In order to understand the pathogenesis and symptomatology of Dupuytren's contracture it is essential to have a thorough acquaintance with the anatomy of the palmar aponeurosis. Such knowledge is also indispensable to the performance of suitable surgical treatment of afflicted hands. Since Dupuytren (1832) demonstrated that changes localized to the aponeurosis are the cause of this deformity there has been a marked interest in the fascial framework of the palm, and the cure obtained by removal of the palmar aponeurosis still justifies an interest in the aponeurosis per se.

The purpose of this paper is to report on some original observations on the arrangement of the transverse palmar ligament, and the behaviour of the transverse elements of the palmar aponeurosis in Dupuytren's contracture. From these findings conclusions are made with regard to the pathogenesis of the disease and a technique for selective aponeurosectomy is recommended for the surgical treatment of contracted hands.

**Observations on Anatomy and Pathology**

The anatomy and pathology of the transverse fibres of the palmar aponeurosis will be described as they present themselves during the surgical dissection in Dupuytren's contracture. This account of the transverse palmar ligament (the superficial transverse ligament) is based on the uniform findings at operation in more than 300 consecutively treated hands. The aponeurosis is exposed by cutting close to the aponeurosis the fibrous strands that moor the palmar skin to the aponeurosis. The thin bundles forming the transverse palmar ligament than become visible at the level of the distal crease of the palm. Being located deep to the predominant mass of longitudinal fibres, the ligament will without further dissection only appear between these structures. In normal parts of the aponeurosis the longitudinal bands are, however, easily dissected off the underlying transverse ligament.

In areas where the aponeurosis is affected by Dupuytren's disease the longitudinal elements either form a mass of tissue, completely covering the transverse palmar ligament (Fig. 19.1C), or the pretendinous bands may have been transformed into distinct cords, which by retraction elevate and expose the transverse fibres more widely. To expose the ligament within diseased areas the contracted mass is cut transversely at the level of the distal crease of the palm. It will then be found that, although the transverse fibres are firmly adherent to the diseased tissue, when freed by careful sharp dissection they invariably prove normal in character (Fig. 19.1D). In certain cases forcible extension following division of contracted tissue may give the impression that the transverse ligament has become completely integrated with the pathological tissue. Closer examination will reveal that the transverse fibres have been pulled away with the separated mass, and when dissected off the deep surfaces of the cut ends they will always regain their normal position. In continuing the dissection it will be found that the longitudinal pretendinous bands have deep attachments of their own, both proximal and distal to the transverse ligament. When the longitudinal structure have contracted, their deep attachments are regularly thickened, particularly those distal to the transverse ligament. In some instances they will have turned into substantial bands, thus limiting the bow-string effect of prominent cords in the palm.

With this technique of dissection I have, contrary to Kaplan (1965), regularly found the fibres of the transverse palmar ligament to form a continuous band and never to be the site of pathological tissue changes characteristic of Dupuytren's contracture. Corresponding in density to other parts of the aponeurosis, it varies from a well defined structure, about 1 cm wide, to a few strands of fibrous tissue. It is particularly noteworthy that the ligament is limited to the midpalmar region with bordering deep attachments merging with the paratendinous septa on the radial side of the flexor tendons to the index and on the ulnar side of the flexors to the fifth finger. In transversing the palm the fibre bundles are throughout their course intimately related to the underlying paratendinous septa, and together with these they form a fibrous tunnel system which should be recognized as a separate anatomical structure (Fig. 19.1E, 19.2E). By its architecture this fibrous system will aid in stabilizing the transverse palmar arch, in protecting nerves and vessels, and in retaining the flexor tendons in position. These functional aspects are supported by observations on hands following radical aponeurosectomy.

Prior to my first observations in 1959 of the entity of the transverse palmar ligament and the paratendinous septa, I had not been able to recognize its anatomical
Figure 19.1
A, Dupuytren's disease of more than 2 years' standing in a railway worker aged 55 years. Pre-operatively multiple palmar nodules with adherent skin in the medial palm and mild digital deformity; B, C, the aponeurosis is exposed by scalpel dissection leaving as much fat as possible in the skin flaps; D, after division of the longitudinal bands at the level of the distal palmar crease the normal appearance of the transverse palmar ligament is well seen. E, the longitudinal fasciectomy is completed leaving the superficial transverse ligament and the peritendinous septa immediately beneath it. Note that the fat and planes of fine areolar connective tissue have been left covering the deeper palmar structures. C, the wound is closed with 6/0 nylon.
Figure 19.2
Diagram showing the transverse palmar ligament after removal of the longitudinal pretendinous bands. This ligament is never the site of pathological lesions indicative of Dupuytren's disease.

characteristics; this despite the personal experience at that time in removing the palmar aponeurosis for the treatment of Dupuytren's contracture in about 400 hands. The explanation why this constant structure was overlooked is the operative technique that had been used, i.e. the palmar aponeurosis was severed transversely in the proximal part of the palm and the alternate tunnels for flexor tendons and nerves, vessels, and lumbricals were split open by longitudinal incisions; the sections thus isolated were excised by cutting the paratendinous septa. With this technique the transverse palmar ligament never became exposed.

