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CLINICAL AND EXPERIMENTAL TESTING OF SPECTROPHOTOMETRIC METHODS IDENTIFICATION OF ADHESIVE SYSTEMS IN FORENSIC DENTISTRY

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Summary : In modern dental industry has not been fully resolved is the assessment of the quality of dental care. Given the high prevalence of caries (61-96%), basic dental procedures is filling cavities by fotocomposite materials, which in turn makes use of adhesive systems. But, including epidemiological studies and high level of appeals patients complaining of poor dental fillings, one of the reasons of the use of adhesive systems are poor quality, there is a pressing question in respect of the identification of adhesive manufacturers.Development of spectrophotometric methods for the identification of adhesive systems to study the evidence base in dentistry and forensic medicine. Conducted laboratory tests found that the adhesive spectrophotometric method of identification V-VII generations can transmiss and absorb light waves in the range (400-700 nm.) are significant.

Key words : identification of adhesive systems, forensic dentistry, spectrophotometric method, light spectroscopy

Actuality of theme: The issue of assessing the quality of dental care delivery to the population remains unresolved in the modern dental industry (Samoilenko A.V, Sokolova I.I. 2016). According to the Ministry of Health of Ukraine, the prevalence of caries and its complications in the adult population is 61-96% (Pavlenko O.V., 2013) That is why the main dental manipulation is the filling of carious cavities with photocomposite materials, which in turn determines the use of adhesive systems of V-VII generations. [1,2,3,4].

However, according to the results of the epidemiological analysis and the reliability of the patients' dental cards, a high level of treatment of patients with complaints about poor quality sealing was noted, one of the reasons for which is the violation of the technique of work with adhesive systems and the use of adhesive systems of poor quality due to the large amount of falsification To the dental markets of Ukraine, confirming the latest dental monitoring data.

Since the development of a new adhesive system prior to its introduction and application in clinical practice, there is a sufficiently long period during which the physical, chemical, biological properties of the new material are comprehensively studied for compliance with accepted standards. [4,5,6] . Studies at the preclinical level include the evaluation of cytotoxicity, teratogenicity, allergic and other effects in the experiment on cell cultures, animals, and strength tests. [7,8] Following the successful passage of this stage, the results of the clinical approbation of the new material in various expert organizations . Only after this the new adhesive system gets on sale on the dental market. [9,10]

According to IOFOS (Solheim T., 2012) Bidi VI, Mischalova V.D. (2013), the largest number of conflict situations between patients, doctors and clinics is determined precisely in this segment of medical-legal relations, which become the subject of commissions for quality assurance of dental care. The analysis of the sources of scientific and medical information shows that to date, in practical health care, there are no substantiated methods for identifying dental adhesion systems in relation to the manufacturer. [11,12]

Practical verification of identification efficiency by means of physical research methods will allow to establish not only the level of correspondences and reliability of the results obtained, but also the expediency of implementation of the method in terms of the volume of the narrative part of the quantitative data, the financial feasibility of broad implementation, the conditions of implementation and approaches to minimize errors and nature their occurrence.

Identification of dental adhesive materials under conditions of invitro will allow experimentally arguing the effectiveness of the proposed method using the principles of statistical processing of results and formulating a set of criteria defining the key identifiers for laboratory testing of adhesive systems. [12]

Consequently, expanding the evidence base of expert criteria for evaluating the dental status when considering complaints about inadequate dental treatment is an urgent scientific task for dentistry and forensic medicine, which needs further resolution.

Materials and methods of research. Laboratory research was carried out on the basis of the Faculty of Cetology of UzhNU, the Research Center for Forensic Dentistry and the Department of Optical Physics of the Faculty of Physics, Uzhgorod National University During the experiment, a spectrophotometric device based on the spectrophotometer SF-4 and representatives of the main generations of adhesive systems was applied: Prime & Bond NT (Dentsply) - V generation acetone-containing adhesive system, OptiBond Solo Plus (Kerr) - V generation - ethanol-based adhesive system, ForBond (CromDental) - V Generation Ethanol Adhesive System, Single Bond Universal (3M) - Generation VII, Ethanol and Water Adhesive System, Adper Single Bond (3M) - V Generation, Ethanol Adhesive System, Tetric N Bond Self Tech (Ivoclar) - VII Generation , adhesive system based on water. From all representatives of adhesive systems, identical workpieces were made, measuring 10 x 5 x 2 mm. The sizes of the test plates were checked using a caliper. The plates were labeled with digital numbers to optimize the process of categorizing the results. After the formation of the test plates, each of them was investigated by spectrophotometry (reflection, transmission, absorption).

