Review Article

Accuracy of elastomeric impression materials on repeated pours

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There are doubts persisting in dentistry concerning the accuracy of elastomeric materials on repeated pours of impressions, since their introduction in 1950s. Greatest accuracy with all impression materials is obtained when the impressions are poured immediately. The accuracy of elastomeric impression materials on repeated pours is reviewed in this article.

Key words: Accuracy, elastomers, repeated pours

Polymerization shrinkage and deformities associated with distortion have long remained the problematic aspect of elastomeric impression materials, regarding the accuracy and stability. Due to various difficulties the impressions may not be poured immediately. Hence the dimensional accuracy and stability of impressions also depend on the storage conditions, when the pouring is delayed or repeated later and also the distortion of the impression material during the retrieval of stone casts, influences the dimensional accuracy of the subsequent casts, when multiple casts are poured in the same impression.[1,2] ADA specification Number 19 recommends a maximum negative change in dimension to be 0.50% after a minimum of 24 h.[3]

REVIEW OF LITERATURE

Numerous investigations have been done regarding the effect of delayed and repeated pours on the accuracy of elastomeric impression materials. Gilmore, Schnell and Phillips[4] in a study on the accuracy of rubber impression materials concluded that the most accurate results were attained only when the impression was poured immediately. As a group, the distortion of condensation silicones was severe and storage was contraindicated.

Stackhouse[5] studied the accuracy of stone dies made from rubber base impression materials and concluded that in all materials, bench setting generally caused the stone dies poured successively from the same impression to become increasingly shorter in length and thicker in diameter. The successively poured stone dies seemed to indicate that the hourly dimensional changes of the elastomers were greater than specified by the A. D. A specification No. 19.

Sawyer *et al*[6] studied the accuracy of casts produced from three classes of elastomeric impression materials. They concluded that polyether was the only material, where a second accurate cast in the same impression or a delayed pour after a week, produced essentially the same accuracy, compared to that of the cast poured immediately. The delayed excessive shrinkage of silicones did affect the second and delayed pours.

Eames *et al*[3] in a study evaluated the accuracy and dimensional stability of elastomeric impression materials. They concluded that the new addition silicones exhibited the least change dimensionally. They were found to be statistically equivalent to polyether. They recommended that in situations, which preclude the immediate pouring of impressions only the stable materials should be selected.

Lacy *et al*[7] investigated the time dependant accuracy of elastomeric impression materials and concluded that polyvinyl siloxanes were the most stable of elastomers. However, with putty wash system, they may reveal some loss of accuracy of dies produced by retrieval from multiple pours after 2-4 days.

Marcinak and Draughn[8] evaluated the dimensional change in addition silicones by delaying the pouring of impressions from 2 h to one week. They concluded that these materials remained remarkably accurate even after one week, with the greatest change at any time being 0.3%.

Williams *et al*[9] investigated the time dependent

dimensional stability of eleven commercially available elastomeric impression materials and found that the addition silicone materials exhibited excellent dimensional stability for all storage times. Delayed pouring of artificial stone in the impressions made with these materials should result in very little change in die accuracy.

Johnson and Craig[2] studied the accuracy of few types of elastomeric impression materials as a function of model location, time of pouring and repetition of pouring. They found very little change in dimension among abutment preparation for all materials, for all times of pour and with repeated pouring. The addition silicones and polyethers were the least affected with delay of 1, 4 and 24 h in pouring the impression.

Tjan *et al*[10] conducted a clinically oriented evaluation of the commonly used impression materials, by repouring the impressions at intervals of 6 hours and 24 h. Also a one week delayed pour was made for addition silicones and polyether. They concluded that the advantage of elastomeric impression material is that they may be poured serially (repeatedly) and will still maintain the accuracy. The impressions made of addition silicone and polyether was accurate after one week and possibly longer.

The council on dental materials, Instruments and Equipment[11] in a status report on polyvinyl siloxane impression materials recommended that the advantages of using the polyvinyl siloxanes include:

- The ability of the impression to be poured up after one hour or one day or for some products after one week without significant loss of accuracy
- The possibility of repouring the impression a second time and producing an accurate cast.

Tjan *et al*[12] evaluated the accuracy of monophase polyvinyl silicones and found that repeat pour at later time periods, did not affect the dimensional accuracy and stability of impression made with these materials.

Anusavice *et al*[13] in a review of nonaqueous elastomeric impression materials reported that, additional silicones are the most dimensionally stable of all the existing materials. This unusual stability means that the impression does not have to be poured in stone immediately. In fact, these impressions are often sent to the laboratory to be poured. They also reported that the combination of excellent dimensional stability and superior elasticity of addition silicones mean that multiple casts made from the same impression, have the same degree of accuracy.