In marked contrast to the characteristic behaviour of the transverse fibres in the palmar region, the interdigital ligaments are frequently the site of pathological changes, resulting in contracted bands which prevent the fingers from being separated (Fig. 19.3). The fibre bundles of normal interdigital ligaments are, however, in character indistinguishable from those which form the transverse ligament in the palm.

**PATHOGENESIS**

Since Dupuytren first described the deformity as produced by contraction of the palmar aponeurosis, several authors have suggested that the basis of the condition should instead be placed in the palmar tissues superficial to the aponeurosis (Goyrand, 1833, and others). From histological studies MacCallum and Hueston (1962) concluded that, although the palmar aponeurosis is intimately involved in Dupuytren's contracture, this represents only one aspect of a change which may occur in any of the palmar connective tissues and is usually secondary to changes arising within the fibrofatty tissue on its superficial aspect.

In 1948 the author suggested that the strain to which

Figure 19.3
A, contracture of 14 years' standing in the case of a 69-year-old joiner. B, the retracted muscular bands at the level of the 3rd (ring) finger and of the little finger have been divided, and the normal character of the transverse palmar ligaments can be seen. C, the forceps indicate the thick retracted interdigital commissural ligament which is preventing the separation of the third and little fingers.
certain elements of the aponeurosis are subjected is essential in the pathogenesis of Dupuytren's contracture and that the disease originates in fibrillar ruptures within the aponeurosis (Skoog). This view was well supported in an experimental study by Larsen, Taka-gishi, and Posch (1960), who were able to reproduce the characteristic tissue changes in monkeys by traction causing fibre ruptures of the palmar aponeurosis. The observation reported here and first mentioned in 1963 (Skoog), that the transverse palmar ligament never becomes the site of pathological changes in Dupuytren's contracture, may be regarded as additional clinical evidence. It should then be pointed out that in no function of the hand are the fibres of this transverse band subject to tension or strain such as could reasonably be thought to cause them to rupture.

This conception of the pathogenesis of Dupuytren's contracture, formed on the basis of reported observations, leads to the practical conclusion that the transverse palmar ligament should be left alone in the surgical treatment of the diseased aponeurosis. The experience of such selective aponeurosectomy has been entirely satisfactory as will be reported later in this paper; no sign of recurrence has appeared at that site and the function of a well defined structure of the aponeurosis has been preserved.

Contrary to the transverse palmar ligament, the interdigital ligaments are in several functions of the hand subjected to strain: separation of the fingers will cause tension and these ligaments are also partly responsible for limitation of flexion of a finger when the other fingers are extended. The striking difference between the transverse interdigital ligaments and the transverse palmar ligament, in the respect that pathological changes occur only in the more distal of the two, can hardly be explained without the acceptance of strain as a causative factor. These morphological findings are thus of particular interest for our understanding of the nature and cause of the structural changes in Dupuytren's contracture; and they are obviously incompatible with most theories on the aetiology of this disease put forward through the years.

It should be emphasised that the pathogenesis and the aetiology of Dupuytren's contracture must be considered separately, as in any other disease. Several previously reported observations indicate that certain biomechanical qualities of the connective tissue in general, demonstrated in brittleness and decreased elasticity of the fibrous elements, are essential in creating a predispositions for the condition. The conception of the pathogenesis advanced here does not imply that the nature of the aponeurotic tissue differs from other fibrous elements of the individual concerned. The reason that the disease manifests itself in such a typical manner in the hand is readily explained as a consequence of the functional anatomy of the palmar aponeurosis (Skoog, 1963). The pathological process itself is based on the fundamental principle of scar formation and contracture.

**SURGICAL TREATMENT**

**PALMAR APONEUROSIS**

In the past 15 years, 807 hands (621 patients) have been operated upon for Dupuytren's contracture in our Department. The numerous observations made on this material justify several conclusions of general interest; in this paper the comparisons are mainly limited to the quality of the results and the surgical techniques used in removing the palmar aponeurosis.

