

Interposition Distraction Arthroplasty of the Elbow

Article by Lori Banitt, CST

The use of grafts consisting of natural or synthetic materials in arthroplasty has been practiced for more than 150 years. The interposing of a substance into the joint space during arthroplasty serves the purpose of restoring motion capability while preserving the functional capacity and stability of the affected joint. This technique has been used to treat arthritis of the knee, hip, wrist, elbow, shoulder, and temporomandibular joints. Historically, a wide variety of materials have been tested for their potential use as interposition grafts, including metals, muscle flaps, animal membranes (pig bladders), fascia transplants, and skin grafts (cutis). Currently, fascia lata and skin are favored as providing the greatest success when used as grafts in interposition arthroplasty of the elbow.

The standard surgical technique involves extensive harvest of cutis from the abdomen as well as adequate exposure of the operative site that often requires release of ligaments, potentially rendering an unstable joint.

An alternative approach employed by the Mayo Clinic incorporates a distraction device to separate the bones of the elbow, allowing the interposed tissues and ligaments to heal and lessening the tendency toward joint instability. The greater complexity of this technique is reflected in its accompanying instrumentation setup. One modification of this technique, also attributed to the Mayo Clinic, is unique in the manner in which the cutis graft is harvested: a clean, incision-type scar at the graft site replaces the usual defect that results from traditional skin-grafting techniques; thus, the outcome is significantly less disfiguring for the patient. This article will present the Mayo Clinic surgical technique for interposition arthroplasty.

Indications for Surgery

The degenerative effects that arthritis has on the elbow joint include osteophyte formation in the medial humero-oulnar joint and mild-to-moderate flexion contracture of the tendons and ligaments. These degenerative changes usually indicate the necessity of interposition distraction arthroplasty of the elbow. The primary goals of the procedure are to provide pain relief, improve function, and maintain reasonable arthral stability. Interposition arthroplasty is believed to be most appropriate for young and middle-aged patients diagnosed with posttraumatic or degenerative arthritis (Figure 1). A young person afflicted with congenital arthropathy may also be a candidate for this procedure. Generally, this form of arthroplasty is indicated for patients suffering from joint dysfunction and an intensity of pain that together significantly limit their ability to perform daily activities.

Contraindications

Contraindications for this procedure include the presence of infection or osteomyelitis and the condition of having a grossly unstable elbow rendered thus by rheumatoid arthritis or trauma. For patients older than sixty, total prosthetic replacement of the elbow is considered a more appropriate form of treatment.

Preoperative Planning

A preoperative evaluation of the patient includes the following assessment criteria:

Function. The functional capacity of the elbow (ie, range of motion) and the degree of difficulty in performing activities of daily living (ADL) are assessed.

Pain. The intensity of pain experienced by the individual is rated on a scale of zero to three (ie, 0 = none; 1 = mild; 2 = moderate; 3 = severe).

X-ray films. Routine anteroposterior

and lateral radiographic films are necessary. Computed tomography may be used to identify the existence of degenerative changes to the articular surfaces, the integrity of the osseous portion of the joint structure, and evidence of nonunion.

Instrumentation

The following instruments are needed in the performance of interposition distraction arthroplasty:

- Basic elbow setup (Figure 2)
- Electric dermatome for skin graft
- Power drill for drill holes and to insert pins
- Distraction device (Dynamic Joint Distractor; stainless steel, from Howmedica) packaged in its own instrument tray (Figure 3).

Patient Preparation

The patient is brought to the operating room and placed in the supine position on the operating table. The patient is



Figure 1. Severe elbow arthritis.

anesthetized and a nonsterile tourniquet is placed as proximal as possible on the operative extremity. A supportive stockinette is placed around the hand so that a 10-minute prep can be performed on the area between the wrist and the tourniquet cuff. The donor graft site, in this instance the cutis of the abdomen, is also prepped for 10 minutes. The donor site is draped with sterile towels and an abdominal sheet surrounds the prepped area. The operative extremity is placed in an impervious stockinette, followed by a regular stockinette, which is rolled over the hand to the tourniquet cuff. An extremity sheet is then placed as far proximal as is feasible with regard to sterile technique. An elastic bandage is used to cover the hand for additional sterile protection and later is used for exsanguination of the extremity. Additional sterile sheets are used to cover the remaining surfaces of the patient's body.

