

Application Note

Tooth Thin Section Preparation



1. Introduction

Thin sections of teeth provide an excellent tool for dental research and can easily be produced using Logitech lapping, polishing and sawing equipment. Machines, such as the PM5 range, ensure all requirements can be met - from lapped sections in the 70-100µm range (for routine microradiography) to polished, 10-15µm thin sections for detailed cellular analysis.

There are several factors which can determine exactly how a tooth thin section is lapped and/or polished, including the shape, thickness and the intended use of the sample. The following process route is recommended for achieving optimal results on larger (70-100µm thick) sections, without recourse to encapsulation.

2. Equipment

The system is based on the PM5 Precision Lapping and Polishing Machine. The PP5GT Precision Polishing Jig is the main sample holding fixture, and the Model 15 Diamond & Wire Disc Saw is used for the cutting operations.



Logitech PM5 Lapping & Polishing System

3. Process

Producing a larger lapped tooth section, for example between 70-100µm, does not normally require the initial sample to be encapsulated as is recommended for achieving polished thin sections of 10-15µm. The following lapping and bonding process has consistently produced a high standard of results for lapped tooth thin sections using Logitech equipment, supporting such work as routine microradiography.

The process involved depends on the form that the finished sample will take. It is either necessary to make serial sections or alternatively one single section; they may be lapped and/or polished on one or both faces; and the sections may be demounted from their support substrates after processing or permanently bonded to a microscope slide if required.

A. Bonding and Cutting

The first step is to bond the tooth to allow it to be sawn. For this, the tooth must be temporarily bonded to the appropriate sample holder, to allow it to be mounted on the saw for cutting. The sawn face will then be used for bonding the sample to a support substrate or microscope slide, for subsequent lapping & polishing operations. Bonding is carried out by building up Quartz Wax on the sample holder to support and bond the tooth (see Figure 1). It is the

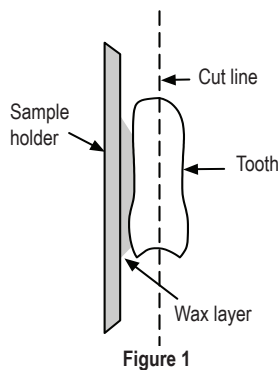


Figure 1

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positioning at this stage which will determine the direction in which the cut(s) will be made - so the tooth should be bonded as flat as possible on the sample holder - i.e. the intended cut line should be parallel to the surface of the holder. However, it is also important to bear in mind that the Quartz Wax should cover as much of the sample face as possible to ensure a strong bond.

B. Cutting - Single Selection

Figure 2 shows the arrangement for the cutting of a single section on the Model 15 saw.

The sample holder is positioned relative to the blade, as in Figure 2, and the first cut carried out. It is then repositioned closer to the blade to produce a slice of the appropriate thickness.

The slice now exhibits two cut faces, and must be thinned by lapping to reach the required thickness (section E onward).

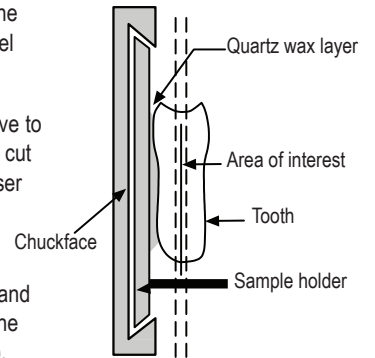
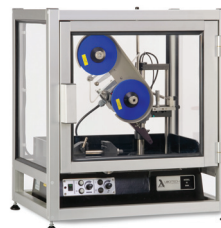


Figure 2

C. Cutting - Serial Selection

This is identical to section shown in Figure 2, except that more cuts are made.



Model 15 Saw

Serial sectioning on the Model 15 is facilitated by the ability to precisely position the sample holder relative to the blade, by way of the saw's micrometer. Thus the first cut can be made, the position altered by a precise amount, and the next cut carried out.

These sections exhibit two cut faces, and must now be thinned by lapping to the required thickness.

D. Bonding - for first Face lapping

The tooth slices produced as above must be mounted on a glass support to allow the first face to be lapped on a precision lapping & polishing jig. The bonding medium depends on the user's own requirements. If the sample is to be demounted after first face processing (to turn and process the second face), Quartz Wax is used as a temporary bonding medium. In such a case, the precision of the bond is not of critical importance, as this stage is only creating a flat reference surface for the second face. Bonding by hand will suffice here (Figure 3).

