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Pressurised putty technique: A technical report

Joshua Ee Xin Ong[1,2]

[1]Centre for Restorative Dentistry Studies, Faculty of Dentistry, MARA University of Technology, Malaysia
[2]Faculty of Dentistry, Oral & Craniofacial Sciences, Guy's Hospital, King's College London, United Kingdom

Abstract

The surface detail reproducibility of conventional putty impressions is hindered by high viscosity and low flowability. In the plastic industry, injection moulding application utilizes an influx of pressure to achieve better flowability. Leveraging this concept, this technical report investigated the impact of pressure on surface detail reproducibility and structural homogeneity, featuring the pressurised putty technique. Surface detail reproducibility and structural homogeneity of three techniques (non-pressurised, putty & light body wash and pressurised) were visually assessed and differences in surface detail reproducibility were observed among all techniques. Whilst a pressurised clear-based putty index presented a more uniform glassy finish. The outlined technique suggests a simplistic and cost-effective way of improving a putty index, which may benefit many clinicians in terms of prosthodontic success.

Keywords: *pressurised putty, surface detail reproducibility, structural homogeneity*

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***Corresponding author**
Address:
Centre for Restorative Dentistry Studies, Faculty of Dentistry, MARA University of Technology, 47000 Sungai Buloh, Selangor, Malaysia
Telephone: +603-61266161
Email address:
joshua@uitm.edu.my

Introduction

The ability to register good dental impressions is an important skillset to be developed by all clinicians, as it accounts for a wide array of uses in everyday dentistry. Regardless of its many applications, the ultimate purpose of all dental impressions is to create an accurate, void-free negative imprint, so that a true positive reproduction of surface details can be correctly transferred to dentitions or study models, ultimately improving chances of treatment success. In the field of prosthodontics, diagnostic wax-ups are particularly useful in the evaluation of treatment options, dental aesthetics, and fabrication of short/long termed provisional restorations.

For the last-mentioned, indexes are used and they are commonly made up of a silicone impression material in a putty consistency as it is rigid and dimensionally stable. However, one major disadvantage of a putty silicone impression material is its poor ability to record fine surface detail. This is attributed to its high filler content, which leads to high viscosity and low flowability, thus hindering its ability to capture fine details (Ghahremanloo *et al.*, 2017). Although this can be overcome by the application of a wash technique with a light body silicone impression, either in a one-step or two-step technique, this is seemingly technique sensitive and not cost effective. In most situations, light-bodied silicone impression has a tendency of being displaced and torn when the putty index is loaded and removed, which in turn will lead to a compromise of impression accuracy (O'Brien, 2002). Therefore, the fabrication of conventional putty indexes warrants further improvements.

Based on the fundamental principle of differential pressure flow, particles flow from high to low pressures within a system. The plastic industry incorporates this concept in injection moulding applications, where the influx of pressure forces polymers into a mould so that proper uptake of shape is ensured (Kirk & Patrick, 2011). Leveraging on the aforementioned concept, this report aimed to examine the impact of pressure on surface detail reproducibility and structural homogeneity of putty impressions.

Report

The materials included a maxillary dental model (Frasaco AG3, VDDI Dental Solutions, Germany) to act as a framework for the fabrication of putty index, a putty consistency silicone impression (Aquasil Soft Putty, Dentsply Sirona, United States), a light body silicone impression (Aquasil Ultra+, Dentsply Sirona, United States), a clear-based silicone impression (Exaclear, GC Corporation, Japan), and a polymerising pressure pot (R-030420, Mestra, Spain).

Three techniques, specifically non-pressurised, putty & light body wash and pressurised were employed, and a full-arch putty silicone impression was made for each. The first two techniques were allowed to polymerise under ambient pressure, while the pressurised putty index was polymerised under 1.5 atmosphere of pressure (atm). Based on the manufacturer's recommendation, 1.5-2.0 atm is desirable to achieve optimum polymerisation and prevention of damage to the pressure pot (R-030420, Mestra, Spain). Putty & light body wash was carried out in a two-step technique, in which the intaglio surfaces of polymerised putty index were scrapped to accommodate light body impression material. For fabrication of clear based putty indexes, Exaclear was dispensed onto the Frasaco model and seated with a pre-loaded non-perforated stock tray. They were set under pressurised and non-pressurised manner.

