Plastic and Reconstructive Surgery

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THE HAND—I

The hand is a highly specialised organ that has developed over thousands of years from the primitive fish pectoral fin. It is part of a multijoint system extending from the clavicle and scapula which allows a prodigious range of movement together with fine dexterity and also great strength. Its well developed sensory function results in it being described as the third eye.

Congenital hand abnormalities

Failure of differentiation—for example, syndactyly
 Arrest of development—for example, phocomelia
 Congenital absence—for example, no thumb
 Duplications—for example, extra digits
 Overgrowth
 Constriction bands
 Generalised skeletal abnormality

Hand anomalies occur in about 1 per 700 live births. Some hand deformities are often associated with generalised syndromes—for example, Poland's syndrome, which includes a hypoplastic hand and the absence or hypoplasia of the breast and underlying pectoral muscle on the same side.

Timing of surgery

There is no unanimity about the precise timing of surgery, although there is agreement that factors in favour of early surgery are: (a) very early surgery within 3 months of birth can be done on a thin hand; (b) the reconstructed part can be used early in development; and (c) psychologically it helps parents. Against early surgery are the facts that (a) the hand is small and often very fatty in the first year or two of life, (b) the bones are small and therefore postoperative immobilisation can be difficult, and (c) there is little cooperation from the patient.

All reconstructive surgery should be completed before the child goes to school, usually between the ages of 2 and 4 years, although pollicisation of an index finger for an absent thumb is often best performed far earlier. As with all hand surgery, it is important to remember that even though a child may have a severe abnormality there may be very little functional disability and in general cosmesis alone is not a reason to operate.

Syndactyly, one of the two most common congenital anomalies, is a failure of separation of the distally progressing finger elements. In simple cases it consists of only a skin bridge but in compound cases it affects the digital bones and joints. It is often associated with other anomalies. Bone union causes increasing deformity because of disproportionate growth, and the fingers should therefore be separated early. No matter how simple the syndactyly there is always a shortage of skin. This may be replaced by skin taken from either the groin or the instep of the foot. The dressings are usually left for two weeks, and then the patient will often need splints or a pressure garment during scar maturation.

Complete absence of the thumb is rare (though it was more prevalent when thalidomide was used), but it is important to treat it because the thumb contributes 45% of hand function. Pollicisation of the index finger, whereby it is shortened and transferred to the thumb is the treatment of choice. The interosseus muscles are used to construct thenar muscles. Advantages of this procedure are that an aesthetically pleasing new thumb is produced, which has good sensation and useful active opposition to the other fingers.

Excision of part of first metacarpal plus rotation.

Rheumatoid arthritis

If the intrinsics are short the proximal interphalangeal joint cannot be flexed when the metacarpophalangeal joint is extended.

A Swanson arthroplasty.

Harrison-Nicolle polypropylene peg.

Patients with rheumatoid arthritis are best managed in a combined clinic so that there is consultation between the rheumatologist, the hand surgeon, and the hand therapist. Many patients with severe chronic hand deformities are able to do most activities of daily living through trick or substitution motions, and thus preoperative assessment should be thorough and practical. The mere existence of a deformity is not an indication for surgery, and the aim should be to relieve pain, prevent further damage, and restore function. The patient must also realise that the operation will only interrupt a progressive disease and not cure it. Other joints in the body are often affected by the disease and there may be other medical conditions to consider. A patient who is being considered for surgery must be able to cooperate, particularly in the rehabilitation programme, if he is to get the best from the surgery.

Surgery is based on five procedures:

Joint synovectomy—In rheumatoid arthritis the synovium proliferates, causing necrosis of the joint cartilage, and also stretches the supporting structures—the collateral ligaments—and eventually causes their destruction. Synovectomy should be undertaken before these two processes become apparent, and in general it is usually performed too late. Most hand surgeons believe that some benefit is derived from synovectomy, which can never be complete, but there is little proof of this as controls are extremely difficult because of the progressive nature of the disease. Undoubtedly it provides good pain relief with minimal risk of functional loss.

Tenosynovectomy—Synovial proliferation also occurs in the tendon sheaths on the dorsal and volar aspects of the wrist and the flexor tendon sheaths of the fingers. This can compress the median nerve at the wrist and produce limited painful movement, locking of the fingers on flexion, or tendon rupture. Tenosynovectomy at the wrist will relieve local symptoms, but radical tenosynovectomy of the flexor tendon sheaths may have a high morbidity.

