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An Overview of Dupuytren's Disease

Michel Burgess

University of North Dakota

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AN OVERVIEW OF DUPUYTREN'S DISEASE

by

Michel Thomas Burgess
Bachelor of Science in Physical Therapy
University of North Dakota, 1997

An Independent Study
Submitted to the Graduate Faculty of the
Department of Physical Therapy
School of Medicine
University of North Dakota
in partial fulfillment of the requirements
for the degree of
Master of Physical Therapy

Grand Forks, North Dakota
May
1998
This Independent Study, submitted by Michel T. Burgess in partial fulfillment of the requirements for the Degree of Master of Physical Therapy from the University of North Dakota, has been read by the Faculty Preceptor, Advisor, and Chairperson of Physical Therapy under whom the work has been done and is hereby approved.

(Faculty Preceptor)

(Graduate School Advisor)

(Chairperson, Physical Therapy)
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Title An Overview of Dupuytren's Disease

Department Physical Therapy

Degree Master of Physical Therapy

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ABSTRACT

Dupuytren's disease is defined as a pathologic change in the palmar and digital fascia which often results in a secondary, painless, fibrous, flexion contracture of the digital joints. Normally, the disease process is painless, but a severe contracture of 30° or more at the metacarpophalangeal joint and 15° or more at the proximal interphalangeal joint can interfere with the biomechanics of the hand, preventing the performance of activities of daily living. Though the use of modalities is ineffective as a conservative approach to treat the disease, a therapist can positively affect postoperative rehabilitation outcomes using manual techniques, physical modalities, and exercises.

The purpose of this literature review is to describe the etiology and pathologic anatomical structures involved in the disease, indications for surgery, specific surgical techniques, postoperative rehabilitation measures, and common postoperative complications. Presenting this information will provide clinicians with further knowledge about the disease process and help clinicians apply proper treatment techniques when confronted with the challenging disease.
CHAPTER I
INTRODUCTION AND ETIOLOGY

Dupuytren's disease (DD) is defined as a pathologic change in the palmar and digital fascia which often results in a secondary fibrous flexion contracture. It is usually painless, and often occurs in the digital joints (metacarpophalangeal joints and proximal interphalangeal joints) of the ring and little fingers. Occasionally, the disease process involves the thumb and thumb web space as well. Dupuytren's disease affects mainly the aponeurosis, but the aponeurosis in the palm and digits attaches to the dermis to prevent shearing of the skin on the underlying tissue, so the skin ultimately becomes involved as well.\(^1\) Clive first described the disease in 1808, but Dupuytren first described an operation as a method for treating this abnormality, thus his name was given to the disease.\(^2\)

Incidence is approximately ten times more frequent in men than in women, and the condition is limited almost entirely to the Caucasian race (particularly of Celtic origin), although it has been reported in African Americans.\(^3\) The abnormality is very rarely seen in Asians.\(^4\) The condition usually presents itself between the fifth to seventh decades of life and is rarely developed before the age of 25.\(^2,3\) In the past, it was somewhat supported that alcoholism, epilepsy, and pulmonary tuberculosis may have been etiologic factors in severe
cases.\textsuperscript{3} Cailliet\textsuperscript{2} reports association with these factors is no longer considered pertinent.

With the exception of heredity, all of the causative factors remain unknown. A dominant gene may be responsible for the disease.\textsuperscript{4} Repetitive trauma has been studied extensively as a factor because the presence of hemosiderin in the lesion suggests bleeding from tears, but in Caucasians, the lesion occurs as often in the non-dominant hand as it does in the dominant one.\textsuperscript{3} From this evidence, it seems to be unlikely that trauma is the cause as most people use their dominant hand more often than their non-dominant hand when performing repetitive tasks, but it still has not been excluded as a possible factor.\textsuperscript{3} Trauma is still studied broadly as a causative factor because its role is an important legal topic and manifests serious implications concerning workmen's compensation in today's physical medicine.\textsuperscript{4}

Patella\textsuperscript{4} reports two basic theories which have been presupposed to help illustrate the occurrence and evolution of DD. The first theory, called the intrinsic theory, states that the primary lesion is within the palmar fascia itself. A contracture which develops is due to a repeated rupturing of the fascia as newly formed scar tissue progressively adheres the fascia into a contracture formation.

Secondly, the extrinsic theory suggests that a change occurs in the overlying tissue of the palmar fascia and that this causes the contracture of the fascia and any other fibrous structure attached to the fascia to contract.\textsuperscript{4} Paletta\textsuperscript{4} reports that the layer immediately beneath the dermis of the palmar skin (hypodermis) is a potentially powerful activator of fibroblastic proliferation of the
subjacent tissue. The subjacent tissue to which he is referring is the palmar fascia; thus, it is called the extrinsic theory due to the changes not starting within the palmar fascia itself, but outside this structure.

The purpose of this literature review is to extensively describe the etiology and pathologic anatomical structures involved in DD, indications for surgery, specific surgical techniques, postoperative rehabilitation measures, and common complications following surgical intervention. Presenting this information in an extensive literature review will provide clinicians with further knowledge of DD and help clinicians in determining proper treatment applications for this pathologic process.
CHAPTER II

PATHOLOGIC ANATOMY

To completely understand the pathologic anatomical structures of DD, a basic knowledge of the affected structures in their non-diseased state is imperative. A clinician’s ability to recognize secondary findings as well as distinguish pathologic anatomy will also allow for earlier diagnosis, proper treatment, and possibly give the patient a better prognosis. This chapter will describe the basic structures involved with DD in their normal and diseased state, along with a description of secondary or remote findings that often accompany the diseases.