Interposition Procedure

The arm is exsanguinated, the tourniquet is inflated, and the arm is brought across the patient's chest. The operating table is tilted 10 degrees, which allows either a straight posterior (Mayo) or a posterior-lateral (Kocher) incision to be made (Figure 4). The ulnar nerve is identified and protected with a nerve tape. Normally, the triceps mechanism is reflected from the tip of the olecranon at this time, and the common extensor tendon is released to expose the elbow capsule laterally. The lateral collateral ligament is exposed, released from its origin at the lateral condyle, and tagged with sutures for reattachment. The tip of the olecranon is excised and a complete anterior and posterior capsulectomy is performed to complete the exposure of the elbow joint (Figure 5, p14).

If the articular surfaces of the joint are found to be severely degenerated, the contour of the humerus is fashioned, as necessary, with a power burr and rongeur. The area selected to serve as the cutis graft donor site, usually the abdomen, is exposed (Figure 6, A, p14). A modification of this technique, performed at the Mayo Clinic, utilizes the "bikini line" as the donor graft site (Figure 6, B, p14). Using an electric dermatome, a rectangular split-thickness skin graft that is approximately 8 cm long and 5 cm wide is harvested. The cutis layer of the graft is removed with a

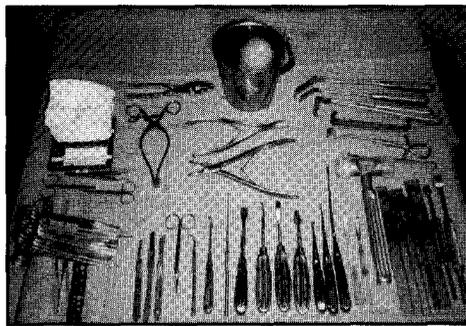


Figure 2. Basic elbow instrumentation and setup.

sharp knife and the rectangular defect is converted to an incision of elliptical shape, which allows for primary closure of the defect (see Figure 6, B). No. 1 non-absorbable sutures are placed through the anterior portion of the graft and tagged with small clamps. The graft is immediately placed in a small basin containing 0.1% neomycin sulfate solution.

Small drill holes are made in the lateral, midline, and medial aspects of the distal humerus to accept the graft. After the graft has soaked in the antibiotic solution for approximately 15 minutes, it is placed against the distal humerus in such a way that the subcutaneous layer is exposed to the new joint space. The graft is secured by means of No. 1 non-absorbable sutures placed through the

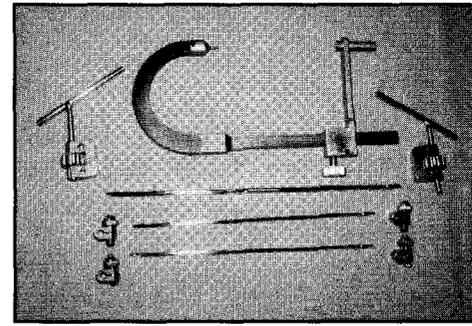


Figure 3. Components of the Mayo Dynamic Joint Distractor.

graft, across the distal humerus, and tied to the graft (Figure 7, p14).

Application of Distraction Device

Following the interposition procedure, and with the elbow joint fully exposed, the distraction device is applied. A targeting device facilitates the accurate insertion of a 3.2-mm drill bit across the distal humerus and assists in identifying the axis of rotation while providing a landmark for the placement of small drill holes needed to reattach the lateral collateral ligament (Figures 8 and 9). After reattachment of the ligament, the 3.2-mm drill bit is withdrawn and replaced with a 4-mm transfixing pin driven across the distal humerus, a maneuver during which the ulnar nerve is carefully protected. Two smooth 3-

