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Review Article

A Few Words about Upper Extremity and Plastic Surgery

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Abstract

Aesthetic surgery is a narrower branch of medicine, that is, a subspecialization of surgery that deals with the reconstruction and change of the physical body through various minor and major aesthetic procedures. Cosmetic surgery is one of the two main categories of plastic surgery (the other is reconstructive surgery that corrects, minimizes, or eliminates deformities that occurred at birth or are caused by disease and accidents), and the goal of cosmetic surgery is to improve the physical appearance of the body.

Keywords: upper extremity; the hand; axilla; tendon; plastic surgery

Introduction

The hand is a remarkably designed structure with complex anatomy and precise biomechanics [1]. The hand must be able to generate enough strength to carry out daily activities. In addition, it must ensure finger coordination for precise grasping and fine motor tasks. A comprehensive understanding of the detailed bone, muscle-tendon, aponeurosis, vascular, neural and lymphatic components is therefore essential for optimal functional and esthetic outcomes in patients requiring hand surgery. Additional challenges arise from the possible range of motion of the various joint surfaces, aided by muscle action and ligament support.

Planning

The surgeon planning reconstructive operations on the upper extremities must be aware not only of the complex anatomy of the hand and arm, but also of the physiological interplay of balanced muscle functions under the influence of the complex coordination of the system central nervous system, as well as maintaining physiological vitality through the central and peripheral circulatory and lymphatic systems [1]. A thorough understanding of the basic anatomy of the hand and upper extremity is of paramount importance.

Fibers

The dorsal skin of the hand is thin and elastic and anchored to the deep fascia only by loose areolar tissue [1]. The skin of the palm has a thick dermal layer and a heavily keratinized epithelial surface firmly attached to the thick fibrous palmar fascia by scattered vertical fibers. The skin on the hands is burdened with a high concentration of specialized sensory organs and sweat glands.Palmar skin folds can be used to identify and locate joints and underlying structures to help plan the exact placement of a skin incision. Kaplan's cardinal line is an important reference point for the hand's critical internal structures. To avoid contractures of the hand, Littler described imaginary diamond-shaped areas of skin where a longitudinal scar should be avoided. These diamond surfaces can be visualized by observing each articular axis and the kissing surfaces of the volar skin in full flexion.

Palmar fascia composed of tough fibrous tissue arranged in longitudinal, transverse, oblique, and vertical fibers.

Longitudinal fibers:

- Concentrate at the proximal origin of the palmar fascia at the wrist.
- Originate from the palmaris longus when present (80–85% of patients).
- Make up the fibrous flexor sheath of the digits.
- Attach to the volar plate and intermetacarpal ligaments at the level of the metacarpal heads.

Transverse fibers:

- Concentrated in the midpalm and the web spaces.
- Make up the transverse palmar ligament.
- Act as pulleys for the flexor tendons proximal to the level of the digital pulleys.

Vertical fibers:

- Superficial to the longitudinal and transverse fibers, vertical fibers travel to the palm skin dermis.
- Deep to the palmar fascia, they coalesce into septae and form eight individual compartments for the flexor tendons to each digit and the neurovascular bundles together with the lumbrical muscles.

In the fingers, there are two important bands of fascia, which help contain and protect the ulnar and radial digital arteries and nerves: Grayson ligaments and Cleland ligaments.

- Grayson ligaments are volar to the neurovascular bundles and are quite flimsy.
- Cleland ligaments are dorsal to the neurovascular bundles and are much stouter.

Bones

The hand skeleton is divisible into four elements [1]:

i. The fixed unit of the hand: the second and third metacarpals and the distal carpal row.

ii. The thumb and its metacarpal: displays a wide range of motion at the carpometacarpal (CMC) joint allowed by the joint, ligaments, and insertion of five intrinsic and four extrinsic muscles.

iii. The index digit: independence of action within the range of motion allowed by its joints, ligaments, and the action of three intrinsic and four extrinsic muscles.

iv. The third, fourth, and fifth digits with the fourth and fifth metacarpals: function as a stabilizing vise to grasp objects for manipulation by the thumb and index finger, or in concert with the other hand units in powerful grasp.

