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Hydrophilicity of Precision Impression Materials During Working Time

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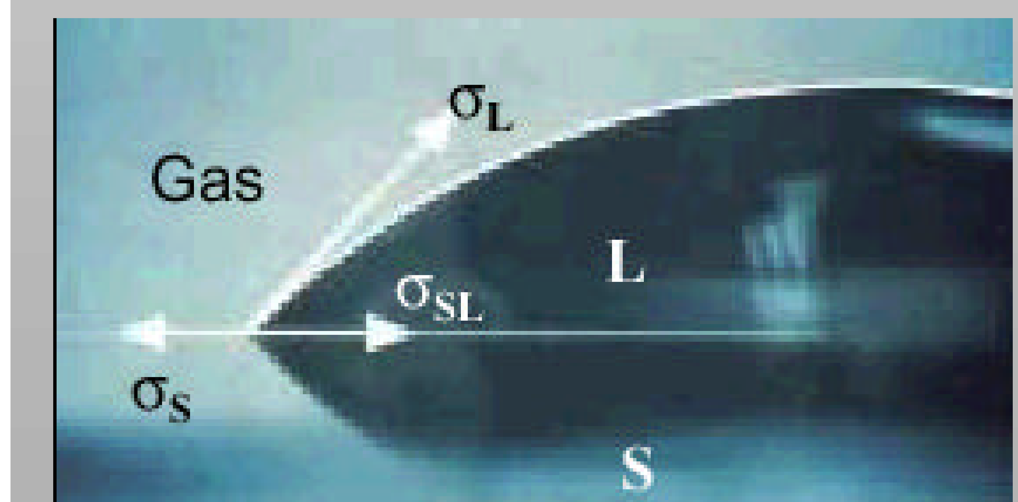
Introduction

Hydrophilicity of precision impression materials is regarded as one of the most important properties for clinical success. There are many investigations about the hydrophilicity of set impression materials published in the literature. However, very limited information is available about the hydrophilicity of impression materials in the unset stage (1, 2). On the other hand hydrophilicity is most clinical relevant during working time. During this time it is necessary because the material flows, e.g. while syringing or seating the tray. At these very moments a new surface of impression material is generated and in contact with moisture. This is the point when hydrophilicity is needed for clinical success. The hydrophility at this point is called initial hydrophilicity.

Objective

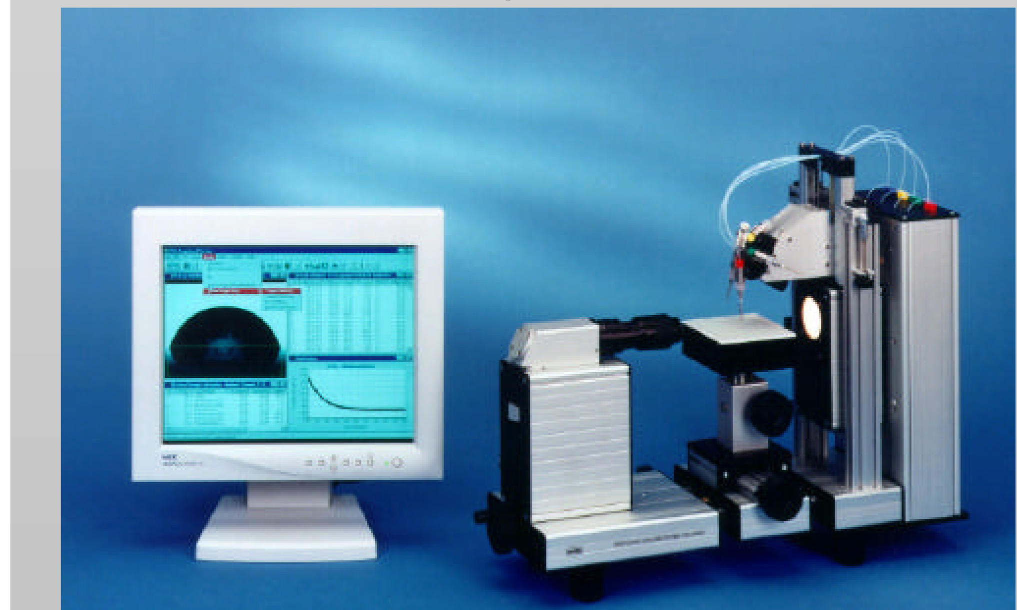
Goal of the present study was to investigate the hydrophilicity of unset light bodied precision impression materials delivered from a hand dispenser.