Palmar Fascial Structures

The palmar aponeurosis (Fig. 1) is generally triangular in shape with its proximal apex and is continuous with the flexor retinaculum, which is joined by the palmaris longus tendon. The lateral and medial borders of the palmar aponeurosis blend in with the fascia covering the thenar and hypothenar muscle groups respectively. At the distal end of the palmar aponeurosis, the fascia fans out longitudinally over the metacarpal heads and slightly over the flexor tendons. These fascial structures are collectively referred to as the pretendinous bands. From here on it is important to realize that when the term “band” is used, it is referring to normal tissue and the term “cord” refers to diseased tissue.
Fig.—Palmar aponeurosis (Adapted from Cailliet²)
Throughout the palmar aponeurosis, there are superficial fibrous radiations called fasciculi (Fig. 2) connecting the fascia to the overlying skin.\textsuperscript{2} There are also deep radiations called vertical septa which run from the deep palmar fascia to the interosseous fascia forming eight longitudinal compartments which contain the flexor tendons, neurovascular bundles, and the lumbricals.\textsuperscript{2} The thickest of these vertical septa is the most medially or ulnarly located septum, termed the internal intermuscular septum.\textsuperscript{2,5}

Deep to the pretendinous bands lies the superficial transverse ligament.\textsuperscript{2} This ligament runs from lateral to medial and curves from the proximal thumb crease to the distal hypothenar area. Along with the superficial transverse ligament, there is also a deep transverse metacarpal ligament which blends in with the flexor palmar plates and conforms into fibrous sheaths, forming tunnels in which the flexor tendons run. These sheaths progress from the palmar aponeurosis distally to the distal phalanx, ending near the insertion of the flexor digitorum profundus tendon. These sheaths become thin at the joints and form two tunnels, one on each side of the proximal interphalangeal joint, to allow for greater flexibility and agility.

Digital Fascial Structures

A transverse band that runs from lateral to medial in the digital web spaces and lies along the most distal aspect of the palm is the natatory ligament (Fig. 3).\textsuperscript{2} In addition to the natatory ligament, there is a group of ligaments called the paired spiral bands that angle from the distal end of the pretendinous band to the natatory ligament and runs deep to the neurovascular bundle.
Fig.—Cross section of the hand (Adapted from Cailliet²)
Fig. 3—Digital fascial structures (Adapted from McFarlane9)
There are also three fascial bands (Fig. 3) in the digits, two of which are involved in a contracture caused by DD (Grayson's ligaments and the paired lateral digital sheets).\textsuperscript{1,7-9} Grayson's ligaments affix the volar collateral skin to the flexor tendon sheath. In addition, the paired lateral digital sheets which derive from the natatory ligament run along the sides of the phalanges deep to the neurovascular bundles. Collectively, there are sloped bands which pass from the lateral digital sheets and fuse with the phalangeal periosteum to form Cleland's oblique ligaments. However, these are not involved with a contracture caused by DD.

**Neurovascular Structures**

Knowledge of the vascular arrangement to the palmar and digital fascia of the hand is also helpful in the understanding of DD. Deep to the fascia is the superficial volar arch of the radial and ulnar arteries, the median nerve branches, and the superficial branch of the ulnar nerve.\textsuperscript{5} The skin along the palm receives its circulation from tiny branches off the superficial volar arch which pierces through the fascia. The branch to the little finger is the proper digital artery, while the other digital arteries dive profoundly along the flexor tendons and then become superficial just inferior to the superficial transverse ligament.

**Pathologic Anatomical Structures**

While the fascia progressively thickens and contracts through fibrosis, it draws upon the fasciculi which are attached to the skin.\textsuperscript{2} This pulling on the fasciculi causes a "dimple" to develop. As the fascia continues to thicken, the
circulation eventually becomes occluded and causes skin atrophy. This ischemic chain of events foreshadows poor healing when surgical treatment is considered.

Besides the occurrence of fascial thickening, the vertical septa and the pretendinous bands which pass over the metacarpal heads and attach to the base of the phalanges are also involved. Watson states, “the most commonly affected longitudinal structure is the pretendinous band, with progressive contracture of the metacarpal-phalangeal joint.” Nodules form in the aponeurosis, most commonly at the fourth and fifth metacarpal heads, and the finger flexors develop contractures. These contractures of the fingers establish the impairment of DD. A considerable contracture is indicated by a positive “table top” test and flexion of 30° or greater at the metacarpophalangeal joint. The “table top” test is performed by actively trying to extend all the joints of the fingers while keeping the wrist in neutral or by actively trying to flatten the hand on a table while keeping the wrist in neutral. While performing daily living activities, the fingers will attempt to extend over and over again. Continued extension gradually stretches the fascia causing further hypertrophy of the fascia and possibly beginning a vicious cycle because repetitive trauma has not been excluded as a causative factor.

The spiral cord is another common occurrence with this disorder. The band, which refers to the structure in its non-pathologic state, is actually a continuation of the pretendinous band that attaches to the skin, bifurcates slightly distal to the metacarpophalangeal joint, and spirals around the neurovascular bundle. When the spiral cord forms, the pretendinous bands begin to straighten.
and run less obliquely. At the same time, the pretendinous band, spiral band, lateral digital sheet, and Grayson's ligament go through a fibroblastic fusion forming a common spiral cord (Fig. 4). The spiral cord forces the neurovascular bundle more volar and into a position more midline than normal. This spiral cord eventually joints the central cord, another pathologic structure that occurs int he digital fascia secondary to DD. The spiral cord lies just over the proximal interphalangeal joint. Usually, the spiral cord is evident as a circular, soft, pulpy prominence on either side of the pretendinous band at the level of the metacarpophalangeal joint. It is important to realize that an increased flexion contracture at the level of the proximal interphalangeal joint causes the spiral cord to move superficially, proximal, and more toward the midline. Because this displacement puts the neurovascular bundle in an exposed position deep to the subcutaneous area, it is vital to recognize its existence prior to surgery. McFarlane explains that the nerve is never embedded into the fascia, and there is always a plane for dissection. He also reports that although the nerve displacement is common, it only happens in the fingers and that signs and symptoms of neurovascular compression (numbness and tingling) are relatively uncommon. Visual assessment for the soft, pulpy prominence is very important, even if there are no reports of neurovascular compression, because it may prevent an accidental dissection of the spiraled cord.

