

# Methylmethacrylate (MMA) Thin Sections Can Be Superior to Thick Ground MMA Sections for Histologic Evaluation of Complex Submillimeter Metallic Medical Devices

M. T. O'Brien<sup>1</sup>, T. Dorsey<sup>1</sup>, L. Ensminger<sup>1</sup>, L. Kuhn<sup>1</sup>, B. Dieterle<sup>1</sup>, J. Burgenson<sup>1</sup>

<sup>1</sup> Charles River Laboratories, Frederick, Maryland, USA

## 1 ABSTRACT

Hard plastic resin embedding is necessary for histology of tissues containing hard and/or metallic medical devices if the device is to be retained within the section for microscopic assessment. Traditional methylmethacrylate (MMA) embedding and sectioning of tissues containing hard and/or metallic devices requires targeted sectioning of the block with a diamond blade saw followed by careful grinding of the MMA-embedded specimen with a calibrated grinder. This method provides a tissue section for histology that is approximately 50-60  $\mu\text{m}$  in thickness (MMA thick section). However, the process of creating a MMA thick section is somewhat imprecise and results in considerable sample loss due to requisite attrition during MMA block sectioning and grinding procedures. For submillimeter (<1 mm) and/or similarly small, topographically complex medical devices, this level of relative imprecision, specimen attrition, and loss of cellular detail due to inherent thickness of tissue section can result in unacceptable diagnostic slide quality or even complete loss of a valuable specimen during sectioning/grinding procedures. To circumnavigate these challenges, we utilize MMA hard plastic resin embedding of small metallic medical devices followed by acquisition of thin (3-5  $\mu\text{m}$ ) MMA sections using a motorized microtome. Thin MMA sections provide superior cellular detail, greater precision of sectioning, and excellent retention of high quality device-tissue context when compared with traditional MMA thick plastic sections. Although acquisition of MMA thin sections can be limited by larger device sizes and/or composition, MMA thin sections can provide superior histologic quality for permissible specimens.

