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Comparison of clinical and technological auxiliary dental materials, gypsum

Abstract: Comparative evaluation of physical and mechanical properties of dental gypsum as auxiliary material during orthopedic treatment of dental patients with clinically-oriented view of production technology will improve the quality of dentures. Gypsum is the most accessible auxiliary materials in prosthetic dentistry, and even indispensable, since the vast majority of dental prostheses made it to gypsum models in plaster press form.

Comparative assessment of the quality of different types of plaster certified carried out in accordance with the requirements of international standard ISO-6873 accredited laboratory in pre-clinical testing of dental materials and products of JSC« Stoma» (Kharkiv). For comparison were taken following brands plaster «GW-G-10-III», «Base Stone», «GC Fudjirok EP».

In terms of the ratio of hydrophilic materials meet all requirements of ISO-6873. In terms of "total work time" all the studied materials on 25-60% higher than the indicative value of ISO-6873 that can provide leisurely work. Time structuring all samples plaster for casting the combined collapsible working models of the jaws is within the respective indicative value, the relative expansion in the structuring of all the studied materials at 20-70% below the indicative values relative expansion after plaster structuring all samples within the indicative values of ISO-6873. As revealed by the analysis of these laboratory tests, compression strength material samples to 15-60% higher than the ISO-6873 and the most important «GC Fudjirok EP» - (32,0 ± 2,1) MPa, the following meanings - «Base Stone» (28,5 ± 1,5) MPa, and the lowest is «GW-G-10-III»- 23,0 ± 0,8 MPa.

It is proved that the studied species gypsum have very different physical and mechanical properties that can not affect the quality of dentures made on plaster models.

Keywords: physical and mechanical properties, gypsum, ISO, dentures.

Actuality. Recently, many new auxiliary materials for the manufacture of orthopedic constructions in the treatment of dental patients appeared. However, the gypsum is still used in dental laboratory and in clinical prosthodontics, it is the most accessible material, and even indispensable, since the vast majority of dentures made on gypsum models and gypsum molds. Dental gypsum is used in almost all stages of manufacturing dentures, production models of the jaws, face masks, molding materials, solder and other works [1].

Natural gypsum is a widespread white, gray or yellowish. His sensitive occur together with clay, limestone, rock salt. The chemical composition of natural gypsum - dihydrate calcium sulfate. Gypsum formation is a result of its loss in the sediment in lakes and lagoons of aqueous solutions, where many of calcium sulfate are. The main deposits of gypsum belong to the sedimentary gypsum. In its pure form is rare. Tooth-technical gypsum is produced by burning natural gypsum. This dihydrate calcium sulfate loses crystallization of water and goes into the semi-aquatic calcium sulfate-hemihydrate. The process of dehydration is the most intensive in the temperature range from 120 to 190° C [2].

It is important in each type of dental work, to use the proper brand gypsum and to know its characteristics. Using in dental laboratory gypsum varieties adhere to standard varieties ISO 687, [3, 4] and are classified by the International Classification:

Type 1. Gypsum for prints.

Type 2. Medical Gypsum.

Type 3. High-strength gypsum models.

Type 4. Supersolid gypsum models and stamp with small index extension.

Type 5. Supersolid gypsum models and stamp of the high rate of expansion.

The main feature is the ability of gypsum is reacting with the water, becoming dihydrate gypsum. This process is called grasping gypsum and is accompanied by the release of energy. The heat of reaction is 16.38 kJ/1 mol of gypsum [5].

Just during crystallizing gypsum, it begins to form and to grow. According Napadov M.A., Herner M.M. (1984) under normal operating conditions linear expansion gypsum varies in the range of 0.06 to 0.5%. In deviation from optimal conditions could reach 1.15%. But the manufacture of dentures linear expansion can

reach larger values. It is clear that production of high-quality prosthesis in this case is impossible. Even the use of modern impression materials doesn't give shrinkage, which gives fairly accurate prints prosthetic bed tissues and is reduced to naught when casting gypsum model without observing some special measures to compensate for expansion in the gypsum grasping [6, 7].

Many manufacturers of gypsum described in the instructions that it is better to use distilled water. However, the results of unofficial survey shows that 70% of dental technicians workers use tap water.

The purpose of research. Comparative evaluation of physical and mechanical properties of a gypsum dental material support improving the quality of orthopedic treatment of dental patients given clinically-oriented manufacturing techniques of dental dentures.

Materials and methods of research. Comparative assessment of the quality of different types of certified gypsum is carried out in accordance with the requirements of international standard ISO-6873 accredited laboratory in preclinical testing kits, according to materials and products of JSC «Stoma» (Kharkiv). For comparison following brands of gypsum «GW-G-10-III», «Base Stone», «GC Fudjirok EP» were taken.

To determine differences in the application and distilled water at hardening gypsum, are used his samples of gypsum, which have an average length of 97.8 mm. Using a special device (micrometer) was measured samples of gypsum expansion after 30 minutes, after 8 hours, 24 and 72 hours.