Full arch putty indexes were divided into three sections for inspection of surface detail reproducibility, while the clear-based putty indexes were assessed for structural homogeneity from a labial view. Figure 1 outlines all three techniques according to their polymerisation conditions, while figure 2-4 illustrate the comparison of three techniques from different viewpoints. Figure 5 depicts the comparison of non-pressurised and pressurised clear-based putty indexes.

In figures 2 and 3, non-pressurised putty and putty & light body wash presented with crude voids and improper registration from maxillary lateral incisor to lateral incisor, and left first premolar up to third molar (pinpointed by yellow arrows),

In the maxillary anterior region, both surface detail reproducibility of putty & light body wash and pressurised were seemingly comparable. However, due to the inherent properties of low-filled light body impression, some parts of the putty & light body wash succumbed to tears. In figure 4, all three depictions were almost identical with no conspicuous voids from the non-pressurised putty. As for figure 5, multiple minute voids were seen in the non-pressurised putty, while the pressurised counterpart has a more uniform glassy finish.

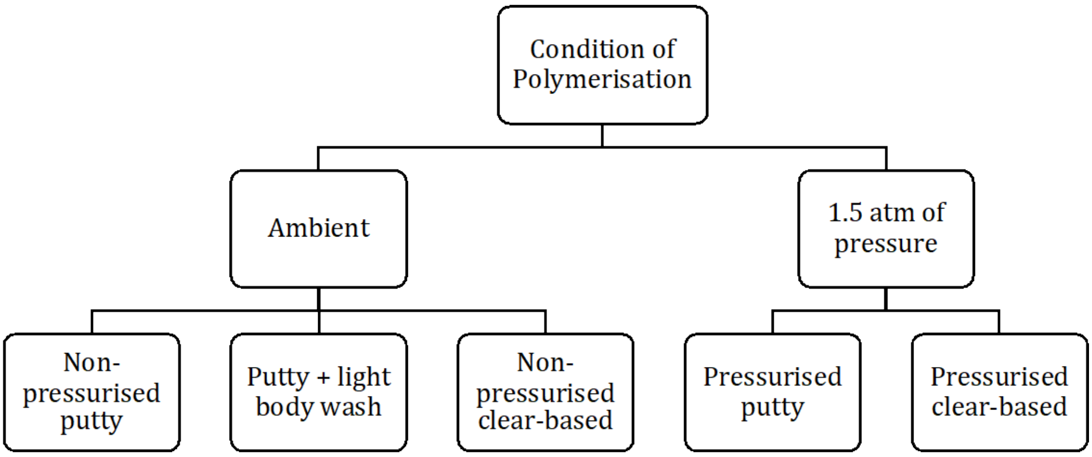

Figure 1. Flowchart of techniques according to their polymerisation conditions.

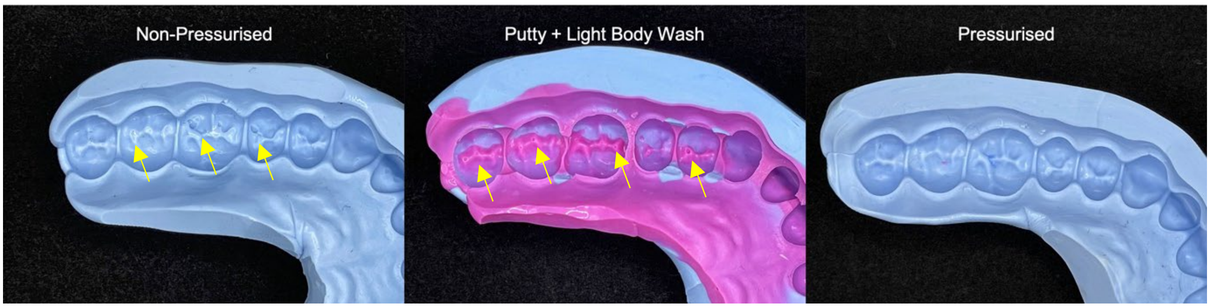

Figure 2. Comparison of surface detail reproducibility of maxillary left region.