## 2 METHODS

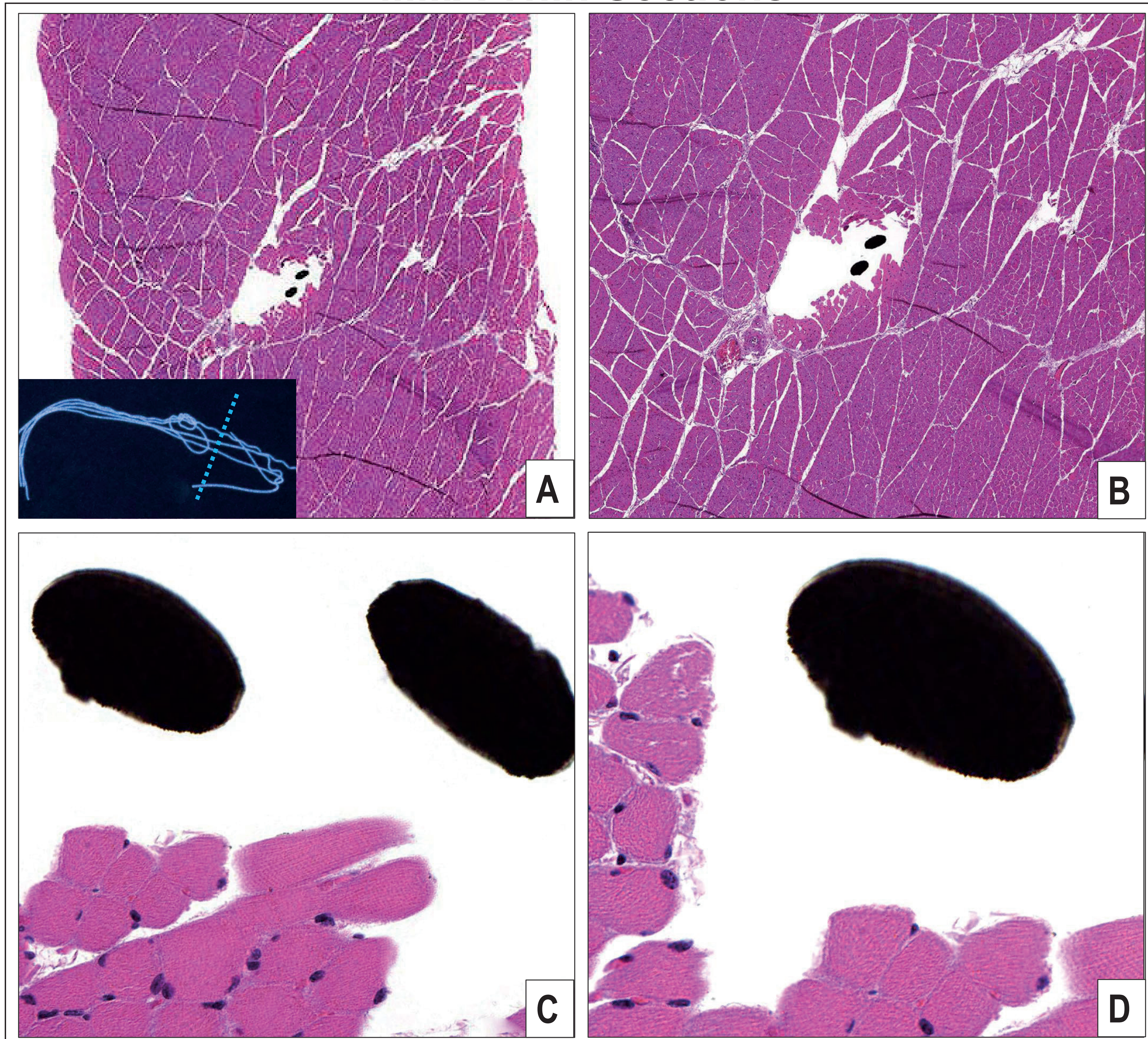
Formalin-fixed swine muscle tissue containing a metallic mock "medical device" implant was embedded in MMA resin

MMA thin sections obtained using motorized microtome (5  $\mu\text{m}$  thickness)

MMA thick ground sections obtained using calibrated microgrinding wheel (~50  $\mu\text{m}$  thickness)

