Plastination in Dentistry: Methods and Polymers

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Plastination as a means of preserving human biological tissues indefinitely, involves the use of reagents and polymers (S10, E12 and P40), with physical methods as vacuum, cold temperatures and photo polymerization. Invented over 30 years ago by the German pathologist Gunther von Hagens, plastination methods can be used successfully in over six areas of medicine and other specialties such as archeology or anthropology. The used of plastination of the oral tissues is directed towards the teaching and scientific research that implies microscopy and optical coherence tomography.

Keywords: plastination, polymers, oral tissue, biotechnology, preservation

The steps that are followed for making this process are largely dependent on the chemicals used for fixation, dehydration and polymers represented by S10 liquid silicone, epoxy resins (E12) and polyester (P40). The technique that requires the use of low viscosity and colorless silicone named S10, which is used to preserve macroscopic specimens of oral cavity: teeth, tongue, muscles, vessels and nerves. Epoxy resins used for histological sections up to 1 mm thick and for microscopic examination. P40 technique, due to the high degree of fluidity, is used to achieve plastination of brain sections that are 1-2 mm in thickness. All three techniques are preceded by collecting, fixating and dehydrating of tissues [1, 2].

Experimental part

The plastination process consists of four basic steps: fixing, dehydrating, forced impregnation and curing.

Fixation. The type of fixatives is chosen according to physical and chemical properties aimed to be achieved for preventing autolysis and putrefaction of the tissues and preservation the morphological structures. Formaldehyde preserves very well the mitochondria and formations of the central nervous system but in a pure solution it is a poor histological fixative, making harder the differentiating of tissue and color acidophilus of cells elements. As a solution in 8-10% NaCl solution it preserves very well the nucleus. In time, formaldehyde can decalcify when forming formic acid. [3]

Dehydration by freeze substitution (-25°C). As solvent for dehydration, in the literature are cited acetone and methyl ethyl kethone. Most of the laboratories in the world, as well the laboratory of Victor Babes University, use acetone because of low cost and low degree of flammability, compared with methyl ethyl kethone. At this stage inter and intra-cellular fluids (water, etc). Clamps agents are removed to replace the desiccant agent. Acetone solution employed must be pure and constantly monitored by measuring with acetonometers.

Forced impregnation. Dehydrated pieces are immersed in polymers and then subject to the action of vacuum. The principle is to remove the acetone by action of vacuum pump, allowing the penetration of the polymer. Duration depends on the size and type of tissue, and the polymer used. It can be carried out at room temperature or cold temperatures (-15 ° C or -25 °C).

- S 10 technique: S 10 silicone is mixed with S3 (100:1), which does not polymerize at negative temperatures, but at 30-40 ° C. S 10 - S 3 mixture will finally polymerized under the action of a gas S6. S 10 is a polydimethylsiloxane with chemical formula CH3[Si(CH3)2O]nSi(CH3)3, having molecular weight of 27,200 g / mol. The polydimethyl-siloxane has viscoelastic properties with density of 0.764 g/mL at 20 °C. S3 is supposed to be dibutyltindi-laurate with oleate. The dibutyltindilaurate has the chemical formula C32H64O4Sn and 1.066 g/mL at 25 °C density. S 6 is tetraethyl orthosilicate Si(OC2H5)4 and the density of 0.94 g/mL, whose vapors are irritating to upper respiratory tract [4].

- E 12 technique: provides a mixture composed of Biodur E12, 100 pbw, Biodur E1, 30 pbw, and Biodur AE 10, 20 pbw. E 12 is a transparent and less viscous epoxy resin. E1 is cyclohexylamine having the chemical formula C6H13N and 0.867 g/mL at 25°C density. Biodur 10 AE additive is a plasticizer based on dialkylaryldicarboxilic acid ester. Use of this mixture in forced impregnation is subject to a limited maximum 32 h, because the polymerization reaction is exothermic resins harden. Temperature undergoing this technique is room temperature and dimensions of specimens varies between 10 to 200 mm length and 1-2 mm thickness. The addition of larger quantities of plasticizer results in a greater tissue elasticity and transparency [5].

- P 40 technique: using polyester as forced impregnation polymer, which is very fluid suitable for impregnation of exceptionally soft tissue.

Polymerization. Silicone Biodur S 10 hardens in two stages: first there is the reaction between S10 and S 3 at a temperature of 30-40°C, followed in second phase mixture S10-S3 to S6 gas completely polymerized. If E 12 polymerization technique is presented as an exothermic reaction after forced impregnation pieces have to be placed in a fan oven at temperatures around 50°C for 1-2 days, although the polymerization can be done to room temperature, but over a period of time (4-8 days). Polyester Biodur P40 used as catalyst in the polymerization reaction UV-A [5 - 7].

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Results and discussions

After the plastination process the human teeth present an improved resistance that could be very useful for the teaching procedures. By preservations, the teeth could be used long time for didactic purpose or to present special situations like multiple roots teeth (upper premolar that usually has 2 roots but some times could present three roots). A nonplastinate tooth, by ageing, is easily broken along the examination and they are lost. For the soft tissue, an optical microscopy or an optical coherence tomography could be easily affected due to the mobility of the tissues. By plastination the investigations are easy to be performed exactly in the same area and incident direction.

Conclusions

The methods usefulness lies primarily in the facility and oral tissues to permit definitive evaluation of their morphological investigation.

Although relatively new and little known, plastination offers the advantage to preserve human tissue indefinitely without emanates after the process is completed, resulting pieces which are not toxic to humans and constitute a serious alternative to conventional preservation in formaldehyde solution.

Applicability of this method is primarily morphological in all areas where teaching and research needs require preservation unlimited human biological preparation. Thus plastination is a valuable tool in medical fields as anatomy, histology, pathology, dentistry, forensic medicine and surgery, but also in other fields such as archeology and anthropology.

Tissue fragments can be examined either microscopically after deplasticizing the tissue, or by optical coherence tomography.

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