CHAPTER 9

The Wrist Joint

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INTRODUCTION

Wrist surgery typically involves outpatient procedures performed on healthy people. The most common procedures are performed for the treatment of ganglion cysts, benign tumors, and tendinitis. The surgical time in these cases is usually less than 1 h. Complex procedures are typically done for fractures and arthritis, which last from 1 to 4 h and may require postoperative hospitalization for pain control, neurovascular monitoring, and antibiotic administration. The occasional patient undergoing wrist surgery may be debilitated, with the most common associated condition being systemic arthritis from rheumatoid disease.

BIOMECHANICS OF THE WRIST JOINT

The wrist joint is a complex articulate structure involving the distal radius, distal ulna, and seven carpal bones plus the pisiform bone. It comprises multiple intercarpal joints as well as the distal radioulnar joint. The stability of these articulations is provided by a multitude of small ligaments, some of which must withstand strong forces during strenuous activities. The primary function of the wrist is to provide a movable yet stable platform for the hand. Twenty-four tendons cross the wrist to supply stability, power, and movement to it and the fingers. There is little soft tissue coverage for the important neurovascular structures as they cross the wrist into the hand. Because of its demanding functional requirements and constant exposure to extreme conditions, the wrist is particularly susceptible to injury in all age groups.

ANATOMIC CONSIDERATIONS OF WRIST SURGERY

Surgical Anatomy

The wrist joint and its surrounding soft tissues are abundantly innervated by the median, ulnar, radial, and lateral antebrachial cutaneous nerves, including their major branches, which are the anterior interosseous, posterior interosseous, dorsal branch of the ulnar nerve, and superficial radial nerve (Fig. 9-1). Anesthesiologists who perform peripheral nerve blocks for wrist surgery or postoperative pain relief, even for a simple ganglion excision, should recognize that the entire brachial plexus is involved in the innervation of the wrist and, for that matter, all major joints of the upper limb. Thus, there is no place for selective peripheral nerve blocks in surgery of the wrist joint or any other major joint of the upper limb.

The superficial branch of the radial nerve (SRN) emerges from beneath the dorsal edge of the brachioradialis tendon approximately 6 cm proximal to the radial styloid. It begins branching immediately, with several sensory branches proceeding to the dorsal aspects of the thumb, first web space, and index finger. Although primarily a cutaneous sensory nerve, it sends branches to the radiocarpal joint and the first and second carpometacarpal joints to a variable extent.

The posterior interosseous nerve (PIN) is also a branch of the radial nerve, which lies on the posterior surface of the interosseous membrane in the distal forearm. All of its motor branches, which supply the extensors of the wrist and fingers, are given off within the proximal two-thirds of the forearm. After crossing the midline of the wrist joint dorsally, the PIN gives branches to the radiocarpal, intercarpal, and the second, third, and
fourth carpometacarpal joints. The PIN is the main articular nerve on the dorsal aspect of the wrist.

The median nerve emerges from beneath the flexor digitorum superficialis in the distal forearm and then passes through the carpal tunnel. The palmar cutaneous branch takes off from the nerve proper approximately 4 to 6 cm proximal to the wrist crease. It supplies sensibility to variable extents to the proximal aspects of the thenar eminence and midpalm and may occasionally send a branch to the region of the distal scaphoid. The median nerve does not have direct articular branches.

The anterior interosseous nerve (AIN) is a branch of the median nerve, which lies on the anterior surface of the interosseous membrane. It supplies branches to the digital flexors in the proximal and midforearm and the pronator quadratus muscle in the distal forearm. Terminal branches of the AIN supply the distal radius bone and the radiocarpal and distal radioulnar joints.

At approximately the pisiform bone, the ulnar nerve divides into the deep motor branch, the sensory branch, and a small articular branch to the pisotriquetral joint. The sensory branch provides sensibility to the ulnar third of the palm and the palmar surfaces of the small finger and ulnar half of the ring finger. The motor branch innervates multiple intrinsic muscles of the hand, including the hypothenar, interosseous, two ulnar lumbricals, and adductor pollicis. The dorsal branch of the ulnar nerve branches from the ulnar nerve proper approximately 6 to 8 cm proximal to the wrist. It provides sensibility to approximately the ulnar third of the dorsal aspects of the hand and wrist, including the dorsum of the entire small finger and the ulnar half of the ring finger. Despite being considered primarily a sensory nerve, it has articular branches to the articulation between the carpus and the distal ulna, the distal radioulnar joint, and the fourth and fifth carpometacarpal joints.