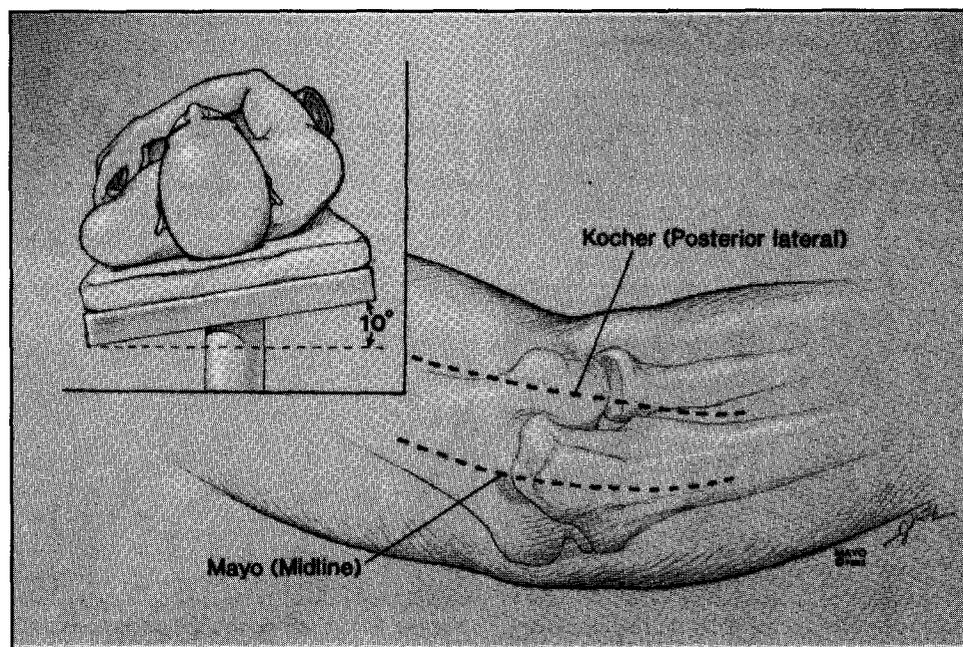


Figure 4. Positioning of the patient.

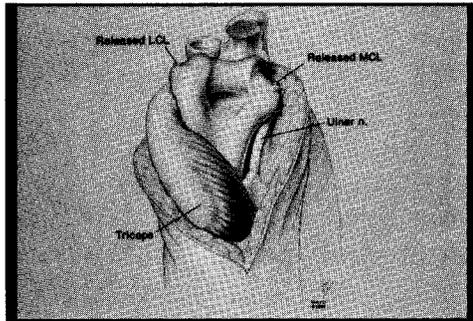


Figure 5. The fully exposed elbow joint with ligament release.

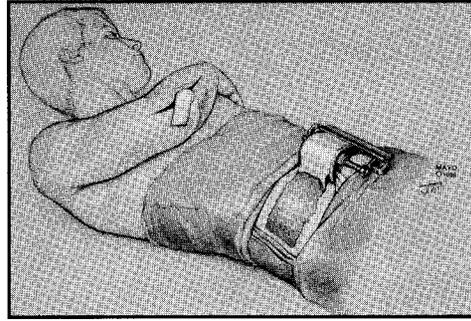
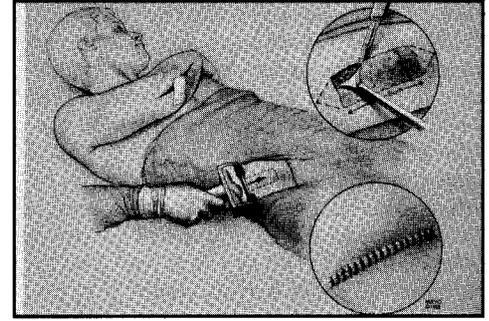


Figure 6. *Left*, Cutis graft from the abdomen (standard technique). *Right*, Cutis graft from the bikini line; note primary closure (Mayo technique).



mm pins are then drilled across the proximal ulna; these pins should be parallel to the humeral transfixing pin and to one another. Next, reattachment of the triceps is performed using No. 5 nonabsorbable sutures placed through the drill holes in the bone and drawn through the triceps and back through the ulna. The distraction procedure is concluded through the distraction of approximately 3 mm to 5 mm of the joint's surface (Figure 10).

Special Considerations

During this procedure, the surgical technologist must be visually attentive to the ulnar nerve, making sure that it is properly retracted with retractors that are not sharp, such as a band retractor. In addition, the ulnar nerve should be irrigated regularly with saline or antibiotic solution to keep the nerve moistened. Since the arm is brought across the patient's chest, the surgical team needs to be aware of its possible close proximity to the intubation tube.

