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Case Report

Enhancing Damage Visibility on Metallic Bearing Surfaces A Simple Technique for Photography and Viewing

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ABSTRACT

Damage to metallic bearing surfaces typically involves scratches, scrapes, metal transfer, and organic deposits. This damage can cause accelerated wear of the opposing surface and subsequent implant failure. Photography and viewing of metallic bearing surfaces, for documenting this damage, are hindered by optical reflectivity. This note demonstrates a simple, practical technique for metallic bearing surface photography and viewing that minimizes this reflectivity problem, that does not involve any modification of the bearing surface, and that allows for improved observation and documentation of overall damage. When the metallic bearing surface is placed within a tube of translucent material, the appearance of damage on that bearing surface is dramatically enhanced, showing up against a smooth, even background with excellent contrast and with fine detail achievable.

Damage to bearing surfaces, caused by third bodies, subluxation, dislocation, closed reduction, etc., involves scratches, scrapes, metal transfer, and organic deposits. Bearing surface damage can cause accelerated wear of the opposing surface and subsequent implant failure. Photography and viewing of a metallic bearing surface, for documenting this damage, are hindered by the surface optically reflecting features in its surroundings, such as photography lights and room lights, onto the image. This problem occurs ubiquitously in the archival forensic literature for total joint arthroplasty retrievals. The purpose of this note is to demonstrate a simple, practical photography and viewing technique that minimizes this reflectivity problem, that does not involve any modification to the bearing surface, and that allows for improved observation and documentation of overall damage.

Materials and Methods

The essential concept for this technique is to mask extraneous reflections by placing the bearing surface within a tube of translucent material (Fig. 1). Ordinary white paper works reasonably well for this purpose (Fig. 1A–B), is readily available, and can be quickly formed into a tube. This paper tube should fit snugly around the camera lens, with minimal circumferential overlap (about 5 mm) for taping the tube shut (using invisible cellophane tape), as the overlap will appear on the bearing surface as a narrow, slightly darker wedge. This wedge appearance can be minimized by rotating the overlap away from light sources such as a camera flash. A more robust alternative is a translucent plastic tube (Fig. 1C–D), which also avoids the wedge problem; clear acrylic tubing, spray-painted white, works well. This tube should also fit closely around the camera lens. Described below are variations of this masking technique that can be used in less-controlled (Fig. 1A–B) and more-controlled (Fig. 1C–D) settings, with the former favoring expediency and simplicity, and the latter favoring higher picture quality.

To quickly view or photograph a metallic bearing surface under less-controlled conditions, such as in an operating room, place one end of the masking tube over the bearing surface, and look or photograph through the other end of the tube (Fig. 1A–B). For quick photography, a compact point-and-shoot camera can be used. The masking tube length should be long enough that the camera can achieve focus when the tube completely covers the bearing surface (Fig. 1B). An alternative technique is to hold up a sheet of white paper (or other white surface) near the bearing surface, and view or photograph the part of the bearing surface reflecting that white surface.

To obtain metallic bearing surface photographs of higher quality, a camera with a macro lens is attached to a copy stand, with the bearing