The distal row of carpal bones forms a strong architectural arch with the capitate as the keystone. Together with the second and third metacarpals, they form the stationary unit of the hand. As a stable base, this unit provides the support base for the other three movable units: the first metacarpal, the fourth metacarpal, and the fifth metacarpal. The first metacarpal moves through a wide range of motion due to loose capsular ligaments and a flat saddle joint between it and the quadrilateral. Movement is stabilized by the capsular ligaments, including the palmar ligament of the beak, and by its attachment to the fixed axis of the hand through the thumb adductors, first dorsal interosseus, fascia, and skin of the first arachnoid space.The mobile heads of the fourth and fifth metacarpals move dorsally and volarly with respect to the central axis of the hand due to the limited mobility of the CMC joints. These metacarpal heads are attached to the medial metacarpal bones by the intermetacarpal ligaments [unite adjacent metacarpophalangeal (MCP) volar plates]. The third MCP joint serves as the anatomical center of the hand. When the toes are fully abducted, the toes form equal-length rays from that point. The same ray projected proximally falls on the wrist. The primary single motor powering the medial hand bundle at the wrist is the extensor carpi radialis brevis (ECRB), which works against gravity to extend the pronated hand.

Axilla

Anatomically, the axilla is the space between the medial aspect of the upper extremity and the lateral aspect of the chest wall [2]. Many important neurovascular structures pass through this space between the thorax and the upper extremity. The usual axillary anatomy is well known to all surgeons, however, the anatomical variations of the area are not well defined, although neither rare nor uncommon. Classically, the axilla includes the lateral branches of some intercostal nerves, neurovascular structures such as the axillary vein, artery and its branches, the subclavian part of the PB and its peripheral branches, the loose connective tissue of the adipose sheath, some lymph nodes and vessels. , and sometimes the axillary tail of the chest.

Its appearance resembles a pyramid. Its blunt tip goes to the root of the neck, the so-called cervico-axillary canal. The top is bounded by the first rib, the scapula and the clavicle. The front wall limits the large and small pectoral muscles. The posterior wall covers the subscapularis muscle.The border of the medial wall is formed by the serratus anterior muscle. The lateral wall is narrow and is formed by the intertubercular groove. The base covers the fascia and axillary skin. The posterior border is the latissimus dorsi and subscapularis, the medial border is the serratus anterior, the anterior border is the pectoralis major, and the lateral borders are the axillary fascia, chest wall, and humerus. There are some discrepancies in the literature regarding axillary components.The most common variation of the axillary region is the abnormal position of the axillary arch. For example, the arc may alternatively originate from the lateral border of the latissimus dorsi, which passes through the axilla and inserts at the pectoralis major tendon near its humeral insertion. Variations are also sometimes defined in the literature. Classic anatomy texts describe axillary arches inserted into the long head of the triceps muscle or the medial intramuscular septum of the arm. The axillary arch is not clinically significant. During axillary knot removal, the presence of the axillary arch may interfere with normal anatomy. The arc of the free edge of the latissimus dorsi can erroneously lead the surgeon to dissect more proximally along the arc than along the muscle, as is usual. The high risk of unknowingly damaging the AP and axillary vein can also result in incomplete removal of lymph nodes, so surgeons in the armpits may be overdoing it. If the axillary arch is present during breast reconstruction with a latissimus dorsi flap, it may need to be separated due to epiphyseal compression in the axilla, resulting in flap damage.

The axilla contains many neurovascular systems and structures important to the region.The axillary artery, which begins as a continuation of the subclavian artery as it passes under the outer border of the first rib, nominally terminates at the inferior border of the greater teres, where it is called the brachial artery. It was placed deep in the subclavian BP. During dissection, the axillary vein runs approximately 1 cm cranially along the lateral border of the latissimus dorsi. The inferolateral part of the clavicothoracic fascia in the upper part of the area is well visualized. Once the underlying fat has been removed and gently pushed back, you can clearly see the blue coloring in the axillary vein. More commonly, two axillary veins are identified.

