

# Prediction of recurrence in the treatment of Dupuytren's disease: Evaluation of a histologic classification

Histologic staging of Dupuytren's lesions into three types is proposed: a proliferative type with high cellularity and mitosis, a fibrocellular type characterized by the presence of a reticulin network, and a fibrous type with few cells. Sixty-three patients (77 hands) who had selective fasciectomy as a primary procedure and whose histologic specimen was available were clinically reviewed for disease recurrence and extension. Twenty-two hands (29%) were free of disease; twenty-five (32%) were free from recurrence but showed an extension, and thirty (39%) had a recurrence. This histologic classification seems to have a prognostic value because the recurrence rate is higher in type I (70%) and lower in type III (18%). The risk of extension did not correlate with the histologic type. (*J HAND SURG* 1989;14A:644-52.)

Jean-Jacques Rombouts, MD, Henri Noël, MD, Yvonne Legrain, MD, and  
Everard Munting, MD, *Brussels, Belgium*

During the last 20 years, the results of surgical treatment of Dupuytren's contracture have been improved by a more rational approach to the disease and by better surgical techniques. This improvement is shown in the early functional results and the rate of operative and postoperative complications.<sup>1-6</sup> Recurrence and extension of the disease remain the unsolved problems, which influence the long-term results.<sup>4, 7-10</sup>

In 1961, Hueston<sup>3</sup> stated that certain features of Dupuytren's disease result in a more aggressive course of the disease as well as a greater tendency for recurrence. These features are an early onset of the disease, bilaterality, a positive family history, and the involvement of other areas. This concept has been tested on a large series of patients in a multicenter study performed by the committee on Dupuytren's disease of the International Federation of Societies for Surgery of the Hand,

which was published by McFarlane<sup>11</sup> in 1985. When all the factors are present, the rate of recurrence or extension is 78%; when all the factors are absent, the rate of recurrence or extension is only 17%. The role of other factors such as sex<sup>12-16</sup> and associated diseases is more controversial.<sup>11, 17</sup> In 1959, Luck<sup>18</sup> divided evolution of the disease into three stages: proliferative, an involutional, and a residual stage. Later, in 1978, Chiu and McFarlane<sup>19</sup> proposed a clinicopathologic staging of Dupuytren's disease integrating morphologic features and the duration of disease activity. It is generally agreed that surgery should be avoided in the early proliferative stage of the disease<sup>8, 20</sup> because a high rate of recurrence and extension may be expected.<sup>3, 7, 8, 12</sup>

Despite the number of morphologic studies of the histology in Dupuytren's lesions,<sup>2, 18, 21-28</sup> no morphologic classification of these lesions has been widely adopted. The prognostic value of the histologic pattern of the pathologic tissue was described in 1941 by Meyerding et al.<sup>2</sup> who found the tissue in cases in which the condition recurred to be relatively immature. By contrast, in 1955, Tubiana<sup>21</sup> wrote that the histologic study undertaken by Nézelof had not given any indication regarding prognosis, since each anatomic section discloses variable histologic appearance. In 1980, Gelberman et al.<sup>29</sup> stated that the risk of recurrence after fasciectomy was related to the electron microscopic findings of myofibroblasts in the nodules and fibroblasts containing prominent microtubules in the fascia of the

From the Department of Surgery, Division of Orthopaedic Surgery and the Department of Pathology of Saint-Luc University Hospital and the University of Louvain (U.C.L.), Brussels, Belgium.

Received for publication Sept. 28, 1987; accepted in revised form July 29, 1988.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

Reprint requests: J. J. Rombouts, Service de Chirurgie Orthopédique, Cliniques Universitaires Saint-Luc, Avenue Hippocrate 10, 1200 Bruxelles, Belgium.

patients. None of the patients who lacked both myofibroblasts and prominent microtubules on electron microscopic studies had a recurrence.

Since 1980, we have adopted a practical morphologic classification of Dupuytren's lesions in studies using conventional optical microscopy.<sup>30</sup> This classification in three stages is based on the conceptions of the disease proposed by Luck<sup>18</sup> and Chiu and McFarlane.<sup>19</sup>

Because electron microscopic study is not routinely available and although the histologic appearance of Dupuytren's tissue varies depending on the site of the biopsies, we evaluated the prognostic value of this classification relating to clinical recurrence following fasciectomy. The results of this anatomoclinical correlation form the basis of this report.

### Materials and methods

We studied retrospectively the records of all the patients operated on at Saint-Luc University Hospital in Brussels for an 8-year period (1976 to 1984). During this time 107 patients had 130 operations; there were 90 men (84.1%) and 17 women (15.9%). We excluded 20 patients who were either operated on previously in another service and were treated on our service for recurrence of the disease (13 patients) or were first operated on by our service and then reoperated elsewhere (2 patients) or patients whose anatomopathologic examination could not be found (5 patients).

