Complications of hand surgery

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Abstract

Hand surgery involves the surgical treatment of hand conditions and encompasses small bone fixation, arthroscopy, joint replacement and reconstruction of tendon and nerves. Complications following surgery to the hand may be due to patient factors, surgical decisions and the complex anatomy of the hand. Here we describe the complications associated with common surgical interventions for both elective and traumatic injuries to the hand. Following hand surgery, a balance between immobilisation and early range of motion is offset by the risk of wound complications, non-union of fractures and tendon re-rupture with stiffness and reduced range of motion of the digits. Superficial infection is relatively common following procedures to the hand, however long-term sequelae are rare. Implant failure, subsidence, instability and reduced range of motion are seen following arthroplasty procedures. Complex regional pain syndrome offers a significant challenge following injury to the hand and specifically after surgical procedures. Surgeons should consider the risk of particular surgical techniques, other perioperative factors and patient factors that may contribute to the development of complications following hand surgery. Patients should be adequately counselled in order to make an informed decision regarding the management of their condition.

Keywords arthritis; complex regional pain syndrome; complications; fracture; hand surgery; tendon

Introduction

Hand surgery involves the surgical treatment of hand conditions and encompasses small bone fixation, microsurgery, arthroscopy, joint replacement and the reconstruction of skin, muscle tendon and nerves. Hand surgery may involve the treatment of traumatic injuries of the hand as well as the elective treatment of chronic hand conditions. In the UK, 240000 injuries to the hand require surgical intervention each year. The demand for elective hand surgery is growing, with a predicted increase of 39% in the next 10 years.[1] Complications after surgical intervention are an inevitability and may be attributed to poor planning, performance, patient factors or chance. Surgery to the hand offers unique challenges with regard to the conflicting demands of healing and maintenance of range of motion, particularly after trauma. The complex anatomy of the hand may increase the risk of complications, but a detailed knowledge of that anatomy may improve the surgeon's outcomes. There are many patient associated factors that may increase the likelihood of complications following hand surgery and these include increased age, diabetes mellitus, chronic obstructive pulmonary disease, ischaemic disease, steroid use and increased ASA grade.[2] Here we discuss the complications associated with common conditions of the hand that may require surgical intervention.

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Tendonopathies and tendon injuries of the hand

Tendonopathies of the hand are commonly encountered pathologies. The majority of these may be treated conservatively, or with corticosteroid injections. Occasionally surgical intervention is required in the management of tendinopathies of the hand. Tendon injuries may occur as a result of trauma or secondary to degenerative changes or rheumatoid arthritis. The pathoanatomy of the lesion impacts on the potential complications of surgical intervention.

Trigger digit

Trigger digit is a common condition, with a reported incidence of 28 cases per 100,000, which may be treated conservatively with a corticosteroid injection or surgically by percutaneous or open release of the A1 pulley.[3] Complication rates vary, with many reporting no adverse events and others reporting up to 31% minor or major compilations following open trigger finger release.[4] Following open trigger finger release major complications, although rare, include: digital nerve injury, A2 pulley release leading to bowstringing, synovial fistula and proximal interphalangeal joint arthrofibrosis.[5] Minor complications include reduced range of motion, transient wound erythema, scar tenderness and pain.[4] A systematic review of outcomes following percutaneous trigger digit release reported a 94% success rate. Pain and stiffness were the most commonly reported minor complications in less than 1% of 2114 cases. Two infections, one fixed flexion deformity and one digital nerve injury were reported as major complications in the same group.[6] Amirfeyz et al. reviewed treatment options for trigger digit, concluding that there were no differences in reported complication or recurrence rates between open and percutaneous trigger release.[3]

De Quervain tenosynovitis

De Quervain tenosynovitis can be successfully managed with a corticosteroid injection into the first dorsal compartment. Failure of conservative management with steroid injection is reported to be between 17 and 30%.[7,8] In many cases requiring operative intervention, 73–91%, a separate compartment for Extensor Pollicis Brevis is noted.[7,8] Most commonly a longitudinal incision is used to release the first dorsal compartment, with a success rate of 82–100%. Radial sensory nerve injury is reported in 2–27%, with rare complications of recurrence, scar tenderness, wound infection and complex regional pain syndrome (CRPS) also reported in between 1 and 2%.[9–11]

