138

Characterization of New Quick Setting Polyether Impression Materials

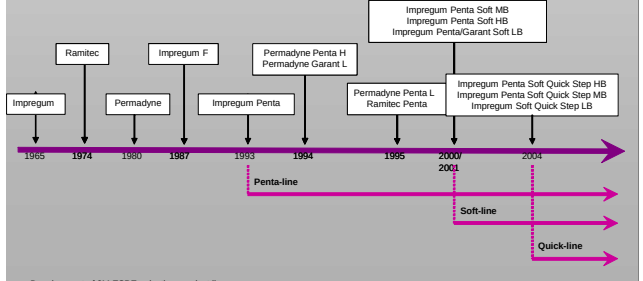
B. Gangnus*, T. Klettke, C. Fuehrer, B. Kuppermann, and A. Rombach
3M ESPE AG, Seefeld, Germany

Introduction

Introduced in the mid-1960's, polyethers have become indispensable for impression taking. The precision provided by these materials is well respected. At the heart of polyether impression materials is a series of key attributes - intrinsic hydrophilicity, unique rheology, as well as a snap setting behavior. Through a continuous innovation process, polyethers have become significantly easier to handle. Automatic mixing in the 3M ESPE Pentamix unit provides exactly dosed material that is homogeneous and void free. With the launch of the Impregum Penta Soft product line in 2000, major improvements have been achieved with respect to removal and taste.

The launch of the new Impregum Penta Soft Quick Step line is answering the market demand for fast-setting polyether impression materials especially suited for one and two unit cases.

The objectives for the development of these products were to accelerate their setting characteristics and to tailor them for use with double bite trays, ensuring that overall they resemble their corresponding regular setting polyether material.



Development of 3M ESPE polyether product line

Objective

The objective of this study was to compare the material properties of the new quick-setting polyether impression materials, Impregum Penta Soft Quick Step Heavy Body, Impregum Penta Soft Quick Step Medium Body and Impregum Soft Quick Step Light Body with the well established regular-setting Impregum Penta Soft Heavy Body, Impregum Penta Soft Medium Body and Impregum Garant Soft Light Body using internationally standardized methods.

Materials and Methods

Consistency (CO), total working time (WT), detail reproduction (DR), linear dimensional change (LC), compatibility with gypsum (CG), recovery from deformation (RD) and strain in compression (SC) were determined according to ISO 4823:2000 [1] using 5 specimens per test. Tear strength (TS) and elongation at break (EL) were determined according to DIN 53504 [2].

Impregum Penta Soft Quick Step Heavy Body (HBQ)
Impregum Penta Soft Quick Step Medium Body (MBQ)
Impregum Soft Quick Step Light Body (LBQ)
Impregum Penta Soft Heavy Body (HB)
Impregum Penta Soft Medium Body (MB)
Impregum Garant Soft Light Body (LB)

all products are manufactured by 3M ESPE

Results

Mean values and standard deviations are listed in the table. For DR the required 20 µm line (LB, LBQ, MB, MBQ) or 50 µm line (HB, HBQ) and for CG the required 50 µm line for all materials was visible for all specimens. Data analysis by 2-sample t-test for corresponding pairs HBQ-HB, MBQ-MB, LBQ-LB revealed statistically significant differences ($p < 0,05$), which are marked with an asterisk.

	CO [mm]	WT [sec]	LC [%]	RD [%]	SC [%]	TS [MPa]	EL [%]
HBQ	33,1 (0,42)*	141 (8)*	-0,33 (0,05)	98,28 (0,04)*	2,78 (0,04)*	2,30 (0,23)*	391 (37)
HB	34,5 (0,35)	195 (4)	-0,31 (0,03)	98,02 (0,06)	5,53 (0,12)	1,88 (0,21)	360 (53)
MBQ	35,5 (0,35)	129 (8)*	-0,38 (0,08)	98,08 (0,08)	2,64 (0,05)*	2,29 (0,16)*	330 (25)
MB	35,7 (0,45)	174 (13)	-0,33 (0,06)	98,02 (0,07)	5,19 (0,11)	1,82 (0,21)	301 (56)
LBQ	41,6 (0,55)	150 (4)*	-0,38 (0,004)	98,83 (0,06)	4,83 (0,12)*	1,63 (0,07)	224 (13)
LB	41,4 (0,55)	195 (4)	-0,40 (0,028)	98,96 (0,07)	5,32 (0,13)	1,70 (0,14)	245 (35)

