Evaluating Bone Healing with [^{18}F]NaF PET/CT During Bone Segment Transport in Femoral Fracture Treatment

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A 25-y-old woman was referred to the nuclear medicine department for an [^{18}F]NaF PET/CT examination to assess bone-healing capacity after she received a magnetic intramedullary transport nail in her left femur because of a segmental bone defect after a femur fracture. This case was not part of a clinical trial and was published with the individual's consent.

A bone transport nail is an implant that gradually moves a bone segment along the nail in the intramedullary canal, promoting new bone growth to fill large bone defects (*1,2*). The nail provides a magnetic gear system to move a bone segment created by osteotomy, progressing about 1 mm per day to encourage callus formation (*2,3*). In our patient, this procedure was performed to treat a 7.4-cm segmental bone defect, which was too large to heal spontaneously, after an open femoral fracture with bone loss that was initially stabilized with a nail. Unlike x-rays and CT, [^{18}F]NaF PET/CT provides metabolic data (osteoblastic activity), allowing earlier detection of bone-healing issues (*4*). Therefore, [^{18}F]NaF PET/CT imaging was performed 3 mo after the bone transport procedure to monitor the bone transport process and healing capacity. To our knowledge, this is the first patient monitored with [^{18}F]NaF PET/CT during this procedure.

[^{18}F]NaF PET/CT images were acquired using a Biograph Vision Quadra system (Siemens Healthineers) scanning only 1 bed position (106 cm) with a 5-min time frame 60 min after intravenous tracer injection. The images showed high [^{18}F]NaF uptake at the anterior, medial, and posterior bone transport site (distal), indicating progressive bone healing. Corresponding CT images showed early callus formation. At the docking site (proximal), focal uptake was seen at the medial side with decent callus formation (Fig. 1). The degree of bone activity at the distraction site (distal) and docking site was sufficient, allowing for a wait-and-see approach regarding bone healing. Follow-up of the patient showed progressive bone healing and an uneventful recovery.

In conclusion, [^{18}F]NaF PET/CT is a valuable tool for assessing bone transport and healing in orthopedic trauma surgery. In the future, this tool may help optimize osteotomy placement, refine surgical techniques, and evaluate the need for additional procedures to enhance healing at the docking site.

DISCLOSURE

No potential conflict of interest relevant to this article was reported.

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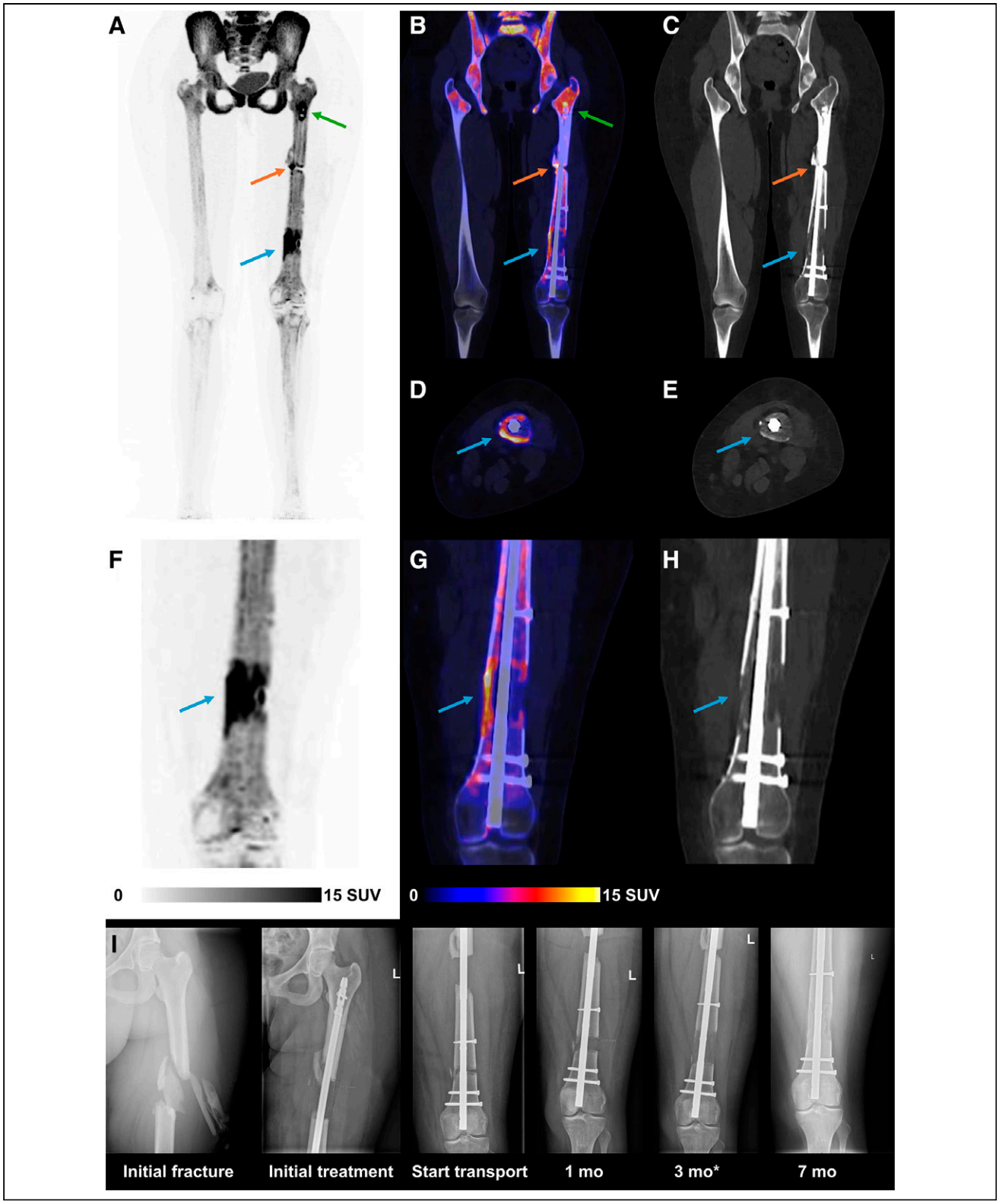

FIGURE 1. (A) Maximum-intensity projections showing high [^{18}F]NaF uptake at bone transport site (blue arrow, SUV_{max} of 35), docking site (orange arrow, SUV_{max} of 27), and proximal screws (green arrow, SUV_{max} of 28), with normal uptake in axial skeleton and bladder. (B and C) Coronal PET/CT image and low-dose CT image of femur, respectively, showing more medial uptake in transport and docking site and with early callus formation, likely due to medial compression (load-bearing area). (D and E) Axial PET/CT image and low-dose CT image, respectively, showing distal transport site with increased anterior, posterior, and medial [^{18}F]NaF uptake and early callus formation. (F, G, and H) Close-up of bone transport site, comparing [^{18}F]NaF PET, PET/CT, and CT imaging. (I) Monitoring of fracture healing through x-rays: initial fracture and treatment with retrograde femur nail (74-mm bone defect), at start of transport with magnetic intramedullary nail, 1 mo after transport onset (19-mm movement), 3 mo after transport onset, which is 3 d before [^{18}F]NaF PET/CT (50-mm movement), and 7 mo after transport onset, showing fracture healing progression.