

Application Note

Tooth Thin Section Preparation

...process carried out with ease on Logitech systems

1. Introduction

Thin sections of teeth provide an excellent tool for dental research and can be routinely produced using Logitech lapping, polishing and sawing equipment. New machines, such as the PM5 range, ensure every conceivable requirement can be met - from lapped sections in the 70-100 μ m range (for routine microradiography) to polished, 10-15 μ m thin sections for detailed cellular analysis.



Tooth Thin Section

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. Whilst it is recognised that there are a variety of potential methods for preparing ultra thin sections (10-15 μ m) of teeth using encapsulation, these are detailed in a separate document. The following process route is recommended for achieving optimal results on larger (70-100 μ m 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 **AXL1 Precision Saw** is used for the cutting operations.

3. Process Description

Producing a larger lapped tooth section, for example between 70-100 μ m, does not normally require the initial sample to be encapsulated as is recommended for achieving polished thin sections of 10-15 μ m. 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.

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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 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.

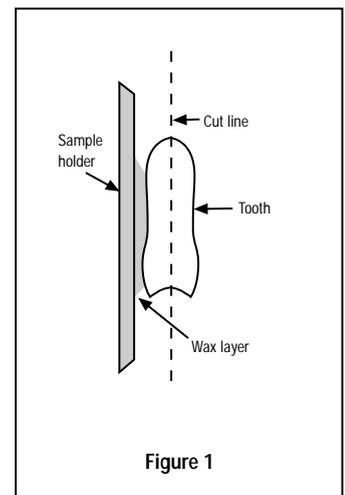


Figure 1

B. Cutting - Single Selection

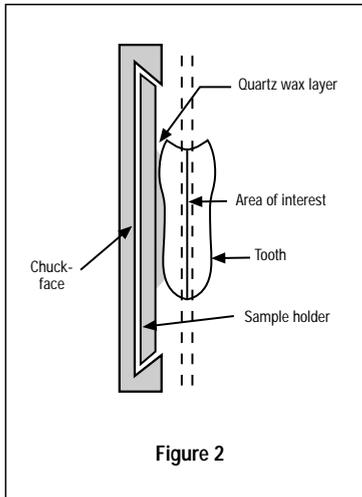


Figure 2

Figure 2 shows the arrangement for the cutting of a single section on the AXL1 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 4 onward).

C. Cutting - Serial Selection

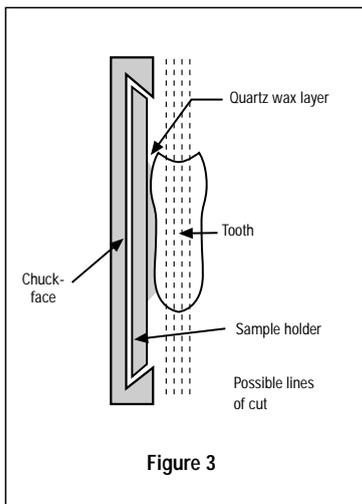


Figure 3

Figure 3 shows the intended arrangement for sample cutting on the AXL1 saw. In essence, this is identical to section 2, except that more cuts are made.

Serial sectioning on the AXL1 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



AXL1 Saw

D. Bonding - for first face lapping

The tooth slices produced in Fig 2 and 3 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. If, however, the user wishes only to lap and polish one face and to keep the sample permanently bonded to the slide, Epoxypack 301 Resin is used, and the bonding is carried out with the aid of a bonding jig such as the low pressure BJ3.

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.