Figure 3. Comparison of surface detail reproducibility of maxillary anterior region.

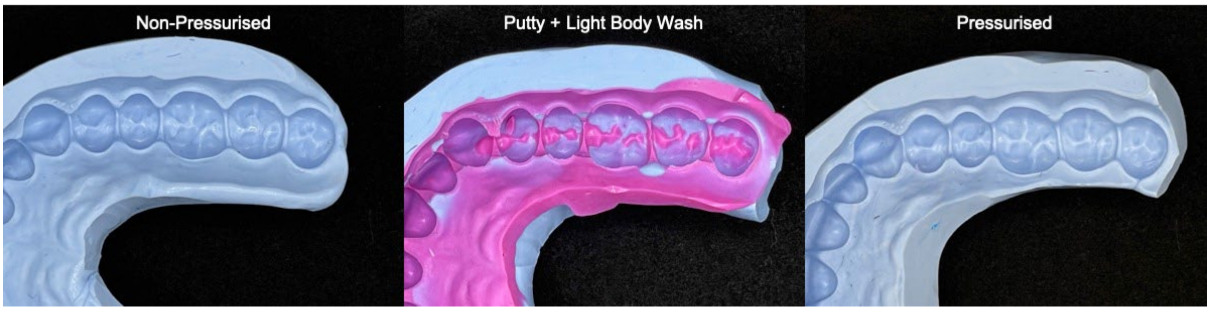

Figure 4. Comparison of surface detail reproducibility of maxillary right region.

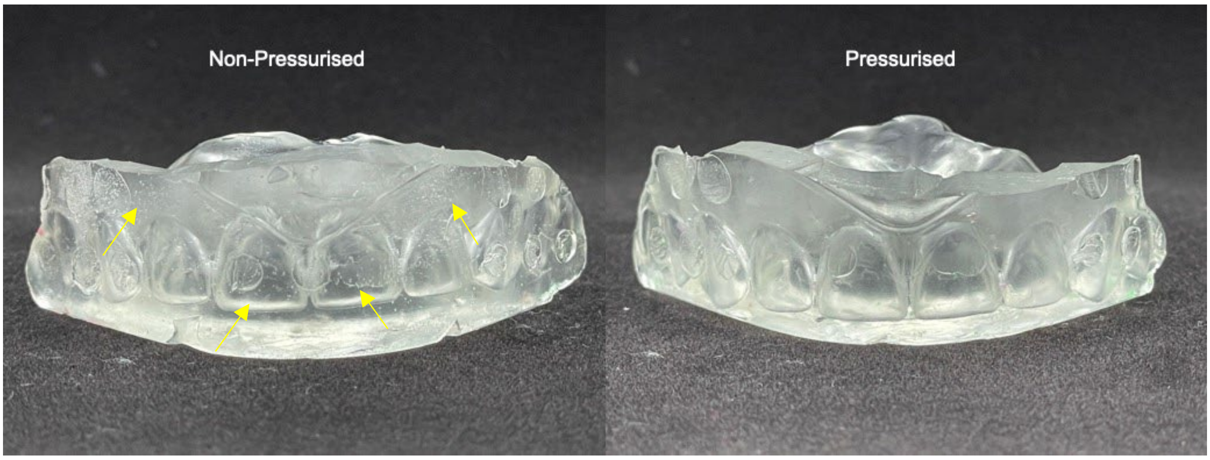

Figure 5. Comparison of structural homogeneity of clear-based putty indexes.

Discussion

This report has demonstrated how pressure has affected the surface detail reproducibility and structural homogeneity of putty indexes. Based on a study (Nishigawa *et al*., 2013), they have demonstrated an apparent pressure-induced flowability using a theoretical model, in which a Newtonian viscoelastic material (*e.g.,* a silicone-based dental impression) was able to travel through a channel when pressure is applied. This is seemingly congruent with the author's speculation. Hence, on the latter basis and the outcomes of this report, the initial hypothesis is duly accepted.