Physical and mechanical investigation of the above gypsum types studied the following parameters: hydrophilic ratio (wt / %), total working time, time structure, the relative expansion in the structuring, the relative expansion after structuring, compression strength of 240 samples.

Results of research. The largest expansion of gypsum samples were recorded using hot tap water. Samples of gypsum expanded for 3 days, which was 0.11 mm (0.07%).

Comparative analysis of the quality of dental auxiliary material included summarizing the results of the laboratory study of the physical and mechanical properties of different types of gypsum. A total of qualimetrical assessment gypsum investigated indicative properties supporting materials: "GW-G-10-III», «Base Stone», «GC Fudjirok EP», which provides ISO-6873: hydrophilic ratio (wt /%), total

working time, time structure, the relative expansion in the structuring, the relative expansion after structuring, compression strength.

In terms of the hydrophilic ratio, as confirmed by the results of laboratory tests (Table 1), all materials meet ISO-6873, but the most accurate indicator of a «GC Fudjirok EP» and amounts to 0,28 ± 0,01, while the material «Base Stone» - 0,28 ± 0,03, and the «GW-G-10-III» - 0,29 ± 0,01. For these materials obtained qualimetric relevant indicators, information varies (0,0÷0,050) bits and is accordingly: «GW-G-10-III» - 0,0 bit, «Base Stone» - 0,050 bits «GC Fudjirok EP» - 0,050 bits.

In terms of «total work time» (Table 1), all the studied materials were on 25-60% higher than the indicative value of ISO-6873 that can provide leisurely work. Thus, for material «GC Fudjirok EP» total work time is 48,0 ± 2,3 minutes, while the material «Base Stone» - 41,5 ± 2,0 minutes, and «GW-G-10-III»- 37,5 ± 1,5 minutes. For these received materials and the corresponding relative qualimetric and standardized indicators which fluctuated within (0,258 ÷ 0,424) bits.

Structuring time of all gypsum brands for casting of combined collapsible jaws working models (Table 1) is located within the respective indicative value ISO-6873. Thus, for the material «GC Fudjirok EP» it is 18,0 ± 0,5, for material «Base Stone» - 12,8 ± 0,8, for «GW-G-10-III» - 7,5 ± 1,0, and provides relevant indicators qualimetric investigated materials within (0,330 ÷ 0,471) bits.

Table 1

The results of the laboratory study of the properties of auxiliary dental materials: gypsums

Properties of auxiliary materials		Quality indicators for ISO-6873	Auxiliary materials		
			«GW-G-10-III»	«Base Stone»	«GC Fudjirok EP»
Hydrophilic ratio (wt /%)	M±m, unit	0,28÷0,30	0,29±0,01 [a]	0,28±0,03	0,28±0,01 [в]
	S	1,0	1,000	0,965	0,965
	h_0	0	0,000	0,050	0,050
Total working time	M±m, minute	≥30,0	37,5±1,5	41,5±2,0 [c]	48,0±2,3 [в]
	S	1,0	0,800	0,723	0,625
	h_0	0	0,258	0,338	0,424
Time structuring	M±m, minute	4,0÷20,0	7,5±1,0 [a]	12,8±0,8 [c]	18,0±0,5 [в]

	S	1,0	0,375	0,640	0,900
	h_0	0	0,531	0,412	0,137
The relative expansion at structuring	M±m, %	≤0,100	0,080±0,010 [a]	0,050±0,010 [c]	0,030±0,010 [в]
	S	1,0	0,800	0,500	0,300
	h_0	0	0,258	0,500	0,521
The relative expansion after structuring	M±m, %	≤0,020	0,020±0,005 [a]	0,010±0,001	0,009±0,001 [в]
	S	1,0	1,00	0,500	0,450
	h_0	0	0,000	0,500	0,518
Compression strength	M±m, MPa	≥20,0	23,0±0,8 [a]	28,5±1,5	32,0±2,1 [в]
	S	1,0	0,869	0,701	0,625
	h_0	0	0,176	0,359	0,424
Synthesis Quality Score - H bit			0,204	0,360	0,346

[a] – significant differences between the material 1 and material 2 at level p ≤0,05;

[в] – significant differences between the material and the material 3 at level 1 p≤0,05;

[c] – significant differences between the material 2 and material 3 at level p ≤0,05;