The central cord is easily recognized (Fig. 4). It is located along the anterior mid axis of the phalanges and is responsible for the joint contracture of
Fig. 4—Pathologic digital cords (Adapted from McFarlane⁹)
the interphalangeal joints.\textsuperscript{5} A compensatory hyperextension of the distal interphalangeal joint may be present due to the oblique retinacular ligaments. Watson\textsuperscript{10} reports that the lateral and retrovascular cord (which will not be explained) within the digit may also contribute to contracture of the proximal interphalangeal joint.

In the non-diseased state, the volar plate is not attached to the proximal phalanx because this would limit full extension. During the diseased state, collagenous fibers, called the check reins, develop between the proximal corners of the volar plate and the fibrous sheath around the proximal interphalangeal joint limiting full extension.\textsuperscript{5} These structures are normally pyramidal and thicker at the base connected to the volar plate and thinner at the apex connected to the fibrous sheath. The check reins usually lie atop the communicating artery of the viniccular system. For a surgeon, it is important to understand where this artery is positioned prior to surgery. Preservation of this artery will allow for better healing postoperatively.

Secondary or Remote Findings

Dupuytren’s diathesis basically is a term used to describe a very aggressive form of DD.\textsuperscript{1,3,11} A typical person who presents with a strong diathesis has a strong family history of DD, an early age of onset, and extensive involvement of both hands. Furthermore, patients with Dupuytren’s diathesis who have diseased fascia removed via excision have a relatively high probability of recurrence.\textsuperscript{1}
A physical manifestation that may be visible are Garrod’s nodes on the dorsum of the hand, commonly called knuckle pads. Smith\textsuperscript{12} reports, “Their incidence (Garrod’s nodes) is poorly defined, but probably is in the one to two percent range.” They are usually present when the patient has a strong diathesis, which should cause the practitioner to be aware of the generally poor prognosis.\textsuperscript{1,12} Pathologically, the nodes do resemble diseased fascia and may present with pain over the dorsal areas of the proximal interphalangeal joints. However, they are rarely ever excised, as surgery should be avoided and thought of as a last resort of treatment. Presently, steroidal injection is the treatment of choice if nodes remain tender for a prolonged period, but this only provides a temporary symptomatic relief.\textsuperscript{12}

Besides knuckle pads on the dorsum of the hands, fascial nodes on the plantar aspect of the feet may also occur, and this phenomenon is referred to as Lederhose’s disease.\textsuperscript{1,12} It is also a rare finding with minimal symptoms similar to the ones experienced with Garrod’s nodes. Most often, this physical abnormality is treated by orthotic fitting, but occasionally the nodes are excised and skin grafted if the condition is disruptive and prevents the patient from performing activities of daily living.\textsuperscript{12}

The third secondary finding often correlated with DD is Reyronie’s disease. This condition is characterized by a plaque or benign lump which develops on the penis and probably occurs in less than one percent of patients with DD.\textsuperscript{1,12,13} Often times, contraction of the penile fascial envelope results in a tightening usually causing angulation of an erect penis in the direction of the
plaque's position in relation to the body. Even though it is rare, the condition can make sexual intercourse difficult and periodically painful causing the person to seek medical attention. Treatment of this condition is usually directed at getting the patient sexually active again with minimal symptoms. In terms of effectiveness, surgery seems to be the gold standard, but is usually performed on long-term cases in which the deformity prevents sexual intercourse.

Finally, it is important to realize that these secondary findings can occur alone or in accordance with another along with DD. Furthermore, if a case presents with any or all of these secondary manifestations along with DD, it is a probable indication that the patient may have a strong diathesis, or an aggressive form of DD.
CHAPTER III
TREATMENT OPTIONS

Throughout the literature, surgical intervention is reported as the only effective way to alter the course of DD.1,7-9 Currently, there is no proven non-surgical method of treatment that is equally effective as surgery.8 Reports of Vitamin E therapy taken orally and local injections of triamcinolone may cause some change in nodules, such as a softening or a flattening effect over a period of months, but is not even remotely close to being considered a cure.14

Physical therapy intervention of stretching contracted cords in the early stages of the disease has been proven to be effective.1,8,9 A therapist’s continued attempts at stretching may even exacerbate the disease process as repetitive trauma has not been excluded completely as a contributing factor in the disease process.2 Other modalities, such as heat and ultrasound over the diseased cords to alter the disease process, have also been proven to be of no benefit.1,7-9

Indications for Surgery

Contrary to belief, the presence of a nodule in the palm or digit does not necessarily indicate surgical intervention.8,9 If the nodule becomes too large and is negatively affecting the patient’s way of life, excision may probably be indicated.8 If the skin on the palm becomes drawn into pits or folds making
cleansing difficult or callous formation, early surgical intervention may be initiated to allow for the overlying skin to be restored to its previous state.