Pressure polymerisation is not a whole new endeavour, in fact, such approach was first described about a century ago, where isoprene was subjected to polymerization under 0.9-1.2 GPa of pressure (Conant & Tongberg, 1930). Over time, this method was adopted and experimented in other polymeric materials as well. Reportedly, the introduction of pressure had improved the mechanical and physical properties of polymethyl methacrylate (PMMA) and composite resin blocks via a high degree of resin cross-linkages, reduced intermolecular distances and free volume, ultimately an increase in bulk density and fracture toughness. Moreover, the occurrence of defects and voids can be effectively mitigated due to the isotropic compaction of the polymeric structures (Kojima *et al*., 2002; Nguyen *et al*., 2012; Schettino *et al*., 2008). Pressurised putty indexes, especially clear-based ones will be greatly beneficial to clinicians when injection moulding technique with flowable composite resin is used as it helps in achieving proper contouring and better operational visualization. In addition, the stiff nature of pressurised putty indexes may reduce the incidence of flexing when seated intraorally. On the whole, pressurised putty index seems desirable as it enhances prosthodontic efficiency and success.

This report has its setbacks and can be improved in several ways. Firstly, the magnitude of improvements in surface detail reproduction and structural homogeneity was not quantified but relied on the author's perspective. Secondly, the material chosen in this study does not represent the spectrum of all silicone impressions available in the market. With all things considered, the evidence mentioned should not be hastily concluded, but as mere adjunctive evidence to clinical practice and a pathway for more impactful and evidence-based studies to be conducted in future. For future recommendations, microscopic in-vitro studies should be carried out to measure the amount of surface detail reproduction and structural homogeneity improvement on a more precise scale, with the inclusion of more silicone impressions. Lastly, the effects of higher pressure should also be investigated as the pressure used in this report was limited by the manufacturer's instructions.

Conclusion

Within the limitation of this report, differences in surface reproducibility were seen between non-pressurised, light body wash and pressurised techniques. A uniform glassy finish of a pressurised clear-based putty index was observed. The outlined technique suggests a simplistic, sensible and cost-effective alternative for an improved putty index. These admirable traits may benefit many clinicians, given that they all need to use a putty index at some point in their careers. In hindsight, the uses of dental pressure pots are not limited to the conventional denture reline and repair, but also can be used for the application of the pressurised putty technique. In the author's opinion, the investment of an inexpensive dental pressure pot would be more than repaid in time saved for later procedures, adjustments, and remakes.

Conflict of Interest

None declared

References

Conant, J.B., Tongberg, C.O. (1930). Polymerization reactions under high pressure. I. Some experiments with isoprene and butyraldehyde. *Journal of the American Chemical Society*, 52, 1659-1669.

Ghahremanloo, A., Seifi, M., Ghanbarzade, J., Abrisham, S.M., Javan, R.A. (2017). Effect of polyvinyl siloxane viscosity on accuracy of dental implant impressions. *Journal of Dentistry (Tehran, Iran*), 14(1), 40-47.

Kirk M.C., & Patrick W. (2011). Plastics Processing. In: M. Kutz (ed.), *Applied Plastics Engineering Handbook.* New York: William Andrew Publishing, pp. 195-203.

Kojima Y., Matsuoka. T., Takahashi. H. (2002). Structure of poly(methyl methacrylate) synthesized under high pressure. *Journal of Material Science Letters*, 21, 473-475.

Nguyen, J.F., Migonney, V., Ruse, N.D., Sadoun, M. (2012). Resin composite blocks via high-pressure high-temperature polymerization. *Dental Materials*, 28(5), 529-534.

Nishigawa, G., Maruo, Y., Irie, M., Oka, M., Tamada, Y., Minagi, S. (2013). New theoretical model to measure pressure produced during impression procedure for complete dentures-Visual inspection of impression material flow. *Dental Materials*, 29(5), 530-534.

O'Brien, W.J. (2002). *Dental materials and their selection*, 3rd ed. Chicago: Quintessence Publishing, pp.90-112.

Schettino, V., Bini, R., Ceppatelli, M., Citroni. M. (2008). Activation and control of chemical reactions at very high pressure. *Physica Scripta*, 78, 1-5.