8. THE CLINICAL AND MORPHOLOGICAL COURSE OF DUPUYTREN'S DISEASE

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The large number of publications on Dupuytren's contracture (D.C.) which continue to appear in the literature, demonstrates the great interest in this disease. Numerous theories on the aetiology and pathogenesis have been and still are being advanced, an indication that none of them is fully satisfactory. Many fundamentally different methods of treatment are recommended, and reports of excellent results can be read regarding each method. It is surprising that the therapy of D.C. is still discussed at all, seeing that every form of treatment, whether conservative or operative, promises success.

There are fundamental differences of opinion with regard to operative treatment. Many surgeons still follow McIndoe's teaching (1948) and remove the palmar aponeurosis as completely as possible in order to prevent the reappearance of new foci. Other authors believe that recurrences or extensions of the disease in areas originally healthy are not associated with an extension from the operation, and recommend the most limited intervention possible. Even by the method of simple section of the contracture band lasting results are alleged to have been achieved (Le Chuiton, 1957). This method, described as long ago as 1878 by Adams, was given up on account of the large incidence of recurrences. McIndoe's (1948) so-called radical fasciectomy was developed because the previous and less extensive interventions had not given lasting results.

Hueston (1961) recommended the so-called limited fasciectomy, and based his opinion, amongst other things on patients treated by this method not exhibiting any more recurrences and extensions than another series, which had been treated by radical fasciectomy an appreciably longer time previously. Critical examination of this study, and indeed of many other reports of successes, demonstrates that the time factor has not been adequately appreciated. When dissimilar periods of time are applied in the comparison of two series, it is frequently pointed out that time can be ignored because the majority of recurrences and extensions occur within two years following operation. This assertion pre-supposes that, at least in those cases which exhibit no recurrence or extension, D.C. is eliminated, even in the areas not included in the operation—or else its appearance there is prevented. Such an assertion should only be founded on an exact knowledge of the natural and uninfluenced course of D.C. But such a study of the disease is completely lacking, and only in a few works is this fact taken into account. One can on the contrary read between the lines in the literature, especially in reports of successes, that a constant progress of the disease is accepted. Cessation of progress of the disease following the use of conservative treatments such as X-ray, radium, ultrasonic sound, vitamin E etc. has been reported as denoting success, without the question of post or propter hoc being taken into account.

From what has been said it follows that a knowledge of the natural course of D.C. is of the greatest significance. An insight is only to be had by longitudinal sections from a series of untreated patients over a period of many years. Such an investigation does not yet exist. Cases in which doctors suffering from D.C. and who have made observations on the course of the disease (Moser, 1936; Moorhead, 1956) point to a phasic course with alternating periods of progress and intermission.

There is confusion not only in regard to the clinical course but also in relation to the nature of the pathological–anatomical changes. A number of morphological investigations appear to have shown that, in the course of D.C., tissue with very marked cell proliferation, predominantly consisting of fibroblasts, gradually changes to scarlike tissue mainly consisting of masses of collagen. Demonstration of an association between the histological picture and clinical behaviour—whether active or inactive—has not been successful in spite of various attempts (Meyerding, 1936). The questions regarding the origin of the morphological changes has also remained unexplained. The answer to this question would certainly be of very great practical significance. If, in the nodules exhibiting marked cell proliferation, we were concerned with a genuine new growth in the tense connective tissue on the volar aspect of the hand, prophylactic removal of healthy parts of the palmar aponeurosis would be pointless, and the use of limited fasciectomy (local excision) would be theoretically confirmed. On the other hand if we are concerned with a primary pathological disturbance in the collagen fibres of this connective tissue, which gradually involves the whole of the fibre system, prophylactic removal of fibres potentially liable to involvement would be justified, and ought to be reflected in the results of treatment. The greatest possible comparative objectivity in relation to results of treatment will, however, only be achieved if all the factors influencing the

further course of the disease are borne in mind, and thus serve as a criterion for its natural course.

In the present study an attempt is made to answer three fundamental questions:

1. What is the process of the histological changes, especially of the early changes, and from which tissues do these pathological changes originate?
2. What is the natural clinical course of disease?
3. What inferences are to be drawn in regard to the evaluation of results of treatment?

The investigation is based on the interpretation of patient material in the Department of Plastic and Reconstructive Surgery in No. 1, University Surgical Clinic in Vienna (director Prof. Dr. P. Fuchsig). From 1951 until the beginning of 1967, 750 cases of D.C. were recorded. The majority of patients underwent operation, others were treated conservatively, while in a third of the cases no therapy was involved because the changes were not sufficiently marked to render operation necessary. All specimens from operation were subjected to thorough histological investigation by various methods and with various points of view in mind. A detailed work regarding the technical particulars can be referred to (Millesi, 1965). In that paper a survey on literature is given.