Contracture of a digital joint seems to be the number one reason surgical intervention is recommended.\textsuperscript{8} It is important to understand that indications for excision depend on the joint involved. McFarlane\textsuperscript{8} reports it should always be possible to correct metacarpophalangeal joint contractures regardless of their severity by an appropriate surgical procedure. The simple reason the metacarpophalangeal joint is always correctable is because when the metacarpophalangeal joint is in a flexed (contracted) position, the collateral ligaments are on stretch; therefore, there is no restriction into full extension once the diseased fascia has been released. Thus, there is no hurry to operate on a contracted metacarpophalangeal joint, and surgery is usually scheduled at the convenience of the patient or when the metacarpophalangeal joint has contracted 30° or more.\textsuperscript{1,7-9} Usually at 30° most patients will note some difficulty with activities of daily living, so this seems to be the standard for operating on a contracted metacarpophalangeal joint.\textsuperscript{9}

In respect to the metacarpophalangeal joint, the proximal interphalangeal joint is much more difficult to correct.\textsuperscript{1,7-9} The reason is that the collateral ligaments at the proximal interphalangeal joint become shortened when the joint is in a flexed position of any degree. If the joint remains in a flexion contracture for several months, excision of the abnormal aponeurosis may not allow full range of motion into extension. As a guideline, a 15° or greater flexion
contracture at the proximal interphalangeal joint is an indication for surgical intervention.\textsuperscript{9}

The distal interphalangeal joint rarely presents with a flexion contracture associated with DD.\textsuperscript{1,8,9} Instead, it usually presents with a compensatory hyperextension, somewhat like a boutonniere deformity.\textsuperscript{9} This, like the proximal interphalangeal joint, is also difficult to correct, and surgery usually consists of an extensor tendon division.\textsuperscript{15}

Finally, if the diseased fascia affects the thumb and web space or if the patient presents with a strong diathesis, frequent monitoring of the patient’s condition should occur.\textsuperscript{8} If a patient presents with problems such as these, surgical intervention should be initiated early.

**Surgical Intervention**

It is important to differentiate between excisional and incisional procedures. The excisional procedure basically defines what will be cut out during the operative intervention. The incisional procedure describes the incisional technique the operative physician used to excise the diseased fascia. In other words, two different incisional procedures may be used to excise the same, exact tissue, depending on the physician’s preferred method.

**Excisional Procedures**

Generally, there are four different excisional procedures: the open fasciotomy, fasciectomy, dermofasciectomy, and the open palm technique.\textsuperscript{9,11} The type of incision made to perform these operations is left to the surgeon’s discretion. It is important to realize that there is a broad variety of incisional
procedures. Ultimately, the stage of the disease, where it has occurred, the age of the patient, and whether or not a strong diathesis is present will also play a role in determining what type of operation will take place.

An open fasciotomy is a simple division of the diseased retracted band either with or without an aiding skin graft that is normally done under a local anesthetic.\textsuperscript{11} This is the original surgery performed on patients suffering from DD.\textsuperscript{14} The open fasciotomy should never be performed in the digits, where the neurovascular bundle may be easily injured.\textsuperscript{8} It also seems to be reserved for the elderly population who are usually unfit or unsuitable for a more complicated operation.\textsuperscript{15}

Secondly, there are basically two types of fasciectomies performed: regional and extensive.\textsuperscript{11} In a regional fasciectomy, the operation is confined to excision of the macroscopically (recognizable with the naked eye) contracting nodule band elements. With this operative procedure, it is only possible to correct the contracted rays. In an extensive fasciectomy, all of the longitudinal pretendinous bands across the palm from the first web space to the abductor digiti minimi are excised for prophylactic reasons.\textsuperscript{16}

Thirdly, when a dermofasciectomy is the technique of choice, the contracted fascia and the overlying skin are excised.\textsuperscript{11} This surgical method is usually performed on patients who have recurrent cases and/or a strong diathesis.\textsuperscript{8,11} This procedure is performed because, for unknown reasons, DD never reappears beneath a skin graft, thus providing prophylaxis against recurrence especially in the digits.\textsuperscript{11}
Finally, the favored technique that is especially effective in patients with advanced cases and have diabetes is the open-palm technique. McCash felt that the transverse palmar wound that resulted from an extensive fasciectomy should be left open (unsutured) with the metacarpophalangeal joints splinted into extension. Because the wound is left open, it is impossible for a hematoma to occur, and the blood will escape onto the sterile dressings. Both the fingers and the palm can be left open with an average healing time frame of 25 days (the palm usually heals one week before the fingers). Depending on the surgeon, a delayed split skin graft may be used to shorten the healing time frame.

Incisional Procedures

According to the Wheeles’ Textbook of Orthotics, the surgeon should keep two ideas in mind when choosing an incision. First of all, the physician should attempt to raise the cut skin flaps so that the normal skin lies at the base of the flap while the diseased skin that has nodules or cords adhered to it lies at the tip of the flap. Secondly, if a flap is not to be raised, then the incisions should be placed directly over the nodules or cords, thus minimizing ischemia to the normal surrounding skin.

In the transverse palmar incision, a cut is made from the distal crease of the palm on the ulnar side to the proximal crease on the radial side (Fig. 5). Most of the palmar fascia can be excised through this incision without having to make a second, more proximal incision. This type of incision works well for patients who have never had involvement with metacarpophalangeal and
Fig. 5—Transverse incisional techniques (Adapted from McFarlane)
proximal interphalangeal joint contractures, palmar skin fixation, or involvement of two or more rays. Transverse incisions can be made at any level, even in the digits, but exposure is usually not adequate and excision of the diseased fascia is usually incomplete if this method is performed. Many times, a separate Z-plasty is used to remove diseased digital fascia in the proximal segment of the finger. A Z-plasty is a generic incisional procedure that can be performed anywhere in the body and often times is beneficial for wound closure, especially in soft tissue contractures. When performing a Z-plasty, the angles should be about 60° and all three sides of the Z should be of equal length. This allows for more adequate exposure of the diseased fascia than with the transverse incisions. The limitation of the transverse incisional procedure is the removal of digital fascia distal to the PIP joint is difficult. When finishing the operative procedure, the transverse palmar incision may be closed (fasciotomy or fasciectomy) or left open (open-palm technique) or may be skin grafted depending on the physician’s preference.