Extensor tendon injuries of the hand

Lacerations to the extensor tendons of the hand requiring surgery usually occur in zone II and zones IV to VI. Following surgical repair an extensor lag is more likely the more distal the tendon injury. However, extensor tendon injuries may lead to a loss of flexion in any zone due to adhesion formation following surgical repair.[12] Newport et al. report outcomes at mean 5 year follow-up in 60 extensor tendon repairs, with superficial infection in two participants and failure of repair in four participants.[12] Zone III injuries may progress to Boutonnière deformity if left untreated. However, reconstruction of the central slip may lead to stiffness and limitation of tendon excursion. A higher rate of infection is noted with Zone V injuries, as these commonly occur as a result of a "fight bite". Inoculation with oral bacterial flora into the wound necessitates early washout and broad-spectrum antibiotics with surgical repair of the tendon to mitigate against this complication. More proximal injuries are associated with better outcomes, as the increased tendon diameter allows for a core suture to be used allowing early mobilisation and less adhesion formation.[13]

Flexor tendon injuries

Flexor tendon repair poses a unique challenge due to the need to repair not only the tendon but re-establishment of the gliding mechanism of the tendon to achieve a satisfactory outcome. Early primary repair with a strong core stitch improves outcomes, however function following surgical repair may still be variable. Crush injury, zone 2 injury, associated injuries and wound contamination are risk factors for worse outcome. Dy et al. report the results of a meta-analysis of complications after flexor tendon repair. Adhesions occurred in 4% of repairs, but the use of a modified Kessler suture reduced this risk.[14] It is suggested that due to the bulkiness of the repair in a narrower tendon sheath, adhesions occur more frequently in zone 2 injuries.[15] Reduced range of movement is reported in between 6 and 17% of cases. Early active motion following repair may improve range of motion; but bowstringing, volar plate injury adhesion and skin contractures may worsen joint contracture at the distal and proximal interphalangeal joints.[15,16]

Quadregia is a rare consequence of adhesions and contractures and functional shortening of the flexor digitorum profundus tendon (FDS). Restricted flexion of one of the FDP tendons to the middle, ring and little fingers leads to restricted flexion in the uninjured digits due to loss of contraction of the shared muscle belly. Atraumatic handling of the tissues may reduce adhesion formation but may also increase the rate of repair rupture. The repair is weakest between days 6 and 18 following surgery, with reported rupture rates of 4–5%.[14–16] The use of an epitendonous suture increases the strength of the repair and reduces re-rupture rates.

Infection following flexor tendon repair is rare, estimated at 4%. However, the routine use of peri-operative antibiotics has not been shown to reduce rates of infection postoperatively.[17] Increased rates of infection are seen in wounds contaminated with marine and farm yard debris, after crush injuries and in patients with diabetes.[15]

Surgical management of arthritis of the fingers and thumb

The joints of the hand are commonly affected by arthritis. The distal interphalangeal joints (DIPJ) are most commonly affected, followed by the carpometacarpal joint of the thumb (CMCJ), the metacarpophalangeal joints (MCPJ) then the proximal interphalangeal joints (PIPJ). In the early stages, conservative management with physiotherapy, exercises and orthoses improve pain and function. Intra-articular steroid injections provide short term relief from pain and improve function but may not have long term benefit.[18] Surgical interventions include arthroplasty, arthrodesis and excision arthroplasty.

Surgery for the DIPJ

The distal interphalangeal joint may be successfully treated using arthrodesis to provide a painless and stable digit for pinch grip. Arthroplasty procedures have been used but have largely fallen out of favour due to high failure rates, instability and implant breakage. Arthrodesis with a headless compression screw offers advantages over headed compression screws, Kirschner wire fixation or cerclage wire, with a union rate of 96%. Dickson et al. found an infection rate of 2.3%, screw prominence in 2.2%, cold intolerance in 2.1% and subsequent removal of metalwork in 5.2%, in a review of headless compression screw fixation of DIPJ arthrodeses.[19]

Surgery for the PIPJ and MCPJ

At the PIPJ and MCPJ, arthroplasty procedures have been shown to provide good pain relief and restoration of function. Silicone implants appear to offer advantages over metal and pyrocarbon implants with regard to failure of the implant and reoperation.[18] Indeed, revision surgery with conversion to arthrodesis after metal implant arthroplasty may be required in up to 27% of patients. Complications of these implants include loosening, instability, swan neck deformity, fracture, dislocation and infection. Pyrocarbon implants provide a better range of motion at the MCPJ than the PIPJ but require explantation in 39% versus 11% of silicone implants, due to higher rates of dislocation and subsidence. Silicone implants are not, however, without potential complications. Subsidence (8%), sclerosis (43–78%) leading to reduced range of motion and implant fracture (5–30%) have been reported in long term studies.[20]