HISTOLOGICAL CHANGES

The histological picture of D.C. reveals two fundamental changes. On the one hand a cell proliferation, the cells resembling fibroblasts, without the presence of an intermediate substance. On the other hand a scar-like tissue consisting of masses of collagen, and containing only a few mature cells. These are referred to as the stage of cell-proliferation and the fibrous or lamella stage respectively. Between them there is every stage of transition with maturing of the cells, decrease in the cell count, and increase of the intermediate substance consisting of pre-collagen and collagen. It seems logical to put the cell-proliferation as occurring before the fibrous stage. The fibrous stage would thus be regarded as the end-product following increasing cell maturity and as a result of production of collagen by the cells. Cases which in the histological picture predominantly present the stage of cell proliferation ought accordingly to be earlier cases and exhibit a shorter history than cases in which the fibrous stage predominates. The proof of such a time relationship was unsuccessfully attempted by Meyerding (1936). From an analysis of his own clinical material Millesi (1959) attached the following figures to the average duration of the disease:

| Stage of cell proliferation | 5·8 years |
| Fibrous stage | 4·6 years |

This statement shows the fibrous stage, that is to say the end stage, as having a shorter duration than the stage of cell proliferation. There is no doubt that the fibrous stage occurs only through maturing and collagen production following the process of cell proliferation. An explanation for this contradictory state of affairs could be found in the assumption that the structure of the group of cases represented in the fibrous stage was not uniform, and contains cases in the end-stage with longer duration and others with shorter duration, in which fibre changes may well be present, but in which the stage of cell proliferation still persists.

This hypothesis is supported by observations we were able to carry out on several hundred operation specimens. In all these cases the appearance of cell proliferation was seen in fibre bundles which had already undergone pathological change. In no case had cell proliferation developed either in or between normal fibre bundles. Further elucidation regarding this question can only be expected through inquiry into early changes in D.C. It must of course be clearly understood that the expression 'early stage' as applied to the morphology or in the clinic are two different things. From the clinical point of view we refer to an early stage where there is a nodule or band in the palm or on the volar aspect of the fingers, and when there is still no contracture. An analysis of the duration of the history for cases in this group (Stage 'O' in Iselin's classification), revealed a mean duration of the illness of 2·64 years according to the statements made by the patients. The actual duration must have been longer, as the first minute changes are not immediately noticed by the patient. Under these circumstances it is certainly not possible to speak of early changes.

The only possibility for studying early changes is provided by the examination of the hand from the cadaver. If a continuous series of hands from the cadaver, on which macroscopically there is no evidence of contracture, is minutely examined, a certain percentage showing D.C. changes can be anticipated, the percentage depending on the average age at the time of death.

An investigation of this nature was undertaken in the Anatomy Department of Vienna University on 152 palmar aponeuroses. The average age at the time of death was 70 years. Changes in the macroscopic structure of the collagen fibre bundles were studied using a magnifier and in addition a histological examination was carried out. Ninety-seven aponeuroses were fully normal. In nine hands complete evidence of D.C. was demonstrable on a finger ray. Forty-six palmar aponeuroses presented, on one or two finger rays, changes in the collagen fibre bundles, while the remainder of the aponeurosis was completely normal.

The normal fibre bundles of the aponeuroses were, on examination with the loupe, slender and well demarcated from one another. In the relaxed state they displayed transverse striations if examined with a low angle light (Nauck, 1931) which originates from the

wavy course followed by the fibre bundles. Under longitudinal tension the waviness is smoothed out and transverse striation disappears. When tension is released the previous state is resumed. In 14 palmar aponeuroses some of the fibre bundles even in the relaxed state had lost their waviness and transverse striation, but the fibre bundles were still slender and well demarcated. In 20 specimens, whereas individual fibre bundles presented similar changes, the bundles were, in addition, thickened. Twelve specimens showed, together with the changes just described, a tendency on the part of the thickened fibre bundles to fuse together in individual places, and to form larger bundles. So much for the changes as seen under illumination with the loupe. Histological sections showed increased collagen in the changed fibre bundles compared with the normal (Fig. 8.1). The elastic fibres were no longer
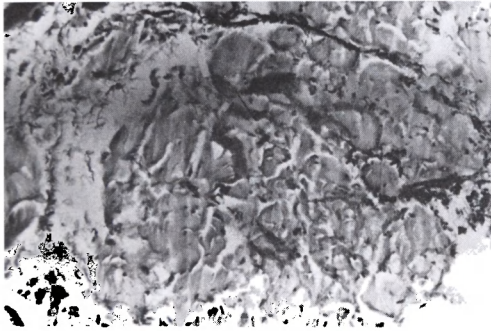

Figure 8.1
Elastica after Pranter (1 : 100).

evenly distributed in the fibre bundle but were situated only sparsely on the periphery. The individual collagen fibres in the bundles were thickened and tended to fuse together. The thick bundles structure, especially the perifascicular connective tissue separating the bundles from one another, were normal (Fig. 8.2). In the 12 specimens, where, under the magnifier, fusion of bundles had been observed in individual places, in the histological sections numerous areas which could be interpreted as cell proliferation were observed, but always only within those fibre bundles which had undergone pathological change. The changes described fitted in perfectly with the features in the nine specimens macroscopically identified as D.C.

The contention that the changes described have a real relationship with D.C. is supported by the following considerations:

1. Individual fibre bundles were always the only ones concerned, while the remainder of the bundle in each specimen presented a normal picture, so
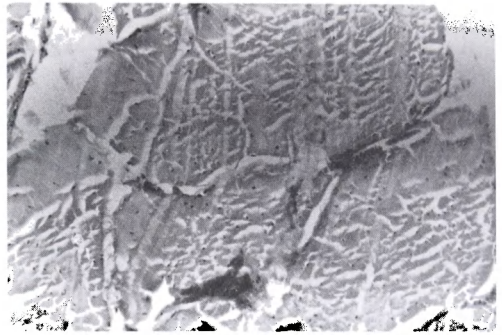

Figure 8.2
Haematoxilin-eosin (1 : 100). Thickened collagen fibres in cross section. The single collagen fibres are thickened and show tendency to fusion.