There are a variety of different longitudinal incisions that are especially useful in excision of the diseased fascia in the digits. Brunner’s incision (Fig. 6) is characteristically one continuous zig-zag from finger tip to the middle of the palm. This incision provides relatively good exposure to diseased fascia in the digits and is usually used when the contracture is not severe. Brunner’s procedure is a useful procedure when skin closure into extension poses no threat to tissue healing at the wound site.
Fig. 6—Longitudinal incisional techniques (Adapted from McFarlane⁹)
When skin closure into extension poses a problem, the multiple V-Y incision (Fig. 6) would probably prove to be more effective than Brunner’s procedure. The advancement of the V-Y flaps gains additional skin length needed for wound closure. The major advantage the V-Y incision has over the Brunner incision is that the V-Y skin flap allows for a variable amount of skin flap elevation, thus allowing the wound to close without having to completely elevate the skin flap.

A more complicated incisional procedure is used when multiple rays are involved and there is no fear of neurovascular compromise to the intervening palmar skin. This is the longitudinal oblique incision using three small Z-plasties (Fig. 6). After excision of the diseased aponeurosis by virtue of the longitudinal oblique incision, the three Z-plasties are planned so that, when the transpositioning of the skin flaps occurs, the horizontal incisions fall near the PIP and MP joint lines along with the distal palmar crease. Wheeles’ Textbook of Orthopaedics reports that once a Z-plasty flap has been raised, it can only be closed in the transposed position, thus making this procedure slightly more difficult to perform.

When the disease has affected the thumb-index web space, a T-shaped incision (Fig. 6) is generally used to adequately expose the diseased fascia for excision. Only a part of the T-incision may be needed depending on the severity of the disease. Closure by Z-plasty, like the ones used with the longitudinal oblique incision, is usually done to prevent a scar contracture of the thumb web space.
No matter what the operative technique, Hueston\textsuperscript{11} feels there are two primary objectives that are involved when surgical intervention is chosen as the method of treatment for the condition of DD. The first, which is done by the surgeon, is to release longitudinal tension. The second is directed at physical therapy and rehabilitation to ensure proper skin management of the hand while the wound is progressively healing.
CHAPTER IV
POSTOPERATIVE REHABILITATION

Following surgery, the primary long term goal is to improve or maximally restore hand function.\textsuperscript{8,18,19} To do this, the therapist should follow certain principles and establish certain short term goals to enhance the rehabilitation process of a postoperative patient with DD. Certain goals the patient must accomplish to fully benefit from rehabilitation and restore hand function would be to regain flexor strength of the fingers while maintaining extension to soften the surgical scar and prevent complications. Postoperative complications will be described in further detail in the next chapter, but they include wound infection, granuloma, pain, flare reactions, and reflex sympathetic dystrophy (RSD).\textsuperscript{1,18,20}

First and foremost, the therapist must regain flexor strength of the fingers and maintain the regained extension obtained by surgery with the application of the appropriate splint.\textsuperscript{8,18} On the first postoperative day, the dressings are removed and a static dorsal finger-extension splint is molded with a basic thermal plastic material.\textsuperscript{2,8} The use of velcro straps help fasten the splint to the hand and hold the digits in extension. In using the splint, two purposes are served.\textsuperscript{8} The first purpose for using a splint is to gain the degree of finger extension that was obtained at the time of operation. Secondly, the splint holds the digits in maximum extension during the period of wound healing preventing
the formation of an adhesive scar. During this initial splinting, the patient is instructed to gradually tighten the velcro straps within his or her pain tolerance until the digits have fully extended. Ideally, full extension is one of the major goals of treatment, but with a severe longstanding contracture of the proximal interphalangeal joints, it is unlikely full extension will be obtained, especially in the little finger.\textsuperscript{1,7-9,18} The splint is to be worn at all times during the day and night while the wound is healing. Once the wound has healed and full flexion and extension of the fingers has been obtained, the patient is advised to continue wearing the splint at night for three more months.\textsuperscript{8}

Even though the splint is to be worn at all times initially, it may be taken off to perform appropriate exercises.\textsuperscript{8} Every hour the patient is to remove the splint and perform active or active assisted flexion and extension movements at the metacarpophalangeal joints and interphalangeal joints. If similar exercises are to be performed at home, it is important for the therapist to make them as easy to remember as possible. Therefore, gross pattern motions are advised. For example, instead of individually flexing and extending the digits at each joint, the patient would perform complete flexion of all fingers to the distal palmar crease as well as full finger extension. Other active exercises that can be performed early include thumb opposition, abduction, extension, finger abduction, adduction, extension, and flexion to the thenar eminence, fist making, wrist flexion and extension, intrinsic extension, and finger blocking which is the isolation of distal interphalangeal joint flexion while holding the proximal joints
static. Ten repetitions three to four times a day is one recommended schedule in performing these listed exercises.

The use of hand putty, a gripper, or a tennis ball is an excellent way to improve grip strength and should be initiated around four to six weeks postoperatively. The use of hand putty, instead of the latter two initially, is softer and obtains an elastic property which provides an adequate amount of give when force is applied to it, causing less of a disruptive force to be applied at the site of the healing wound. Therapeutic putty usually comes in varying colors signifying the amount of resistance it obtains. Beginning with the lowest resistance allows the patient to begin resistive exercises and also makes it easier for the therapist to teach the patient the proper technique and form. From here, the therapist can gradually progress the patient to a higher level of putty and eventually end with the use of a gripper or tennis ball once the wound has adequately healed.

