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ACCELERATED AND CONVENTIONAL CASTING TECHNIQUES: A REVIEW

Dental Science

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ABSTRACT

The "conventional casting" technique has been used since long time, and it has become common practice in dentistry after it was documented by Taggart in 1907. The conventional casting is time-consuming and requires approximately 2 to 4 hours for completion. There have been numerous reports mentioned to perfect the casting procedure in dentistry after improvisation in dental material science. Accelerated, nonstandard casting technique has been reported in an effort to achieve similar quality results in comparison to conventional casting technique significantly in less time that is approximately in 30 to 40 minutes. Although researchers have documented that, accelerated casting technique can be successfully employed for the fabrication of post and core and single full crown restorations, but on reviewing and critically analyzing the literature it is found that there is further scope for the studies, to know about the success of the accelerated casting technique to achieve quality cast restoration and fixed partial dentures.

KEYWORDS

Conventional casting, Accelerated Casting, Fixed Partial Dentures.

Introduction:

In fixed prosthodontics the treatment of damaged teeth or missing teeth by cast metal restorations plays a significant role in fulfilling the functional and esthetic requirements of the patient.1-3 Production of an accurate casting requires development of precise casting procedure that produces consistent results. The lost wax casting technique has been used since ancient times for production of cast metal restoration from the wax patterns. It was described by W. H. Taggert in 1907 to produce metallic restorations like inlays, onlays, crowns, bridges, cast partial dentures and post and core.4 The lost wax technique also called conventional casting technique although has been used routinely in fixed restorations but the whole process is quite time consuming, requiring approximately 2-4 hours for complete casting.[5]

The fabrication of cast restoration within a short period of time is the need of the hour, for present clinical reality.6 A search for an alternative to the conventional casting procedure for cast metal restorations has become necessary to avoid the longer duration of the time required for casting procedure. Thus an accelerated casting technique was introduced by Marzouk and Kerby in 1987.7 Initially accelerated casting technique was used for making cast post and core restorations for their easy placement into the prepared canals as it was used to provide required casting shrinkage in post-core restoration.

In accelerated casting technique, the wax pattern is invested in phosphate bonded investment material and it is allowed to set for 13 to 17 minutes for initial bench set and kept in the furnace which has been preheated to temperature of 815°C (1500° F) for 15 minutes for the burnout, and also to allow thermal expansion of the investment. Hence, the operator can complete the procedure of investing and casting within 30 to 40 minutes.[8]

The ability to fabricate precisely fit casting has been the principal objective of many investigators. Many factors affect the overall acceptability of cast restoration and many methods and techniques are used to improve it.9-13 This presentation is a review of the research done by various investigators for describing the advantages of accelerated and conventional casting technique used for making fixed cast restorations.

Review:

A look back into the history reveals how the metallic restorations have come into existence and attained the present day status. The foregoing review is amply illustrative of the various methods of casting procedures. A number of variables have been shown.

Keeping these various factors in mind following review was collected, to know the studies of various authors especially on accelerated and conventional casting technique and casting alloys on marginal fit of cast metal crown.

Thus following review of literature was collected and written year wise.

Papadopaulos T and Axelsson M in 1990:14 Tested thermal expansion of phosphate-bonded investment material at three different heating rates. A phosphate-bonded investment material (Heravest Super, Heraeus) and a gold alloy for metal ceramic were used. They concluded with as the heating rate increases, it decreases the thermal expansion of phosphate-bonded investment material.

Campagni W and Majchrowicz M in 1991:7 Suggested an accelerated method for casting post and core. By this method the clinical and laboratory procedures could be completed within one hour. Direct pattern of the canal was made by using plastic for dowel (parapost-whaledent) and the core was built-up with acrylic resin. The pattern was sprued and invested in phosphate-bonded investment material (jelenko). A ring liner was used and the special liquid has been diluted with water using a 50/50 ratio. The investment was allowed to set firm and its peak thermal setting temp. (12-15mint.), the ring was placed in the furnace preheated to 815°.C for burnout, Type - III gold alloy was used to make the casting.

They concluded that the entire clinical and laboratory procedure to complete casting of post-core pattern can be done within one hour.