The remaining 87 patients were called in for a clinical examination. Of these 87 patients, 11 had died and 13 were not traced or declined to be examined. Thus the study contains 63 patients (77 operations): 9 women (9 operations) and 54 men (68 operations). The average age at the time of surgery was 58 years (range, 32 to 82 years). The interval between the operation and the clinical examination was 5 years and 3 months on average (range, 2 years to 10 years and 7 months). The operations were done with the patients under axillary brachial block anesthesia. The technique used was selective fasciectomy. Dermofasciectomy described by Hueston<sup>31, 32</sup> was not done in this series.

The histologic study was carried out independently, with no information concerning the clinical findings available to the pathologist.

All material surgically removed was fixed in Bouin's fixative, sliced into 3 to 4 mm thick pieces of tissue, and embedded in paraffin. Five to ten slides were taken from each of these specimens and before microscopic examination were stained by the following: hematoxylin and eosin, Giemsa, periodic acid-Schiff, Alcian blue, Perls' Prussian blue, Masson's trichrome, and silver stain for reticulin.

According to Gordon,<sup>33</sup> Millesi,<sup>34, 35</sup> Gelberman et al.<sup>29</sup> and Tonkin et al.,<sup>36</sup> *recurrence* after operation is defined as the appearance of new lesions (bands or nodules) determined by appearance and palpation in an already operated area. In contrast, *extensions* are the appearance of lesions outside the operated area where previously no disease had been detectable. Like Millesi<sup>35</sup> and Tubiana and Leclercq,<sup>10</sup> we considered *total activity* the presence of either a recurrence or an extension or both simultaneously. Care was taken to distinguish from a true recurrence, false recurrences caused by scar contracture, joint contracture, and extrinsic tendon imbalance.<sup>29, 36, 37</sup>

### Clinical staging

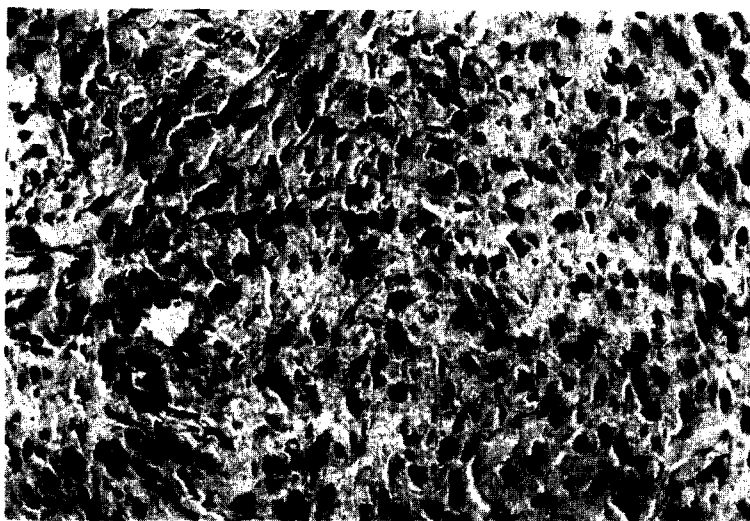
Tubiana et al.'s classification<sup>38, 39</sup> grades the seriousness of the lack of extension of the affected finger(s). Using this classification, no hand was operated on at stage 0, 4 were classified as stage 1, 32 as stage 2, 27 as stage 3, and 14 as stage 4.

We classified our patients in three evolutionary groups on the basis of clinical criteria. This classification resembles that of Chiu and McFarlane.<sup>19</sup> Group 1 (*early disease*) is characterized by the presence of nodules in the absence of retraction. Group 2 (*active disease*) is characterized by increasing retraction. Although frequent, the presence of clinically detectable nodules is not required as in McFarlane's classification.<sup>19</sup> Group 3 (*advanced disease*) is characterized by a long-standing condition that has not worsened during recent months. At the time of operation, only one hand was classified in group 1, 66 were in group 2, and 10 in group 3.