In the early part of my series, exposure was obtained according to the McIndoe (1946) method, through a wide incision in the distal palmar crease supplemented by separate Z-incisions on the fingers involved. The palmar aponeurosis was always radically excised, including the paratendinous septa down to their deep attachments. The subcutaneous and subaponeurotic fatty tissue, including the fat pads of the metacarpophalangeal region, were also extensively removed and thus the subaponeurotic anatomy became exposed in great detail. Following such extensive dissection, wound healing required about three weeks. Some of the patients subjected to this treatment have now been observed for more than 15 years. None of them has mentioned symptoms which could imply that the palmar aponeurosis is essential for the function of the hand. Several patients, however, complain of paraesthesia and pain in gripping, a feeling of the palm being 'unprotected', or that they have lost some strength in heavy gripping. On examination the palmar surface appears unnaturally flat, the normal palmar creases become less distinct, and a new pattern of finer creases has developed (Fig. 19.4). The fingers are easily hyperextended and the transverse palmar arch can be passively reversed. In some instances the pulsation of palmar arteries could be seen through the thin skin.

For the last five years our surgical approach in Dupuytren's contracture has been more conservative, leaving the surrounding delicate system of connective and fatty tissues as far as possible in place. It has also become a standard procedure to perform selective aponeurosectomy, i.e. to separate and preserve intact the transverse palmar ligament as well as the underlying paratendinous septa (Fig. 19.1E). In doing so these structures act as a safeguard in protecting the delicate anatomy of the deep palmar space during dissection. The neurovascular bundles are no longer isolated throughout their course; their freeing is mainly restricted to finger bases and adjacent parts of the palm, where the close relationship of the nerves and arteries to contracted bands may make such exposure useful for their protection. After com-
Figure 19.4
Although the retraction in this case is confined to the third finger (A), a radical fasciectomy has been carried out using a transverse palmar incision. Skin closure has been promoted by a Z-plasty at the level of the third (ring) finger. Thirteen years later (B, C, D), at the age of 77 years, the patient displays full finger extension and complete freedom in the palm of the hand.

Completion of the dissection an operative field is left in which the nerves, vessels, and muscles are veiled by sheets of fine connective tissue. The structures of the subaponeurotic space can therefore only to some extent be identified due to these sheets and surrounding fatty tissue. Another technical advantage in leaving the transverse palmar ligament is that, in closing the basic line of incision in the distal palmar crease, a few mattress sutures can be used for fixing the skin edges to the band, thus obliterating the palmar wound pocket (Fig. 19.5).

After limited excision of the palmar aponeurosis had been carried out as described, recovery was much quicker than following more radical procedures. Wound healing occurred in 10 to 12 days, and postoperative swelling of the fingers was markedly reduced. In hands in which the transverse fascial system of the palm was preserved in aponeurosectomy, there has been no recurrence within the palmar field of operation during the five years in which the method has been in use. When postoperative swelling and stiffness had subsided and sensation fully returned, the patients considered their hands to be normal in every respect. The configuration of the palm was normal with distinct transverse palmar creases, the metacarpophalangeal fat pads maintained, and the palmar arch preserved (Fig. 6). One patient in this group, who had previously undergone radical aponeurosectomy of his other hand, reported the strength and general feeling of that hand to be slightly, but definitely, inferior compared to the normal condition of the hand operated upon according to the more conservative technique.

Atraumatic surgical technique in the sense that the
Figure 19.5
The skin suture has been secured to the transverse palmar ligament in such a way as to conceal the subcutaneous separation.

Figure 19.6
A, a contracture of 15 years' standing in a 55-year-old factory worker. B, C, D, the transverse palmar ligament has been left intact and the normal configuration of the palm can be seen; Note the transverse palmar flexion crease and the metacarpophalangeal fatty pads. The scars show that a Z-plasty has been carried out on the 5th finger.
dissection is restricted to the palmar aponeurosis and its extensions has proved essential; surgical intervention outside the fascial system will unfavorably interfere with the lymphatic system of the hand and the venous return, both in the early postoperative period and later owing to the formation of scar tissue. Excessive scarring laid down in the process of repair may also cause recurrence of unpredictable nature, not necessarily related to the site of the palmar aponeurosis. Preservation of the subcutaneous fibrofatty tissues of the palm, particularly the metacarpophalangeal fat pads, also seems advantageous for protection and for moulding the surface of the hand in gripping. Apparently recurrences do not occur within these tissues, and reasonably so because the fibrous elements of the subcutaneous tissue layer are left loose when their deep attachments are cut in removing the aponeurosis.

Whether removal of aponeurotic tissue as a prophylactic measure should include pretendinous bands of normal appearance has to be decided upon in each individual case, considering the patient's age, disposition to the disease, etc. From a surgical and functional point of view, it makes little difference if the longitudinal bands are totally or only partially removed from the palm. One technical consideration should, however, be emphasized in this connection. From a prophylactic point of view it is recommended that in partial removal of the aponeurosis the line of resection is placed along the longitudinal fibres and care taken not to damage the bordering fibres of the portion left in place; the healing process of severed longitudinal fibres is likely to cause reappearance of the disease at that site.