Campagni W, Reisbick M and Jugan M in 1993:13 Compared an accelerated technique for the casting of post and core restorations with traditional technique. The difference in the seating of the castings as compared with the patterns was considered clinically unacceptable. They found that the technique using gypsum investment without ring liner gave best seating of the castings, and then phosphate-bonded with conventional technique was next best, and the ferrule subgroups showed clinically unacceptable seating for all groups.

Blackman S in 1993:6 Determined marginal sharpness and diameter

changes for full metal crown copings using a phosphate–bonded investment (Complete Jelenko) with rapid burn-out techniques. All samples were casted by using Type III alloy. He found that rapid burnout technique showed marginal gap increased by approx. 8-10 microns.

Bailey J and Sherrard D in 1994:11 Evaluated the accelerated wax pattern elimination technique using three commonly used phosphate-bonded investments. He found that castings made with accelerated technique were significantly different than those made with the conventional technique. The accelerated casting technique produced castings with a relative dimensional increase of 0.11% to 4.80% and conventional casting technique ranged from a 0.04% decrease in size to an increase of 3.65%.

Schneider R in 1994:12 Described a procedure of making cast post and core restorations in a single appointment. The recent development of visible light curing acrylic resins allows Chair side fabrication of direct post and core pattern. An accelerated casting procedure has been suggested and has shown clinically an excellent result.

Efstratios Konstantoulakis, Hiroshi Nakajima, Ronald Woody and Amp Miller in 1998:8 Conducted a study on "Marginal fit and surface roughness of crowns made with an accelerated casting technique, in which four types of phosphate-bonded investments and a high noble metal ceramic alloy was used.

The marginal discrepancy and surface roughness of crowns fabricated with the accelerated casting technique were not significantly ($p>0.05$) different from those fabricated with the conventional technique and concluded that the accelerated casting technique could be a vital alternative to the time consuming conventional techniques.

Elaine Shilling, Barbar Miller, Ronald Woodey, Amp Miller and Martha Nunn in 1999:5 Presented a paper on "Marginal gap of crowns made with a phosphate bonded investment and accelerated casting method".

Forty-four individual stone casts were poured from impressions made ' from a master die.

The following conclusions were drawn from this study.
1. Marginal gaps for castings made with an accelerated technique showed no statistical difference when compared with a conventional casting group.

2. The accelerated casting technique offers cost effective and time saving methods by which single unit castings for metal/ceramic crowns can be fabricated.

3. The methods used for accelerated casting procedures are technique sensitive. Minor variations in the procedures can cause casting defects such as nodules, fins and porosity.

Blackman R in 2000:15 The purpose of this study was to evaluate the dimensional changes and surface roughness of gold crowns cast with accelerated technique and invested with phosphate-bonded investment material. Three groups of 10 crowns were cast with a type III gold alloy out of which, two groups were used accelerated technique and third group was used conventional technique for making cast crowns. He summarized that crowns were successfully prepared using accelerated mould preparation technique with a small loss margin length or marginal sharpness was observed, as well as there may be a risk of mould fracture in such techniques because of short bench set and burnout schedule of 15 minutes.

Osvaldo Luiz Bezzon, Hamilton Pedrazzi, Osvaldo Zaniquelli, Tania Bose Cambuy da Silva in 2004:16 The aim of this study was to assess the surface roughness of two base metal alloys by using different casting techniques, to determine the influence of surface roughness on loss of mass after polishing as compared to commercially pure titanium castings. Within the limitations of this study following conclusions were drawn, the base metal alloys casted with vacuum casting showed decreased surface roughness, similar to that of titanium, compared to base metal alloys casted by acetylene oxygen flame casting. There were no significant differences in loss of mass after polishing for all tested specimens.

Yang Chun-Chuan et al in 2007:17 Evaluated the characteristics of commercial quick-heating phosphate–bonded investments for accelerated casting technique. They summarized that the accelerated casting technique may be adopted for fixed partial dentures.

Abhayjit Bedi, Konstantinos X Michalakis, Hiroshi Hirayama and Paul C Stark in 2008:18 This purpose of this study was to evaluate the effect of different investment techniques on the surface roughness and irregularities of gold palladium alloy castings. The results of this study showed that the surface roughness of castings made by investing technique under atmospheric pressure were more likely to produce surface irregularities than the castings made by investing technique under positive pressure.

