Figure 7. Fetal coronal section (embedded in celloidin, 2 mm) stained with Darrow red and subsequently plastinated.

USE OF PLASTINATED TISSUE IN THE CONSTRUCTION OF HOLOGRAMS

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INTRODUCTION

Holography is a vast new field of wave-interference technology discovered by Denis Gabor and first reported in 1948 (Collier, 1971). Despite its profound significance, holography has been described as a "solution in search of a problem" because it has fulfilled only a small part of its potential. This is due to a number of limitations, among which is that the production of holograms requires considerable knowledge, skill and equipment.

A hologram is a pattern of wave-interference microimages of an object, encoded onto a photographic plate with completely coherent (laser) light. Illumination of this plate with coherent light of the same wavelength produces a three-dimensional image of this object. This is a true three-dimensional image, not an optical simulation. Because of this, holography would seem to offer boundless promise, however its practical applications have been limited by the uncompromising severity of its technical demands. At present there are only about 100 working holographers in the United States and its contemporary use is confined almost exclusively to optical elements (holographic lenses), security-enhancing devices (on credit cards) and the creation of novel forms of art.

HOLOGRAPHIC IMAGES AS MEDICAL TEACHING MEDIA

Because of their striking three-dimensional quality, holograms would make excellent teaching media for the medical subjects such as anatomy and pathology. Notonly would the student benefit from the third dimension, but the hologram, unlike the specimen, can be reproduced, permitting the sharing of a single image among many institutions. Making (and sharing) holograms of human tissue, however, presents a unique set of problems.

For example, in constructing a hologram it is essential that the object remain absolutely motionless during a rather long photographic exposure period. (The only alternative to this is the use of an extremely expensive pulse-laser). Movement through a distance corresponding to % of the wave length of the light being used will cause blurring. Thus, even the slight dimensional change associated with evaporation of tissue water is intolerable.

HOLOGRAPHY OF PLASTINATED TISSUE SPECIMENS

It occurred to the authors that, due to enhanced rigidity, and because natural water has been replaced with polymer, plastinated specimens would make ideal holographic objects. We had established a laboratory for experimenting with the preparation of holograms from tissue and had access to a collection of plastinated specimens. Thus, the construction of holograms of plastinated tissue was undertaken with the intent of using them as an adjunct to pathology instruction in the Mercer medical curriculum. The results have been promising.

Different types of holograms were prepared in an effort to find which would be most useful. Given our present technical capability and teaching requirements, the image-plane hologram has proven most appropriate. This type can be illuminated with a simple, hand-held halogen lamb and easily transported to the classroom.

Also, it became apparent that the hologram is best used as a substitute for specimens that actually depehdon three dimensions for their information content. Holographic images of flat tissue surfaces offered little improvement over photographs but those of specimens with depth were considerably better. Our favorite hologram to date is one of a segment of colon, showing hereditary podyposis.

SPECULATION ABOUT THE FUTURE OF HOLOGRAPHY IN HEALTH SCIENCE EDUCATION

The use of holography in health science education has been extremely limited (Lungershausen, 1983). Most of the reason for this has to do with technical limitations and cost. If holography is to be useful as a medium for medical-school instructing, not only must we be able to create high-quality master images but accurate hologram copies must be mass-produced. This would reduce the cost sharply and would even allow their incorporation into textbooks.

At present, two methods hold most promise for doing this: 1) The embossed hologram (heat-shaped onto plastic) and 2) photopolymer hologram (contact-printed onto photosensitive plastic). The former process has not, as yet been able to yield holograms of suitable quality (this is the type used on credit cards). The latter is rapidly approaching a degree of sophistication that should prove useful. The senior author has recently begun negotiations to be able to experiment with photopolymer material in the preparation of holograms from plastinated tissue specimens.

REFERENCES

Collier RJ, CB Burckhardt, LH Lin: Optical holography (Student edition). Orlando, Academic Press Inc. 1971.

Lungershausen S: Current and future uses of holography. Biomed Communications 11(6):29-33, Dec, 1983.