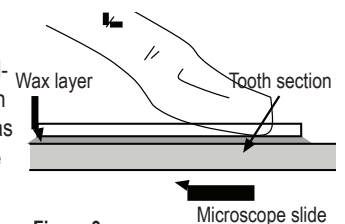


Figure 3

If, however, the user wishes only to lap and polish one face and to keep the sample permanently bonded to the slide, Epoxy-pack 301 Resin is used, and the bonding is carried out with the aid of a bonding jig such as the low pressure BJ3, as Figure 4.

Whatever the case, the thickness of the slice should be measured before bonding, to allow the correct amount of material to be removed in the subsequent thinning processes.

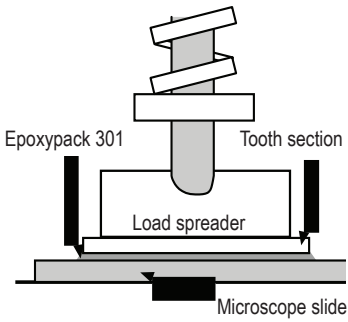


Figure 4

E. First Face Lapping

The microscope slide is retained by vacuum on the chuckface of the PP5GT Precision Lapping & Polishing Jig, and lapped (and polished if necessary).

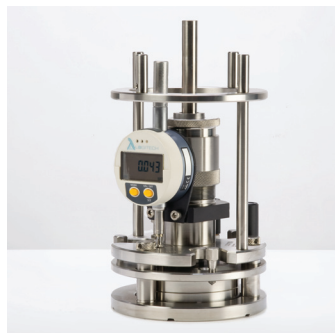
If both faces are to be processed, it is sufficient to remove a maximum of 100µm of material from the first face. This will completely remove any traces of the sawing process but at the same time ensure that the sample is not too thin, to allow it to be turned for second face processing. If only the first face is to be processed, the sample can be lapped to a few microns from the desired final thickness and then polished to obtain improved surface quality, if necessary.

F. Turning and Second Face Lapping

To proceed with second face processing, the sample must be removed from the glass slide, turned, and re-bonded with the first face down. The wax may either be melted, after a short time on a hotplate, or dissolved with a suitable organic solvent.

The tooth section is then bonded, first face down, using a bonding jig (see Figure 4) to ensure it is as flat on the microscope slide as possible - thus giving a section of high thickness uniformity. Again here the choice of bonding medium - Quartz Wax or Epoxy-pack 301 - depends on the requirement to subsequently demount the sample.

The slide is mounted on the vacuum chuckface of the PP5GT Lapping and Polishing Jig. The sample is lapped to a few microns from the desired final thickness and then polished to obtain improved surface quality, if necessary.



PP5 Precision Lapping Jig

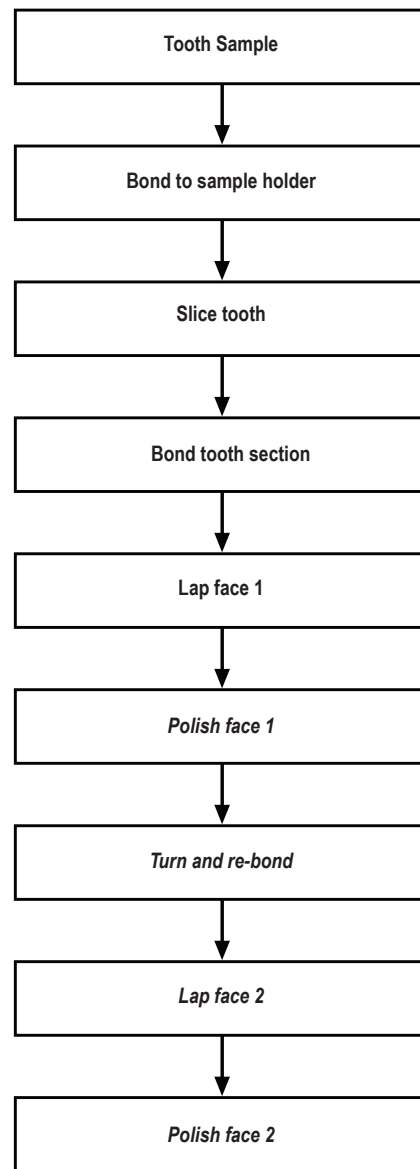


Figure 5: Process Overview (optional steps in italics).

A summary of the process route can be seen in Figure 5. For further information on tooth thin section preparation, please contact us.

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