Wound Closure

The tourniquet is deflated and hemostasis is achieved. Absorbable sutures are

used in wound closure at both the elbow and donor sites. Antibiotic ointment is applied around the pin sites and the elbow receives a compressive dressing. The donor site is covered with sterile bandages.

Postoperative Patient Care

While the patient remains in the recovery room, an assessment is performed to evaluate the status of neurovascular competence of the operative extremity. The anesthesiologist provides a continuous axillary block that relieves the patient's pain for 2 to 3 days postoperatively. Once the patient has been moved to a hospital room, his/her arm is placed in a continuous passive motion (CPM) machine for 4 to 5 days. The elbow is carefully inspected for swelling and evidence of infection.

After sufficient progress is noted, the patient is discharged from the hospital on the 4th or 5th postoperative day and provided with a portable CPM machine to be used for 3 to 4 weeks. Upon completion of this regimen, the patient returns to the hospital for removal of the distraction device and for postoperative examination that requires the appli-

cation of general anesthesia. Radiographic films are taken during this visit to verify the status of the reduction and the stability of the elbow.

For 6 to 12 weeks following surgery, the patient wears flexion and extension splints that are alternated (one worn at night and one worn the next day). A maintenance program is undertaken for an additional 3 months to prevent abnormal postsurgical contracture of the tendons and ligaments of the arm.

Results of Surgery

In a 10-year follow-up evaluation of 50 consecutive postsurgical patients, the improved range of motion averaged 90 degrees, as compared with a limited 30-degree range prior to surgery (Figure 11). Studies have shown that approximately 90% of patients claimed to be satisfied with the results of the operation, which included lessened pain, improved function, and increased range of motion.

Conclusion

Interposition distraction arthroplasty is a lengthy and challenging procedure. Impressive results have been achieved

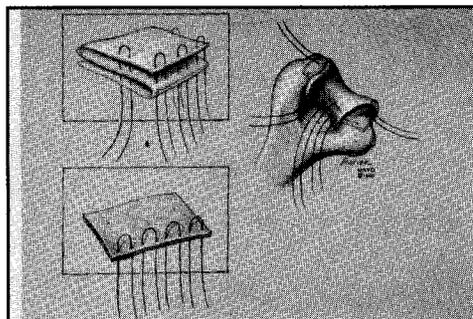


Figure 7. Fascia (top) and cutis (bottom) graft secured to distal humerus.

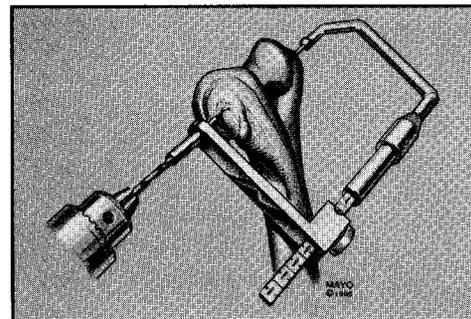


Figure 8. Targeting device accurately places the humeral pin.

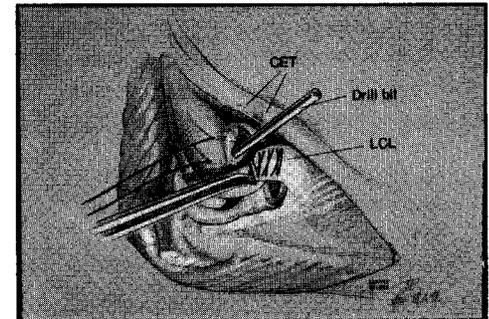


Figure 9. The lateral collateral ligament (LCL) is reattached prior to repair of the common extensor tendon (CET).