It should be mentioned that this change in surgical technique for the removal of the palmar aponeurosis has been developed simultaneously with the introduction of a variety of skin incisions for exposure. Though this might to some extent be responsible for quicker wound healing, it is felt strongly that the new principle adopted for the dissection and resection of the aponeurosis has been decisive for the improvement of operative results.

**Skin and Subcutaneous Tissue**

Suitable skin incisions in the surgical correction of contracted hands will be discussed briefly in this paper, and only with regard to the method for selected aponeurosectomy recommended.

The principle of restricting the removal of the aponeurosis to its longitudinal portions including diseased parts of the interdigital ligaments and as far as possible avoiding interference with fatty tissues and adjacent systems of thin connective tissue sheets makes good exposure essential. At the same time the limitation in dissection minimizes the need for exposure by wide undermining of palmar skin (Fig. 19.7). It has therefore been considered worth while to add still another pattern of incisions to the numerous ones recommended for the surgical approach in Dupuytren's contracture (Fig. 19.6B). The basic line of incision is placed in the distal palmar crease, in length corresponding to the section of the aponeurosis to be removed. Distally extensions are made over present cords and carried on to the fingers, bifurcated contracted bands being exposed by Y-shaped incisions (Fig. 19.3C). Proximally a crease in the centre of the palm is incised, extending from the transverse incision line; the triangular skin flaps thus formed proximally are raised no further than to expose the border of the aponeurosis on either or both sides. Despite the extensiveness of these incisions, healing conditions have been excellent because of the good blood supply maintained due to limited undermining of the skin.

On the fingers the Z-plasty, introduced by McIndoe, still offers the best solution for wide exposure and for elongation of the shortened skin. Occasionally this ingenious procedure may be indicated to correct contracture in the distal portion of the palm (Fig. 19.8).

In areas where the pathological process has invaded the subcutaneous and dermal layers causing pits, deep furrows, and ridges, the palmar skin will regain most of its original surface when dissected off the underlying mass. Even when the skin has to be cut very thin in this manoeuvre its blood supply has proved to be sufficient, and after healing the skin has gradually become soft and pliable, indicating that the skin symptoms are only secondary and maintained by the mechanical effect of underlying contracted fibrous elements.

In no case have I found it necessary in primary treatment to replace palmar skin with skin grafts. Like Hueston (1963), I find the principal use of skin grafts to be after digital dissection of recurrent Dupuytren's contracture where the skin generally has decreased

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*Figure 19.7*

Diagram showing the extent of subcutaneous palmar separation required in carrying out a selective fasciectomy as described in the text, when the 4th and 5th longitudinal bands are affected.
viability and elasticity, which makes it unfit for further rearrangement. Only in the case of a severely flexed finger of long standing may additional skin be needed at a primary operation to compensate for apparent shortage on the volar aspect (Fig. 19.8). The wrist then has been our first choice as a donor site for a full-thickness skin graft.

**SUMMARY**

Some original observations on the anatomy and pathology of the transverse elements of the palmar aponeurosis are reported. The transverse palmar ligament forms a continuous band, strictly limited to the midpalmar region with deep attachments at each end merging with the paratendinous septa bordering the compartment on the radial and the ulnar sides. Throughout its length the transverse band is intimately related to the underlying paratendinous septa and together they form a well defined fibrous tunnel system. The function of this separate anatomical structure is discussed, and related to observations on hands following its removal. In all stages of Dupuytren's contracture it was noticed that the transverse palmar band was not involved in the pathological process, this being confirmed as a constant feature in more than 300 consecutively operated hands. In marked contrast, the transverse fibres of the interdigital ligaments were frequently the site of pathological changes, resulting in contracted bands.

The striking lack of pathological changes in the transverse palmar ligament and their presence in the interdigital ligaments are obviously incompatible with most theories proposed on the aetiology of Dupuytren's contracture. Considering the anatomy of these bands, the difference in functional strain on their fibrous structures offers, however, a reasonable explanation. The observations made are regarded as additional clinical evidence in support of the author's previously expressed view, that Dupuytren's contracture develops as the result of ruptures of fibrils in the aponeurosis, affecting individuals with a general predisposition in their connective tissue. The pathological process itself is based on the fundamental principle of scar formation and contracture.

In the surgical treatment of Dupuytren's contracture selective aponeurosectomy is recommended, i.e., the transverse palmar ligament is separated from the
contracted tissue and left intact together with the paratendinous septa. In doing so the function of this fibrous tunnel system has been preserved; no recurrences were noticed at this site; healing time was reduced compared to that required following more radical procedures; and the functional restoration of the hand was also quicker. The principles for exposure of the contracted palmar aponeurosis are briefly discussed and a pattern of incisions is suggested to facilitate the dissection and to reduce the need for undermining of the skin.

REFERENCES


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