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ORIGINAL ARTICLE

Improved postoperative outcome of segmental fasciectomy in Dupuytren disease by insertion of an absorbable cellulose implant

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Abstract

In this case-control prospective study, we investigated if we could improve the surgical outcome of interrupting strands in Dupuytren disease by creating a blocking effect with an absorbable cellulose implant, a known absorbable adhesion barrier. We studied 33 operations in 29 patients who had the potential for recurrent disease. The cellulose was implanted in the first 15 patients. An intraindividual control was added in 4 patients, who were given the implant in 1 of 2 operated hands. Goniometric evolution was monitored on digital photography, and satisfaction was measured on a visual analogue scale (VAS) with a preliminary one year follow-up. With the implant the postoperative range of movement improved significantly (by 33%) and remained unchanged after three months to a one year follow-up. The VAS for satisfaction also improved. We conclude that cellulose implants may improve the outcome of segmental fasciectomy in Dupuytren disease by achieving a better extension of fingers and a higher patients' satisfaction.

Key Words: *Dupuytren's disease, segmental, fasciectomy, outcome*

Introduction

In Dupuytren disease, the objective of operation is to correct the disabling contractures of the fingers. Once full extension of the fingers is achieved, the main concern is to preserve this mobility during the postoperative period. A second operation should be avoided because operative risks in operation for recurrence are higher and results are poorer, with even a risk of amputation [1–5]. However, Dupuytren disease is not curable. Bulstrode et al. even suggested that recurrence of the contractures is likely if only the patient lives long enough [6,7]. Yet, in patients with a likelihood of Dupuytren disease, recurrence can occur rapidly within months or even weeks after the operation, at times widespread [8].

Numerous surgical techniques have been used for Dupuytren disease, ranging from minimally invasive surgery to subtotal preaxial amputation with skin grafting [9–11]. Segmental fasciectomy has the advantages of low postoperative morbidity and short rehabilitation [1]. Although not all of the affected tissue is removed by this technique, recurrence is no higher than with more invasive surgery.

Cellulose is known to be an adhesion barrier, which is used in infertility surgery and adhesiolysis of tendons in hand surgery [12,13]. Because the strands in Dupuytren disease consist of fibroproliferative tissue, we hypothesised that cellulose implants could possibly prevent recurrent contractures after interruption of segmental strands.

We therefore initiated a one centre prospective case-control study to find out if the short term outcome of interruptions of the strands can be improved by intensifying the effect with an absorbable cellulose

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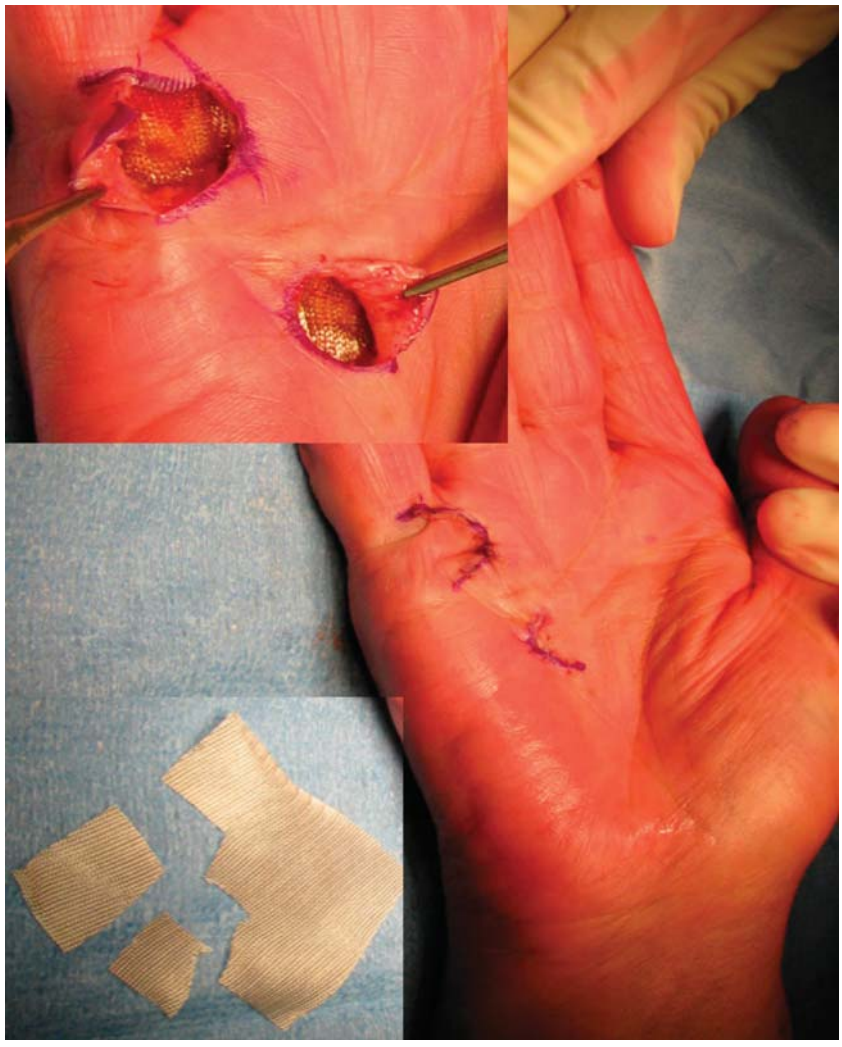