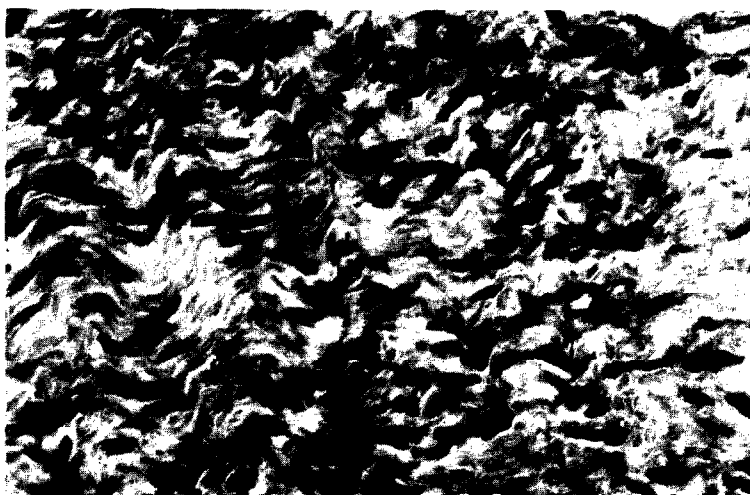
### Histologic staging

An attempt at *histologic staging* had been developed and used for 8 years<sup>30</sup> in a classification grouping the lesions under three types. Such a classification was inspired by the work of Luck<sup>18</sup> and Gokel and Hübner<sup>25</sup> who suggested that Dupuytren's disease progresses from a proliferative stage through an involutional phase to a residual stage of contracture. Biochemical studies<sup>29, 40, 41</sup> have shown that in its active phases, Dupuytren's disease is characterized by an overproduction of type III collagen, which is known to correspond mainly to reticulin fibers.

General experience resulting from the microscopic analysis of many specimens shows that all three classes of these authors may be found simultaneously in a good proportion of the cases. There is a need to choose clear-cut histologic criteria allowing a separation between these three stages.



**Fig. 1.** Type I or proliferative stage. A mitotic figure is present at the center of the picture. (Hematoxylin and eosin stain; original magnification  $\times 640$ ).



**Fig. 2.** Type II or fibrocellular stage. (Hematoxylin and eosin stain; original magnification  $\times 640$ ).

The presence or absence of mitotic figures in the cellular nodules is the criterion for separating the stage (I) of proliferation and the stage (II) of involution. A problem in classification arises when grading the activity of the cellular nodules. When grading the fibrous cords, in which more or less cellular areas can still be found, the involutional stage (II) is distinguished from the residual stage (III) by the persistence or the complete disappearance of stainable reticulin fibers. Indeed, the change from one stage to the other implies a difference in the stage of maturation of the collagen, resulting from a different cellular activity.

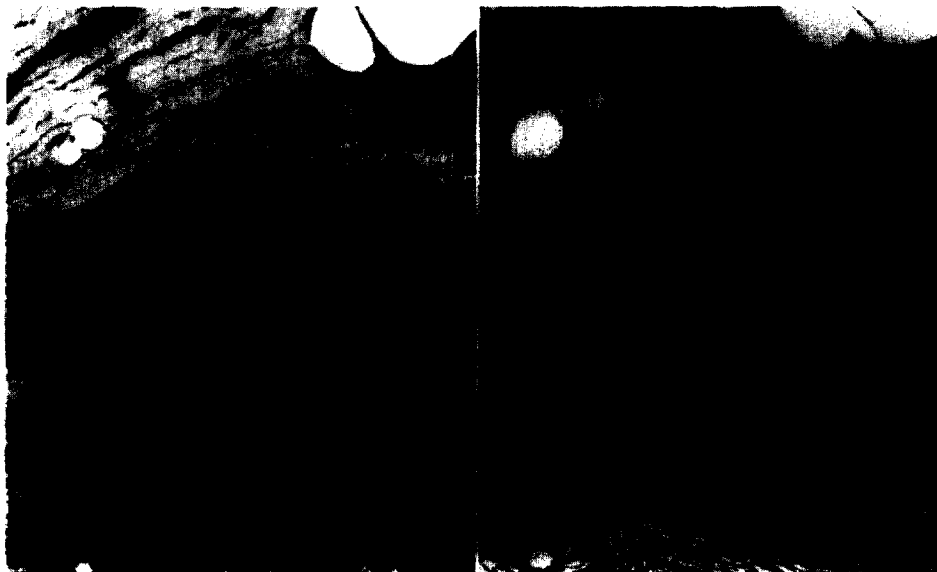
**Type I or proliferative stage.** All the lesions in this

type show the presence of mitotic figures. These mitoses are always regular in shape and are quite rare in most cases, requiring a careful search. This is best achieved on slides stained with Giemsa; the individual chromosomes appear more neatly than in the hematoxylin and eosin preparation. The mitotic figures are found only in very cellular areas in which the cells have mostly round to oval nuclei with visible nucleoli and more or less basophilic cytoplasm (Fig. 1).

**Type II or fibrocellular stage.** This type is characterized by a high cellularity but has no mitotic figures. The presence or the absence of mitoses is thus used as a differential criterion between types I and II. The nuclei



**Fig. 3.** Type III or fibrotic stage. (Hematoxylin and eosin stain; original magnification  $\times 640$ ).



**Fig. 4.** To illustrate the solution of a differential diagnostic problem between type II and III, two slides, one stained with periodic acid-Schiff (A) and the other for reticulin (B) were photographed using magnification  $\times 500$ . The presence of a dense network of reticulin fibers seen in B corresponds to a more cellular area, as seen in A, demonstrating the fibrocellular character of this area, characteristic of type II and classified as such. The area above this is of a fibrotic type, with dense fibrous material containing no reticulin fibers.

are mostly elongated with a vermicular shape; the interstitial material is abundant between the cells, formed mainly by wavy collagen fibers (Fig. 2). Silver stain always shows a dense reticulin network in the more cellular areas, in contrast to the areas with reduced cellularity and abundant collagen fibrosis where no more reticulin fibers can be seen.