The lateral antebrachial cutaneous nerve is a branch of the musculocutaneous nerve. It emerges from the lateral margin of the biceps tendon near the elbow and passes through the forearm toward the middorsal wrist. Its cutaneous supply on the dorsum of the wrist and hand is quite variable but is usually radial to the branches of the superficial radial nerve. There are consistent articular branches to the radiocarpal and first carpometacarpal joints.

The medial antebrachial cutaneous nerve is a direct branch from the medial cord of the brachial plexus. Although its branches usually terminate in the forearm, they occasionally extend to the ulnar aspect of the wrist, including articular branches.

The posterior antebrachial cutaneous nerve is a direct branch from the posterior cord of the brachial plexus. Its branches typically terminate in the posterior aspect of the forearm but occasionally extend to posterior aspect of the wrist, including radiocarpal articular branches.

**SURGICAL PROCEDURES**

**Positioning on the Operating Table**

Wrist surgery is performed with the patient’s arm on a hand table, which requires shoulder abduction and elbow extension. This position may be difficult or uncomfortable for some patients.

**Tourniquet**

A tourniquet placed on the upper arm or forearm is nearly always used in wrist surgery to improve visualization. The position of the tourniquet often depends on the surgeon’s preference. Many surgeons prefer a tourniquet on the forearm for simple procedures of short duration.
because patients report less discomfort at this site. Regardless of the tourniquet site, the patient will often complain of pain fairly quickly when it is inflated if the regional anesthesia does not extend to this level. The generally accepted safe duration for an upper extremity tourniquet is 2 h.

**Common Basic Wrist Procedures**

Common indications for basic surgery of the wrist are ganglion cysts, benign tumors, and tendinitis. Arthroscopy is also a common procedure that is minimally invasive. Because these are elective and ambulatory procedures, patients rarely have unstable medical problems. In fact, if the preoperative evaluation reveals substantial medical problems, the procedure should probably be postponed.

The surgical tissue penetration may extend to or through the joint capsule, but it is limited to small areas and does not involve bone. Thus, the intraoperative and postoperative analgesia requirements are usually predictable and straightforward. Depending on the extent and duration of the operation and the patient’s comorbidities, some surgeons use a single dose of prophylactic antibiotics, usually cephazolin. When regional anesthesia is used, excessive sedation should be avoided so that the patient does not become disoriented and uncooperative. Less sedation also allows more rapid discharge from the postsurgical recovery unit. Many surgeons and anesthesiologists prefer ketorolac in the immediate postoperative period for young healthy patients.

When wrist arthroscopy is being performed, the patient’s arm is typically held by a traction device, sometimes referred to as the traction tower, which is placed on top of the hand table. The upper arm is strapped to the base of the traction tower, the elbow is flexed 90 degrees, and the hand is held in vertical position by finger traps applied to two or more digits. Wrist joint distraction is applied by mechanisms built into the device, allowing the scope and other instruments to be inserted through small portals in the dorsum of the wrist. Various instruments are used to perform debridement or repair damaged tissue. Depending on the anesthetic method, local anesthetic can be administered by the surgeon at the portal sites and within the joint as needed. Postoperative management depends on specifics of the procedure. If only debridement was performed, a soft dressing or simple plaster splint is applied. When a ligament repair is done, a more encompassing plaster splint is often applied to the limb.

Analgesics given on the patient’s discharge range from ibuprofen to oral narcotics, sometimes in combination with mild sedatives such as hydroxyzine. Discharge instructions include elevation of the arm for 2 to 5 days, limitation of grasp, and limitation of repetitive use of the hand. However, light use of the hand for daily activities and clerical work is often permitted by the second postoperative day. Patients return after 10 to 14 days for wound inspection, removal of sutures, and instructions for progressive use of the hand. If oral analgesics are still used, they are weaned at this time. Formal rehabilitation is rarely necessary.

**Complex Wrist Procedures**

Complex wrist surgery is most commonly performed for trauma and arthritis (see Chaps. 8 and 16). Trauma involves all age groups, with causes ranging from simple falls in the elderly to severe industrial injuries in young adults. Many wrist injuries are emergency cases, including open fractures with contamination and crush injuries or deep lacerations with vascular compromise of the hand. Although elderly patients with wrist fractures have in the past been treated nonoperatively, there is a modern trend toward open reduction and internal fixation of fractures in this age group as well because these individuals are increasingly requesting treatment that will allow them to resume a relatively high level of activity. Since they often have comorbidities and yet the injury requires modestly urgent operative treatment, their preoperative evaluation and management must be expedited. In some cases, this urgency necessitates compromises that are not made in elective surgery. Younger patients with wrist injuries can be difficult due to lack of medical compliance, both pre- and postoperatively.