Figure 1. After resection of segmental strands that results in full extension of the finger in case 15 the absorbable cellulose is implanted. Intraoperative pictures show the augmentation with a single layer cellulose implant (upper corner inlay), sized to fit (lower corner inlay) the surgically created defects.

implant in patients with a high probability of recurrent disease.

Patients and methods

The single centre study was approved by the institute's ethics board. We included 29 patients who presented to our department requiring correction of Dupuytren contracture in a hand that had never been operated on before. All patients had multiple risk factors and were scored by Abe et al. with 1 point (fifth finger, age of onset under 50, bilateral disease) or 2 points (radial involvement, knuckle pads, plantar fibrosis, or Ledderhose syndrome) [8]. The familial occurrence of Dupuytren disease was noted, as it is also thought to be important in Dupuytren disease [11].

Fifteen cellulose implants were used (Divide© Johnson & Johnson). The first 15 patients were treated with the implant. In 4 cases, bilateral operations were planned. They were informed of the implant only six months after the first hand had been operated on and the second hand was listed for operation. These 4 patients therefore served as intraindividual controls.

After the 15 cellulose implants had been used, the next 14 patients had segmental fasciectomy without an implant. The patients who had the implant were informed and consented to be included in the study, the patients who had no implant were informed about an intensive follow-up for academic reasons, but did not know about the implant option to avoid disappointment, possibly compromising outcome.

In all patients, minimal invasive surgery was proposed, using mini-incisions [10]. The strands

were explored through small semicircular skin incisions. Strands were interrupted by removing small parts approximately 1 cm long until a full correction of the finger contracture had been achieved (Figures 1, 2). After careful haemostasis the cellulose implant was placed in a horizontal single layer technique. Absorbable 5/0 polyglactin 910 (Vicryl) sutures were used to close the skin. All patients had a similar postoperative regimen, with a light pressure dressing for four days. After this a small bandage was applied under a custom-made extension splint to extend the operated fingers to prevent reformation of the cord while the finger was flexed in the resting position [10]. The first four weeks the patients had to wear the splint 2-hours-on, 2-hours-off. They were advised to exercise their fingers when it was off. For eight weeks they wore the splint continuously during the night. After this, the splint was discontinued.

The first 15 patients were given an implant to interpose between the fingers after the limited fasciectomy [10]. Within this group, four patients were included as an intraindividual control. Another 14 patients were included in the control group without an implant. Outcome was monitored with the help of standard digital photography of maximal extension of the finger before the operation, immediately after (on the table) and after three months, and six months and one year later [3,14,15]. Goniometric measurements were made in a blinded fashion at the end of the study. Special attention was given to wound problems, stiffness, and satisfaction. To simplify comparisons, contractures were measured in both the metacarpophalangeal and proximal interphalangeal joints of the most severely contracted ray, even if two rays were operated on. The Thomine correction coefficient as introduced by Tubiana et al. was used to compare the relative goniometric correction/ray [16].