**Type III or fibrotic stage.** At this stage the fibrous cords only rarely contain cells with elongated dense nuclei separated by broad bundles of collagen fibers of the hyaline type (Fig. 3). The differential criterion between type II and type III is the presence or absence of reticulin fibers except around vessels or appendages, demonstrated by the appropriate silver stain (Fig. 4).



**Table I.** Disease state related to follow-up time

Follow-up time	Hands free of disease		Hands with recurrences		Hands with extensions without recurrence		Total activity	
	No.	%	No.	%	No.	%	No.	%
2 to 4 years	7/32	22	15/32	47	10/32	31	25/32	78
4 to 6 years	7/20	35	6/20	30	7/20	35	13/20	65
6 to 8 years	3/10	30	4/10	40	3/10	30	7/10	70
More than 8 years	5/15	33.3	5/15	33.3	5/15	33.3	10/15	66.6
Whole series	22/77	29	30/77	39	25/77	32	55/77	71

No significant difference among the four groups.

**Table II.** Disease recurrence and histologic type

Histologic type	Hands free of disease	Hands with recurrences	Hands with extensions without recurrence	Total activity
Type I	2/13 15 ± 10%	9/13 70 ± 13%	2/13 15 ± 10%	11/13 85 ± 10%
Type II	9/42 21 ± 6%	17/42 41 ± 8%	16/42 38 ± 7%	33/42 79 ± 6%
Type III	11/22 50 ± 11%	4/22 18 ± 8%	7/22 32 ± 10%	11/22 50 ± 11%

NS, Not significant.

In most cases, an exhaustive examination of all the removed material reveals more than one histologic type. The lowest grade found defines the stage in each case (Fig. 4). According to these criteria, 13 specimens in our study were classified as histologic type I, 42 as type II, and 22 as type III.

### Statistical analysis

We studied the relationships between the long-term results expressed in four groups (free of disease, extension, recurrence, extension and recurrence) and the following factors: length of follow-up, age, sex, clinical stage according to Tubiana,<sup>38, 39</sup> evolutionary group,<sup>19</sup> histologic staging, bilaterality of the disease, family history, association with ectopic localization, history of trauma, occurrence of perioperative and postoperative complications and handedness. The data are expressed in frequencies (percentage) and therefore have been analyzed using the contingency table method (chi-square tests). When a significant dependence between long-term results and a particular factor is found ( $p < 0.05$ ), the frequencies are compared  $2 \times 2$  to establish the origin of the dependence. The standard deviations of the frequencies are given (if needed) and

calculated as  $Vp(1 - p)/n$  where  $p$  is the frequency and  $n$  is the number of patients.

### Results

At the clinical review, 22 hands (29%) were found free from recurrence and extension, 25 (32%) were free from recurrence but showed an extension of the disease, 30 (39%) had a recurrence, and 27 were associated with an extension of the disease. Among the 30 patients with recurrences, 10 subjectively considered that their operation had been worthwhile. Most of them had not even noticed the recurrence. Of the other 20 patients with recurrences, 13 were still improved when compared with the preoperative state, 1 returned to the preoperative state, and 6 had worsened.

Table I shows the extent of extension and/or recurrence compared with the follow-up since the operation. The cases are classified in four groups by elapsed time (2 to 4 years, 4 to 6 years, 6 to 8 years, and >8 years). No significant difference was found among the four groups. Moreover, there was no correlation between the long-term results observed on both hands of the same patient.

Table II shows the degree of extension and/or re-

**Table III.** Age and histologic staging

Histologic type	Hands free of disease		Recurrences		Extensions without recurrence		Total activity*	
	No.	%	No.	%	No.	%	No.	%
<i>Under 60 years of age</i>								
Type I	0/7	0	6/7	86	1/7	14	7/7	100
Type II	1/28	4	13/28	46	14/28	50	27/28	96
Type III	6/13	46	4/13	31	3/13	23	7/13	54
	7/48	15	23/48	48	18/48	37	41/48	85
<i>Over sixty years of age</i>								
Type I	2/6	33	3/6	50	1/6	17	4/6	67
Type II	8/14	57	4/14	29	2/14	14	6/14	43
Type III	5/9	56	0/9	0	4/9	44	4/9	44
	15/29	52	7/29	24	7/29	24	14/29	48

\*No statistical analysis was possible because of the small number of cases.