Discussion

The international standard, ISO 4823:2000, specifies requirements and tests for evaluating dental impression materials. It aims at the characterization of clinically relevant parameters through easy to perform measurements. Although these simple tests will not allow one to fully judge and predict clinical performance of impression materials, they actually do allow one to classify them as "clinically acceptable". Obtained results can be considered as a basis for comparison of different impression materials. The standard looks at:

Consistency to enable a basic understanding of the rheological properties

Total working time to determine the time a dentist can handle the unset material before distortion, as a consequence of developing viscoelasticity, occurs.

Detail reproduction to assess the accuracy of the oral imprint.

Compatibility with gypsum to address the ability of the impression material to deliver precise models in the dental lab.

Linear dimensional change to ensure that polymerization shrinkage of the impression material is sufficiently low to generate adequate models.

Recovery from deformation to verify that material deformed by removal from the mouth recovers adequately.

Strain in compression to measure the elastic properties in order to determine whether flexibility of the set impression is sufficient to allow safe mouth removal, but stiffness is high enough to avoid deformation while pouring a model.

McCabe Rheometer

Detail Reproduction
Linear dimensional change

Comaptibility with gypsum

Discussion

Type	Consistency (test disc diameter) mm		Detail reproduction (line width reproduced)	Linear dimensional change %	Compatibility with gypsum (line width reproduced)	Elastic recovery %	Strain in compression %	
	Min.	Max.	µm	Max.	µm	Min.	Min.	Max
0	---	35	75	1,5	75	96,5	0,8	20
1	---	35	50	1,5	50	96,5	0,8	20
2	31	41	20	1,5	50	96,5	2,0	20
3	36	---	20	1,5	50	96,5	2,0	20

Physical property requirements of ISO 4823:2000

Specimen acc. to DIN 53504

Tear properties are not addressed by ISO 4823:2000 despite their importance, as modern impression materials will easily flow into narrow interproximal spaces or deep sulci. In fact, in dentistry no standard for tear properties exists, yet. This led us to use German industrial standard DIN 53504 to assess **tear strength** and **elongation at break**.

The new quick setting polyether materials exhibit working times according to ISO 4823 which are about 25% shorter than the WT of their regular setting counterparts. Since a change in WT is generally over-proportionally related to changes in setting time, these results back up claims of the manufacturer of a reduction of one third of the impressioning procedure time in clinical practice.

Besides their setting characteristics the tested materials behave quite similar, although some statistically significant differences can be detected. HBQ exhibits a somewhat firmer consistency than its regular setting counterpart and also a slightly higher recovery from deformation. However both parameters stay well within ranges typical for these type of materials. Both HBQ and MBQ display a somewhat improved tear strength. Despite being measurable such small differences might not be detectable by the practicioner. All the required lines are completely visible for every specimen when testing for detail reproduction and compatibility with gypsum. Linear dimensional change is well within ISO limits.

The major difference besides setting characteristics is a lower strain in compression value for all quick setting materials. Lower SC indicates a higher rigidity of the set elastomer. Such rigidity is especially beneficial when pouring models from impressions which are not supported by a rigid tray, i.e. in the dual-arch impression techniques.

Conclusion

The new quick-setting Impregum Penta Soft Quick Step polyether impression materials are similar to controls despite small differences. Fast set (WT) in combination with higher rigidity as indicated by lower strain in compression could make these materials especially attractive for dual-arch technique impressions.

Literature

[1] ISO 4823:2000, Dentistry – Elastomeric impression materials

[2] DIN 53504, Prüfung von Kautschuk und Elastomeren - Bestimmung von Reißfestigkeit, Zugfestigkeit, Reißdehnung und Spannungswerten im Zugversuch