Tendon surgery—Rupture of the tendons, particularly the extensor tendons of the thumb, ring, and little fingers, occurs through their attrition as they glide over the dorsum of the wrist. The most common form of repair is to suture the distal divided tendon to an adjacent, intact tendon. If the extensor tendon in the thumb is ruptured then one of the two extensor tendons in the index finger is transferred. Boutonnière and Swan neck deformities are both common in rheumatoid arthritis. Boutonnière deformity is caused by rupture or an attenuation of the central slip of the extensor tendon inserting into the middle phalanx. Swan neck deformity is usually associated with intrinsic muscle tightness, which alters the balance of the complicated extensor tendon mechanism. Surgery for these two conditions depends on the underlying cause, and the results may be disappointing.

Arthroplasty—Despite an increasing awareness of the factors leading to finger and thumb deformities many patients ultimately develop joint subluxation and dislocation. Despite horrendous deformities in the hand, there may, however, be little incapacity. Joint prostheses may be inserted into the metacarpophalangeal joint and more rarely the proximal interphalangeal joint. Alignment of the finger is always improved by a successful arthroplasty operation, as is joint stability, but the actual movement through the metacarpophalangeal joint may not be improved. For painful disease at the wrist, especially where the ulnar styloid has become subluxed, ulnar styloidectomy can provide great symptomatic relief in most cases.

Arthrodesis—Despite improved artificial joints there continues to be an important place in rheumatoid surgery for joint fusion. Fusion is thought to be the best way to correct many of the advanced deformities and is particularly good in restoring the pinch stability of the thumb and index and middle fingers. Arthrodesis also is successful for severe disease at the wrist, which is of great importance as it is the key to the function of all the other joints in the hand. The wrist should be immobilised in a neutral position; the use of intramedullary fixation prevents the need for prolonged plaster immobilisation. Arthrodesis of the interphalangeal joints using a Harrison-Nicolle peg, which can be straight or angled, is quick and simple.

Osteoarthritis

Grinding the thumb metacarpal on the trapezium (right) causes pain in a diseased joint.

The incidence of osteoarthritis is high. The cause remains unknown, but there is an interplay of genetic and mechanical factors leading to biomechanical alterations in the cartilage. Disabling osteoarthritis of the hand is often misdiagnosed. Many patients respond well to simple physical and medical therapy and by moderating their activities. Patients with destructive joint disease in the digits can have excellent results with arthrodesis and implant arthroplasty for the basal joint of the thumb, which are the most common joints affected.

Dupuytren's disease

Dupuytren's tissue dissected.

Open palm technique of McCash.

Dupuytren's disease is thought to be a genetic abnormality caused by a single dominant gene. The disease originated in the Celtic races of northern Europe and has been disseminated by migration to Australia and North America. Its incidence in Scotland is about 25% in men over 65 years of age. It is much more common in patients with epilepsy.

Treatment

Fifty per cent of patients followed up for more than five years will show recurrence or extension of the disease, but it is not possible to predict which patients these will be, and there is an appreciable morbidity from radical surgery. The surgeon should plan operations appropriate to the patient's age, general health, extent of the disease, and rate of progression. Hueston suggests that if the patient can not place his hand and fingers flat on a table then surgery is advisable. It is always possible to correct contracture of the metacarpophalangeal joint but it is not always possible to correct flexion at the proximal interphalangeal joint, especially if it has been present for any length of time. The aim of treatment should be to control the disease and at the same time retain as much hand function as possible.

Four operations are available:

Fasciotomy—A single band of fascia is divided either blindly subcutaneously or after more formal dissection. In the old patient this operation has a lot to offer especially for disease in the palm of the hand.

Fasciectomy—Radical fasciectomy, especially in the palm of the hand, is no longer advocated. In general a limited fasciectomy is performed in the palm and this may be extended into the fingers, where a more extensive dissection may be required. Skin can be closed either by direct suture or, if a transverse incision is made, by a skin graft, or it may be left open.

Open palm technique of McCash—A transverse incision is made and if there is a relative shortage of skin the hand can be splinted and the fingers extended, leaving a skin deficit in the hand. This is left to heal spontaneously, within four to six weeks. The skin incision heals, leaving a linear scar and the fingers in an extended position.