**Table IV.** Influence of age on disease outcome after surgery

Patient's age	Hands free of disease	Hands with recurrences	Hands with extensions without recurrence	Total activity
Under 60 years	7/48 15 ± 5%	23/48 48 ± 8%	18/48 37 ± 7%	41/48 85 ± 5%
Over 60 years	15/29 52% ± 10%	7/29 24 ± 9%	7/29 24 ± 9%	14/29 48 ± 10%

NS, Not significant.

currence compared with the histologic type. Among the 13 cases classified as type I, only 2 hands were clear of the disease at review, 9 showed recurrences, and there were 2 cases of extension [total activity rate, 11 out of 13 (85%)]. Forty-two cases were classified as type II. In this group, 9 hands (21%) were free of the disease, 17 (41%) showed a recurrence, 16 (38%) an extension [total activity rate, 33 out of 42 (79%)]. Twenty-two (22) cases were classified as type III. In this group, 11 hands (50%) were clear of disease, 4 (18%) showed a recurrence and 7 (32%) an extension. The total activity rate was 11 out of 22 (50%).

Statistical analysis showed a relationship between histologic staging and the results ( $p < 0.05$ ). There is a significant difference of recurrence between type I and type III ( $p < 0.01$ ) and type II and type III ( $p < 0.05$ ). There is no significant difference between type I and type II ( $p < 0.1$ ) when extension is considered. Concerning total activity, there is a significant difference between type I and type III and between type II and type III ( $p < 0.05$ ).

No statistical analysis of the simultaneous influence

of both age and histologic staging (Table III) was performed because of the limited number of cases in the different groups. However, the combined influence of age under 60 and type I should be noticed (86% recurrence) as well as the absence of recurrence in patients older than 60 years with histologic type III.

Independent of the histologic staging, patients under sixty years of age at time of operation are at a significantly higher risk for recurrence ( $p < 0.05$ ) (Table IV).

There were only four hands in patients presenting with all four criteria of Hueston's diathesis (early onset of the disease, bilaterality, positive family history, and involvement of other areas). They were classified in histologic group II; all showed extension of the disease without recurrence.

Statistical analysis of the prognostic value of the clinical stage is not possible because most of the hands belonged to group 2 (66) and only 11 out of 77 were classified in groups 1 (1) and 3 (10). The same is true concerning diathesis (4 out 77), sex (9 out 77), and associated diseases (3 out 77). When considered alone,

the dominant hand, unilateral or bilateral affection, perioperative and postoperative complications, ectopic localization, and history of trauma had no significant prognostic value concerning recurrence or/and extension.

### Discussion

Gordon<sup>33</sup> and Hueston<sup>7, 31</sup> found that the majority of recurrences after surgery for Dupuytren's disease appear early (87% within 2 years in Hueston's series). On the contrary, Millesi<sup>34, 35</sup> claimed that 48% of recurrences in his series occurred more than 3 years postoperatively. Our findings (Table I) confirm that the rate of recurrences can be correctly judged after a 2-year follow-up.

Comparison of the results of our preliminary studies done by a questionnaire<sup>42</sup> with the data of the present clinical review shows a considerable difference between the subjective and objective evaluation of the results of this operation. Patients overlook minor recurrences and extension, the majority of which were without contracture. Few series of selective fasciectomy<sup>4, 7-10</sup> have been reviewed clinically with an adequate follow-up. In 1963, Hueston<sup>7</sup> personally reexamined 224 patients. The time lag that separated this examination from operation was variable. He found 62 recurrences (27.6%) and 56 extensions (25.6%); 106 patients (47.3%) were clear of the disease. Recurrences and extensions are obviously more frequent in young patients with ectopic localizations such as knuckle pads. He also remarked that the prognosis of the small finger is poorer. In 1966, Hakstian<sup>4</sup> reexamined in detail 51 patients (73 hands) whose initial operation had been done by Sir Archibald McIndoe 5 to 25 years previously. Redevelopment of the disease was evident in 37 hands (51%); 25 (34%) showed recurrences and 24 (33%) extensions. Of these cases 18 (25%) required secondary surgery and 6 (8%) a third surgical procedure. Redevelopment of the disease was much more common in patients with bilateral disease than those with unilateral involvement. In 1971, Honner et al.<sup>8</sup> reexamined 108 patients (138 hands), from 1 to 9 years after operation. They discovered 56 (41%) recurrences; 19 (13%) required a new operation, and 28 (20%) had extensions. In 1976, Rodrigo et al.<sup>9</sup> reexamined 112 hands more than 2 years after operation. Of the 65 hands treated by subtotal fasciectomy, 41 (63%) had developed recurrences; of the 47 hands that had fasciotomy, all showed some recurrence, with 15% secondary procedures in the first series and 43% in the fasciotomy series.

