Cancer ablation and focal fixation for focal lesions in the proximal or distal femoral osteolytic metastases: One long-implant fits all? or Personalized focal AORIF oncologic fixation?

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INTRODUCTION:

Osteolytic metastases in the femoral head, femoral neck, proximal pertrochanteric regions, and distal metaphyseal/epiphyseal lesions have been managed by intramedullary nailing, tumor implants, or plate & screws. All these treatment methods are implant-centric with emphasis on arthroplasty or trauma surgery techniques for normal bone. Furthermore, open surgical techniques may either delay or even preclude life-saving chemotherapy when there are complications such as infection or delayed wound healing.

In osteolytic metastases, there are cancer cells that make bone dysplastic and weaker even after radiation, chemotherapy, bisphosphonates, or denosumab. Given the fact, many cancers in metastatic lesions are chemo- or radio-resistant, an ideal skeletal metastasis-specific treatments may include cancer ablation to decrease cancer burden and regional spread through reaming or implants (mono-rail seeding of cancer cells), cement augmentation for immediate stability, and minimally invasive percutaneous stabilization to start or resume life-saving chemotherapies.

This study aims to determine ambulatory functional outcomes of patients who underwent percutaneous focal radiofrequency ablation-balloon osteoplasty-PMMA bone cement reinforcement-cannulated screw fixation (AORIF) for osteolytic metastases in the femur.

METHODS:

Inclusion criteria are focal osteolytic lesion in the periarticular regions including angulated but not displaced fractures. Exclusion criteria are displaced fractures and diffuse osteolytic lesions extending into diaphysis with cortical bone destructions.

27 femoral lesions in 24 patients (3 bilateral femoral lesions) were treated with AORIF at the single cancer center and then followed up to 25 months or until death. AORIF techniques employed currently used kyphoplasty balloon and cement injector that delivers cement in an incremental manner under fluoroscopic guidance. Standard screw fixation patterns are 2-3 screws stabilizing femoral head & neck and one vertical screw of which distal end passes distal to the lesser trochanter. Percutaneous ablation, balloon osteoplasty, and cement injection were done through a central hollow tunnel of the cannulate screws for proximal or femoral lesions. There were 2 cases of distal femur lesions that were stabilized with percutaneous distal femur plating. PMMA bone cement was mixed with zoledronate (0.8 mg zoledronate/20 cc PMMA bone cement mix). 10 patients presented with ipsilateral acetabular lesions and proximal focal femoral lesions that were separately treated by AORIF instead of open hip implant reconstructive surgeries (**Figures 1-2**). Pain and functional improvement was documented by using combined pain (VAS) and functional ambulatory score, ECOG score, and Karnofsky performance score. Two patients with painful renal cell cancer metastases patients has concurrent one-stage angiography, embolization, and AORIF under one anesthesia.

RESULTS:

Geographic location of the cancer center allowed thorough follow up of patients. The surgical wound measured less than 1 cm each and transfusion was not required. There were no complications such as infection, blood loss, or prolonged hospitalization. All patients showed improved pain and functional ambulatory scores along with ECOG and Karnofsky performance scores. Ambulatory patients were discharged to home or oncology service for continued oncologic care without delay. 10 patients died of disease (follow-up range:6 - 22 months) but did not develop fractures or did not require revision surgeries. Among 14 patients alive with cancer, 4 patients required conversion surgeries due to subtrochanteric fractures (n=2), delayed hemiarthroplasty for an existing femoral neck fracture (**Figure 3**) 21 months after AORIF and chemotherapy, and progressive bone loss (n=1). All patients except one patient did not demonstrate at the site of AORIF reconstruction. Overall fracture rate excluding 2 established fractures is 8% (2 fractures/25 femur).

DISCUSSION AND CONCLUSION:

Metastatic cancer-laden bones are dysplastic due to cancer-induced bone loss, prior radiation, post-AORIF radiation, chemotherapy, bisphosphonates, and denosumab. More comprehensive skeletal metastases-specific oncologic procedures need to be implemented for improving bone quality and decreasing cancer burden by ablation techniques and bisphosphonate-loaded bone cements. There are often cases with massive bone loss in the ipsilateral concurrent acetabular and proximal femoral bone loss. AORIF provided a very practical minimally invasive solution that allowed life-prolonging or life-saving chemotherapy without delay. Based on atypical fracture-like insufficiency fractures, we are now modifying our screw fixation by entering the femoral head and neck above the lesser trochanter. In summary, AORIF is a safe and effective alternative minimally invasive percutaneous procedures for a focal periarticular osteolytic metastases in patients with advanced cancers before extensive open reconstructive surgeries are contemplated.