Purk, Willes *et al*[14] studied the effects of different storage conditions on polyether and polyvinylsiloxane. Their study compared the effects of different time and temperature storage conditions, including temperature extremes of 66°C and 10°C, on the accuracy of addition silicone and polyether impressions. The greatest distortion generally occurred as a result of the 66°C temperature extreme. The authors therefore recommend that impressions be poured in stone according to manufacturers' specifications before being shipped to a dental laboratory to prevent impressions being exposed to excessive temperatures.

Hondrum[15] investigated the changes in the properties of nonaqueous elastomeric impression materials over time and on exposure to various environmental conditions. Materials investigated included a polyether impression material, a polysulfide material (light, regular and heavy consistencies) and an addition-reaction silicone material (light, regular, heavy and putty consistencies). Tests included viscosity of individual pastes, elastic recovery, working and setting times, strain in compression, dimensional change, creep compliance and tear energy. They concluded that although most batches of the materials and consistencies tested remained efficacious well past their designated shelf lives under a variety of storage and use conditions, separation of components was seen with polysulfide and addition silicone materials and some batches of polysulfide base paste and polyether reactor paste solidified in the tube.

Thongthammachat, Moore *et al*[16] evaluated the influence on dimensional accuracy of dental casts made with different types of trays and impression materials and poured at different and multiple times. Two types of stock trays (plastic stock tray, perforated metal stock tray) and four types of custom tray materials (auto polymerizing acrylic resin, thermoplastic resin and four types of light-polymerized acrylic resins) were used with 2 types of impression materials (addition polymerizing silicone and polyether), to make impressions of a metal master model. Each tray and impression material was used to make 5 impressions. Casts were made by multiple pourings at 30 min, 6, 24 h and 30 days after impression making. Using a measuring microscope, 12 distances were calculated based on measurements of eight reference points. The absolute value of the difference of each measurement was calculated, as was the corresponding measurement on the master model. They concluded that accurate casts could be made with either stock trays or custom trays. An impression made from polyether should be poured only once and within 24 h after impression making, because of the distortion of the material over time. Silicone impression material has better dimensional stability than polyether.

DISCUSSION

Accuracy of impressions with repeated pours is of interest clinically, because duplicate models are sometimes desired. Most of the studies carried out on

addition silicones including the monophase polyvinyl siloxanes showed that they were dimensionally accurate even upto one week. This is advantageous because multiple casts can be poured in the same impression upto one week without concern for dimensional inaccuracy.[1,2,7,9,12,14,16] These materials exhibit the least amount of distortion from loads imposed on the set materials. Thus pouring the impression, removing the casts several times will not alter the dimensional stability of the impression, even though a fairly substantial force is needed each time the cast is removed from the impression.[17] Polyethers were found to be statistically equivalent to addition silicones and exhibited the least change dimensionally. It is recommended that in situations which preclude the immediate pouring of the impressions, only the stable materials should be selected.[3,10] However, studies have reported that polyether should be poured only once and within 24 h after impression making.[16] One property that has a negative effect on polyether impression material is the absorption of water or fluids and the simultaneous leaching of the water soluble plasticizer. Thus the stored impression must be kept in a clean, dry and cool environment to maintain its accuracy.[17]

If maximal accuracy is to be maintained, whenever a polysulphide or a condensation silicone is employed the stone die or cast should be constructed within the first 30 minutes after removal of the impression from the mouth, even when putty wash technique is used. Likewise, some of the condensation silicones take much longer to reach a maximum contraction than polysulphides, addition silicones or polyethers.[18] In addition both polysulphides and condensation silicones lose polymerization byproducts water and alcohol respectively thereby producing poor results.[17]

Purk *et al*[14] studied the effect of different storage conditions on polyether and polyvinysiloxane and recommend that impressions be poured in stone before being shipped to a dental laboratory to prevent impressions being exposed to excessive temperature. In a study conducted on the change of properties of nonaqueous elastomeric impression materials over time and on exposure to various environmental conditions, it was concluded that although most batches of the materials and consistencies tested remained efficacious well past their designated shelf lives under a variety of storage and use conditions, separation of components was seen with polysulfide and addition silicone materials and some batches of polysulfide base paste and polyether reactor paste solidified in the tube.[15]

CONCLUSION

It is evident that all materials change dimensionally over time. The present review on the accuracy of elastomeric impression materials on repeated pours would suggest that addition silicones and polyethers to a certain extent were least affected with delay in pouring the impression. However, since condensation silicones and polysulphide materials are not dimensionally stable, the time interval between pours should not be greater than 30 min and repouring would result in significant loss of accuracy.

Addition silicones are the most versatile, widely used, dimensionally accurate and stable of all materials followed by polyethers This stability exhibited by both these materials suggest that, these impressions do not have to be poured with gypsum products immediately.

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Source of Support: Nil, **Conflict of Interest:** None declared.