Surgery for the CMCJ

Late stages of CMCJ arthritis, Eaton and Littler stages 2–4, may be treated with arthrodesis, or excision arthroplasty with or without ligament reconstruction and tendon interposition. In young patients, less than 50 years old, in a high demand job with painful instability, arthrodesis proves a stable thumb for function. However, there is a non-union rate of 7% and subsequent adjacent osteoarthritis is reported in 14%. Long term complications, including implant wear and silicone synovitis, preclude the use of arthroplasty at the CMCJ.[21] Trapeziectomy with or without ligament reconstruction (LR), tendon interposition (TI) or ligament reconstruction and tendon interposition (LRTI) may be used to successful treat CMCJ osteoarthritis. It is proposed that the TI reduces metacarpal subsidence and LRTI is used to improve stability of the thumb. However, a Cochrane review comparing surgery for thumb osteoarthritis showed no advantage of LRTI, TI or LR over trapeziectomy alone. Adverse events across groups showed no significant difference and include sensory changes, transection of the palmar cutaneous branch of the median nerve, complex regional pain syndrome,

persistent pain, scar tenderness, neuroma formation and instability. Trapeziectomy with LRTI offers a greater post-operative range of motion over trapeziectomy alone, but risks tendon rupture as a further complication.

Carpal tunnel syndrome

Carpal tunnel syndrome is the most common peripheral nerve entrapment. It is estimated that 1 in 10 people develop carpal tunnel syndrome. Risk factors for its development include diabetes mellitus, menopause, hypothyroidism, obesity, arthritis, and pregnancy. Non-surgical management of the condition reduces the severity of symptoms in the short term and includes education, splinting, laser therapy and corticosteroid injection. However, surgical intervention is two times more likely to return normal nerve conduction studies than non-surgical techniques.[22] Endoscopic release and minimally invasive carpal tunnel release show no functional improvement over the traditional open technique in the long term. Minimally invasive surgery may offer a quicker return to work and reduced wound complications over an open approach but is reported to have a 9% reoperation rate.[23] Endoscopic carpal tunnel release shortens return to work compared with open release, but has an increased risk of transient paraesthesia.[24] Reported complication rates for carpal tunnel surgery vary widely in the literature from 11 to 25%. Complications include CRPS (2–5%), structure damage (0.5%), scar tenderness, pillar pain, neurapraxia and reoperation (2.5%).[22,24]

Dupuytren's contracture

Dupuytren's contracture is a benign fibroproliferative disorder that affects the palmar fascia of the hand. Excess collagen deposition leads to progressive contractures of the fingers. Minimally invasive techniques for the management of mild to moderate Dupuytren's contracture involve percutaneous needle fasciotomy (PNF) and collagenase clostridium histolyticum (CCH) injections. These techniques have similar efficacy with good short term results but higher recurrence rate than open fasciectomy, 10–75% reported at 7 years.[25,26] Skin tears are the most commonly reported complications after these procedures, 11% after PNF and 13% after CCH injection. Other reported complications include haematoma (89%), oedema and pain following CCH and neurapraxia (1.6%) and infection (0.8%) following PNF.[26] Moderate to severe Dupuytren's contracture may not be amenable to these minimally invasive techniques. Open procedures such a limited or total fasciectomy may be required to correct more severe contractures. Limited fasciectomy, whereby the diseased tissue is removed using an open approach is associated with higher complication rates that closed procedures, but significantly lower recurrence rates than PNF, RR 4.06 (2.24, 7.33) P=<0.001.[25] Reported complications include wound healing problems (22.9%), CRPS (2–13%), infection (2–12%), digital nerve injury (2.5–3.5%) and digital artery injury (2%).[26–28] Following revision procedures for Dupuytren's contracture the risk of digital nerve and digital artery injuries increases tenfold, to around 20%.[27]