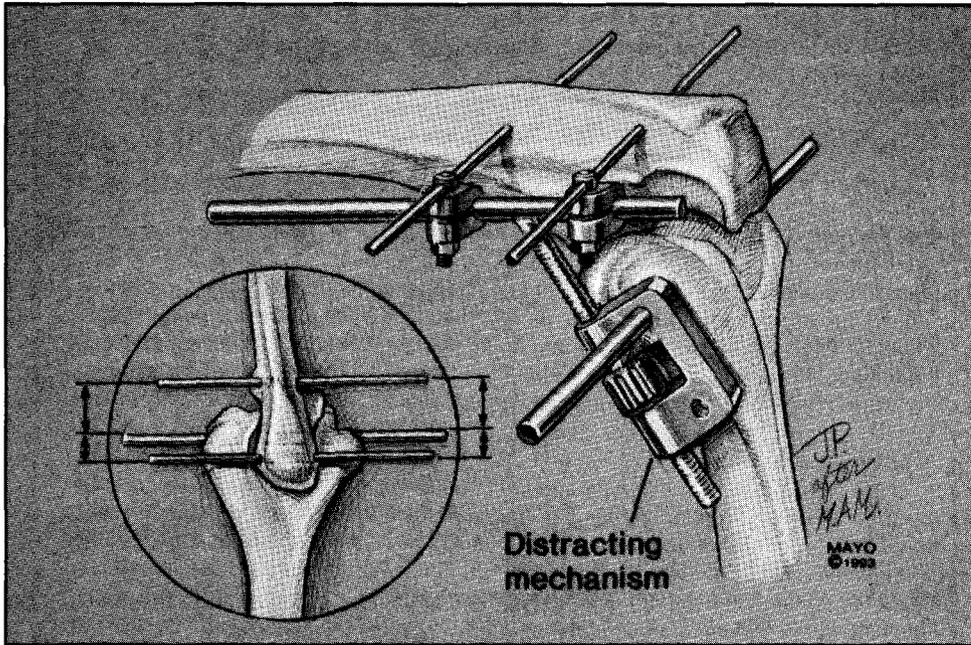


Figure 10. The fully assembled Mayo Dynamic Joint Distractor.

at the Mayo Clinic through the use of a distraction device, which allows for improved graft incorporation and joint stability (Figure 12), and the harvest of cutis graft. The author has worked extensively with the surgeon to perfect the method of harvesting cutis graft in a manner that ensures patient safety while safeguarding the cosmetic integrity of the graft donor site.

This technique can also be adapted for treating other joint disorders. An expanded application of this technique, using the distraction device without cutis interposition, can be used to treat a fractured and dislocated elbow that is unstable.

Undergoing interposition distraction arthroplasty allows the young or mid-

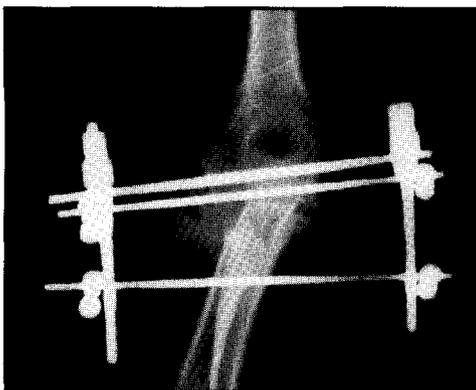


Figure 12. Patient treated with interposition distraction arthroplasty.

dle-aged patient diagnosed with incapacitating arthropathy to receive treatment without compromising joint stability or requiring the use of a prosthesis. Such patients are afforded the benefits of pain relief, enhanced functional capability of the affected joint, and improved ease in conducting daily activities.

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Lori Banitt, CST, has been a surgical technologist at the Mayo Clinic in Rochester, Minnesota, for 16 years. She specializes in orthopedic surgery and has assisted Dr Morrey for the last 14 years. This article won first place in the 1996 Writer's Award.

THE STIFF ELBOW

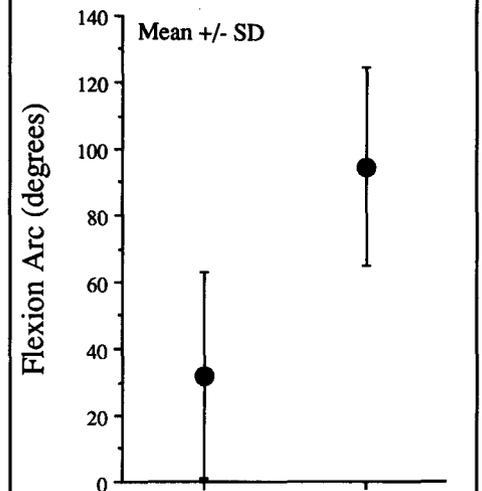


Figure 11. Preoperative and postoperative results.

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