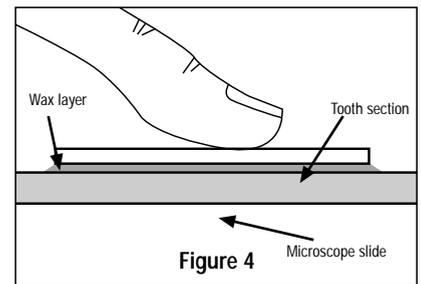


Figure 4

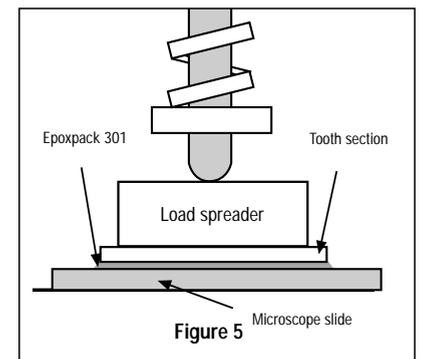


Figure 5



BJ6 Bonding Jig

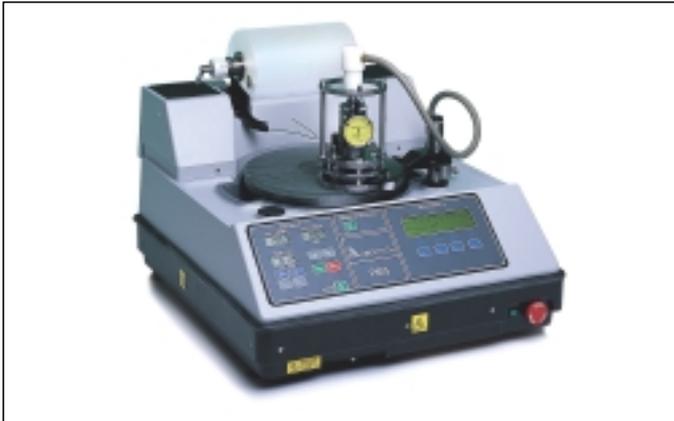
E. First Face Lapping

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 100 microns 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.

Turning and second face lapping

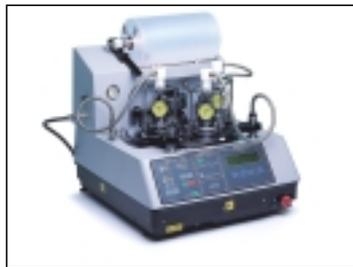
To proceed with second face processing, the sample must be removed from the glass slide, turned, and re-bonded with the first face down. The wax may either be melted, after a short time on a hotplate, or dissolved with a suitable organic solvent.



LP50 Precision Lapping and Polishing Machine



PP5 Precision Lapping And Polishing Jig



LP50 Precision Lapping and Polishing Machine

The tooth section is then bonded, first face down, using a bonding jig (see Figure 5) 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 Epoxyack 301 - depends on the requirement to subsequently demount the sample.

Again, 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.

A summary of the process route can be seen in Figure 6. For further information on tooth thin section preparation systems, please contact Logitech.

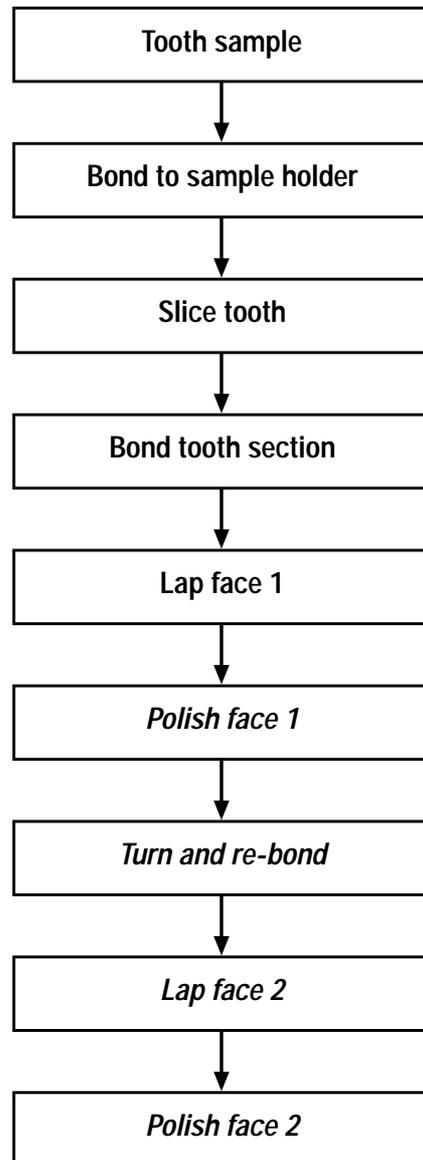


Figure 6: Process Overview (optional steps in italics)



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