Tendon

Injuries to the distal upper extremity range from simple lacerations to complex open injuries with destruction of vital soft tissue, nerves, and vascular structures [3]. Successful evaluation and treatment requires careful attention to the mechanism, timing, and extent of the injury. The initial assessment of an injured hand or forearm includes a thorough assessment of bone, vascular, and soft tissue damage. Complex injuries require reconstruction priority. First, bone structures are stabilized by internal or external fixation methods.Once the limb is rigidly stabilized, soft tissue repair is performed to protect and minimize stress on the delicate vascular and nerve reconstructions. When soft tissue loss is significant, bone stabilization and revascularization are priorities. A soft tissue blanket is then placed and the soft tissue is allowed to stabilize and heal for 3 weeks. Reconstruction of tendons and nerves is delayed until soft tissue coverage has stabilized.

Tendon injuries of the forearm and hand range from the simple incomplete rupture of a single tendon to maceration and structural loss of multiple musculotendinous units.The mechanism of injury determines the repair method. Simple tendon tears are repaired directly using any known tendon repair technique. Repair of tendon tears resulting from blast and avulsion injuries is usually delayed because the extent of the tendon damage is not immediately known. A 3-4 week delay allows the viable tendon to be determined, after which tendon reconstruction with tendon grafts is performed.

Reconstruction

In upper extremity reconstruction, flaps are used to cover intact wounds such as exposed tendons, bones, joints and release contractures of the reticular space [4].

The area most prone to damage and requiring hip coverage is the elbow, both in the ulnar region and in the underlying bursa and elbow cavity, where contractures are common. The bony processes and aponeurotic origin of the outer forearm muscles predispose the elbow region to a frequent need for well-perfused tissue. Local coverage options include tissue sampling from the upper arm (distal) or forearm (proximal). In our experience, the most commonly used coverage is the reverse lateral coverage of the shoulder, which relies on the anterior or posterior recurrent radial arteries. The use of a recurrent ulnar knee is also possible, but not optimal due to the proximity of the ulnar nerve.A posterior interosseous drape, a radial forearm drape, or an ulnar forearm drape have also been used, but these may be required to function as distal drapes of the palmar and wrist surfaces in a multiple burn patient. Careful planning is required to avoid "burning bridges".

The wrist and hand are another potential area for knee coverage. its area is particularly vulnerable to exposed bones, joints, and tendons due to the thin layer of skin. In addition, the contracture of the first reticular space is particularly problematic and the use of an inverted posterior interosseous flap has shown good results in our experience. Coverage of the back of the hand with the tendon exposed can be achieved with the inverted radial forearm or inverted elbow forearm flaps. For smaller defects, the use of proximal and axial metacarpal bandages may also be helpful.

Digital reconstruction with overlays is also common and consists mainly of covering the dorsal surface of the PIP joint or resolving the contracture of the PIP joint, which can be extensor or lexor. Proximal or distal local overlays of the metacarpal or great toe were used for the reconstruction.

Vascular System

Vascular imaging is often essential for preoperative planning of complex upper extremity reconstructions [5]. In cases of trauma, indications include abnormal distal pulse, evidence of hemorrhage, limb ischemia, turbulent blood flow, damage to adjacent structures, or penetrating damage near a large vessel, particularly in pressure and gunshot wounds or in patients with non-traumatic injuries. Vascular insufficiency with decreased peripheral pulse or clinical signs of ischaemia. These tests are also recommended in for vascular malformations or tumors close to the vessels.

Free tissue transfer has been considered as a possible option within the reconstructive option to cover large resection defects following traumatic events, tumor surgery, or other issues requiring amputation surgery. Before the operation, it is necessary to obtain detailed information about the vascular status of the graft and the host area, since one of the crucial factors for the success of these microvascular reconstructions is adequate graft perfusion, which must be provided by the vascular guests.

Establishing adequate perfusion at the donor site is critical to ensure limb survival after flap removal, as vascular damage and peripheral arterial disease can cause limb ischemia.