that an artefact or a diffuse change within the definition of senile degeneration could be excluded.
2. The distribution of the changes in the finger rays nearly corresponds to the distribution in D.C. It was as follows:

    Middle finger ray   12 times
    Ring finger ray   34 times
    Little finger ray   28 times

3. Only longitudinal fibres were affected; transverse fibres never affected (Fig. 8.3) (Skoog, 1966).
4. The male sex was predominant.
5. The findings form an uninterrupted line from the early changes to the fully developed picture of D.C.
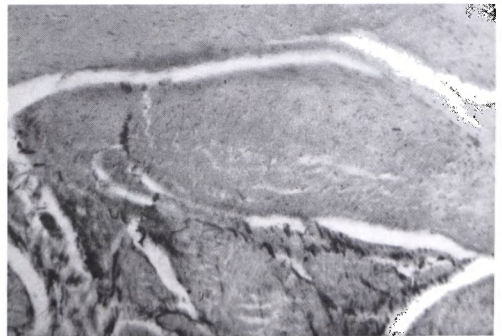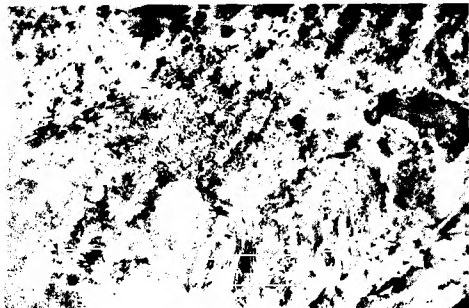

Figure 8.3
Elastica after Pranter (1 : 100). Longitudinal section. The thickened collagen fibre bundle does not contain elastic fibres. In the lower part the normal fibre bundles of the transverse fibre system show elastic fibres in normal number and distribution.

As soon as these early changes had been recognized, it was not difficult to discover them again and identify them in the operation specimens, in which they could be demonstrated in the places where the disease was invading healthy tissue.
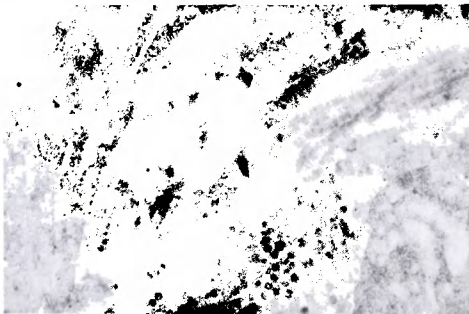
With the above observations in mind we believe that D.C. commences with changes in the collagen fibres in the fibre bundles of the tense connective system on the volar aspect of the hand. With a previous history of a sufficiently significant hereditary component any fibre bundle can be the site of pathological change. The processes of ageing and functional stress are predisposing factors. The collagen fibres thicken, fuse together

Histologically the bundle structure and perifascicular connective tissue are preserved. Up to this point the changes could be described as the *stage of fibre thickening.*

Commencing from the perivascular areas, proliferation of fibroplasts develops in the fibre bundles which have undergone the pathological changes described above. The cells gradually invade the whole cross-section of the fibre bundle, and the collagen substance disappears. Under the electron microscope the micro-fibril bundles can be seen dissolving (Fig. 8.4). At commencement of cell proliferation the septa of perifascicular connective tissue between the fibre bundles remain intact (Fig. 8.5). During proliferation however,
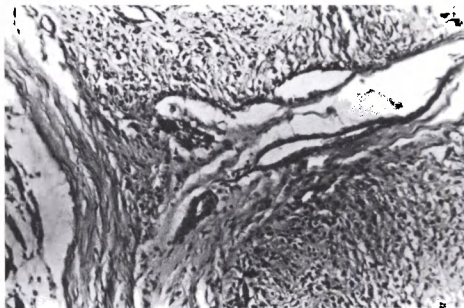

Figure 8.5
Haematoxilin-Eosin (1:100). Two pathologic fibre bundles in cross section. Early cellular proliferation. The perifascicular connective tissue and the septa between the bundles still intact.

Figure 8.4
Fixation Glutaminosmiumsaure. Electron microscope 1:5000 (A); 1:25000 (B). Tissue of a contracture band during early cellular proliferation. The collagen microfibril bundles in dissolution.
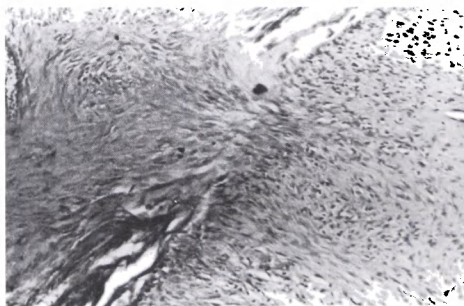
Figure 8.6
Elastica after Pranter (1:100). Two pathologic fibre bundles in cross section during cellular proliferation. The fibre bundles still separated by a septum. The septum is being destroyed by the cellular proliferation.

and as a result there is a thickening of the whole fibre bundle as the next higher structure. The bundle loses the property of assuming the wavy state when it is relaxed. On account of this thickening the space between the fibre bundles decreases, and with the aid of the loupe only they become frequently difficult to delineate.

the septa are perforated (Fig. 8.6) and disintegrate. If parts of the perifascicular connective tissue become enclosed between two fibre bundles in the process of fusing together, the pictures are confused.