Fractures of the hand

Fractures of the hand are the second most common fractures of the appendicular skeleton after wrist and forearm fractures. In a UK population the incidence of hand fractures is 2.8–4.4 per 1000 per year.[29,30] 50% are phalangeal fractures, 42% are metacarpal fractures and 8% are multiple.[31] Only 6% of hand fractures are open injuries and it is estimated that 11% are treated operatively.[29] Many fractures may be treated non-operatively, however indications for surgery include open injuries, multiple fractures, instability of the fracture and intra-articular fractures.[32] Open fractures increase the risk of infection, malunion non-union and stiffness. Operative management of phalangeal and metacarpal fractures include Kirschner wire fixation (K-wire), open reduction and internal fixation (ORIF) and intramedullary fixation. Comparison between K-wire fixation and ORIF has shown equivalent functional outcomes, however each technique poses its own challenges in terms of post-operative recovery and complications.[33] K-wire fixation allows minimal soft tissue exposure but does not provide compression across the fracture and therefore requires a period of immobilisation following fixation. This, in turn, increases the risk of postoperative stiffness. K-wire fixation is associated with up to 25% superficial pin site infection, non-union and tendon adhesion.[33,34] ORIF risks disturbance to the extensor tendons and may increase the risk of tendon adhesion formation. Complications following ORIF of metacarpal fractures include stiffness (14%), extensor tendon injury, infection (6%), and pain (3%) with a re-operation rate of 17%.[32,34] Intramedullary fixation of metacarpal fractures may improve grip strength over K-wire fixation or ORIF. However, there is limited rotational stability with this form of fixation, which may be associated with a higher malunion rate. Transient neurapraxia is also reported following intramedullary nailing of metacarpal fractures.[34] Regardless of the choice of implant for surgical fixation, early range of motion exercises reduces the rate of stiffness and improves range of motion following fixation of phalangeal and metacarpal fractures.[32]

Complex regional pain syndrome

Complex regional pain syndrome (CRPS) warrants special attention, as it is a common and debilitating condition following both hand injury and hand surgery. It is a condition characterised by pain out of proportion to the injury, swelling, movement abnormalities such as stiffness and vasomotor instability with colour and temperature changes. According to the IASP criteria, a diagnosis of CRPS can be made when patients have continued disproportionate pain and one symptom in three of four categories (sensory, vasomotor, sudomotor, and motor), and one sign in two of the same categories; and no other cause can be found. CRPS can be classified into Type 1, with no nerve involvement, and Type 2 with identified nerve involvement, such as after carpal tunnel surgery. The upper limb is most commonly affected and 16% of cases occur following surgery.[35] CRPS occurs 2–4 times more commonly in females than males, has a median age of presentation of 4–53 years and most commonly presents in post-menopausal women. The pain is characterised by hyperalgesia, allodynia and hyperpathia. CRPS is reported in 5% of carpal tunnel releases with symptoms presenting

between 1 and 3 weeks after surgery, in 5–25% after Dupuytren's contracture surgery and 22–39% after distal radius fractures.[35,36] CRPS has been shown to contribute to osteopenia, delayed bone healing, non-union, joint stiffness and tendon adhesions.[36] By 2 years between 74 and 90% of cases have resolved, however there still remains a large proportion of patients with residual symptoms and disability associated with the condition.[35] Management of CRPS is multifactorial and targeted depending on the aetiology of the condition. The mainstay of treatment includes physical therapy, splinting, mirror visual feedback, topical therapy including dimethyl sulphoxide and capsaicin creams, and analgesic medications. Gabapentin has shown to reduce pain associated with CRPS, but little benefit has been shown with Paracetamol and Amitriptyline use. Surgical intervention is rarely indicated unless nerve entrapment has been proven. Amputation for CRPS should not be offered and will not improve pain.[35]

Conclusion

The management of hand conditions may involve surgical intervention to tendons, the small bones of the hand, joint replacement and reconstruction of ligaments, tendons, muscle and nerves. The demand of both elective hand surgery and surgical intervention for traumatic injuries is increasing. The complex anatomy of the hand and proximity of anatomical structures such as arteries and nerves may increase the risk of complications after surgical intervention. Risk factors for the development of complications following hand surgery include increased age, diabetes mellitus, chronic obstructive pulmonary disease, ischaemic disease, steroid use and increased ASA grade.[2] Following hand surgery, a balance between immobilisation and early range of motion is offset by the risk of wound complications, non-union of fractures and tendon re-rupture with stiffness and reduced range of motion of the digits. Superficial infection and wound healing complications are relatively common following procedures to the hand, however long-term sequelae are rare. CRPS offers a significant challenge following injury to the hand and specifically after surgical procedures. CRPS most commonly affects post-menopausal women and higher rates are associated with distal radius fracture, after carpal tunnel release and following surgery for Dupuytren's contracture.

Surgeons should consider the risk of particular surgical techniques, other perioperative factors as well as patient factors that may contribute to the risk of developing complications following hand surgery. Patients should be adequately counselled in order to make an informed decision regarding the management of their condition. ◆

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