Another important issue for a therapist to incorporate into a treatment program is the initiation of functional activities once adequate mobility and strength have been obtained. Certain functional activities that could be performed are the gripping of a ball and a cone along with performing pinch and prehension movements, such as holding and writing with a pencil. Once the wound has closed and healed, the patient may benefit from the use of hydrotherapy or paraffin baths prior to exercises to increase the elastic properties of the new tissue allowing increased range of motion of the digits, thus preventing the formation of an adhesive scar.
Obviously, the time required for recovery of an operation for DD is variable.\textsuperscript{8,9,16} The number of fingers involved, the amount of time excised, and the incisional technique used are all going to play a part in how long recovery will take along with the patient's individual motivation. Typically, if the fascia has been excised through a longitudinal incision in the palm and a finger, the sutures are removed approximately ten days postoperation and the wound is healed in about two weeks allowing toleration of most therapeutic techniques.\textsuperscript{8} If more than one finger is involved, usually a longitudinal incision will be made in each finger, and the transverse incisional technique will be performed along the palm. Depending on the surgeon, the transverse palmar incision may be left open to heal.\textsuperscript{9,11,16,17} The width of the wound determines the time required for the palmar wound to heal, which normally takes anywhere from three to six weeks after surgery. If the palmar wound is left open to heal, the patient also uses a splint as he or she would if it was sutured closed or skin grafted. Dressing changes should be performed two to three times a week by either the nursing staff or the therapist.\textsuperscript{16} Normally, whirlpool treatments are not to be performed on these patients if sutures still exist at the site of the wound. Prosser\textsuperscript{20} reports that whirlpool treatments may be started before the removal of the sutures if the surgeon is satisfied with the rate of wound healing. In the presence of a skin graft, hydrotherapy should be delayed until the graft has taken to the surrounding tissue. Normally, this takes around five days, but it can take anywhere from 10 to 14 days.\textsuperscript{20}
When the open-palm technique is used, wound closure becomes of utmost importance to the therapist. Hydrotherapy with dressing changes three times a week should be initiated early and performed until the wound has adequately closed.\textsuperscript{16,22} Early hydrotherapy with this technique is vital for wound healing both for cleansing the wound and for encouraging early active exercises of the hand and digits involved. Niederhuber\textsuperscript{23} reports that as an adjunctive modality in the treatment of many types of wounds, the therapeutic whirlpool provides the basic physiologic benefits of heat to promote healing and the atraumatic removal of surface eschar and exudates where bacteria reside. Normally, Betadine, an antibacterial water additive, is used with the hydrotherapy treatments, providing an increased cleansing effect and preventing infection from occurring as a prophylactic measure.\textsuperscript{16}

When performing the hydrotherapy treatments, the extremity should be positioned in elbow flexion so that the water just barely covers the hand, avoiding hanging the hand in a dependent position.\textsuperscript{16} The temperature of the water should be between 98°-100° Fahrenheit.\textsuperscript{16,22} While the patient is submerged in the whirlpool, active flexion and extension exercises should be performed. Once the whirlpool treatment is finished, the hand should be elevated out of the water and rinsed with clean (distilled) water. Niederhuber\textsuperscript{23} found that rinsing the hand with clean water after the whirlpool treatment was significantly more effective in removing bacteria than a procedure in which a clean rinse was not followed after a whirlpool bath.
After sutures are removed, scar control techniques may be initiated. Certain techniques found to be of benefit include massage, compression wraps or garments, along with molded silicone compression pads.\textsuperscript{16,19,24} Typically, sutures are removed approximately two weeks postoperatively.\textsuperscript{21} Though the sutures are removed, edema can still be present and increase the likelihood of the formation of a tight surgical scar. Severe pitting edema may warrant the need for intermittent pneumatic compression or the use of compression wraps, such as ace bandaging, as well as incorporating extremity elevation daily.\textsuperscript{16,19} Elastic gloves have also been used for the decreasing of edema in the hand as well.\textsuperscript{19}

When performing manual massage, the use of lanolin or lotion as a medium is also beneficial.\textsuperscript{16,21} If manual massage is used to decrease edema, it should be performed in a retrograde manner, applying pressure from distal to proximal.\textsuperscript{19} A small, deep, circular, stroking massage should be performed where adhesion is present along the tight surgical scar to increase the surgical scar elasticity.\textsuperscript{16} These techniques can be used as needed until adequate extension is gained to allow performance of functional activities. The application of a molded silicone pad into the extension splint allows for a soft resting surface for the newly formed scar, preventing the formation of hard, inelastic tissue within the surgical scar.\textsuperscript{16,19,21,24}

Most patients require six to eight weeks of therapy along with one or two follow-up reevaluations.\textsuperscript{16,20,21} The time required to return to work will depend on the type of job the patient performed.\textsuperscript{16} If a patient has to return to a job that
requires significant amounts of strenuous activity, such as working as a laborer, or someone who uses their hands continuously, like a secretary, will initially have to be put on light duty. If light duty is not an option to patients such as these, then they possibly may not return to work until two months postoperation.
McFarlane and McGrouther\textsuperscript{25} report a complication rate of 17\% following surgical procedure for DD. They also report that the more difficult the surgery, the greater the chance in forming a complication. Certain components associated with complications include bilateral disease, the involvement of three or more rays, extensive fasciectomy in the finger, the use of skin grafts, a proximal interphalangeal joint procedure, and the use of general anesthetic. It should also be understood that pain should never be present and almost always signifies a complication.\textsuperscript{20} Specific complications often associated with postoperative DD surgical procedure include excessive inflammation, hematoma, ischemic skin necrosis, wound infection, granuloma formation, transient paraesthesia, scar contracture, tight lateral bands and oblique retinacular ligaments, joint stiffness, weakness of grip, pain, reflex sympathetic dystrophy (RSD), and recurrence and extension of the disease.\textsuperscript{1,20}

Excessive inflammation and edema (flare reaction) may follow an extensive surgical procedure.\textsuperscript{20} This problem can be controlled by allowing an extended period of rest. Normally, the use of a static splint that allows the wrist as well as the hand to rest works more effectively than other types of splints or devices. If the surgical procedure was an extensive one, the patient may require
a resting period from seven to ten days before an exercise program can be initiated by the therapist. If there are no other contraindications, such as Raynaud's disease or vascular compromise, physical modalities such as cold packs and an ace compression wrap applied gently may help reduce the resting period. Nevertheless, the therapist must be cautious when initiating an exercise program not to elicit a flare reaction. No matter what the case may be, the rehabilitating physical therapist must realize the presence of a flare reaction will prolong postoperative rehab.16,20