Intact connective tissue together with intact elastic fibres can be situated in the middle of a contracture band. The real state of affairs can only be cleared up by examination of a series of sections. At the peak of cell proliferation, the bundle structure has disappeared. A thicker band has developed which in cross-section is mainly occupied by fibroblasts. Longitudinal and serial examination can still reveal the origin of the band through the fusion of a number of fibre bundles.

During further development of the process the cells mature with the formation of precollagen and collagen. The cell count decreases and the mass of intermediate substance increases. The collagen substance is not, from a functional point of view, constructed in regular fibres and fibre bundles, but appears as strata, in a vertiforme arrangement or, in a form resembling a spindle. This period can be regarded as the stage of *cell-maturation and fibre production*.

The development just described results in a scar-like picture. There are now only a few more mature fibrocytes to be seen. The tissue consists of collagen substance in either stratified or spindleform arrangements. We are concerned here with the stage which conforms with the fibrous or lamella stage in the classical descriptions. If only a few sections are available for histological examination, the picture can be confused with the stage of fibre-thickening, because the appearances are similar. Differentiation depends on an evaluation of the perifascicular connective tissue. If this is present, the process is in the stage of fibre-thickening. If the perifascicular connective tissue, together with the bundle structure, has disappeared, we are then concerned with the *fibrous stage*.

In fibre bundles which have passed through all the developmental stages and have reached the stage of scar tissue, cell proliferation can recommence. The whole process—cell proliferation, distintegration of collagen, cell maturation, renewed collagen production can possibly be repeated many times. The possibility of this repetitive process is the cause of the stop–go course of the disease, alternating between periods of activity and inactivity. The clinical course on that account also becomes irregular, because in different places in the tense connective tissue system on the volar aspect of the hand, different stages of the disease process can be present at the same time. The identification of these secondary and tertiary stages is naturally difficult, and can only succeed with absolute certainty if sections in two planes are available, so that a special picture of the arrangement of the tissue can be constructed.

Round cell infiltration which is regarded in the literature as an expression of an inflammatory component of the disease, was not regularly seen. According to Nezelof and Tubiana (1958), and also Larsen and Posch (1958) this occurs in only about 25 per cent of cases, a frequency too small to be of pathogenetic significance. They occur in large numbers where fatty tissue or sweat glands become involved between thickening fibre bundles, and undergo pressure atrophy. We interpret the round cell infiltration as being a reabsorptive inflammatory reaction.

Iron pigment deposits which are occasionally met with, have been considered as being the expression of the termination of haemorrhages, and have been put forward as an argument in favour of the traumatic genesis of D.C. (Skoog, 1948). They can, however, occur within the framework of the tissue transformation described above, and should not be overrated as conclusive evidence.

Operation specimens from 176 cases were examined, with regard to their stage in the disease, by means of sections in two planes and in some cases by series of sections. The determination of the average duration of the pathological changes produced a striking conformity between the histological picture and the duration of the disease. The mean periods were as follows:

Stage of fibre thickening	4	years
Stage of cell proliferation	5·66	years
Stage of fibre production	6·2	years
Fibrous stage	7·55	years
Secondary cell proliferation	10·3	years

Summarizing these morphological investigations, the conclusions are as follows. D.C. is the manifestation of pathological changes in the fibres and fibre bundles of the tense collagen connective tissue system of the volar aspect of the hand. The pathological tissue arises through the transformation of existing fibres and fibre bundles and not by neoformation. Fundamentally any fibre in the system can be subject to this pathological change, and this is confirmed by clinical analysis of the distribution of pathological variations in the hand. Individual fibre systems are of course affected due to specific causes, partly not understood, and in varying frequency. Some form of systemic disease is consequently involved. A comparison between the morphological process and the time factor shows that the course of the disease extends over many years and can always recommence.

THE NATURAL COURSE OF D.C.

As already mentioned, all individual studies of the untreated course of D.C. are contrary to the concept of an unbroken continuity in the progress of the disease, but recognize on the contrary an irregular phasic course for each individual case. An understanding of the natural course of D.C. can only be achieved if a large reservoir of patients is followed up over a considerable length of time and every sign of activity recorded. The following would be regarded as signs of activity.

Appearance of a nodule or band on a site previously free of changes.

Appearance of a flexion contracture within the area of a band which previously had caused no finger contraction.

The worsening of an existing finger contracture.

It is obvious that an assessment is only possible if an exact description of the status was made on the first examination. It is equally clear that such an examination cannot determine the precise activity of the disease, because changes which are a manifestation of early activity but which are below the threshold of recognition on examination for the case record, escape evaluation. For example it is difficult to be precise about the increase in the thickness of a contracture band or nodule. Similarly the increase of an existing flexion contracture from, for example, 40° over a matter of one or two degrees is difficult to determine with the measuring technique at present in use. Hence only recordable differences will be recorded. As long as there is an adequate degree of uniformity in case assessment no harm will have been done to the result.

The percentage of cases in a patient reservoir which manifests activity in the sense described above, is termed the activity rate. Should the reservoir contain a large number of cases with marked predisposition— the expression 'Dupuytren's diathesis' is employed— and a larger activity rate must be expected than when the reverse holds good. It can, however, be accepted that with a sufficiently large number of cases there will be a smoothing out in the overall composition. Inquiry was first directed to the course of the disease in 150 hands which on examination for the first time presented either a nodule or a band on the palm of finger, without any contraction (Stage 'O'). In these cases operation was not called for and no special treatment was given. Activity rate in relation to time of observation was:

3 to 5 years   37   per cent
6 to 12 years   46·5 per cent

In nine hands during the period of observation there was temporary involution of nodules or bands originally present in the hands. Given an adequate length of observation time, no case of involution was permanent.