S – significant differences between the material 2 and material 3 at level p

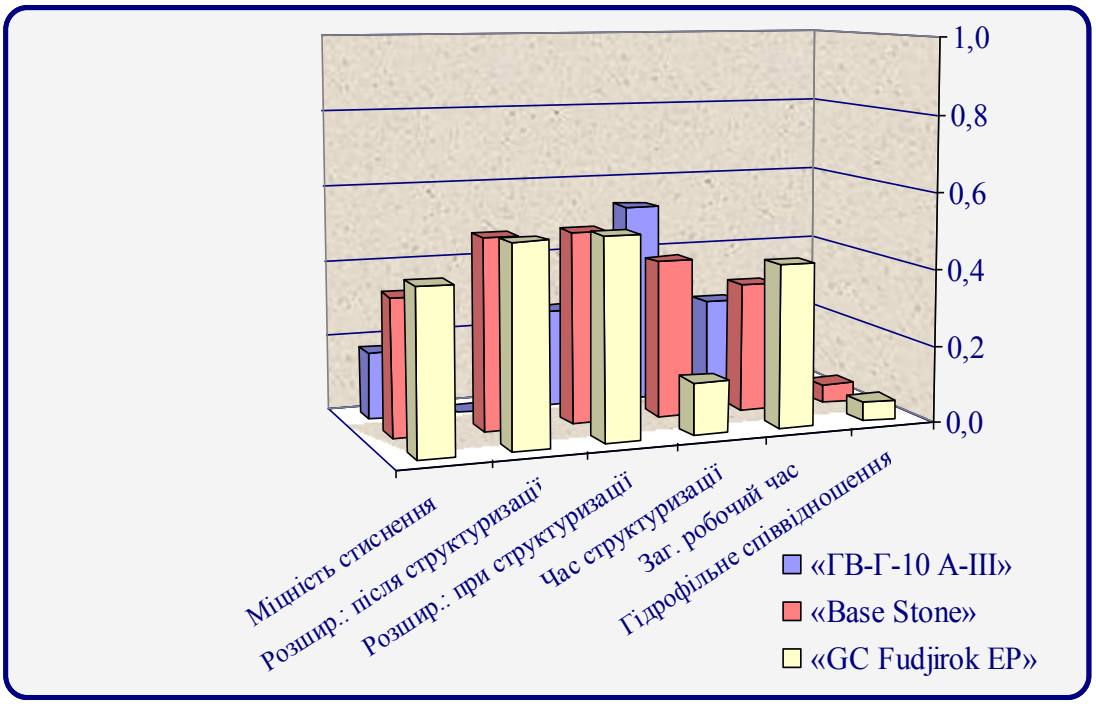

Fig. 1. Qualimetric profile of auxiliary dental materials: gypsum for casting of combined collapsible working models of jaws

The relative expansion in the structuring of the studied materials at 20-70% below the indicative values of ISO-6873, the lowest figure is «GC Fudjirok EP» (r≤0,05), it is (0,009 ± 0,001)%, «Base Stone» - on 50% below its value (0,050 ± 0,010)%, and "GW-G-10-III» - (0,080 ± 0,010)%. These laws and displayed qualimetric parameters whose values are within (0,258 ÷ 0,521) bits.

The relative expansion after structuring of gypsum samples within the indicative values of ISO-6873, with the figure «GC Fudjirok EP» (r≤0,05) 45% lower ISO setting and it is (0,030 ± 0,010)%, «Base Stone» matter (0,010 ± 0,001)%, and "GW-G-10-III» - (0,020 ± 0,005)% and a threshold value. Qualimetric indicators are within (0,0 ÷ 0,518) bits.

As revealed by the analysis of these laboratory tests, compression strength material samples to 15-60% higher than the ISO-6873 (Table 1) and the most important «GC Fudjirok EP» - (32,0 ± 2,1) MPa , the following values - «Base Stone» (28,5 ± 1,5) MPa, and the lowest is "GW-G-10-III» -23,0 ± 0,8 MPa.

Summary. Thus, we have shown that various types of gypsum have very different physical and mechanical properties that can not affect the quality of dentures made on plaster models. Therefore, the study and consideration of the gypsum properties is relevant for many years because it is the most accessible material, and even indispensable, since the vast majority of dental prostheses made it to gypsum models.

Prospects for development research. Determining of impression material's compliance is scheduled with based on the use of gypsum brand for manufacturing combined and collapsible models for making various designs of dentures.

References:

1. Kopeikin V.N., Demner L.M. Denture equipment. - M.,"Triad - X", – 2003. – 165 p.
2. Richard Van Nurt «Fundamentals of dental materials science» (second issue). – 2004. – P. 213-218.
3. Marcus Reze "Dental gypsum" // Dental South, № 2 (43), – 2007. – P. 22-23.
4. Bogdanovich I.A. High-strength gypsum for dental purpose / Bogdanovich I. A. // Abstracts. Proceedings. – BGTU. – 2000. – P. 25-26.
5. Dental materials science: Textbook / E.S. Kalivradzhiyan, E.A. Bragin, Abakarov S.I., S.E. Zheludev etc. – M.: OOO "Publisher" Med.inf.agency, 2014 –320 p.

6. Yanishen I.V. Metrological certification of plaster models cast for reprints of the alginate impression materials // Experimental and Clinical Medicine. – 2004. – № 4. – P. 191-194.
7. Guidelines for dental materials science / Edited by E.S. Kalivradzhiyana, E.A. Bragin. – M.: OOO "Medical News Agency". – 2013. – 304 p.