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Appendix

Detailed Description of Radiographic Analysis of Humeral and Glenoid Implants

1. Osteolysis of the greater tuberosity and/or the calcar was rated as none, partial, or complete. The definition of complete osteolysis was total resorption of the greater tuberosity and/or lesser tuberosity, so that parts of the proximal part of the stem or cement mantle were not covered by bone. Partial osteolysis was defined as partial resorption of the greater tuberosity and/or calcar when the proximal part of the stem and/or cement mantle was covered by bone.
2. Occurrence of radiolucent lines around the humeral components was analyzed according to Sperling et al.[13].
3. Occurrence of radiolucent lines around cemented keeled glenoid components was analyzed according to Mole et al.[24]. Metal-backed components were scored according to Boileau et al.[23]. Wear of the polyethylene was analyzed in patients with metal-backed glenoid components. Wear was defined as present when direct contact between the humeral head and the metal tray of the glenoid implant was detected.
4. Wear of the glenoid bone in patients with a hemiarthroplasty was graded as none, mild (when subchondral erosion was present), moderate (when the erosion did not reach the lateral base of the coracoid), or severe (when the erosion reached or passed the lateral base of the coracoid).
5. Tilting or subsidence of the humeral and glenoid component (tilt or subsidence resulted in the maximum score for radiolucent lines) was diagnosed if both reviewers detected a change in the position of the implant[6].
6. Assessment of stress-shielding included the following parameters:

    a. External stress-shielding: Measurement of the distance between the stem and the external cortex of the diaphysis was performed in several areas in a manner modified from the technique described by Nagels et al.[9]. The center of the prosthetic head was measured using circles with differing radii. A line (center line) was drawn from the center of rotation of the head to the tip of the stem. The measurements were taken at one-third and two-thirds of the distance from the center line perpendicular from the border of the stem to the external cortex on the medial and lateral side, resulting in four regions of measurement. The superolateral region was defined as L1; the inferolateral, as L2; the superomedial, as M1; and the inferomedial, as M2. Moreover, the stem diameter and the humeral shaft diameter were measured in one region, located 10% of the center line distance superior to the distal tip of the stem. The humeral head diameter was also measured as a reference. All the distances were measured in pixels.
    b. Internal stress-shielding was defined as a decrease in bone density or the presence of bone resorption around the humeral component with intact cortices.
    c. Occurrence of spot welds[25].
    d. Occurrence of condensation lines around the tip of the stem.
    e. The canal-fill index was defined as the ratio between the stem width and canal width (distance between inner cortices). This was measured in a standardized fashion at three defined levels: (1) at 10% of the measured stem length inferior to the most proximal part of the stem, (2) at half of the stem length, and (3) at 10% of the measured stem length superior to the tip of the stem. This is a modification of the technique originally described for calculation of the canal-fill index[26]. ■

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Fig. E-1

Anteroposterior radiograph of a right shoulder made ten years after implantation of a cemented total shoulder replacement with a flat-backed glenoid component. There is evidence of glenoid subsidence and complete osteolysis of the greater tuberosity and the calcar.

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Fig. E-2A

Fig. E-2B

Figs. E-2A and E-2B A patient who had a total shoulder replacement on the left side with a cemented stem and an uncemented glenoid component. **Fig. E-2A** Anteroposterior radiograph made immediately after the operation. **Fig. E-2B** Anteroposterior radiograph made nine years postoperatively. There is complete wear of the polyethylene, with metal-on-metal contact between the humeral head and the glenoid component. Osteolysis of the greater tuberosity and the calcar is also present.

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Fig. E-3A

Fig. E-3B

Figs. E-3A and E-3B A patient who had an uncemented hemiarthroplasty in the right shoulder. **Fig. E-3A** Anteroposterior radiograph made immediately after the operation. There is no evidence of bone resorption around the stem. **Fig. E-3B** Anteroposterior radiograph made four years postoperatively. The bone in the metaphysis has become less dense, and there is some bone resorption around the fin of the proximal part of the stem.

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Fig. E-4

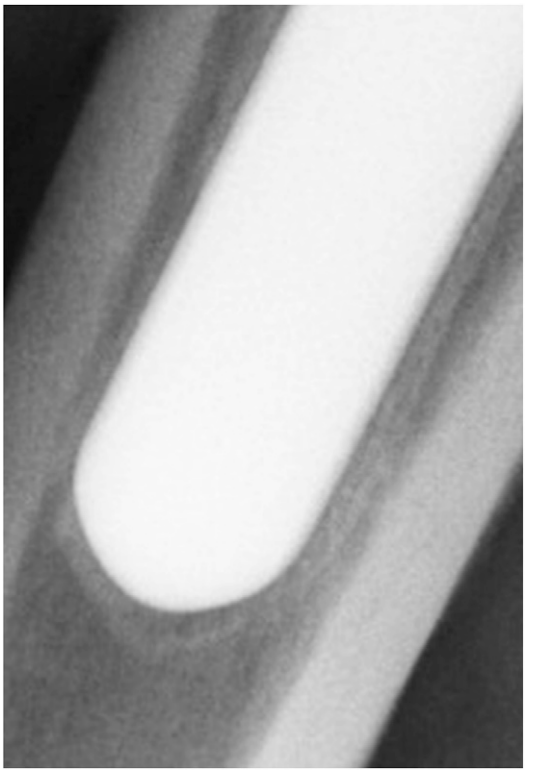

Fig. E-5

Fig. E-4 Radiograph made five years after a total shoulder replacement showing spot welds as a sign of stress-shielding between the cortices and the middle part of an uncemented stem. **Fig. E-5** Radiograph made seven years after a total shoulder replacement showing condensation as a sign of stress-shielding around the tip of an uncemented stem.