A follow-up of 47 cases recently carried out, in which there was no flexion contracture (Stage 'O'), and which were given conservative treatment such as X-ray, vitamin E or ultra-sonic sound, resulted in a similar activity rate (Hassler, 1967) from which the conclusion may be drawn that the course of the disease was not significantly influenced by these methods.

In a further study the fate of 113 hands was followed, in which at the first examination there were no signs of the disease. The patients were being treated for D.C. in the contralateral hand. In the course of time a proportion of the hands originally free of the disease became affected to the following extent:

With an observation time of 5 years   39 per cent
With an observation time of 6 to 12 years   48 per cent

Similar results were found in this investigation when other postulates were used.

If a large group of patients is investigated in which there is more or less advanced flexion contracture, difficulties arise, and not because an actual flexion is easier to determine than a gradually increasing flexion, but because the presence of flexion contracture is an indication for operation and the operation cannot be delayed on investigational grounds. Some criterion as to the activity of the disease can obviously be achieved indirectly, namely as follows. In a large group of patients the duration of the disease is determined as accurately as possible. The cases are arranged in several groups according to the length of the history. The percentage of cases with mild, moderate, or severe flexion in each case is noted. The percentage of moderate or severe cases increases in the course of time. A criterion as to the activity of the disease can be obtained by the rise in the moderate and severe cases. From this system of grouping a picture emerges showing that the activity rate increases in proportion to the number of severe cases in a group (Fig. 8.7).
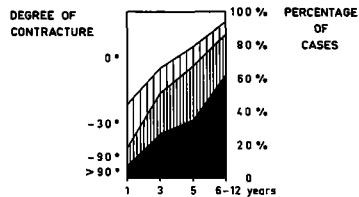

Figure 8.7
In a series of 221 cases the degree of contracture of the most involved digit is plotted against duration of the disease in years. This gives an indirect approach to the progression of the disease in advanced cases.

Investigations regarding the natural course of D.C. justify the following conclusion.

The individual case of D.C. displays a phasic course with periods of inactivity and progress. Prediction regarding the future course of the disease is not possible in an individual case. Only evaluation of a large patient reservoir can elucidate its progress. If such a reservoir is available for homogeneous patient material, the activity rate is shown to be remarkably constant. Its time relationship can be represented by a curve. Activity rate increases with the lapse of time, more rapidly during the first four or five years, but always perceptibly. The activity rate further depends on the medium grade of severity of the disease. The activity rate is higher when a greater number of severe cases are included in the clinical material.

The results of these investigations on the natural course of D.C. are of the greatest significance in the evaluation of treatment. Adequate assessment of

investigations relative to treatment can only be achieved by appropriate consideration of the natural course of the disease.

EVALUATION OF RESULTS OF TREATMENT

An objective evaluation of the results of treatment must be based on two assessments entirely independent of one another.

Furthermore the information they contain must be sufficiently complete if they are to be of adequate value.

1. FUNCTIONAL CONDITION OF THE HAND

The resulting function of the hand depends on various factors not immediately associated with one another. If a severe flexion contracture has already existed for some time, there can be secondary tendon contracture or stiffening of the joints. The functional result can be prejudiced by this, although the postoperative course of events may be free of complications and recurrence. On the other hand serious postoperative complications can be the cause of a bad result, although there is no further D.C. activity. Finally an excellent postoperative result can be ruined by renewed activity of D.C. whether in the form of either a recurrence, or an extension of the complaint into a hitherto healthy area. The functional condition can be expressed most simply by the degree of flexion and extension of the finger worst affected.

2. ACTIVITY OF D.C.

Following operation further activity of the disease can make its appearance in two ways. New pathological tissue can develop within the scene of the preceding operation (recurrence), or contracture tissue can appear in an area originally healthy and with which the operation was not concerned (extension). This new development of contracture tissue can result once again in flexion contracture, and the functional state of the hand deteriorates. It is possible for a band or nodule to be present without causing a contracture and which is therefore overlooked in functional assessment. In the evaluation of results of treatment, activity of the disease must be emphasized, because it is only the rate of activity in relation to the progress to be expected which denotes a real therapeutic influence on the disease.

Finally, a contracture band, functionally insignificant at the time of examination, has the property for potential progress leading to a deterioration of function.

The functional condition of clinical material and its activity rate can be evaluated only if it is considered within the context of the factors in general in which activity and its results depend, these include:

1. The classification of clinical material in relation to its appropriate grade of contracture.

2. The lapse of time since operation or treatment.

The value of a report on the results of treatment is still further enhanced if the findings on two or more examinations carried out within some specified period of time are analysed. In this way a report can be made not only in regard to some specified date but also in regard to the pattern of development.

The anatomical picture of recurrences is significant in two respects. In the first place there is a fundamental difference in the anatomical structure of the tense connective tissue system on the volar aspect of the hand in the area of the palm, and on the volar aspect of the fingers. In the palm the fibrous system is anatomically much better defined than on the fingers where the distribution of fibres is diffuse. There is a difference also in regard to an operation which may eventually be necessary on account of recurrence. The removal of a recurrent nodule on a finger undoubtedly involves a far less extensive undertaking than the reopening of the palm. Information on the anatomical condition of recurrences and extensions is therefore desirable.