Since there is no common method to determine the hydrophilic behaviour of unset impression materials another goal of the present study was to provide a method for determining the initial hydrophilicity of unset impression materials using commercially available equipment.



Materials and Methods

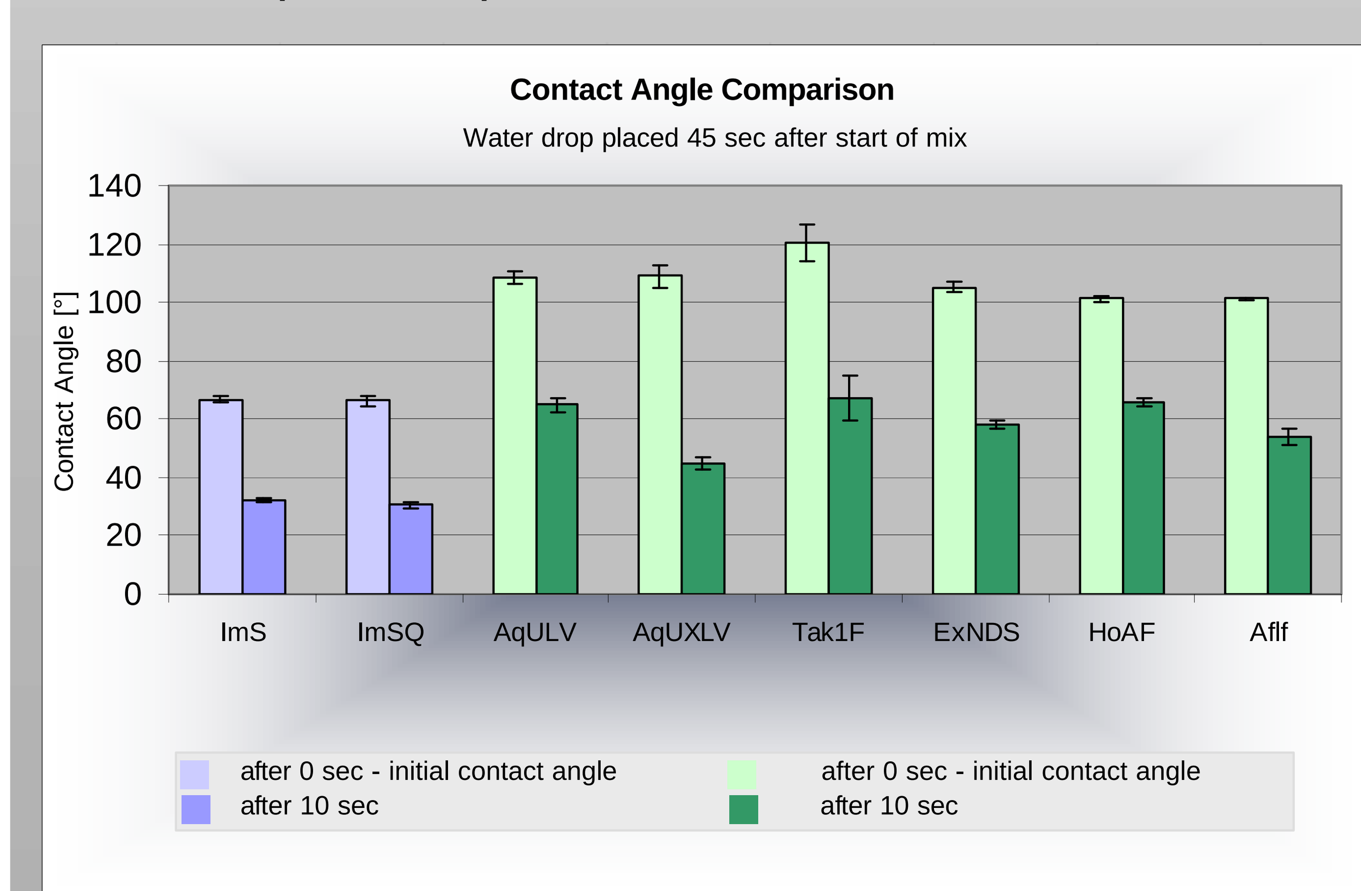
Seven fast set light bodied precision impression materials were compared, Impregum Soft Quick Step Light Body (3M ESPE, a new fast setting material, ImSQ, B156147, C1158043), Honigum Automix Light Fast (DMG, HoAF, Lot 523197), Exafast NDS Injection (GC, ExNDS, Lot 0301231), Take 1 Fast Stet Wash (Kerr, Tak1F, Lot 3-1282), Aquasil Ultra LV Fast Set (Dentsply, AqULV, Lot 031208), Aquasil Ultra XLV Fast Set (Dentsply, AqUXLV, Lot 040112), Affinis light body fast (Coltène, Aflf, Lot MH036), and one regular setting material, Impregum Garant Soft Light Body (3M ESPE, ImS, B169002, C169658).