In the younger age group, distal radius fractures are classically high-energy injuries resulting from motor vehicle accidents. Although a case may be scheduled in an ambulatory surgical setting, other serious injuries may compromise the patient’s overall medical condition. Young and middle-aged people are more prone than older people to attempt suicide by deep wrist lacerations. If vascular compromise of the hand is apparent, emergency care is required. However, in attempted suicides, the possibility of altered mental and physical states due to an overdose of medications, illicit drugs, or alcohol must be recognized.

Arthritis is the other common broad indication for wrist surgery, the most common procedures being joint denervation, resection of the proximal row of carpal bones, fusion of a portion of the carpus, fusion of the entire wrist, or wrist joint replacement. Although wrist joint replacement has in the past been prone to early failure, new implant designs have shown durability similar to those of hip and knee prostheses (Fig. 9-1). Because wrist procedures for arthritis can be lengthy, proper precautions to protect against nerve compression and pressure points should be taken. Patients with arthritis may find it difficult or impossible to have their arm positioned optimally for surgery. A semirecumbent or semilateral decubitus position may be necessary for proper positioning.
of the wrist and the patient’s comfort. Alternatively, the surgeon can compromise by operating with the wrist elevated on top of a sterile bolster. Arthritic patients are usually taking anti-inflammatory medications, which pose potential risks of excessive bleeding during surgery and anesthetic procedures. In addition, these patients often have morbidities associated with systemic arthritis and general debilitation due to older age.

Wrist Arthroplasty

Although total wrist replacement (Fig. 9-2) is perhaps the most complex elective wrist procedure, the perioperative anesthesia and surgical care are similar to those used in other extensive wrist procedures. The indication for wrist replacement is severe arthritis in a patient with relatively low physical demands who wishes to retain wrist motion but is willing to accept permanent restrictions on activity. These patients often have severe generalized arthritis from rheumatoid disease, which is associated with many comorbidities including instability of the cervical spine (see Chap. 8). Preoperative radiographs of the neck in flexion-extension are therefore recommended, as is careful management of the neck during surgery, especially if intubation is required. Patients may need additional padding on the operating table to reduce the risk of pressure sores. Special needs related to the chronic use of corticosteroids should be recognized and managed by additional dosage given perioperatively. Preoperative prophylactic antibiotics are nearly always employed, especially when the patient uses immunosuppressive medication. Regional anesthesia is typically preferred to reduce the overall anesthetic risk and improve postoperative pain management.

Authors’ Technique

The procedure is performed through a dorsal skin incision, which is about 4 in. long. The extensor retinaculum is reflected to allow retraction of the tendons. The entire dorsal capsule is raised to provide a wide exposure of the joint. Using special jigs and instruments under fluoroscopic control, the articular surfaces of the distal radius and a portion of the carpus are resected. Dedicated drill guides and broaches are used to prepare the bones to accept the implant’s stems and screws. The implant may be inserted with or without cement, depending on bone quality and the surgeon’s preference. When bone cement is used, the amount is very small, and it is not subjected to the high intramedullary pressures that have been reported to cause blood pressure reductions (see Chap. 33). After implantation, joint stability and range of motion are tested. The joint capsule is repaired, the tendons and retinaculum are replaced, and the skin is closed. A suction drain is inserted to prevent hematoma formation. Overall blood loss is usually minimal. A bulky sterile dressing incorporating a plaster splint is applied. The patient is transferred to recovery with special care to support the wrist and provide strict elevation of the hand. The patient is hospitalized for 48 h for pain control, administration of antibiotics, bandage change, and initial rehabilitation. The bandages are changed on the morning of the second postoperative day, after which the patient is seen by the physiotherapist for fabrication of a thermoplastic wrist splint and instruction in gentle motion exercises. When a continuous peripheral nerve block is used, it is usually removed after the morning of the second day if the pain can be managed with oral medication, usually an oral analgesic (see Chap. 21).

Insufficient pain control and excessive swelling are the most common problems in the first week. Infection is rare. Stiffness of the hand and wrist is sometimes
prolonged, requiring formal rehabilitation. Like other joint replacements, implant loosening is the greatest long-term complication of total wrist replacement.

