SHORT COMMUNICATION

Concepts of Photoactivation in Adhesive Odontology

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The resinous materials, which are composite resins, adhesive systems, or resin cements, are the materials most used in adhesive dentistry. This material underwent transformations, especially with regard to the mode of polymerization. The first resins were chemically activated and were photographed by ultraviolet light only in 1973.[1] At the end of the operation, the light waves and the polymerization limitation started a study aimed at visible light for photoactivation.

The use of visible light was reported in 1976 by Mohammed Bassoiuny, and since then, is the most widely used method for a polymerization of resinous materials.[2] To this end, the development of new light proteins so that they can be obtained more quickly is in the photochemical systems present in the resinous materials. Thus, it is important that the study understands the performance of current materials, be comprehensive in terms of presentation, in addition to the basic principles governing photoactivation and photoactivation devices.

A visible light is made by waves that form the electromagnetic spectrum and are fundamental to see themselves as nuclei of objects. Without light, they do not see themselves as nuclei. The luminous wavelengths vary in size, and the range corresponding to the visible light corresponds to the region between 400 nm and 700 nm.[3] The outside temperature cores are violet, blue, green, yellow, orange, and red.[4] Thus, the nuclei that see objects are the result of a process that includes reflection and light absorption. If a leaf is green, it is because the object is reflected in waves of green color and absorbs as remaining nuclei of the visible spectrum. For the resinous materials, the applications of a light with specific wave specification, which can excite the photoinitiator, can trigger a polymerization reaction. Currently, the light used for photoactivation of resinous materials is concentrated in the region of the blue light spectrum (400 nm–500 nm).

For a better understanding of the correct application of light on resinous materials, one should understand some basic concepts. The first one is the irradiance or intensity of light, which is nothing more than the amount of photons emitted by a given light source.[3,5] High-irradiation devices emit higher amounts of photons when compared to low irradiance. The unit of measure for this property is mW/cm.[2] A photoactivating apparatus, to guarantee minimum satisfactory photoactivation, requires 400 mW/cm^2.[6] Some factors diminish the irradiance of the photoactivating apparatus: Increase of the tip-restorer material distance, devices with low battery, and equipment with spent filter, among others. There are devices for measuring the irradiance of light sources, called radiometers. They are usually portable and specific to each light source. Some devices have coupled radiometers; however, the most interesting are those that measure the irradiance in a quantitative way. In general, the technician of the companies of the photoactivating apparatus usually has a radiometer, and it is interesting to evaluate if the equipment has the correct minimum irradiance.

The second essential concept is the dose of energy. The energetic dose is the result of the irradiance versus time, i.e., it is the total energy dispensed on the resinous material.[2,3,5,6] The unit of measure is the Joule (J). The minimum energy dose for adequate photoactivation of the resinous materials is 16 J, i.e., for a 400 mW/cm^2 device, it is necessary to photoactivate for 40 s; however, for an 800 mW/cm^2 device, it should be photoactivated for at least 20 s. Practically, the vast majority of manufacturers

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recommend the photoactivation of their materials by time. For example, manufacturers recommend the photoactivation of composite resins in increments of 2 mm for 20, 30, or 40 s, depending on the degree of saturation of these materials (darker resins or cements require longer photoactivation time). However, if the professional has a low irradiance device, around 400 mW/cm^2, regardless of the color and the time recommended by the manufacturer, it is necessary to use a minimum energy dose of 16 J. In other words, the lower the irradiance, the longer the time used for photoactivation.[5,6] It should be remembered that these concepts are only valid for each resin increment applied.

Adhesive agents which do not contain solvent, in general, are suitably photoactivated by any light source. As an example, one has the three-step conditioning and two-step self-etching. Normally, this bond is composed of organic matrix free of solvente. For simplified adhesives, before photoactivation, the solvent must be volatilized at least for 10 s before photoactivation.[7] This causes the polymer matrix to later have less internal porosity and allow greater sealing of the dental substrate.[7,8] In addition, in simplified adhesives, some manufacturers, due to the excessive hydrophilicity of their adhesive materials, add alternative photoinitiators, such as QTX and thyroid peroxidase, which are not very well sensitized with second-generation light-emitting diode (LEDs).

In addition to the correct volatilization of the solvents, the relationship between the distance between the light source tip and the polymerization quality must be understood. In cavities with deep walls, as in classes I and II, where the pulp or gingival wall is located 4 mm–8 mm deep, there is a need for additional photo activation of the adhesive systems.[2] In general, manufacturers indicate photoactivation for 10s; however, it is known that the greater the distance between the light source and the surface wetted by the adhesive, the lower the irradiance reached the material. It is, therefore, necessary to carry out photoactivation for at least 20 s. This additional photoactivation should be carried out with caution because some LEDs of high irradiance emit a lot of heat, especially in the layer of adhesive.

Photoactivation in the present day is a very important process, which guarantees the final quality of the adhesive restorations. The correct knowledge of photoactivating devices and the photoactivation process allows the clinician to select and apply the appropriate material for each clinical situation and ensure the longevity of cosmetic restorations.

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