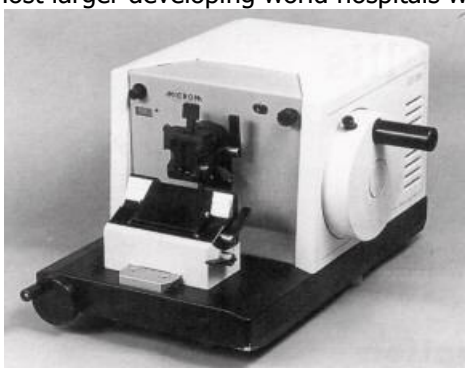
3.4 Microtomes

3.4.1 Use and Principles of Operation

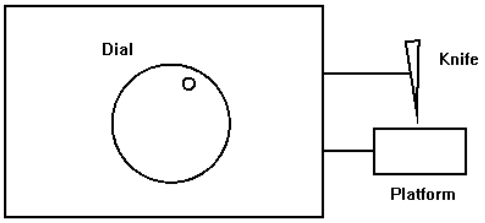
Histology is the study of tissue, restricted in the developing world to using visible light and a microscope, magnifying lens or the naked eye. In order to better examine the tissue sample from the patient, it is first cut (or sectioned) in to thin slices, typically 1- 10 microns (micrometers) thick. The tissue is so thinly cut, that it is translucent. The instrument that cuts the tissue into these thin sections is the microtome.

Most larger developing world hospitals will have a small, manual microtome like this one



A small hospital in the developing world might have a hand operated microtome. Larger hospitals in the developing world will have either a rotary unit or a cryostat microtome for doing frozen sections. No matter what type of microtome is being used, the specimen is prepared, often in paraffin, and then clamped into the microtome. The tissue is then advanced on the feed pawl until its edge is in the cutting zone. The knife is moved by turning a flywheel (or by advancing it by hand). As the knife descends a specimen slice is made. In an automatic microtome, as the knife ascends the specimen is drawn back so the knife edge does not touch the specimen.

A manual microtome slices a thin piece of tissue off of the preparation with a knife. The platform holds the tissue. The dial advances the tissue a few micrometers.



There are additional types of microtomes such as the sledge microtome (for hand cutting large pieces), the freezing microtome (with a cutting stage that freezes the tissue) and the ultramicrotome (which cuts very fine sections), but these are rarely seen in the developing world.

3.4.2 Common Problems

The most typically problem with a microtome is the knife. Many modern microtomes use disposable knives. These are inconvenient in the developing world due to the expense. The disposable knives are often reused for that reason. Durable knives are a better option, as long as they are sharpened periodically. Knife sharpening is typically available in the developing world, but may not be used.

The knife angle can cause problems. The clearance angle is the angle between the knife edge bevel and the block, typically between 2 and 4 degrees for paraffin sections, and between 5 and 7 degrees for resin or frozen sections, being most effective. If the cutting angle is too great it can cause compression in the cut section. If the cutting angle is too fine, the edge of the knife can vibrate causing chatter in the section. These angles can be adjusted and sections cut until the technician is satisfied with the results.

The machine needs to be well maintained to operate correctly. It should be cleaned after each use. You can use a very light oil to prevent corrosion and improve the operation of the mechanism. The knife should be removed after each use. A dust cover should cover the machine's cutting surfaces after each use. If you don't see evidence that these procedures are in place, thoroughly clean the machine and attempt the sectioning again.

On cryostat machines, you can also suspect the cooling elements. There is a defogging mechanism that allows the user to see the section inside the cold chamber. This may become clogged or otherwise broken.

Finally, you should suspect user error. The preparation of the tissue and the handling of the tissue after sectioning can greatly affect the results. The hardness of the embedding compound being one of the primary factors affecting tissue sectioning. Embedding compounds range from gelatin (50 to 200 microns), simply freezing the tissue (5 to 20 microns), paraffin (1 to 15 micron), paraffin/wax/resin mixtures (0.5 to 2 microns and pure resin (0.05 to 1 microns). You may encounter any of these preparations in the developing world, and you may encounter a technician using the wrong embedding material for the thickness of section desired.