Fasciectomy and skin graft—This procedure is based on the observation that Dupuytren's disease does not usually recur beneath a full thickness skin graft. This technique may be reserved for recurrent disease or for patients with a strong Dupuytren's diathesis in whom the likelihood of recurrence is high.

Postoperative complications

The overall complication rate is high (20%) and includes haematoma, skin necrosis, and infection, which are a related triad and usually follow extensive operations in the palm, especially where there has been tight skin closure. This sequence may precipitate reflex sympathetic dystrophy, which occurs in up to 3% of operations and is more common in women. More seriously, damage to digital nerves or loss of a finger may also occur.

Ganglion

Ganglion arising from distal interphalangeal joint.

The most common hand tumour presents usually as a cystic swelling. The peak incidence is in the young adult. The most common sites of presentation are: (a) next to the wrist either on the volar aspect, usually near the radial artery where it may communicate with the radial carpal, or on the inferior radial lunar joint; (b) on the dorsal aspect of the wrist commonly arising from the scapholunate or mid carpal joint, where it may give rise to pain and weakness of the wrist; (c) at the base of the finger, arising from the proximal end of the digital flexor tendon sheath; and (d) arising from the distal interphalangeal joint on the dorsal aspect adjacent to the nail bed.

Treatment—Up to half of all ganglia disappear spontaneously. Rupture by firm pressure or banging with a family bible has a high recurrence rate, as does aspiration and injection of cortisone. Surgical excision is indicated for those lesions causing discomfort, pain, or nerve compression. The success of the operation depends on successful dissection of the communication down to the point of origin from a joint or synovial sheath. The operation should therefore be done under a tourniquet with either regional or general anaesthesia and the incisions large enough to allow adequate surgical exposure of the structures.

Carpal tunnel syndrome

Symptoms

Numbness in distribution of median nerve to thumb and fingers
Pain severest at night, relieved by opening and closing fingers
Pain on acutely flexing wrist
Clumsiness of hand
Muscle wasting at thenar eminence
Sensory disturbance
Positive Tinel sign at wrist

Causes

Developmental
Neurofibromatosis
Anomalous intrinsic or extrinsic muscles
Persistently large median artery

Traumatic
Colles fracture
Indirect damage—for example, severe trauma to hand resulting in oedema

Inflammatory
Rheumatoid arthritis

Tumour
Ganglion or lipoma

Endocrine
Pregnancy or myxoedema

Carpal tunnel syndrome results from compression of the median nerve within the carpal tunnel. It can occur in adults of any age but usually occurs in those aged 30–60 years. It is rare in children, in whom it is usually associated with neurofibromatosis. It is five times more common in women than in men and occurs more often in the dominant hand; however, both hands are often affected. In men the disease is unusual but may be associated with vibrating tools.

On the flexor aspect of the wrist there are three canals: on the radial side that for the flexor carpi radialis tendon, on the ulnar side Guyon's tunnel, where the ulnar artery and nerve lie, and in between the carpal tunnel, through which 10 structures pass, including most superficially the median nerve. Any component or content of the carpal tunnel which increases in size will compress the nerve. A pressure of 30 mm Hg is enough to reduce the intraneural vascular blood flow.

Treatment

Conservative treatment in mild symptomatic cases and in pregnancy consists of splintage, restricting activity of the hand, corticosteroid injections into the canal, and diuretics in pregnancy. Conservative treatment may also include vitamin B₆ 100–200 mg daily for two to 12 weeks.

About 40% of patients need surgical treatment carried out under regional block or general anaesthesia with tourniquet. The carpal ligament should not be divided blindly through a very proximal incision, but the incision should be made on the ulnar aspect on the thenar crease. This allows the carpal ligament to be divided under direct vision and prevents damage to an abnormally situated thenar motor branch. After operation there may be weakness of the wrist and hand for several months and the scar may be associated with painful neuromas. In a very few cases there may be a persistent carpal tunnel syndrome which is due to incomplete division of the flexor retinaculum or due to fibrosis around or in the median nerve.

Carpal tunnel decompression totally relieves symptoms in half the cases, but in about 10% there is little improvement.

Line of surgical incision.

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