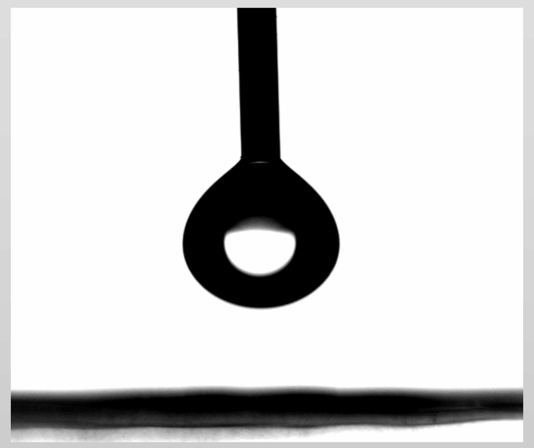
For determining the hydrophilicity contact angle measurement was chosen. Contact angles were measured at room temperature within the recommended working time of the manufacturer. The materials were dispensed and placed between two glass plates. Then one of the glass plates was removed to yield a layer of unset impression material. 45 seconds after start of mix a water drop (5 µl) was placed on the material and data were collected using a Drop Shape Analysis System DSA10 (Krüss GmbH, Hamburg) employing video analysis. The sotware permits data collection of 25 data points per second for the duration of about 12 seconds. The high resolution of the measurement even allows one to determine the initial contact angle when the water hits the material for the very first time.

Results

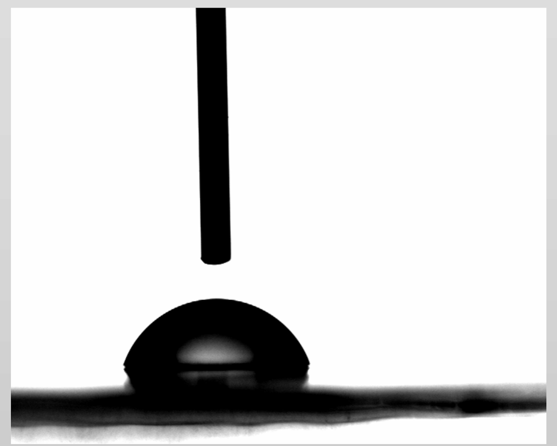
The following contact angles Test 1 (advancing contact angle = initial hydrophilicity)/Test 2 (contact angle 10 seconds after the water drop was placed), units in °, SD in brackets, were determined (n = 5): ImSQ: 66,7/32,3 (1,1/0,9), HoAF: 101,2/65,5 (1,0/1,4), ExNDS: 105,3/58,0 (1,8/1,5), Tak1F: 120,4/67,5 (6,5/7,7), AqULV: 108,6/64,9 (2,2/2,6), AqUXLV: 109,0/44,9 (4,0/2,1), Aflf: 101,4/53,8 (0,4/2,6), ImS: 66,2/30,7 (1,5/1,1). Results were analyzed by ONE-WAY ANOVA and Tukey Test (p<0,01). The contact angles of the materials ImSQ and ImS were found to be significantly lower than those of the materials HoAF, ExNDS, Tak1F, AqULV, AqUXLV, Aflf.