On the other hand information on the frequency and types of complications is of less significance in so far as the assessment of long-term results is concerned, because complications which cause a lasting influence on function become apparent in the evaluation of the functional state. As, however, complications not leading to permanent deterioration of function cause a prolonged postoperative disability this factor obviously plays an important part in the comparison between various methods of treatment. Records on the type and frequency of complications should therefore be made.

An attempt will now be made to put into effect the above principles in a group of 395 patients who underwent operation on their hands for D.C. The average time since the date of operation was 4·8 years. As regards operation, four different procedures were employed. As there are frequently confusing reports in the literature regarding precise operation procedures, exact definitions are necessary.

Fasciotomy signifies an open or closed transverse division of a contracture band without removal of the tissue. The immediate postoperative result is as a rule very good, but the entire pathological tissue remains *in situ*.

By *local excision* we mean the excision of the contracture band without extending the operation into neighbouring healthy tissue. The operation is limited to pathological tissue and is believed* to be identical with so-called 'limited fasciectomy' (Hueston, 1963), but we avoid the expression fasciectomy as the ending 'ectomy' in general usage denotes the removal of a structure to which this particular word ending is attached, in this case 'fasci'. In limited fasciectomy, however, the healthy remote parts of the fascia remain

*Wrongly, Ed. (J.T.H.).

where they are and it is closer to a 'partial fasciectomy'.

Fasciectomy means the removal of the palmar fascia with all its processes and indeed not only diseased but also healthy tissue. Fasciectomy can be limited to the ulnar side of the palm, in which case we are dealing with a *partial fasciectomy*. In spite of this transverse limitation, removal of the palmar fascia within the scene of operation is carried out without regard to whether the tissue is diseased or not. Finally fasciectomy can include the whole of the palm. We describe this as *complete fasciectomy*. The expression 'radical' should be avoided, as it has a special connotation in relation to the surgery of tumours, and is out of context in the field of D.C.

Fasciotomy was performed on only 9 of the 395 patients.

In all these 9 hands the postoperative result was very good, and the function of the hand notably improved. In a follow-up of 3 to 5 years eight of the nine hands had deteriorated considerably from a functional point of view, and was the same or even worse than the preoperative status. We soon abandoned this procedure, so that the number of cases has remained small.

The results of the three other procedures are shown in Fig. 8.8. On the left of each column the preoperative
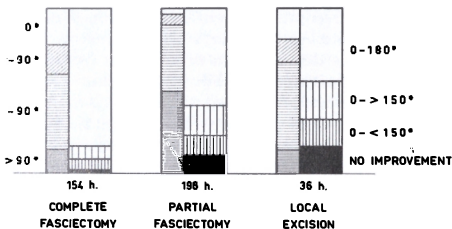
(Stage 'O') and where following operation extension was only possible up to 175°, in other words a deterioration of 5°, must be placed in the fourth group (no improvement or deterioration) and not in the group 0° to 150°. Cases should only be placed in this group if there is an improvement in function.

The figure shows that partial fasciectomy led to more unfavourable clinical results because this group comprised more advanced cases. In spite of this, however, the functional results are better than in the local excision group. The two groups complete fasciectomy and local excision comprise cases with a comparable functional state before operation. The difference in the percentage of unfavourable results is correspondingly marked. It must be emphasized that the immediate postoperative results of these two groups were equally good, and that the difference only emerged over the years during the development of recurrences and extensions. A follow-up a short time after operation would not have recorded the difference.

Figure 8.9 is a summary of the activity rate in the three groups. The left-hand side of the columns shows the rate after three to five years, and the right-hand side after six to twelve years. The development of functional

Figure 8.8
The functional results of three different methods are compared. The mean observation time is 4·8 years. It is equal in the 3 groups of patients. On the left side of each column the functional state before operation is shown.

functional conditions are set out. Four groups are differentiated according to the degree of flexion contracture of the finger worst affected. On the right-hand side the functional states are set out in relation to the follow-up, namely after an average of 4·8 years. Here also there are four different groups. Three of them include all cases with complete flexion and in which there is an improvement in relation to the preoperative condition. They are classified according to the degree of limitation of extension of the worst finger. The fourth group comprises all cases where there is flexion deficiency and cases where the functional condition at the time of follow-up was either the same as the preoperative condition or had become even worse. A hand which before operation had completely normal extension
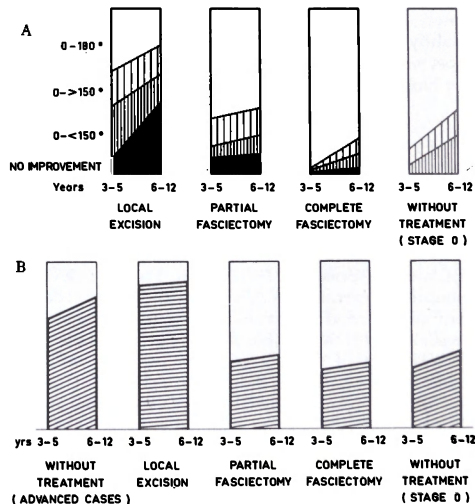

Figure 8.9
Functional state in relation to time of follow up. This figure represents the cases with a follow up of more than 3 years. The functional result after 3 to 5 years and after a follow up of 6 to 12 years is compared to show the progression of the disease from the functional point of view (A).

Rate of activity in relation of time. In Figure 9 B the percentage of cases showing any sign of activity of the disease after 3 to 5 years (left side of each column) and after 6 to 12 years (right side) is represented.

results for the same periods can be read from the shaded parts of each column.

