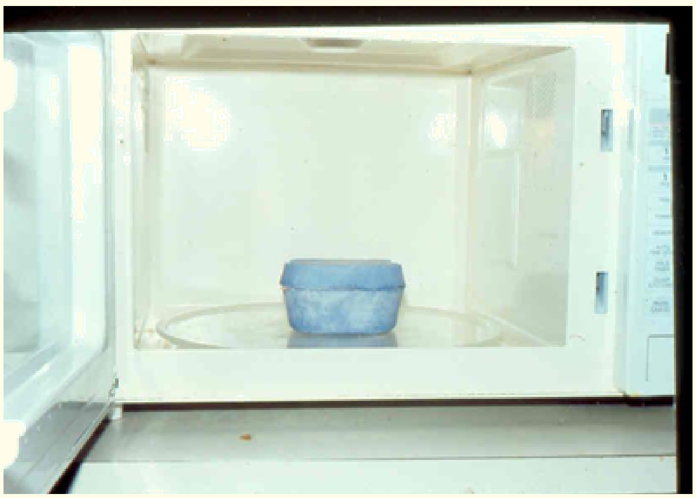

Figure 6: *Packed stone mold inside microwave oven during curing.*

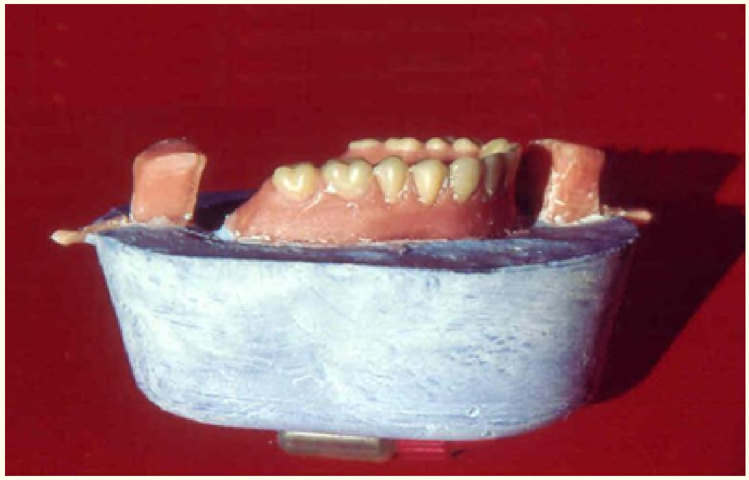

Figure 7: *Deflasking of the cured denture.*

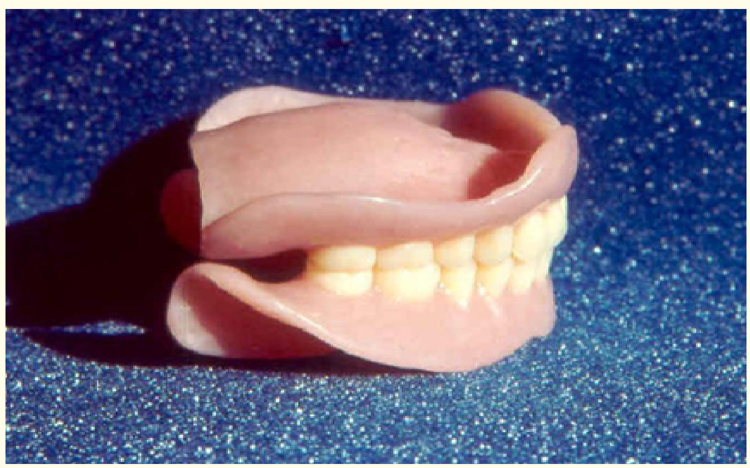

Figure 8: *Finished and polished denture cured by the current technique.*

Discussion

Heat cure poly methyl methacrylate (PMMA) is the most commonly used denture base resin despite having some short comings. Lengthy polymerization time being one of them and in order to overcome this fact microwave curing method was recommended. Unavailability of low cost metal free flask for microwave curing of PMMA resin made this technique unpopular. Therefore, in this work, heat cure PMMA was polymerized by microwave energy with the help of metal flask until finishing trial closure. Then the whole plaster mold that was packed with heat cured PMMA resin was delivered from the metal flask and cured with microwave energy.

Difficulties were met during removal of the plaster mold from metal flask during the pilot study such as fracture of the investing plaster mold totally or partially where parts of the investing plaster remain attached the metal flask interior wall. Some modifications to the interior wall of the metal flask were done by making its vertical walls slightly divergent toward its free margin. Also, some smoothening was done to its interior wall and was painted with Vaseline to facilitate plaster mold retrieval. This eliminated such difficulties totally.

Painting of the interior wall of the investing flask with nail paint was tried and proved to be efficient separator.

Conclusion

Within the limitations of this work, heat cure PMMA can be cured by microwave energy without the need for plastic flasks. The current technique is easy, inexpensive, and reproducible However, testing of the physical and mechanical properties of the cured PMMA resin produced by this new technique must be performed.

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