The light from the incandescent lamp in the experiment goes to the prism of the spectrophotometer SF-2 and decomposes into the spectrum. Then, the light passes through a groove for the filters, in which a sample of adhesive system was installed in advance. Passing through the sample the light of a certain wavelength falls on a photoelectron multiplier (FEP) and creates in the circuit an amplifier and an FEP a photocurrent whose magnitude is proportional to the intensity of this radiation The photocurrent's sunshine is small (10^{-10} - 10^{-8}A) can not be measured by an ammeter. Therefore, not the photocurrent is measured, but the voltage at the output of the amplifier. This voltage is proportional to the photocurrent, and, consequently, the intensity of the radiation emitted by the photodiode.

If there are no samples in the grooves for the samples, we will have a continuous spectrum of the tungsten filament light filament (without taking into account the spectral sensitivity of the FEP). If samples are found in the grooves, we obtain the transmission spectrum of the sample. Comparing it with the spectrum of tungsten filament radiation, one can determine the absorption spectrum and measure the wavelength corresponding to the absorption limit of the sample.

Results of the research and their discussion. As a result of the experimental laboratory study, it was found that the absorption and transmission coefficients of these samples are different, and are purely individual for each sample, and also coincide with the reference base data. The spectrophotometric reflection method is not reliable, since the discrepancies in taking off the indicators from the photovoltaic multiplier were such that they were included in the error margin of the instrument. Therefore, it can be argued that spectrophotometric transmission and

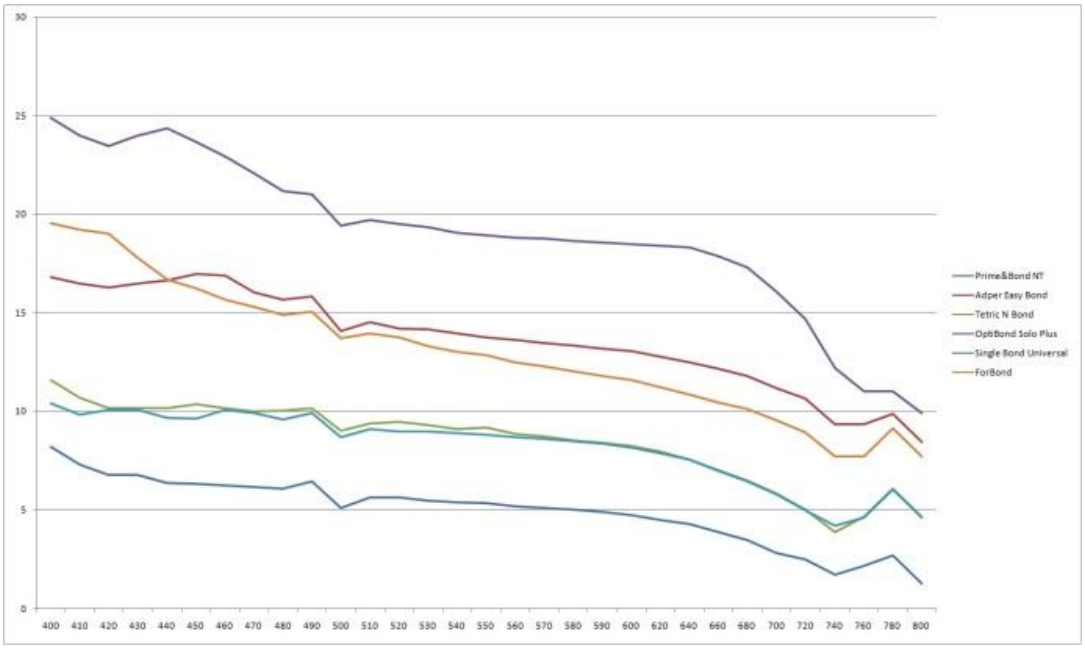
absorption parameters are reliable The use of advanced methods of spectrophotometry allows the identification of V-VII generation adhesive systems capable of transmitting and absorbing light waves in the range (400-760 nm.). This in turn enables us to carry out an objective assessment of the quality of the provision of dental care to the population, to identify falsified products that It appears on the Ukrainian market of dental materials. Therefore, it can be argued that the method of identification of dental adhesion systems with the verification of their specific optical properties in the range of the studied light waves is possible. The results of measuring and calculating the optical properties of dental adhesion systems (absorption and transmission coefficients), their graphical and tabular values are presented below to objectify the dependence of the indicators on the wavelength of the light beam and the manufacturer.