The activity rate of the complete fasciectomy group was 35 per cent after 3 to 5 years and 39 per cent after 6 to 12 years. For the partial fasciectomy groups the corresponding figures are 40 per cent and 44 per cent respectively. If these figures are compared with the untreated cases in stage 'O', for which the corresponding figures are 37 per cent and 46 per cent, the conformity is striking. The activity rate of an untreated group similar to the complete fasciectomy group as regards severity, is found to be 66 per cent for the 3 to 5 year period and 79 per cent for the 6 to 12 year period. The activity rate for an untreated group corresponding to partial fasciectomy grouping must be even higher still. By making use of these two procedures in operation not only was the functional condition of the hands in regard to their eventual condition markedly improved, but the progress of the disease was altered in such a way that the group concerned reverted to stage 'O' and the disease was, so to speak, brought back to the original point from which it started. It is most certainly not to be expected that the disease can be completely extinguished by operation, as we are concerned with a systemic disease and even after very extensive operations sufficient connective tissue is left behind and can become subject to the same pathological change. Reports of successes which reveal either an insignificant or zero percentage of cases with active disease are completely unreliable. The difference in the two groups of complete and partial fasciectomies as regards activity rate is small. It is immediately evident, however, if the anatomical situation regarding persistent D.C. activity is brought into account. The majority of recurrences and extensions following complete fasciectomy occurred in the fingers, only 7·7 per cent being in the palm. Following partial fasciectomy on the other hand, the palm was concerned in 78·6 per cent of the recurrences and extensions. The more extensive operation (complete fasciectomy) could not, admittedly, reduce activity in the finger regions

in relation to the less extensive operation, but does, however, to a large extent prevent recurrence in the palm.

As regards local excision, Figure 8 shows the marked increase in unfavourable results after more than 5 years of observation. But at 86 per cent the activity rate even after 3 to 5 years is very high, though the rise after that is less significant. The activity rate is higher than an assessment for a comparative group of untreated cases in a corresponding analysis structure might be expected, namely 66–79 per cent. It should of course not be forgotten that the number of cases in this group is small, and that the figures read from them are not absolute. Perhaps there would be a smoothing out of the percentage content with an assessment of a larger group. When, however, it became clear, without reference to statistical considerations, that the results in this group would be worse, we immediately discontinued this operative procedure. Although it can be stated that following local excision the condition of the hands was materially improved it was not possible to influence the progress of D.C. On account of the activity which remains, the average improvement declines from year to year. The palm was involved in all recurrences and extensions in this group.

The percentage figures for complications can be seen in Table 1. The frequency of complications is more or less equally distributed over the three groups. A higher incidence was only recorded in regard to haematomata in the complete fasciectomy group, which it was possible to reduce by means of improvement in incisions, a stricter approach to the indications for operation, and by suction drainage.

DISCUSSION

From an evaluation of the results of the above investigation, the following points emerge for discussion:

1. The study of early development of D.C. shows that in the first place there is a pathological change in

TABLE 1 Percentage of complications

	A					B		
	Complete Fasciectomy 51 cases		Partial Fasciectomy 125 cases		Local Excision 31 cases		Complete Fasciectomy 63 cases		Partial Fasciectomy 65 cases
Haematoma	7	7·7 per cent	4	3·1 per cent	1	3·2 per cent	2	3·2 per cent	3	4·5 per cent
Delayed wound healing	11	12·1 per cent	8	6·2 per cent	—			3	4·8 per cent	3	4·35 per cent
Persisting œdema	5	5·5 per cent	6	4·65 per cent	1	3·2 per cent	1	1·6 per cent	2	3·0 per cent
Joint reaction	3	3·2 per cent	2	1·55 per cent	1	3·2 per cent	1	1·6 per cent	1	1·5 per cent
Infection	—		1	0·77 per cent	—		—		1	1·5 per cent

The total number for each complication is counted. As several patients were involved with several complications the total number of complications is higher than the number of patients involved.

A presents the percentage of complications without using suction drainage.

B presents two series of cases operated upon by improved technique; Suction drainage was regularly used and a new skin incision adopted. In advanced cases the complete fasciectomy was not carried out.

the fibre bundles of the tense connective tissue system on the volar aspect of the hand. Cell proliferation then takes place within these fibres already affected. This cell proliferation has been hitherto regarded as the starting point of D.C. The tense connective tissue system of the volar aspect of the hand includes not only the palmar aponeurosis in the strict sense of the term, but all the tense connective tissue rays which are to be found on the volar aspect of the fingers and in the palm. The anatomical arrangement of the individual parts of this system have been the subject of frequent and detailed study, latterly by Stack (1967). A comparative study of the arrangement of the contracture bands among a very large group of patients with D.C. and the arrangement of the fibre bundles of the tense connective tissue system in anatomical specimens present a striking conformity (Millesi, 1959; Stack, 1967). The individual parts of the tense connective tissue system of the volar aspect of the hand are affected in D.C. in varying rates of incidence, in which functional stress would appear to be a predisposing factor. Fundamentally, however, any part may be involved. In patients with a strong tendency to progressive D.C. a large part of the connective tissue system is invaded by the disease in the course of time. From these considerations one must conclude that a prophylactic removal of parts of the tense connective tissue system not yet affected, wherever this is anatomically feasible, in other words over the whole area of the aponeurosis is rational and that this procedure reduces the possibility of further extension of the disease.