## 4 RESOURCES

## MMA Thin Sections

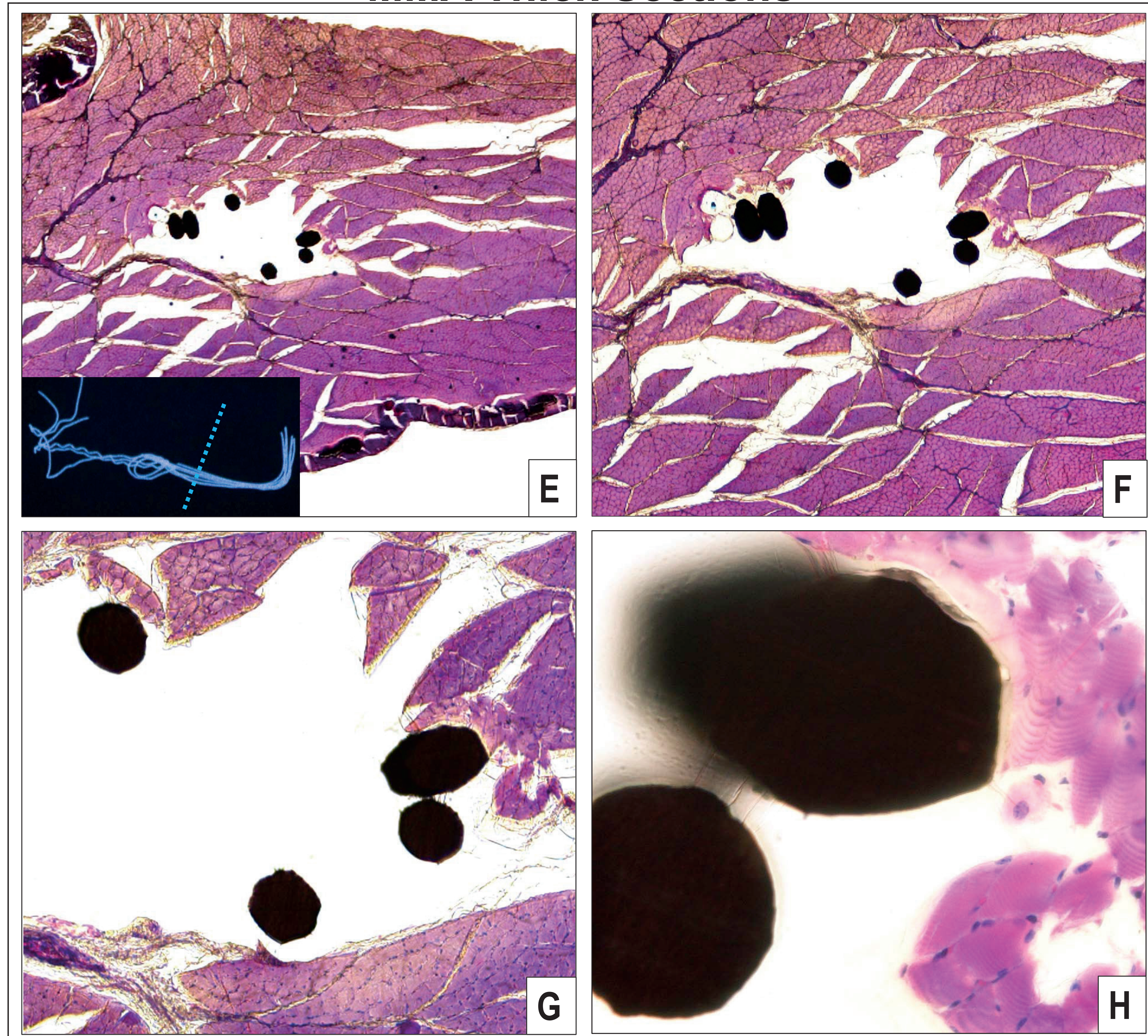


**Figure 1:** H&E, MMA thin (5  $\mu\text{m}$ ) sections. **A.** Muscle tissue with intramuscular metallic "device", 2x. Inset: Faxitron x-ray to illustrate complex metallic structure within muscle; approximate plane of sectioning indicated by blue dashed line. **B.** Magnified view of implant site with retention of intramuscular device segments (2 of 3 were retained) and good muscular detail, 4x. **C.** Device-muscle interface, 40x; and **D.** Device-muscle interface, 50x. Note excellent retention of individual cellular detail at interface in thin sections, to include delicate myofiber cross-striation and distinct nuclear profiles and distinct endomysium.

**Conclusions:** MMA thins can provide superior individual cellular detail and good device-tissue interface retention for small permissible devices that can be sectioned on a motorized microtome. However, MMA thin sections are not always possible for larger, more substantial devices.

## 3 HISTOLOGY

## MMA Thick Sections



**Figure 2:** H&E, MMA thick ground (50  $\mu\text{m}$ ) sections. **A.** Muscle tissue with intramuscular metallic "device", 2x. Inset: Faxitron x-ray to illustrate complex metallic structure within muscle; approximate plane of sectioning indicated by dashed line. **B.** Magnified view of implant site with retention of intramuscular device segments (6 of 8 were retained), 4x. **C.** Device-muscle interface, 20x; and **D.** Device-muscle interface, 40x. Note good device-tissue interface, with mediocre-to-poor individual cellular detail at interface in thick ground sections, although collective myofiber cross striations can be seen in (H). Also, the thicker plastic results in the blurry appearance.

**Conclusions:** MMA thick ground sections can provide valuable histologic insight regarding device-tissue interfaces for a large array of metallic devices and are not generally limited by larger device size. However, individual cellular detail is lost due to thicker sections that obscure fine cellular anatomy.