Specific wound complications include hematoma, skin necrosis, infection, and the formation of granulomas.1,20 These four are grouped together because one usually follows the other if intervention does not take place. Some degree of hematoma is certain following an extensive surgical procedure to the palm.1 A major hematoma in which the rehabilitation process is prolonged occurs in approximately 2.2% of all postoperative DD patients.25 The most reliable surgical procedure in preventing hematoma formation is the open-palm technique that was made famous by McCash.18 If the open-palm technique was not used and a hematoma is suspected, immediate removal of the sutures over the area of tension allowing the hematoma to drain must occur.20 If the hematoma is not recognized early and is relatively large, some degree of skin necrosis along the suture line is probable.1

Skin necrosis occurs in approximately 4.7% of all postoperative DD patients.25 Usually, it develops in the fingers where the diseased fascia and skin are intimately affixed and where the skin is often thin following surgical excision
of the fascia. Improper Z-plasty application or skin flap placement following surgery also predisposes the area to skin necrosis.

Ischemic skin necrosis is usually the result of tension on the neurovascular bundles once the contracted joint and surrounding soft tissues are extended surgically. Besides the normal symptoms of regular skin necrosis, paraesthesia due to tension or stretching of the neurovascular bundles is also usually present. If paraesthesia is present, care should be taken with splintage into extension as to not place even more pressure on a neurovascular bundle that is already strained.

Infection alone, without hematoma or skin necrosis, is unusual. Nonetheless, it may occur in people who have long-standing and severe contractures in which the skin is macerated and difficult to cleanse preoperatively. Wound infection demands rest from all exercises and treatment with appropriate antibiotics should be initiated until the infection is resolved. Hydrotherapy with the use of betadine may also prove to be of benefit in controlling an infection. Once the infection is controlled, gentle exercise can be started once again.

Generally, granulomas can be dealt with using either a pressure dressing, such as hyperfix, or by debridement. The use of chemical debridement can be performed using a silver sulfate pencil or physical debridement may be performed if necessary.

A tight surgical scar can also pose a problem in gaining extension. Management of a surgical scar has already been explained in Chapter IV, but
typically massage and the use of compression wraps and pads are the most effective ways of softening scar tissue.\textsuperscript{16,19,21,24}

Another common postoperative complication is the failure to gain full extension of a digit.\textsuperscript{20} Ultimately, the goal of operation is to gain full extension of the involved digit. Under certain occasions, this cannot be achieved and a residual flexion contracture is likely to occur.\textsuperscript{1,7-9,11} If this is the case, it is unlikely that postoperative physical therapy will increase the correction acquired during surgery.\textsuperscript{1} Regardless of the severity and duration of a contracture at the metacarpophalangeal joint, it can always be fully corrected.\textsuperscript{1,7-9,11} The same is not true for a long-standing contracture at the proximal interphalangeal joint. It is important to remember that the only fascia that contracts the metacarpophalangeal joint is the pretendinous cord of the palmar aponeurosis; thus, this is the only structure that has to be excised in order to attain full extension at this joint.\textsuperscript{1} However, at the proximal interphalangeal joint, there are four cords that bring about a flexion contracture. They are the central, lateral, spiral, and retrovascular cords.\textsuperscript{1,5,7,9} They can all be present in causing a contracture or one may be present. Whatever the case may be, the diseased cords must be identified and properly removed.\textsuperscript{1} If a diseased cord does not seem to be pathologic and the surgeon fails to recognize and remove the diseased fascia, it is likely a flexion contracture will still be present.

Reflex sympathetic dystrophy (RSD), which occurs in 4.2\% of postoperative DD patients, and the symptoms that go along with the complication is probably the most difficult with which to deal.\textsuperscript{20,25} Fortunately, it is uncommon
following operation for DD, although it can occur and prolong morbidity of the disease and result in a permanent disability.\textsuperscript{20} The major disability in particular is the loss of digital flexion.\textsuperscript{1,7} Normally, a patient with DD can fully flex the digits. If the patient cannot flex the digits after the operation, the patient will not be at all satisfied that he or she has attained an increased amount of extension. To lose flexion is usually more disabling than a lack of full extension.\textsuperscript{1}

Reflex sympathetic dystrophy normally presents with signs of extreme pain, edema, stiffness, and discoloration of the hand.\textsuperscript{1,16,20} Changes that occur secondary to the disease process of RSD include bone demineralization, pseudomotor and trophic changes, vasomotor instability, and fibromatosis.\textsuperscript{20} If RSD develops, it is of utmost importance to discontinue the normal postoperative therapy program and hospitalize the patient immediately.\textsuperscript{1} Once hospitalized, the hand is elevated and the pain is controlled by particular medications. The use of a compression garment may prove to be beneficial in relieving edema, while the use of passive motion is contraindicated due to normally increasing the pain.\textsuperscript{20} Physical modalities, such as contrast baths, massage, and transcutaneous electrical nerve stimulation, have all been shown to be of benefit in treating RSD.\textsuperscript{19} In dermatomal areas where extreme hypersensitivity is present desensitization techniques may be indicated. Because extension splintage may also elicit pain, it may also have to be halted temporarily until the RSD signs and symptoms are under control.\textsuperscript{20} If pain and swelling carry on, oftentimes a sympathetic block will be initiated by the physician and will be repeated until the pain and swelling subside. Most often, the axillary nerve block
is the route of choice and normally a long-lasting sedative anesthetic agent is recommended because the sympathetic block may last for as long as 24 hours.\textsuperscript{1,7} Once under control, Prosser\textsuperscript{20} describes the use of a modified stress-loading program to be performed. In performing the stress-loading program, the patient executes both compression and traction loading to the extremity for three minutes, three times a day. Once the acute symptoms of redness, pain, and swelling have subsided, the postoperative exercise and splintage can begin again.\textsuperscript{20}