Discussion:

Fixed restoration is a treatment of choice in most of the dental services. It restores not only impaired functions, esthetics, occlusal equilibrium but also provides psychological boost to the patient.[1]

Cast metal restorations are usually fabricated by “Lost wax casting technique” introduced by W. Taggert in 1906 and popularized this technique as conventional casting technique. This technique is used for fabrication of fixed restorations like inlays, onlays, crowns to restore damaged and missing teeth. For this technique the minimum time required is usually 3-4 hours.[4,5]

With the recent development in the field of dental material science and technology related to the casting procedure, it is possible to provide quality restorations in comparatively less time and also fulfilling demand of function and esthetics, at the same time maintaining harmonious relationship with surrounding oral tissues. Therefore, researchers have focused their attention in completing these procedures in a short period of time for fabrication of fixed restorations so as to save time. Thus, first attempt in this direction was made by Marzouk and Kerby in 1988 who introduced accelerated casting technique.5 The total time involved in this procedure, including investing and casting, was just 30-40 minutes. This was in total contrast with conventional casting technique where, the investing of the mold itself needs 1 hour of bench set before placing it in the oven. “Konstantoulakis, Nakajima, Woody et al and Finger W”,8 also supported this technique by justifying that when the investment reaches its maximum exothermic setting reaction temperature, most of the chemical reactions and the setting expansions are considered to be completed and the investment has sufficient strength to withstand the thermal shock.

Other attempts were made by Wayne Campagni, Michael Majchrowicz7 in 1991 and Robert Schneider12 in 1994 where they utilized an accelerated casting technique for fabrication of post and core restorations. They demonstrated that post and core restorations fabricated by this technique were clinically acceptable and stated that this technique can be successfully employed to produce individual fixed restorations in single appointment and therefore economical to the patients.

Several researchers5,6,7,8,13 have investigated, analyzed, and compared the accelerated technique with conventional methods by using precious and semiprecious casting alloys.

“Konstantoulakis et al” 8 in 1998 evaluated and compared the marginal fit and surface roughness of complete cast crowns, but no significant difference was found in the circumference or in the external diameter at the margin level of crowns made with the accelerated techniques when compared with conventional techniques.

Similarly “Elaine Schilling” 5 utilized an accelerated casting technique and produced single castings within 30 minutes and found no significant difference was evident regarding circumference, external diameter, surface roughness and marginal discrepancy when tested and compared with the conventional techniques.

However Blackman R6 and Chun-Chuan Yang et al17 demonstrated that the accelerated technique resulted in marginal gap in vertical direction which could be due to inadequate thermal expansion of the investment when the mold was subjected to rapid heat procedure.

Inadequate expansion of the investment could be also due to the

investment mold being subjected to preheated oven for a short period of time in the accelerated casting technique.

Among both the technique used, the accelerated casting technique showed more vertical marginal discrepancy when compared with the conventional casting technique. This discrepancy obtained therefore can be solely attributed to type of casting technique used, the results are in accordance with earlier studies.[6]

Although many researchers have advocated the clinical acceptability of accelerated casting technique but till date no study has been documented to prove the effect of oral environment and time with the in-vitro findings. Hence use of accelerated casting technique should be followed cautiously until supported with clinical studies.

Summary:

The "conventional casting" technique has been used since long time, and it has become common practice in dentistry after it was documented by Taggart in 1907. The conventional casting is time-consuming and requires approximately 2 to 4 hours for completion. There have been numerous reports mentioned to perfect the casting procedure in dentistry after improvisation in dental material science. Accelerated, nonstandard casting technique has been reported in an effort to achieve similar quality results in comparison to conventional casting technique significantly in less time that is approximately in 30 to 40 minutes. Although researchers have documented that, accelerated casting technique can be successfully employed for the fabrication of post and core and single full crown restorations, but on reviewing and critically analyzing the literature it is found that there is further scope for the studies, to know about the success of the accelerated casting technique to achieve quality cast restoration and fixed partial dentures.

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