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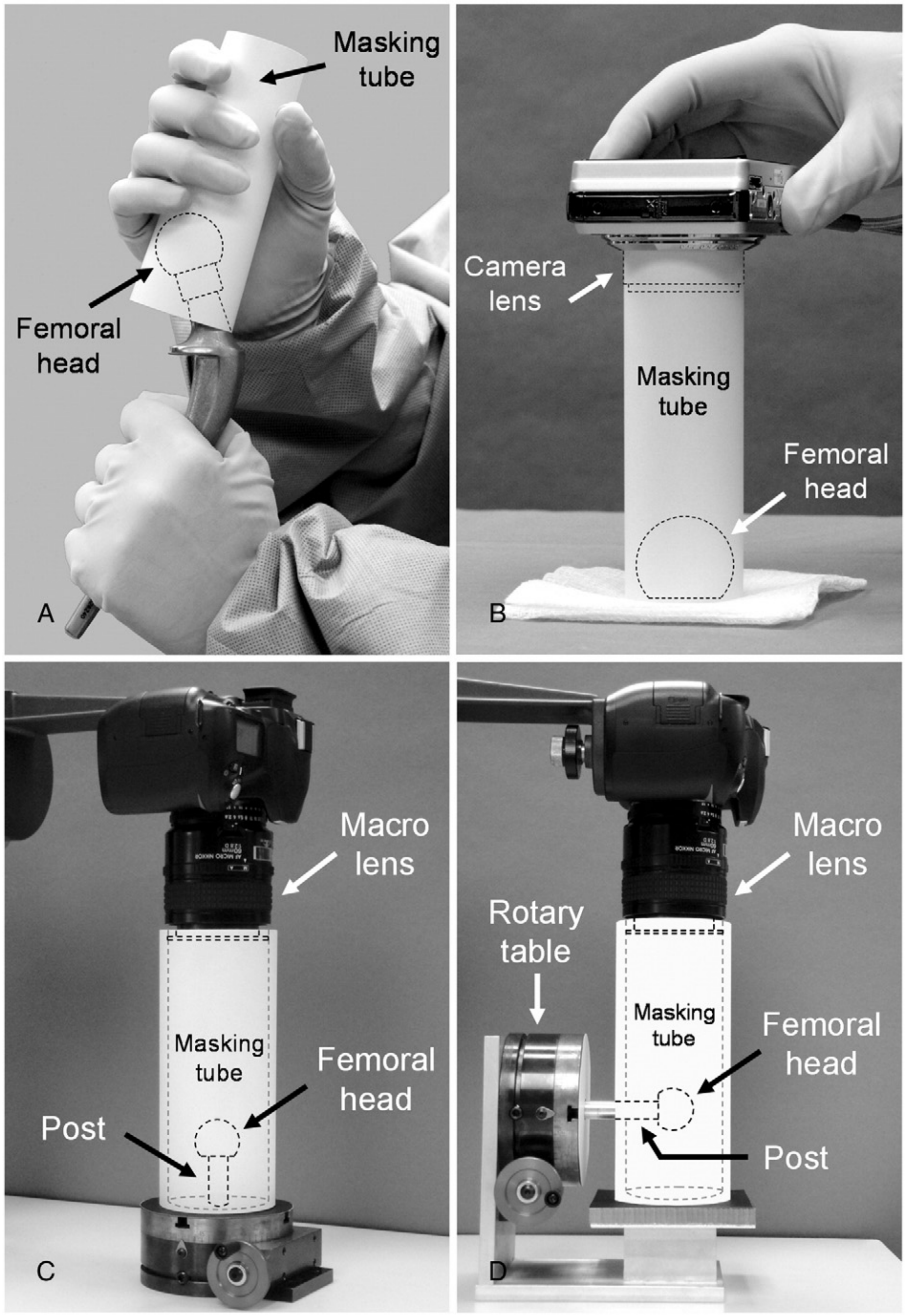

Fig. 1. Metallic bearing surface viewing and photography under (A-B) less-controlled and (C-D) more-controlled conditions. (A) Viewing and (B) photographing a femoral head with a masking tube of white paper. (C) Polar and (D) equatorial photography of a femoral head with a masking tube of clear acrylic spray-painted white.

surface below and the masking tube around the lens (Fig. 1C–D). Room lighting results in more even lighting of the femoral head than do copy stand lights. The use of a post for polar views (Fig. 1C) avoids having a reflection of the base appear on the bearing surface, which occurs when using a wider masking tube. For equatorial views (Fig. 1D), a post passes through a slot cut in the masking tube. This post can be attached to a rotary table, to permit systematic circumferential mapping of bearing surface damage. Two photographs can be digitally combined to fill in the camera lens reflection. Before adding the masking tube, wipe off fingerprints and dust from the bearing surface, and brush dust off the base. Set the camera to its largest f-stop (smallest aperture) to maximize depth-of-field, bracket the exposure, and use a timer to avoid vibrations. Optimum damage enhancement attained with this technique depends on empirical modulation of parameters such as lighting, masking tube material and thickness, and camera exposure time; there are even some types of damage which are better viewed without masking.

Results and Discussion

The appearance of damage on metallic bearing surfaces is dramatically enhanced by the technique described (Fig. 2). Damage shows up against a smooth, even background, with excellent contrast and with fine detail (Fig. 2C) achievable. This aids the observation and documentation of bearing surface damage, including encoding of damage patterns via automated digital image analysis (Fig. 2D) and the identification of damage features that merit closer analytical attention with techniques such as optical profilometry or scanning electron microscopy [1–4]. This technique is also effective on Oxinium surfaces, although it is not as crucial as it is for metallic surfaces [5].