Recurrence signifies the diseased fascia reappears within the operative area, while extension of the disease process implies the disease has appeared beyond the previous area of treatment.\textsuperscript{7} When recurrence occurs, it normally signifies that the surgeon performed an incomplete operation.\textsuperscript{1,7} Frequently, diseased fascia is left on the skin unknowingly by the surgeon while the skin flaps are being developed. Once the flaps are closed, the fascia that remained on the flaps still remains and could cause a recurrence. Typically, recurrence in the palm does not pose a problem because it does not lead to a recurrent contracture at the metacarpophalangeal joint secondary to the pretendinous cords being excised. However, if recurrence presents itself in the finger, classically, a recurrent flexion contracture of the proximal interphalangeal joint occurs. Invariably, if this occurs, the surgeon has committed an error and performed an incomplete operation signifying that at least one of the diseased cords was not properly removed.\textsuperscript{7} Recurrence is most frequent in the little finger
and is commonly due to failure in the removal of the lateral and/or spiral cord that arises from the tendon of the abductor digiti minimi.\textsuperscript{1}

Many times, extension of the disease will be seen one to two years after a surgical procedure has been performed.\textsuperscript{7} If this does occur, the surgical procedure was also not done appropriately. Typically, the scenario presents like this: the surgeon performs a fasciectomy in the palm and leaves the diseased tissue alone in the finger with the assumption that the palmar fasciectomy will eliminate the flexion contracture or the disease extends beyond the proximal phalanx of the digit, but the surgeon does not extend his or her incision beyond this joint. In either of these cases, extension of the disease will probably occur and could have been prevented if a more extensive fasciectomy would have been performed. As a rule, all diseased fascia, along with any potentially diseased fascia, should be removed.\textsuperscript{1,7}
CHAPTER VI

CONCLUSION

DD is defined as a pathologic change in the palmar and digital fascia that often results in a secondary fibrous flexion contracture.\textsuperscript{1} The painless contracture that develops usually occurs in the ring and little fingers, but occasionally, the palmar fascia associated with the thumb and thumb web space is involved.\textsuperscript{1,7-9,11}

The cause of this pathologic change is basically unknown, so treatment application can be challenging.\textsuperscript{2,3} The use of physical modalities or manual therapy techniques to reverse or alter the disease process is an ineffective means of treatment.\textsuperscript{1,7-9,11} Surgical intervention is the only effective way to alter the disease process of DD. Postoperatively, physical therapy can play a major role in the maintenance of the newly acquired extension and the strengthening of the musculature that was put at a mechanical disadvantage secondary to the contracture.\textsuperscript{8,16} Physical modalities such as whirlpool and massage may also aid in wound closure and softening of the surgical scar respectively.\textsuperscript{16,19,22}

Contrary to belief, the presence of a nodule in the palm or the digit does not necessarily indicate surgical intervention.\textsuperscript{8,9} Most often, the contracture of a digital joint is the main reason surgical intervention is indicated. The determining factors of when actual surgery is initiated depends on which joint is affected and
the degree of the contracture.\textsuperscript{1,7-9,11} A flexion contracture of 30° or more at the metacarpophalangeal joint normally limits the functional use of a hand enough to indicate surgery. A flexion contracture of 15° or more of the proximal interphalangeal joint normally warrants surgical intervention as well. It should also be noted that no matter how severe a contracture of the metacarpophalangeal joint, it is always possible to fully correct the abnormality. A long-standing contracture of the proximal interphalangeal joint of 15° or greater may not allow acquisition of full range of motion into extension through surgical intervention. From this information, it should be easily understandable why the early discovery of a proximal interphalangeal joint contracture can be beneficial. The earlier it is discovered, the earlier surgical intervention an occur decreasing the probability of a disability to occur in the affected hand.

There are basically four different excisional procedures: the open fasciotomy, fasciectomy, dermofasciectomy, and the open palm technique.\textsuperscript{9,11} Depending on the stage and the location of the disease, the age of the patient, and whether or not a strong diathesis is present determines which type of excisional procedure the operating physician will use.\textsuperscript{11,15} In excising the diseased fascia, the surgeon has multiple incisional techniques that can be used. The incisional procedures are also determined by the four factors mentioned above as well. No matter what the operative procedure, two primary objectives are involved when surgical intervention is used for treating DD.\textsuperscript{11} The first is to release the longitudinal tension caused by the contracted fascia. The second is
directed at physical therapy and rehabilitation to ensure proper skin management of the hand while the wound is progressively healing.

Following surgery, the primary long term goal is to improve or maximally restore hand function. To do this, other goals must also be accomplished and these are to regain finger flexor strength while maintaining the newly acquired extension of the fingers, softening of the surgical scar, and the prevention of postoperative complications. To obtain these goals, therapy may apply the use of a static dorsal extension splint, use physical modalities to promote wound healing, and incorporate the use of strengthening and functional exercises into the rehabilitation experience. Most patients require six to eight weeks of therapy along with one or two follow-up reevaluations.

Finally, several postoperative complications may arise and should be treated accordingly. Specific complications often associated with postoperative DD include excessive inflammation, hematoma, ischemic skin necrosis, wound infection, granuloma, transient paresthesia, scar contractures, tight lateral and oblique bands, joint stiffness, grip weakness, pain, RSD, recurrence and extension of the disease. Understandably, with complications comes a lengthened postoperative rehabilitation. Prevention of these complications from occurring only increases the probability of earlier return to maximal hand function.
REFERENCES