To evaluate patients' satisfaction, a 10-point graded visual analogue scale (VAS) was used before and after the operation.

The Wilcoxon two sample test was used for statistical analysis and probabilities of less than 0.05 were accepted as significant.

Results

No patient was lost to follow-up. The comparisons of the groups are shown in Tables I and II. Although most patients had involvement of multiple rays, only one or two rays were operated on because of their lack of extension.

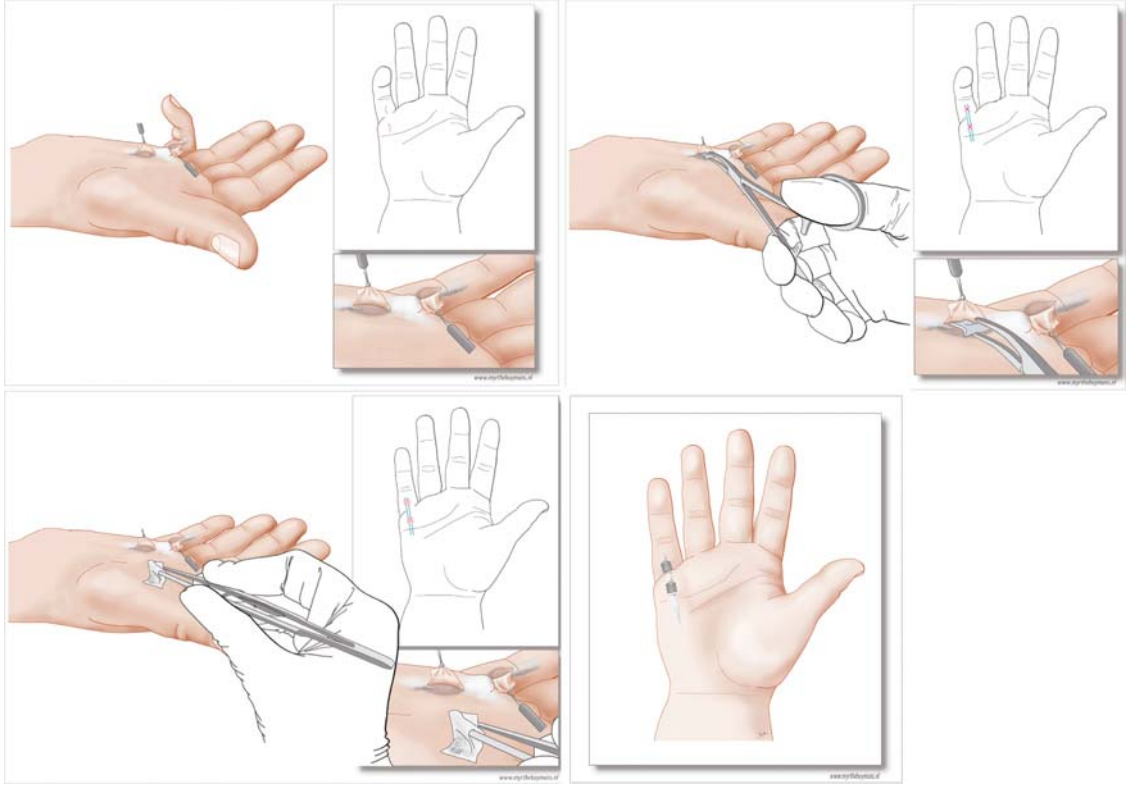

Figure 2. Diagram of the surgical technique in the fifth digit: after segmental resection of the strand that results in full extension of the finger the absorbable cellulose is implanted to interrupt the fibroproliferative strands mechanically.

Table I. Group 1 with the cellulose implant: clinical and personal details.

