Viscoelastic properties of type 3 impression materials during working time

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When type 3 elastomeric impression materials are clinically used, flow characteristics of the mixed materials are necessary to reproduce an surface detail. But over clinically reasonable time periods, they must have an appropriate elastic properties to retain the shape and strength of the negative replica. The viscoelasticity of dental materials is important in the selection of suitable materials for clinical applications.

Rheology is the science of deformation and flow. Rheological experiments do not only reveal information about the flow behavior of liquids, but also the deformation behavior of solids. Rheological test is useful to investigate the viscoelasticity of impression materials, however, most of investigations were performed with the base or the catalyst only. The purpose of this *in-vitro* study was to investigate rheology properties of type 3 impression materials(7 addition silicones) during their working time .

Material and method

7 additional silicones investicated in this study were Aquasil ULV(Dentsply), Aquasil Ultra XLV(Dentsply), Exafast NDS(GC America Inc), Examix NDS(GC America Inc), Honigum(DMG), Imprint II Garant(3M ESPE), Take 1(SDS Kerr).

The strorage modulus(G') and the loss tangent(tan) were measured from 30s after mixing during each materials' specific working time, using universal dynamic spectrometer (Physica UDS, Germany). Visocoelastic properties were evaluated by means(standard deviations) of G' and tan from 5 repeats at different temperatures(21∞C and 33∞C). Individual changes during the working time were evaluated. Results were analyzed by t-test.

Results

The solid-like hardness(G') at the end of their working time differed among all materials, ranging from 423Pa(43.4Pa) for Examix to 25196Pa(9952.3Pa) for Honigum at 21∞C; between 6070Pa(457.6Pa) for Imprint II Garant and 433080Pa(30975.7Pa) for Honigum at 33∞C. The increase of G' showed linear changes at 21∞C; on the other hand at 33C displayed the sigmoidal curves during their working time. In the evaluation of the distribution of individual G' at 33∞C, Honigum, Aquasil ULV, Aquasil Ultra XLV, Take 1 showed significant high G'values compared to the other materials at the end of their working time(t-test : $p < 0.05$). The change of the relative liquid-like fluidity(tan) at the end of working time varied, ranging from 0.44 for Honigum to 1.945 for Exafast at 21∞C; between 0.003 for Honigum to 0.592 for Imprint II Garant at 33∞C.

Conclusion

Within the limitation of this study, type 3 impression materials have different viscoelastic properties, and most materials showed different fluidity at two temperatures.