Sequential Steps Contact Angle Determination

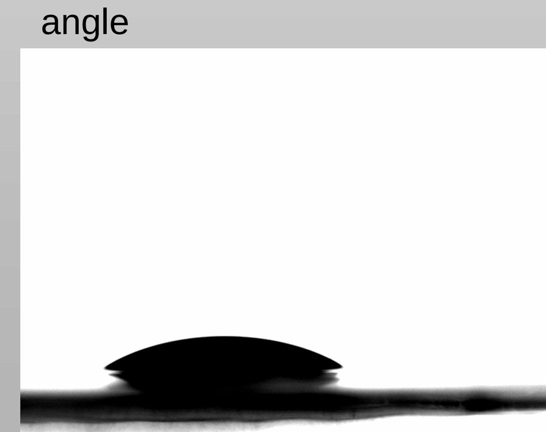


1) Placing the water drop



2) Initial (advancing) contact angle

3) Spreading of the water drop after 6 seconds

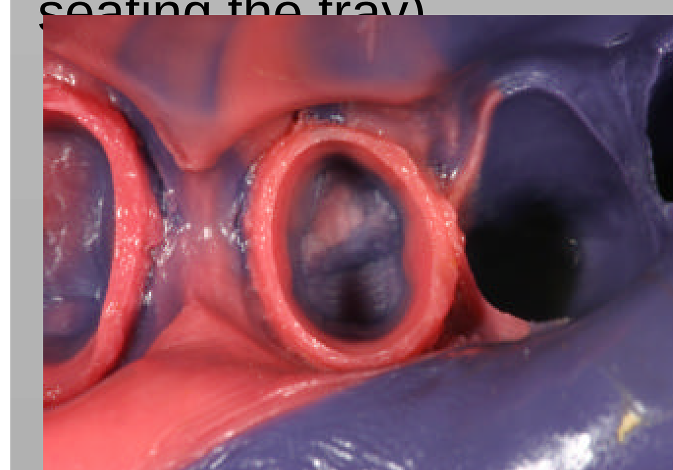


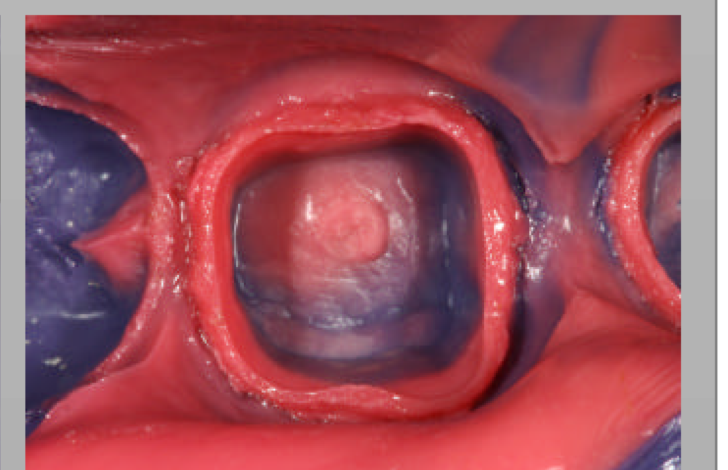
4) Spreading of the water drop after 10 seconds

Discussion

For the two tests the polyether materials ImSQ and ImS exhibited lower contact angles, and thus significantly higher hydrophilicity in the unset stage than all the silicone materials measured. It is important to point out the higher initial hydrophilicity – the hydrophilicity at 0 seconds (first contact of water with material).

The reason for the differences between both groups; polyethers and silicones, is that the polyethers are hydrophilic by nature of their chemical make up. This ensures that from the time the polyether is mixed until it sets, it is characterized by its tendency to favour moist surfaces, such as a preparation, and produce precise reproductions. This is also known as intrinsic hydrophilicity. By contrast, silicone impression materials, which are intrinsically hydrophobic, have to be made hydrophilic by adding surfactants, which are surface-active additives. This results in a different wetting behaviour. When a impression material with surfactants comes into contact with moisture, the surfactant has to “migrate” to the surface. This prevents hydrophilicity from fully developing at the very first contact with moisture. However, hydrophilicity is of capital importance when the material flows and the new surface of material is generated (syringing, seating the tray).





Conclusion

The polyether materials ImSQ and ImS are significantly more hydrophilic in the unset stage than VPS materials HoAF, ExNDS, Tak1F, AqULV, AqUXLV, Aflf.

The utilized measuring method is a very useful and convenient tool to determine contact angles of impression materials in the unset stage.

(1) W. Jia, J. A. Sorensen “Wet Detail Reproduction And Dynamic Contact Angle Of Impression Materials” AADR 2001, #179

(2) M. Mondon, C. Ziegler “Changes in Water Contact Angles During the First Phase of Setting of Dental Impression Materials” Int. J. Prosthodont. 2003; 16: 49-53