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CASE STUDY REPORT

OsteoBridge™ IDSF

Intramedullary Diaphyseal Segmental Defect Fixation

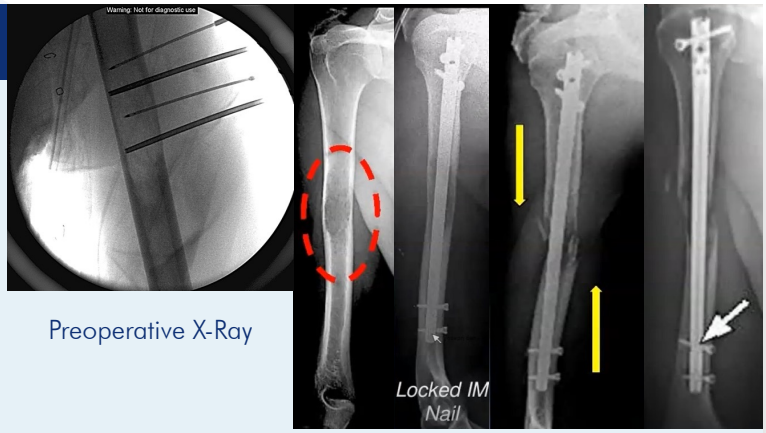
Dr. Joseph Benevenia

Dr. Joseph Benevenia is an Orthopaedic Surgeon at the Rutgers-North Jersey Orthopaedic Institute and he's known for his clinical expertise and investigations in the field of limb preservation.

Dr. Benevenia is a leader in the science and application of allografts and endoprosthetic reconstructions to treat musculoskeletal tumors, and lectures both nationally and internationally. He has numerous publications in peer-reviewed journals. He also serves as Professor and Chair, in the Department of Orthopaedics at Rutgers-New Jersey Medical School.

Case Information

Age:	60
Sex:	Male
Diagnosis:	Myeloma
Bone:	Humerus



Preoperative X-Ray

Patient History

A 60-year-old male with a history of multiple myeloma ISS stage I presented with non-union and increasing pain after undergoing radiofrequency ablation and receiving an intramedullary rod for prophylactic fixation of an impending pathologic fracture of his right humerus. Two months after rod implantation while on bisphosphonates, the patient experienced increased pain and a nondisplaced fracture was identified around the shaft. After eighteen months of conservative management, a follow-up examination showed that resorption caused the rod to migrate with the development of a complete complex fracture in the humeral diaphysis and a broken distal locking screw.

Surgical Intervention Options

Intramedullary (IM) nailing

Intramedullary nailing is usually preferred for humeral shaft fracture fixation due to its associated decrease in intraoperative time and complication rates such as infection[1,2,3]. However, patients with length unstable lesions or segmental bone defects are less than optimal candidates for IM nailing due to the risks of non-union and shortening[4]. Furthermore, the use of cement in a bone with an IM nail is limited.

Extramedullary plating

Osteosynthesis with extramedullary plates has the advantage of spanning segmental defects when using cement[5,6]. Additionally, the plate's load-bearing ability is especially beneficial in a patient with increased bone fragility.

Proximal Humeral Prosthesis

Proximal humeral replacement provides stable fixation. However, this procedure has about a 25% rate of dislocation and usually severely limits the shoulder's range of motion (MSTS 60%) since it typically involves releasing the rotator cuff tendons[7,8,9].

Intercalary Endoprostheses

Intercalary endoprosthetics address segmental bone defects and allow for immediate weight-bearing through load-sharing and use of cement[6].

Intraoperative X-Ray

Surgical Intervention Chosen

The patient presented with persistent symptoms and relapsed multiple myeloma while emphasizing the importance of maintaining his active lifestyle. Given his pathological non-union, shortening, and humeral anatomic location, consideration was given to segmental endoprosthetic reconstruction. Merete's OsteoBridge Intramedullary Diaphyseal Segmental Fixation System (IDSF) allowed us to address the segmental bone loss while the cemented intermedullary stems allowed for more rigid fixation along with less reliance on bone integrity.

Surgical Summary

The patient was placed under general anesthesia and positioned supine with a small bump placed under his right scapula to allow for slight extension of his right humerus and shoulder. To allow for maximum safety of vital neurovascular structures, the anterolateral transdeltoid approach was used to remove the original 24-cm x 10-mm right-sided humeral nail. C-arm fluoroscopy helped localize the 2 interlocking screws placed both proximally and distally, which required separate incisions and dissections for removal.

Once the locking screws and humeral nail were removed, fluoroscopy was used to localize the diaphyseal fracture site, over which a 5-cm anterior incision was made. Deeper dissection via anterior approach to allow for proper fracture exposure was completed with the biceps brachii mobilized medially. Rotational alignment of the proximal and distal humerus was pre-marked with the bovie and then the oscillating saw was used to prepare the humeral bone ends at the level of the proximal and distal fractures. A 4-cm defect was measured, which the 40-mm spacer appropriately replaced.

Curettes were used to clear out additional soft tissue and prepare the medullary canal for cementing. Trialing of the implants confirmed that the 12-mm x 110-mm proximal and 10-mm x 110-mm distal stem appropriately fit within the canal. Before the final prosthetic implantation, a cement plug was used to prevent cement extrusion into the shoulder joint. Both stems were cemented in place. Then, the 40-mm shell was clamped across the proximal and distal stems. Standard torque limiting wrench was used to secure the implant screws after which, implant placement was confirmed.

Patient Outcome

When the patient was discharged from the hospital on postoperative day 3, they reported feeling immediate symptomatic improvement and pain relief without any changes noted on their neurovascular and physical exam. They were prescribed physical therapy to help reach their original functional status, especially to increase their shoulder range of motion.

6 months after their intercalary endoprosthetic replacement, an extramedullary callus was noted about the intercalary segment with no evidence of periprosthetic fracture. Small bone fragments adjacent to the proximal humeral shaft that had initially been noted prior to replacement were unchanged.

At their 1-year follow-up visit, they presented with complaints of rotator cuff insufficiency with a restricted range of motion in forward flexion (120°), which were likely complications secondary to intramedullary nail implantation and subsequent removal. Importantly, they have attained their full level of activity including skiing and hiking without any issues. At this visit, they had an MSTS score of 86.7%.

Postoperative X-Ray

Summary/Conclusion

The IDSF System by Merete provides a simple and optimal solution for treating indications such as the failed reconstruction in this case study. They were able to retain their quality of life by quickly returning to athletic activities with only occasional complaints of well-controlled pain. Modular intercalary endoprostheses have been associated with rapid improvements in pain as seen in this patient. Their functional outcome was also comparable to other cemented intercalary replacements of the humeral shaft[10,11,12].

While custom endoprostheses could have been utilized in this case, development and production are not only more time-consuming, costly, and have higher rates of mechanical failure, but also are not amenable to intraoperative changes that could arise[13]. The modularity of the IDSF system by Merete allows for spacers, which are available in sizes of 40, 50, 60 & 70 mm, to be stacked together, to quickly accommodate different sizes of intercalary defects.

Locked plating with cementation was another possible option but requires significantly more soft tissue dissection and longer operative times. This fixation method also has increased risk of infection, pain, and soft tissue failure[14]. Aseptic loosening is one of the most common complications in intercalary humeral reconstruction[10,15]. The ability to select different stem diameters with cementation for the proximal and distal segments was especially useful to help minimize this risk.

Case study worked on in conjunction with Claire Park

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