Many methods have been described to identify these problems, the condition of the host vessel and the graft before starting the reconstructive procedure, such as the use of invasive procedures (conventional angiography) and non-invasive procedures such as ultrasound, computed tomography, angiography and magnetic resonance angiography (MRA).

After either of these procedures, contrast angiography likely remains the gold standard for assessing upper extremity vascular anatomy. This technique can also visualize the anatomy of the dominant circulation and collaterals and also identify stenosis, occlusions, vascular malformations and finally vasoconstriction. However, the test is expensive, time-consuming, and carries potential risks of arterial puncture, radiation exposure, and patient dye exposure. Although digital subtraction angiography has limitations, including the fact that it primarily assesses the arterial system and provides little information about venous anatomy or soft tissue anatomical relationships, and is relatively expensive, it also has significant potential complications, including concomitant ones bleeding, hematoma, thrombosis, pseudoaneurysm, arteriovenous fistula and contrast media. MRA is another imaging modality that has been used for preoperative evaluation prior to reconstructive procedures. This is a new technology that may show great promise in upper extremity vascular studies as there is no ionizing radiation, no risk of allergic reaction to iodine contrast media and no potential kidney toxicity. This requires high-resolution equipment and specialized computer processing. One of the potential advantages of MRA is that it is less invasive than traditional angiography but (due to the long acquisition time) is very prone to motion artifact and provides poor visualization of intravascular calcifications and bone marrow points and cannot be performed when the patient has metal implants in situ and claustrophobic patients do not tolerate the procedure well.

Computed tomography (CT) angiography is a relatively new technique that provides high-resolution images of vessels and detailed images of adjacent bone and soft tissue. It is relatively noninvasive and involves the injection of contrast material through a peripheral vein.The accuracy of the representation of the arteries obtained is comparable to that of DSA (digital subtraction angiography). In addition, the three-dimensional format enables an excellent assessment of the anatomical relationships between bone, soft tissue and vascular system.

Therapy

Treatment options for muscle wasting are limited and consist mainly of surgical attempts at autologous skeletal muscle translocation combined with intensive physical therapy [6]. However, these approaches almost always fail to restore adequate strength and function, resulting in permanent disability. 65% of military disability is due to volumetric muscle wasting and inadequate available treatments.Unfortunately, the function of the affected limb deteriorates over the course of the patient's life.

Surgical procedures considered standard for the treatment of VML (Volumetric muscle loss) include free and/or rotation flaps and autologous muscle grafts or transpositions. The rationale for these approaches is that covering the wound with fascia and/or muscle tissue should reduce complications such as infection at the wound site. Neither flap surgery nor muscle transplantation replace lost functional muscle tissue with viable, innervated, contractile muscle. The use of flaps and grafts is consistently associated with donor site morbidity and often fails completely due to infection and necrosis, leading in some cases to amputation of the affected limb. Recent preclinical animal studies have attempted to use ground muscle grafts as a therapeutic strategy; however, this approach has not yet resulted in significant restoration of functional tissue.Similarly, the use of orthotics does not allow full recovery of function, and orthotics are often not used for upper extremity injuries.

Physiotherapy is the cornerstone of VML treatment. The goal of physical therapy is to strengthen the remaining damaged muscle and improve the ability to perform everyday activities. However, physical therapy alone does not promote significant muscle recovery. A growing literature suggests that mechanotransduction through dynamic and static mechanical stimuli can alter the phenotype of cells at the site of skeletal muscle injury and create a microenvironment conducive to repair and regeneration. Although complete tissue repair is not possible with physical therapy alone, the benefits of actively transferring stress to the site of the defect include modulation of immune cells, increased vascularity, reduction in fibrosis, and promotion of myotubular alignment and union.Careful and informed use of physical therapy, particularly timing of treatment initiation and type of treatment (e.g., active versus passive), can be a critical determinant of subsequent outcomes.

Conclusion

Due to a decrease in skin elasticity due to aging, hormonal changes or genetic predispositions, men and women suffer from sagging skin and excess tissue on the upper arms. However, many patients with reduced skin elasticity or patients who have lost a lot of body mass have excess skin hanging from the upper arm.

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