Review Article

Frequently Used Devices in Dentistry Research

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Received: 06-03-2014

Revised: 11-03-2014

Accepted: 12-03-2014

Abstract

The presence of the human eye in examining the physical, chemical and mechanical properties of materials is exclusively insufficient. For this reason, the devices which enables the smaller details to be seen have been developed. Because the processing of beams reflected from objects are fundamental in generating vision and images, obtaining much shorter wavelenghts than visible lights have was required in order to reduce into smaller microscales by increasing solubility. As a result, the devives that are capable of doing operations and analysis in high magnifications with a combination of electron and optic systems have been developed. In this study, the needed information about Scanning Electron Microscopy, Quantum Desing Pyhsical Properties Measurement System, XRD Rigaku Rad BDMAX II, Macro Hardness Tester, Nano-Micro-Mechanical Testings, Atomic Force Microscopy, Impact Tester and Color Spectrophotometer which are frequently used in Dentistry Researches.

Key words: Dental Investigation Methods, Dental Research.

This article may be cited as: Kamalak H, Tekin MG, Kamalak A. Frequently Used Devices In Dentistry Research. J Adv Med Dent Scie 2014;2(1):42-46.

Introductıon

The technology has a number of positive effects on human beings life from past to present. People have developed new devices due to the nature of the people with their studies as a result of wondering and questioning. These new devices have not only be a guide in treatment and diagnosis of a disease, but also in examination of materials. Some of the devices used in dentistry researches are:

Nano-Micro Mechanical Tests

This device is used in determining the properties of different materials (soft, hard, fragile and elastic) and the mechanic properties (hardness, elastic modulus) of thin films formed out of these materials.

Akçaboy et al. used various surface hardeners in order to make the plaster be persistent to hardness and abrasion in their study which they used indentation device. In addition, they searched whether it is necessary to use a cyanoacrylate-based adhesive substance that is used with the purpose of bonding as the plaster surface hardener. The surface hardness of the plaster models created in this article were measured. As a result, they informed that Super Glue 3 hardens the plaster surface; but it also causes a thickness of 49 microns.[1] Chung et al. made a research on the effect of surface hardness of resin-based dental composite materials upon material polishing. They informed that the polishing has no any effect on the composite under 10 N load.[2] Wagner WC and Chu TM made a durability test to three porcelain materials and they found out that the porcelain named All Cream was more durable than any others.[3] Yoldaş O. et al. studied composite materials with different micro-hardness tests. Finally, they informed that the used micro-indentation tests must be standardized.[4] Sergi RR et al., in their in-vitro studies, searhed the abrasions formed in enamel and the resistance of enamel against fraction in the teeth with home-bleaching applications. As a result of this study, they came to a conclusion that 10% carbamide peroxide gel causes changes on enamel surface and diminishes fracture resistance.[5]

Color Spectrophotometer

Spectrophotometers records the amount of visible energy reflected by an object for value, chroma and hue seperately as being only a wavelenght at each time.[6] Öngül et al. kept Biodent and GC Gradia hybrid composite samples in mouthwashes and made a color measurement with Spectrophotometer. They found the results significant as statistically.[7] Witkowski et al. informed that even if Crystaleye (Olympus, Tokyo, Japan) Spectrophotometer is used together with the various observer and the light source, it provides consistent results.[8] Kanawati ve Richards pointed that there is the accuracy rate of 85% in in-vivo studies of Vita Easy Shade.[9] Pusateri et al. stated that the Spectrophotometers (Shade Vision and Vita Easy Shade) are much more reliable and gives more accurate results when compared to colorimeters as a result of their work in which they compared different color measuring devices in terms of reliability and repeatability.[10] Paul et al. compared the efficiency of naked-eye and Spectrophotometric color analysis in human teeth color analysis. Paul et al. argued that Spectrophotometric color analysis is a a more reliable and applicable method.[11] It can provide different measurement results in Sun light, incandescent and fluorescent light. For this reason, Spectrophotometers are used in profesional scientific Works, quality standard controls and in describing the color.[12]

Impact Test Device

In in vitro work done by Soygun et al., the lignin was added to PMMA resin composite in concentrations of 13.5%. they stated that the lignin substance has a plasticizer effect.[13] In another in-vitro study done by Soygun et al., they concluded that the Valplast substance doesn't increase the elastic module when it is added to PMMA.[14] Darin R. Lunt et al. examined the energy absorption values of three protective materials named EVA, Pro-form and Polyshok. The Polyshok material has given the best absorbtion value.[15]