**ANESTHETIC CONSIDERATIONS**

**Preoperative**

These patients usually suffer from rheumatoid arthritis and multiple organ involvement. Its anesthetic implications and the drugs commonly used are discussed in Chap. 8.

Airway management may be difficult in these patients and is similar to that discussed for elbow surgery in Chap. 8. Preoperative pulmonary function tests and blood gas and pH analysis may be necessary if severe lung disease due to rheumatoid arthritis is suspected. Postoperative ventilatory support is very rarely needed but should be anticipated if severe restrictive lung disease is present preoperatively.

**Nerve Block**

Wrist surgery is commonly performed under regional anesthesia alone. Many blocks of the brachial plexus have been promoted (see Chaps. 23, 24, and 25); however, it must be recognized that for complete surgical anesthesia of the wrist a complete block of the brachial plexus is required. Moreover, if a tourniquet is used, the branches of the intercostobrachial nerves to the inner upper arm must be blocked. It is therefore our practice to use a single injection infraclavicular block of all three brachial plexus cords (see Chap. 24) for basic surgery to the wrist. Supraclavicular block (see Chap. 23) is also useful, but in both instances the intercostobrachial nerves must be blocked separately.

Single-injection blocks should not be done for complex wrist surgery, since they do not contribute anything to the alleviation of postoperative pain, which is usually severe. Single-injection blocks may even complicate situations where severe pain is present since the patient may be alone in the middle of the night and wake up with severe, unmanageable pain. Readmission for pain management is common in these instances which is counterproductive if a goal of ambulatory surgery and acute pain management is to be cost-effective. Continuous supraclavicular block may be of value, but again, it is important to block the entire brachial plexus in order to achieve anesthesia and analgesia for major wrist surgery. It is our experience that distal brachial plexus blocks (suprACLavicular, infraclavicular, and axillary blocks) provide excellent surgical anesthesia after the initial large bolus dose of local anesthetic. However, use of a continuous infraclavicular catheter may result in incomplete postoperative analgesia because the catheter may be placed against only one of the cords or terminal branches of the brachial plexus, and the smaller volumes and lower concentrations of the local anesthetics will only block that cord or branch. It is therefore our practice to use a continuous cervical paravertebral block (see Chap. 23), which blocks all roots of the brachial plexus, for surgery and for postoperative analgesia.

**Intraoperative**

Because surgery can last 2 to 4 h or more, care should be taken to protect vulnerable nerves against compression by using appropriate padding. Furthermore, the eyes and pressure points of the patients with rheumatoid arthritis should receive special attention.

If the surgery is expected to last more than 2 h, general anesthesia or deep sedation is considered. In such cases, we use an infusion of propofol, a cervical paravertebral block with a laryngeal mask airway and controlled ventilation. In cases of poor pulmonary compliance due to restrictive lung disease, tracheal intubation is used. For shorter operations, a block of the entire brachial plexus with or without sedation will provide excellent surgical conditions. For sedation, we use varying doses of midazolam combined with small doses of meperidine. Sedation with propofol may be problematic, since light sedation may make patients uncooperative, while with deep sedation the airway may be compromised.

In addition to the usual monitoring, the patient’s respiration should be monitored throughout by capnography via a divided cannula. Modern noise-cancellation headphones with soothing music of the patient’s choice go a long way toward comforting the patient during surgery.

Because most or all of the surgery is done under tourniquet control of bleeding, it is not necessary for the anesthesiologist to participate in controlling the quality of the surgical field.

**Postoperative**

Patients who undergo day-case ambulatory surgery under peripheral nerve block anesthesia should be instructed in caring for the anesthetized limb and preventing trauma to the vulnerable nerves (see Chap. 32). They should also be instructed to start taking oral analgesic medication before the effects of the block wear off. If severe pain is experienced after the surgery and discharge from the hospital, single-injection blocks are probably inappropriate. Rather, patients can be discharged from the surgical facility or hospital with continuous blocks in place (see Chap. 21).

A main feature of modern orthopaedic anesthesia is the treatment of acute postoperative pain with continuous
nerve blocks. There are very few instances in which this cannot be offered. In these rare cases, patient-controlled intravenous morphine sulfate should be offered at an absolute minimum. Continuous peripheral nerve blocks should constantly be adjusted to the patient’s analgesic and physical therapy needs on an individual basis and should be discontinued when the patient no longer requires the continuous block (see Chap. 21).

SUGGESTED FURTHER READING