In 1985, Tubiana and Leclercq<sup>10</sup> presented long-term results (average follow-up, 10 years) for 38 patients (50

hands) operated on by Tubiana between 1970 and 1976. Recurrences were noted in 33 hands (66%), with extensions in 23 hands (46%). Extension alone was seen in 8 cases (16%), raising the overall extension rate to 62% and the total activity rate to 82%. These authors emphasized the poorer prognosis in women, young patients, patients with ectopic lesions, associated disease, family history, and small finger involvement. Recurrence was more frequent in patients with more severe deformities and incomplete correction of the contracture of a proximal interphalangeal joint.

Our figures (39% recurrences, 71% total activity, and only 29% of the hands free of the disease at follow-up) are similar to those of Honner et al.<sup>8</sup>

In the early 1960s, Hueston<sup>3, 43</sup> showed that a radical prophylactic clearance of the palm does not give better long-term results than limited fasciectomy at the price of a higher rate of complication. The open palm method described by McCash in 1964<sup>44</sup> has advantages in the early management of these patients. However, the long-term follow-up studies of Schneider et al.<sup>45</sup> revealed a rate of recurrence (32%) and extension (48%) similar to that of regional fasciectomy. Recurrences after surgical excision of Dupuytren's contracture are reduced by replacing the overlying skin with a graft from another area.<sup>31, 33, 46, 47</sup> The Derby study of 1984<sup>36</sup> confirms that skin excision and replacement after fasciectomy prevent any appreciable recurrence of Dupuytren's tissue in this area.

Recently, there has been a trend toward a more conservative approach to the disease. Gonzales<sup>48</sup> and Ketchum and Hixson<sup>49</sup> resurfaced with a full-thickness graft only the defects created by releasing contracture, leaving the nodules alone. Thurston<sup>50</sup> carries out a Z-plastic release of Dupuytren's contracture without fasciectomy. Moermans and Duchateau<sup>51</sup> and Rowley et al.<sup>52</sup> suggest that partial staged fasciectomy or even percutaneous fasciotomy may be of value in selected cases. The former authors,<sup>48, 49</sup> have shown very low rates of recurrences. The latter series<sup>50-52</sup> includes a limited number of patients and the follow-up is still short. However, it now seems obvious that the surgical treatment of Dupuytren's contracture cannot be restricted to one procedure alone and that the selection of the patients is an important part of the therapeutic approach to this disease.

Our classification of the lesions into three histologic types draws its inspiration from concepts expressed by Luck in 1959<sup>18</sup> and specified by Chiu and McFarlane in 1978.<sup>19</sup> Dupuytren's disease is an active cellular process that consists of the proliferation of fibroblasts and the production of collagen.<sup>52</sup> The evolution of the dis-

ease can be considered in three stages: the proliferative, involutional, and residual stages.<sup>18</sup> Chiu and McFarlane<sup>19</sup> wrote that the cell of the early stage is the fibroblast, that of the active or involutional stage is the myofibroblast, and that of the advanced or residual stage is the fibrocyte. Nonetheless, the identification of myofibroblasts requires an electron microscope.<sup>25, 26, 53</sup> The systematic observation of many sections of the Dupuytren's disease has led one of us (H.N.) to develop a practical classification based on simple criteria that can be used routinely with conventional microscopy by any pathologist. Histologic type I corresponds to the proliferative phase and is characterized by the presence of mitosis. Histologic type II, called "fibrocellular," is characterized by the presence of wavy collagen fibers and a dense reticular network on silver stain. Type III or the fibrotic type is paucicellular and no longer contains a network of reticulin fibers. It is well known that the histologic appearance of Dupuytren's tissue varies on biopsy location.<sup>18, 19, 21, 28</sup> Our proposed histologic staging is based on the systematic examination of all the material surgically removed, which is sliced into 3 to 4 mm thick pieces of tissue. Slides of each of these blocks are examined. The criteria that allow a separation between the three stages are clear and easy to identify. The pathologic stage is defined by the lowest observed grade.

It appears from the statistical analysis of our data that there is a significant relationship between the histologic classification and the recurrence rate, which is higher in type I ( $70\% \pm 13\%$ ) and lower in type III ( $18\% \pm 8\%$ ). The risk of extension was not related to the histologic types. As suggested by Luck<sup>18</sup>, Chiu and McFarlane,<sup>19</sup> and Nézelof,<sup>28</sup> it is tempting to consider that the three histologic types represent three evolutionary stages of the disease. Nevertheless, our clinical material did not enable us to establish a correlation between the evolutionary clinical group and the histologic type because 66 of the 77 hands were in the evolutionary group 2 according to the classification by Chiu and McFarlane.<sup>19</sup> There is also no clear difference between the histologic types observed in the different age groups. Our data do confirm that the risk of recurrence and of extension is higher in the young age group.