Atomic Force Microscopy

Valois et al. made a research on NaOCl 's effects on the structural properties of gutta-percha that is used in root canal treatment in different amounts and informed that it is more reliable to use NaOCI in proportion of 5%.[16] Salerno M. et al., in their study, examine the physical properties of commonly used midifill composite

restoration called as Venus Diamond. They point out that pre-polymerized particles in composite causes an increase in physical properties of material.[17] Botta AC et al. compare the surface roughness values by using 4 different composite and 4 different polishing methods. They provide the least roughness in microfill-included composites by aluminum oxide discs.[18] Kakaboura A. et al. compare three-new composite generation and four different polishing techniques with four different test apparatus. Then, they point out that there is a correlation among the found results.[19] Salerno M. et al. examine post-polishing surface roughness values of composite restorations by using air polishing method (including sodium bicarbonate and glycine). They found the lowest surface roughness when they used glycine during 5 seconds.[20]

Quantum Design Pyhsical Properties Measurement System

Quantum Design-9T Pyhsical Properties Measurement System (PPMS) has been pruduces in order to determine thermal conductivity of the materials. PMMS is an essential measurement device that is used in Research and Development proccess of magnetic materials. With this system, measurements can be performed in the temperature range of 2K-1000K and materials can be applied magnetic field up to 9 Tesla.[21]

This device is able to make measurements with two different options. These are the option that allows magnetization measurements and magnetoresistive option allowing for resistance measurements under magnetic field. The magnetic resistance option consists of a sample rotator station and electrical devices for applying and measuring current/voltage.[21]

Scanning Electron Microscopy (SEM)

The first commercial scanning electron microscope was used in 1965. In order to obtain the images in Scanning Electron Microscope (SEM), electrons accelerated by the high voltage must be focused on the sample, and a variety of changes and interacts between sample and electrons atoms must be gathered in the appropriate sensors afer the operation of electron beams onto the sample surface and must be digitized after the performance of signal booster.[22] The digitalized image is formed as three-dimensional. Scanning Electron Microscope has a more visual acuity between 20 and 100.000 and 300 times greater depth of focus than light microscope.[23,24,25] In dentistry, Scanning Electron Microscope can be used in scientific researches such as determining blood and tissue samples, the factors causing diseases, the effects of the drug on the patient, durability of metals and in examining structures of metals, plastics and ceramics.[26,27,28]

XRD Rigaku Rad BDMAX II

X-ray diffraction device (XRD) performs an analysis on samples using characteristic X-rays just similar to SEM device. But when in SEM the electrons are sent to the samples, in XRD, X-rays are sent. X-rays are produced in vitro. The rays from the X-ray tube sentenced break in the plane of the sample atoms are reflected back and the data is digitalized on monitor after having been collected in detectors.[29] XRD is based on breaking the X-rays in the same way at each time depending on the specific atomic pattern of each sample.[30] Finally, the peaks are obtained when XRD impacts atoms. By comparing the obtained peaks with data previously obtained from the results of the analysis, phase information is obtained and image formation is provided.[29] This analysis method doesn't create any damage during analysis of the sample and even provides the analysis of samples with small amount (liquid, powder, crystal and thin film). The qualitative and quantitative analysis of crystalline materials, thin films and polymers can be done with XRD system.[30] In dentistry, it can be used to

detect polymorphs and impurities given in a specific material.[31]

Macro-Hardness Measurement Device

The resistance of the material against deformation is measured. A drill to the material surface is applied in order to obtain the hardness value. Then the hardness of the notch formed on the surface of Sample is determined depending on size or depth. This test can be applied on metals, seramics and plastics.[32]

Results

In 21st century, the whole society has entered a process of change and transformation no matter what the development level is. Today, thanks to advances in science and technology research can be done in an easier way. Thanks to advances in technology, many new materials are produced. Instead of high cost, journey towards high yield is important for research. For this purpose, for example finite element analysis is improved. As described above, there are different kinds of materials. But, these materials and analysis are very expensive.

Thus, by means of both developed materials and devices; research, diagnosis, treatment planning and treatment will be carried out more easily.

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Source of support: Nil
Conflict of interest: None declared