The Effect of Using a Cement Gun With a Narrow Nozzle on Cement Penetration for Total Elbow Arthroplasty: A Cadaveric Study

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Purpose To compare the cement mantle characteristics associated with use of a narrow nozzle cement gun versus the use of a 60-mL catheter tip syringe.

Methods Twelve cadaveric distal humeri were cemented with either a cement gun or a syringe without canal occlusion. The humeri were sectioned and photographed. The corticocancellous junction and the outer margin of the cement mantle were analyzed digitally. The corticocancellous junction defined the available area for cement penetration. The outline of the cement mantle defined the actual area of penetration. The ratio of penetration to the available area was recorded for each slice. The mean ratio for each humerus was multiplied by the number of slices in that sample containing cement to calculate a cement index.

Results The cement penetration ratios observed in cross-sections at the same level and the cement index were significantly greater with the use of the cement gun than with the use of the syringe. There was no difference in the number of slices that contained cement.

Conclusions The use of a cement gun with a narrow nozzle improved cement mantle characteristics compared with the use of a syringe when measured in a cadaveric model in the absence of canal occlusion.

Clinical relevance Improving cement mantle characteristics may decrease the incidence of aseptic loosening after total elbow arythroplasty. *(J Hand Surg Am. 2015;40(2):276–280.*

Key words Elbow arthroplasty, cement, loosening, cement gun.

TOTAL ELBOW ARTHROPLASTY (TEA) is used in the reconstruction of the arthritic elbow and in the management of acute elbow trauma and its sequelae.[1–4] Although uncemented options exist, most TEA prostheses are inserted with cement.[5,6] Regardless of fixation method, aseptic loosening is the most common mode of failure after TEA.[7,8] Cemented total hip arthroplasty studies have demonstrated superior results with advanced cement techniques including canal occlusion and cement insertion with a gun.[9]

Achieving an adequate cement mantle in TEA is difficult. The method of cement insertion may be an important factor and may be even more important in the absence of satisfactory canal occlusion, which is difficult to attain in the humerus because of its shape. Commonly employed methods of cement insertion include handpacking, using a syringe, and using a cement gun. The use of a cement gun in TEA may be best based on studies involving the proximal femur.

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FIGURE 1: The syringe used in the study.

FIGURE 2: Selection of nozzles available for Palamix cement gun. The central nozzle was used in this study. (With permission from Heraeus Medical, Wehrheim, Germany.)

However, insertion using a syringe has also demonstrated low rates of aseptic loosening in the elbow.[10] Most cement guns are designed for use in the femur and, therefore, modifications of the nozzle are often required for use in TEA. Several narrow nozzles are available (Biomet, Warsaw, IN; Zimmer, Warsaw, IN; Heraeus Medical, Wehrheim, Germany). We compared cement penetration in the distal humerus using 2 insertion techniques, a cement gun with a narrow nozzle and a 60-mL catheter tip syringe.

MATERIALS AND METHODS

Local ethics committee approval was obtained. Twelve thawed, unpreserved, paired cadaveric humeri were sectioned just distal to the inferior margin of the insertion of the pectoralis major and cleaned of all soft tissue (2 male, 4 female; mean age at death, 83 y; range, 70–91 y). No gross pathology of the specimens was observed. The distal humeri were prepared to accept a humeral stem, although no stem was actually inserted. The humeri from each pair were randomly assigned to cement insertion with a 60-mL catheter tip syringe or a cement gun with a narrow nozzle (Palamix, Heraeus). The tip of the syringe was 7 mm in diameter and 4.5 cm in length (Fig. 1). The nozzle of the cement gun was 7 mm in diameter and 15 cm in length (Fig. 2). Canal preparation consisted of broaching (same size for all specimens) without brushing, irrigation, or drying. A cement restrictor was not used. A single container of powder and monomer of low-viscosity cement (Palacos LV, Heraeus) was mixed at 24°C at approximately 60 beats per minute for 90 seconds. In the syringe group, mixing took place in a bowl. In the cement gun group, mixing took place in the gun cartridge itself (no vacuum suction) according to the manufacturer's instructions. This created a volume of cement of approximately 55 mL. The nozzle or syringe tip was inserted as far as possible in a retrograde fashion with the humerus in a horizontal position. Cement insertion began 4 minutes after mixing had started and continued until the tip of the nozzle or syringe tip was extruded from the canal by backpressure from the column of cement. At this time, the nozzle of the cement gun was cut short. The cut nozzle or syringe tip was then reinserted and the cement was pressurized for 2 minutes by use of hand pressure on the plunger (syringe) or trigger (cement gun) while sealing any areas of cement extrusion with a fingertip. The gun or syringe was then removed. After complete cement polymerization had occurred, the paired humeri were then cut into 10-mm sections starting at the proximal margin of the olecranon fossa until beyond the proximal extent of the cement mantle (Figs. 3, 4). The number of slices containing cement was recorded. The cross-section of each slice with cement present was photographed and the images printed. The outline of the corticocancellous junction and the outer margin of the cement mantle were then traced. The tracings were scanned and digitized. The digitized images were saved as tricolor jpg images (Figs. 3, 4). The images were digitally analyzed (MATLAB version 7; The MathWorks, Natick, MA) and the degree of cement penetration was calculated. This photographic method of assessment