Довжина хвилі (нм)	Prime&Bond NT	OptiBond Solo Plus	ForBond	Single Bond Universal	, Adper Single Bond	Tetric N Bond Self Tech
400	0.849403	0.375933		0.748764	0.473453	0.648347
420	0.993048	0.239485		0.352845	0.645323	0.235549
440	0.123849	0.383032		0.320643	0.623496	0.732745
460	0.834958	0.839405		0.863055	0.258432	0.521845
480	0.294053	0.483052		0.864304	0.128640	0.392734
500	0.084934	0.746384		0.630493	0.251743	0.129846
520	0.093845	0.439473		0.632034	0.329183	0.762534
540	0.938475	0.258434		0.774934	0.323483	0.473829
560	0.839423	0.637283		0.374937	0.987453	0.873496
580	0.434593	0.201830		0.664839	0.645329	0.540374
600	0.094853	0.638293		0.098463	0.125403	0.128496
620	0.234954	0.445363		0.453222	0.832104	0.096438
640	0.432358	0.735495		0.749312	0.2946834	0.735274
660	0.448345	0.990937		0.442739	0.7342634	0.6647382
680	0.834533	0.442394		0.988836	0.134274	0.6473282
700	0.349503	0.129764		0.836273	0.084632	0.1327454
720	0.673943	0.883628		0.497284	0.095643	0.6243973
740	0.840345	0.319743		0.263943	0.063284	0.0745382
760	0.934753	0.765034		0.732201	0.845323	0.4630293
Коефіцієнти пропускання адгезивних систем V-VII поколінь						

Tab.1 Coefficients of adhesive systems of V-VII generations

Довжина хвилі (нм)	Prime&Bond NT	OptiBond Solo Plus	ForBond	Single Bond Universal	, Adper Single Bond	Tetric N Bond Self Tech
400	0.024567	0.028249		0.937483	0.849324	0.372934
420	0.026904	0.394793		0.845374	0.483283	0.485934
440	0.047592	0.289494		0.610023	0.829437	0.985734
460	0.058394	0.284949		0.745923	0.372643	0.859323
480	0.070384	0.759302		0.139844	0.087321	0.234854
500	0.075849	0.729403		0.149835	0.048329	0.285034
520	0.084583	0.597203		0.175935	0.058323	0.285943
540	0.089345	0.629304		0.183039	0.983745	0.583234
560	0.139844	0.493848		0.194038	0.123753	0.729403
580	0.149835	0.084749		0.397633	0.493848	0.597203
600	0.175935	0.838492		0.044332	0.084749	0.629304
620	0.183039	0.375933		0.753924	0.838492	0.493848
640	0.194038	0.394850		0.374828	0.375933	0.084749
660	0.349503	0.840834		0.528390	0.239485	0.485932
680	0.389312	0.239485		0.327528	0.383032	0.849304
700	0.398374	0.383032		0.221102	0.839405	0.148394
720	0.428494	0.839405		0.923561	0.483052	0.389245
740	0,434944	0.483052		0.349539	0.495032	0.382940
760	0.494030	0.495032		0.934328	0.348392	0.948372
Коефіцієнти поглинання адгезивних систем V-VII поколінь						

Tab 2. Coefficients of absorption of adhesive systems of V-VII generations



Pic. 1. Coefficients of absorption of dental adhesive systems of different manufacturers

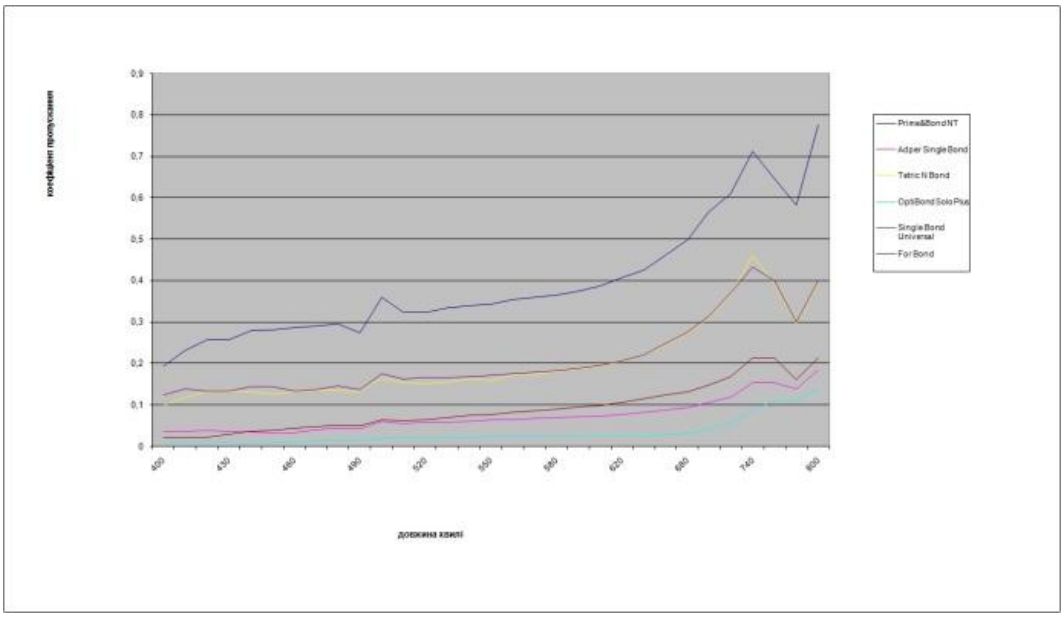


Fig. 2 Coefficients of passing dental adhesive systems of different manufacturers

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