2. An analysis of the process of morphological changes reveals the possibility of a phasic development of the disease, as is also clearly recognizable in the clinical field. Following the pathological process in the collagen fibres (fibre thickening during which the actual bundle structure is preserved), cell proliferation commences. The cells mature and produce collagen fibres, no longer arranged from a functional standpoint. The bundle structure is lost, resulting in fibrous tissue with a poor cell count and in which a renewed secondary cell proliferation can develop. The whole process repeats itself. Multiple repetitions appear to be conceivable. A conception such as this in relation to the morphological development provides conformity between the histological picture and the clinical course of the disease. It provides a closely woven background for the clinical observation that D.C. can become active again after many years of inactivity.

3. The comparision between the average clinical and histological pictures leads to the concept of continuing and repeated stages building up into a disease of very many years duration. Cases which manifest histologically a picture of secondary cell proliferation, have a previous history of the disease of more than ten years. Repeated activity of D.C. can accordingly occur after many years. The assumption that the disease in any way comes to an end cannot be justified by any morphological argument. A worthwhile assessment of the disease by means of a single follow-up examination after a relatively short time is therefore not possible. Only a long-term follow-up programme associated with a large mass of clinical material permits conclusion regarding the average progress of the disease, thereby providing a picture with some semblance of reality.

4. The inventory of successes recorded by various authors following treatment of D.C. by various methods discloses markedly contradictory reports. While the sincerity of individual observations is not to be doubted, there must be something wrong with the organization of the system of assessment. If well balanced regard is not paid to the important factors having a marked bearing on the results of a followup programme comparable and objective findings cannot be expected. The time which has elapsed since treatment is one such factor. If D.C., as morphological research has demonstrated, can become active again after ten or more years, only an observation time extending over very many years can give a really clear picture. For purposes of comparison an equally long period of time is called for. The opinion that the majority of recurrences and extensions occur within two years after operation (Hueston, 1963) cannot be confirmed. In our clinical material 48 per cent of recurrences and 44·7 per cent of extensions occurred later than three years after operation. A follow-up after three years would thus have spotted only about half of the cases.

5. A group of 150 hands in Stage 'O' (band or nodule without flexion contracture) was observed, untreated, for some considerable length of time, in order to get an insight into the natural course of the disease. After an observation period of 3 to 5 years 37 per cent of the cases manifested activity of the disease, and 46·5 per cent after 6 to 12 years. For more advanced stages progress was determined on the basis of information on cases with histories of equal duration and in respect of their functional condition. The percentage number of cases manifesting activity (the activity rate) is higher the more advanced the cases are in the clinical material under investigations. The distribution over the various stages of D.C. should be detailed in a follow-up investigation because it is only by this means that the functional results can be properly evaluated.

6. An evaluation of our own clinical material was carried out with the above factors in mind. The immediate postoperative result was predominantly influenced by the severity of the contracture and by the length of time since contracture had commenced, that is to say by the secondary changes in tendons and joints. Complications were distributed evenly over the various procedures of operation. A high rate of haematomata which at first occurred in the complete fasciectomies

was reduced by improvements in technique. The average long-term result was not materially influenced by complications. The functional result gradually deteriorated, over the course of a period of observation of many years, by the appearance of recurrences and extensions. The number of cases manifesting deterioration rose only slowly following partial and complete fasciectomy, but steeply following local excision. The activity rate following complete and partial fasciectomy corresponded approximately to the activity rate of cases in stage 'O', although, preoperatively speaking, the greater part of the clinical material consisted of more advanced cases. On the other hand activity rate following local excision was the same as was to be expected in the preoperative arrangement of the clinical group. Although there was a similar activity rate following partial and complete fasciectomy, it was noticeable that following complete fasciectomy recurrences and extensions occurred almost only in the fingers, whereas following partial fasciectomy the palm was very frequently involved. From these findings one is forced to conclude that long-term results are very much influenced by the method and extent of operation, and that prophylactic removal of originally healthy parts of the palmar aponeurosis contributes to an improvement in the long-term result by reducing the amount of tissue which is potentially liable to pathological changes.

The majority of reports of successes in the literature following treatment of D.C. reveal too short a period of observation. A recent report has appeared, however, on 73 hands (Hakstian, 1966) which had been operated on by Sir Archibald McIndoe using the method introduced by him, namely radical fasciectomy. The period of observation was 11·1 years. The gradual deterioration of the average functional condition, due to the appearance of recurrences and extensions, emerges from the tables prepared by Hakstian. In this clinical material the activity rate amounted to 51 per cent, thus

being not significantly above 46·5 per cent which we were able to establish for a group of cases in stage 'O'. Our group was evaluated between 6 and 12 years after the first examination. The average period of observation is thus lower than Hakstian's. With an exactly similar period of observation our figures would probably be the same as his. The conformity is, however, obvious without reference to the difference in time of observation. The cases which underwent fasciectomy by McIndoe show a progression similar to our fasciectomy cases as characteristic for stage 'O', although, preoperatively, they were for the most part in the more advanced stages. Discussion on the relative merits of fasciectomy and local excision will only have scientific backing when the advocates of local excision can report on this method over eleven years of equally good long-term results.

The fact that Hakstian in his follow-up arrived at the same percentage figures in activity rates is regarded by us as confirmation of our own investigations into the natural course of the disease.

SUMMARY

Investigations into the morphology of early pathological changes in Dupuytren's contracture leads to the author's own presentation. This demonstrates better than previous theories the conformity with the clinical course. The natural course of Dupuytren's contracture is investigated by observations on untreated cases. The conclusions are evaluated for the purpose of improving the system of assessment of postoperative results.

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