Case No.	Age (years)	Sex	Side	Right rays	Left rays	Abe	Bil	50	5th	LH	KP	1st	Fam
1	58	M	L	1,4,5	1,2,4,5	5	1	1	1	0	0	2	1
2	71	M	R	1,2,4,5	3,4,5	8	1	0	1	2	2	2	0
3	67	M	R	3,4,5	1,4,5	5	1	1	1	0	0	2	0
4	67	M	L	3,4	4,5	5	1	1	1	0	2	0	0
5	46	M	R	3,4,5	1,2,3	7	1	1	1	0	2	2	0
6	78	M	R	4,5	5	4	1	0	1	0	2	0	1
7	54	M	R	5	5	5	1	1	1	0	2	0	0
8	65	M	R	1,3,4,5	3,4	5	1	1	1	0	0	2	0
9	64	M	L	1,5	1,5	6	1	0	1	2	0	2	1
10	74	M	L	3,4,5	4,5	4	1	0	1	0	2	0	0
11	59	M	R	5	5	7	1	1	1	0	2	2	0
12	67	M	L	5	4,5	2	1	0	1	0	0	0	0
13	81	M	R	3,4	4	2	1	0	1	0	0	0	0
14	61	F	R	3,4	3,4	4	1	1	0	2	0	0	1
15	69	F	R	3,4,5	3,4,5	4	1	0	1	2	0	0	1
Median (range)	67 (46–81)					5 (2–8)							

No = number; M = male; F = female; Abe = diathesis risk score according to Abe et al[1]; Bil = bilateral disease; 50 = onset under age of 50; 5th = history of fifth finger surgery; LH = Ledderhose disease; KP = knuckle pads; 1st = first ray involvement; Fam = positive family history; L = left; R = right, SD = standard deviation; 1 = positive, 1 point in Abe's score; 2 = positive, 2 points in Abe's score; 0 = negative.

Table II. Group 2 without implants: clinical and personal details. Intraindividual controls are group 1 no 1, 2, 3, and 6, who are the same patients as no 25, 26, 27, and 33 in group 2, respectively.

Case No.	Age (years)	Sex	Side	Right rays	Left rays	Abe	Bil	50	5th	LH	KP	1st	Fam
16	58	M	L	1,3,4,5	1,3,4,5	4	1	1	0	0	0	2	1
17	53	M	L	5	4,5	4	1	1	0	0	0	2	0
18	65	M	L	3,4	3	1	1	0	0	0	0	0	0
19	76	M	R	1,2,3,4,5	1,4	8	1	0	1	2	2	2	1
20	58	M	L	4,5	3,5	7	1	1	1	2	2	0	1
21	62	F	R	3,4,5	1,2,3,4,5	7	1	1	1	2	0	2	1
22	60	M	L	5	3,5	5	1	1	1	2	0	0	0
23	57	F	L	3,4	3,4,5	5	1	1	1	2	0	0	1
24	75	M	R	1,2,3,4,5	1,2,3,4,5	7	1	1	1	0	2	2	1
25	58	M	R	1,4,5	1,2,4,5	5	1	1	1	0	0	2	1
26	71	M	L	1,2,4,5	3,4,5	7	1	0	0	2	2	2	0
27	67	M	L	3,4,5	1,4,5	5	1	1	1	0	0	2	0
28	61	M	L	1,3,4,5	1,3,4,5	6	1	1	0	0	2	2	1
29	68	M	R	3,4,5	3,4,5	4	1	1	0	0	2	0	1
30	72	M	L	5	3,4,5	3	1	0	0	0	2	0	0
31	60	M	L	4,5	4	3	1	1	1	0	0	0	0
32	69	M	L	0	4	2	0	1	1	0	0	0	0
33	78	M	L	4,5	5	4	1	0	1	0	2	0	1
Median (range)	64 (53–78)					5 (1–8)							

No = number; M = male; F = female; Abe = diathesis risk score according to Abe et al[1]; Bil = bilateral disease; 50 = onset under age of 50; 5th = history of fifth finger surgery; LH = Ledderhose disease; KP = knuckle pads; 1st = first ray involvement; Fam = positive family history; L = left; R = right, SD = standard deviation; 1 = positive, 1 point in Abe's score; 2 = positive, 2 points in Abe's score; 0 = negative.