The authors thank Bernadette Govaerts for the statistical analysis and Laurence Martin for the translation of the manuscript.

## REFERENCES

1. Davis AA. The treatment of Dupuytren's contracture. A review of 31 cases, with an assessment of the comparative value of different methods of treatment. *Br J Surg* 1932;19:539-47.
2. Meyerding HW, Black JR, Broders AC. The etiology and pathology of Dupuytren's contracture. *Surg Gynecol Obstet* 1941;72:582-90.
3. Hueston JT. Limited fasciectomy for Dupuytren's contracture. *Plast Reconstr Surg* 1961;27:569-85.
4. Hakstian RW. Long-term results of extensive fasciectomy. *Br J Plast Surg* 1966;19:140-9.
5. Tubiana R, Thomine JM, Brown S. Complications in surgery of Dupuytren's contracture. *Plast Reconstr Surg* 1967;39:603-12.
6. Hueston JT, Tubiana R. Dupuytren's disease. GEM Monograph. Edinburgh, London, Melbourne, and New York: Churchill Livingstone, 1985:129-210.
7. Hueston JT. Recurrent Dupuytren's contracture. *Plast Reconstr Surg* 1963;31:66-9.
8. Honner R, Lamb DW, James JIP. Dupuytren's contracture. Long term results after fasciectomy. *J Bone Joint Surg* 1971;53B:240-6.
9. Rodrigo JJ, Niebauer JJ, Brown RL, Doyle JR. Treatment of Dupuytren's contracture: Long-term results after fasciotomy and fascial excision. *J Bone Joint Surg* 1976;58A:380-7.
10. Tubiana R, Leclercq C. Recurrent Dupuytren's disease. In: Hueston JT, Tubiana R. Dupuytren's disease. GEM Monograph. New York: Churchill Livingstone, 1985: 200-3.
11. McFarlane RM. Some observations on the epidemiology of Dupuytren's disease. In: Hueston JT, Tubiana R. Dupuytren's disease. GEM Monograph. New York: Churchill Livingstone, 1985:122-6.
12. Hueston JT. Dupuytren's contracture: The trend to conservatism. *Ann R Coll Surg Engl* 1965;36:134-51.
13. Wallace AF. Dupuytren's contracture in Women. *Br J Plast Surg* 1965;18:385-6.
14. Carr TL. Local radical fasciectomy for Dupuytren's contracture. *Hand* 1974;6:40-9.
15. Mikkelsen OA. Dupuytren's disease—Initial symptoms, age of onset and spontaneous course. *Hand* 1977;9: 11-5.
16. Zemel NP, Balcomb TV, Stark HH, Ashworth CR, Rickard TA, Anderson DR, Hull DB. Dupuytren's disease in women: Evaluation of long-term results after operation. *J HAND SURG* 1987;12A:1012-16.
17. Legge JWH, McFarlane RM. Prediction of results of treatment of Dupuytren's disease. *J HAND SURG* 1980; 5:608-16.
18. Luck JV. Dupuytren's contracture. A new concept of the pathogenesis correlated with surgical management. *J Bone Joint Surg* 1959;41A:635-64.
19. Chiu HF, McFarlane RM. Pathogenesis of Dupuytren's contracture: A correlative clinical-pathological study. *J HAND SURG* 1978;3:1-10.
20. McFarlane RM, Jamieson WG. Dupuytren's contracture: The management of one hundred patients. *J Bone Joint Surg* 1966;48A:1095-1105.



