A New Method of Artificial Bone Modeling for Medical Education

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Summary: We have developed an artificial bone modeling method by using negative cast technique. As we decided to use this material in medical student training, we insisted on producing a long-standing and not expensive material therefore we chose a polyester resin.

A good knowledge of human anatomy helps to understand the function of the systems and to treat them when they become malfunctioned.

The practical courses are the implacable part of the training of anatomy for ages. The anatomical illustrations and photographs that are currently being used can not be substituted as the touching of the specimen itself.

The skeleton provides the form of human body, and the skeletal system is the first step to understanding the structure of human body. To teach the skeleton, real human bones have been mostly used during the anatomy courses. Using this kind of precious natural material is a good chance for a routine training.

In our country, increased number of medical schools and decreased number of cadavers obliged us to search for a substitute. We developed an effective method to produce artificial bone using polyester resin.

Method

First a synthetic silicon rubber negative cast was made. As original model we used a cleaned human bone (Fig. 1). Then, by using this negative cast, a positive model was cast. Polyester based resin (styrene) which has a low viscosity was used for the casting process. After six hours for the positive model to harden, it is taken out of the negative cast and the casting hole—an area of 1 centimeter-square—is retouched in order to look like the original surface.

It is found out that the positive model had all the surface qualities of the original one except the retouched area in 1 centimeter-square (Figs. 2 and 3). The model looked very likely to the original in weight and hardness.

Discussion

In dissection courses, working on the natural materials is preferable. But in this situation, this natural materials (cadavers, bones) may cause discomfort because of the hygienic problems. At this point or in the state of insufficient number of natural materials, using the artificial materials could be preferred.

There must be some properties of these materials. These are the resemblance of the model to the anatomic form, multiple usage and being cheap. Our aim in making an artificial bone that would be used in anatomy courses, was to create a material carrying these properties. All the physical properties of an original bone can be imitated (in an artificial bone) except its water content (Scharplatz et al., 1993). We compared our model with the polyurethane (Contraves AG) artificial bones which are being used in the bone surgery training, the lime models which are tried to be made and the plastic ones that are still in trade.

The ones in lime are easily broken, very easily affected by the environmental factors like moisture, heat and, are also getting worn out in short duration of use. On the other hand, it is very hard to produce these models because of the air bubbles that took place in their structure.

Although the plastic models are unbroken they are susceptible to heat. The surface of the model does not look like the original tissue and does not
Fig. 1. Our original model was a human thoracic vertebra. We peculiarly chose the vertebra because of its having a moderate difficulty in preparing a negative cast.

Fig. 2. Our semi-natural model looked very likely to the original (Fig. 1).

have the details. By the way, they are very expensive.

The artificial bones made in polyurethane (Scharplatz et al., 1993) are frequently used especially in the orthopedics, plastic and reconstructive surgery training. Although their being expensive, they are very useful because of their porous construction, variability in hardness and being hygienic. But they can hardly show the anatomic surface details.

The models made in styrene are highly resistant to the environmental factors. The styrene is liquid and toxic in monomer stage, after polymerization (polyester) it becomes solid, and does not go under any other reaction (Budavari, 1989; Kirk et al., 1954). This characteristic makes our material strong, resistant to the heat, non-toxic and inappropriate for the bacteria to live on.

Because the origin of our model is a mixture, by changing the ratio of the compounds and adding different materials, it is possible to increase or decrease its hardness, weight and fragility. By this method, the models have all the outer anatomic structural properties of an original bone except its internal porous structure. But we think that this peculiarity will not cause a problem in the anatomy courses. The artificial bone model we made, has all the morphological details of an original one including its color. It is easily and rapidly produced, and most important of all is its production expenses are very low.

References