21. Tubiana R. Prognosis and treatment of Dupuytren's contracture. *J Bone Joint Surg* 1955;37A:1155-68.
22. Lagier R, Rutishauser E. Anatomie pathologique et pathogénie de la maladie de Dupuytren. *Presse Méd* 1956; 64:1212-16.
23. MacCallum P, Hueston JT. The pathology of Dupuytren's contracture. *Aust N Z J Surg* 1962;31:241-53.
24. Nézelof C. Maladie de Dupuytren. Aspects histologiques. In: Bruner JM, Curtis RM, Gosset J, et al. *Maladie de Dupuytren*. GEM. Paris: Expansion scientifique française, 1966:37-41.
25. Gokel JM, Hübner G. Occurrence of myofibroblasts in the different phases of morbus Dupuytren (Dupuytren's contracture). *Beitr Path* 1977;161:166-75.
26. Martini AK, Puhl W. Mikromorphologische Untersuchungen bei Morbus Dupuytren. *Z Orthop* 1980;118: 291-9.
27. Gabbiani G, Montandon D. The myofibroblasts in Dupuytren's disease and other fibromatoses. In: Hueston JT, Tubiana R, *Dupuytren's disease*. GEM Monograph. New York: Churchill Livingstone, 1985:86-93.
28. Nézelof C. Histological aspects of Dupuytren's disease. In: *Dupuytren's disease*. GEM Monograph. New York: Churchill Livingstone, 1985:82-5.
29. Gelberman RH, Amiel D, Rudolph RM, Vance RM. Dupuytren's contracture. An electron microscopic, biochemical and clinical correlative study. *J Bone Joint Surg* 1980;62A:425-32.
30. Noël H, Wayllace L. Histopathologie de la maladie de Dupuytren. Presented at the Winter Meeting of the Belgian Hand Group. Charleroi, Belgium, January 16th, 1982 (unpublished data).
31. Hueston JT. Digital Wolfe graft in recurrent Dupuytren's contracture. *Plast Reconstr Surg* 1962;29:342-44.
32. Hueston JT. The control of recurrent Dupuytren's contracture by skin replacement. *Br J Plast Surg* 1969; 22:152-156.
33. Gordon S. Dupuytren's contracture: Recurrence and extension following surgical treatment. *Br J Plast Surg* 1957;9:286-288.
34. Millesi H. The clinical and morphological course of Dupuytren's disease. In: Bruner JM, Curtis RM, Gosset J, et al. *Maladie de Dupuytren*. GEM. Paris: Expansion scientifique française, 1966:47-67.
35. Millesi H. The clinical and morphological course of Dupuytren's disease. In: *Dupuytren's disease*, Hueston JT, Tubiana R, eds. Edinburgh and London: Churchill Livingstone, 1974:46-60.
36. Tonkin MA, Burke FD, Varian JPW. Dupuytren's contracture: A comparative study of fasciectomy and dermofasciectomy in one hundred patients. *J HAND SURG* 1984;9B:156-162.
37. Hill NA. Dupuytren's contracture. Current concepts review. *J Bone Joint Surg* 1985;67A:1439-43.
38. Tubiana R, Michon J, Thomine JM. Evaluation chiffrée des déformations dans la maladie de Dupuytren. In: Bruner JM, Curtis RM, Gosset J, et al. *Maladie de Dupuytren*. GEM. Paris: Expansion scientifique française, 1966:43-46.
39. Tubiana R. Evaluation des déformations dans la maladie de Dupuytren. Evaluation of deformities in Dupuytren's disease. *Ann Chir Main* 1986;5:5-11.
40. Bazin S, Le Lous M, Duance VC, Sims TJ, Bailey AJ, Gabbiani G, D'Andiran G, Pizzolato G, Browski A, Nicoletis C, Delaunay A. Biochemistry and histology of the connective tissue of Dupuytren's disease lesions. *Eur J Clin Invest* 1980;10:9-16.
41. Brickley-Parsons D, Glimcher MJ, Smith RJ, Albin R, Adams JP. Biochemical changes in the collagen of the palmar fascia in the patients with Dupuytren's disease. *J Bone Joint Surg* 1981;63A:787-97.
42. Rombouts JJ, Munting E. Revue d'une série de 75 interventions pour maladie de Dupuytren. Presented at the Winter Meeting of the Belgian Hand Group. Charleroi, Belgium, January 16th, 1982 (unpublished data).
43. Hueston JT. Dupuytren's contracture: the trend to conservatism. *Ann R Coll Surg* 1965;26:134-51.
44. McCash CR. The open palm technique in Dupuytren's contracture. *Br J Plast Surg* 1964;17:271-80.
45. Schneider LH, Hankin FM, Eisenberg T. Surgery of Dupuytren's disease: A review of the open palm method. *J HAND SURG* 1986;11A:23-27.
46. Hueston JT. The control of recurrent Dupuytren's contracture by skin replacement. *Br J Plast Surg* 1969; 22:152-6.
47. Gonzales RI. Open fasciotomy and full thickness skin graft in the correction of digital flexion deformity. In: Hueston JT, Tubiana R. *Dupuytren's disease*. Edinburgh and London: Churchill Livingstone, 1974:123-27.
48. Gonzales RI. The use of skin grafts in the treatment of Dupuytren's contracture. *Hand Clin* 1985;1:641-47.
49. Ketchum LD, Hixson FP. Dermofasciectomy and full-thickness graft in the treatment of Dupuytren's contracture. *J HAND SURG* 1987;12A:659-63.
50. Thurston AJ. Conservative surgery for Dupuytren's contracture. *J HAND SURG* 1987;12B:329-34.
51. Moermans JP, Duchateau J. La maladie de Dupuytren: résultats d'une technique simplifiée. *Rev Méd Brux* 1984;5:467-71.
52. Rowley DI, Couch M, Chesney RB, Norris SH. Assessment of percutaneous fasciotomy in the management of Dupuytren's contracture. *J HAND SURG* 1984;9B: 163-4.
53. McFarlane RM. The current status of Dupuytren's disease. *J HAND SURG* 1983;8:703-7.