There were no wound problems. The goniometric evolution of the lack of extension of the most severely inflicted finger is shown in Tables III and IV.

In all patients the fingers were fully extended intraoperatively. They all regained full flexion of the fingers within two weeks after the operation. In the implant group there were 13 men and two women. In the no implant group there were two women and 16 men, of whom four were control cases. In the implant group there were 11 fifth fingers, two fourth fingers, and two third fingers. In the other group there were 16 fifth fingers, one fourth, and one third finger (Tables I and II). Median (range) age at the time of operation was 64 (53–78) years in the group without and 67 (46–81) in the group with implant. In the implant group, median (range) preoperative total lack of extension was 80 (20–169)° with a lack of MCP and PIP extension of 22 (0–77)° and 45 (0–80)° (Table III). The second group (without implant) had a total extension lack of 84 (42–146)° with a MCP and PIP lack of extension 29 (0–68)° and 61 (10–90)° (Table IV). There was no significant goniometric difference between the groups in contractures of the MCP or PIP joints ($p = 0.3$). In both groups risk factors were also similar compared by the score of Abe et al. ($p = 0.9$) with a median value of 5 (1–8) [8].

Extension was lacking at three months and remained so a further 1 year later (Figure 3).

Median (range) total lack of extension in the implant group after three months was 12 (0–50)° of which the lack was 0 (0–16)° and 12 (0–34)° in the MCP and PIP joints. In the other group total post-operative lack of extension was 38 (0–119)°, of which 0 (0–43)° in the MCP and 34 (0–80)° in the PIP joint at 3 months follow-up. This means that the relative gain in total range of movement after correction with the relative correction coefficient of Tubiana was 85 (55–100)% in the implant group compared with 52 (3–100)% in the other group (Figure 4*a*). (Wilcoxon test for two samples $p < 0.0001$) [16].

Visual analogue scales indicating satisfaction improved in both groups (Figure 4*b*, Table V). In group 1 it changed from 7 (4–9) to 10 (6–10) and in group 2 from 8 (4–10) to 9.5 (6–10). Although the preoperative and postoperative values of the VAS did not differ statistically between the groups, the improvement in satisfaction with a mean value of 2 (0–6) in group 1 and 1 (-2–4) in group 2 was different ($p = 0.005$).

Discussion

Dupuytren disease is fibroproliferative and causes progressive flexion contractures of the fingers with highly variable aggressiveness in evolution among

Table III. Group 1 with the cellulose implant: goniometric data before and after operation. There is a relative total goniometric gain of 87%.

Case No.	Ray	Before MCP	Before PIP	After MCP	After PIP	Gain MCP	Gain PIP	Gain% PIP	Total short before	Total short after	Total gain	% gain
1	4	54	8	0	0	54	8	100	62	0	62	100
2	5	77	45	0	18	77	27	60	122	18	104	85
3	5	65	78	16	34	49	44	56	169	50	93	55
4	5	65	44	0	25	65	19	43	109	25	84	77
5	5	62	62	0	26	62	36	58	124	26	98	79
6	5	18	50	0	17	18	33	66	68	17	51	75
7	5	44	45	0	14	44	31	69	89	14	75	84
8	4	22	60	0	0	22	60	100	82	0	82	100
9	5	6	73	0	18	6	55	75	79	18	61	77
10	5	15	24	0	5	15	19	79	39	5	34	87
11	5	30	28	0	0	30	28	100	58	0	58	100
12	5	10	70	0	12	10	58	83	80	12	68	85
13	3	0	80	0	0	0	80	100	80	0	80	100
14	3	20	0	0	0	20	0	100	20	0	20	100
15	5	15	18	0	0	15	18	100	33	0	33	100
Median (range)		22 (0–77)	45 (0–80)	0 (0–16)	12 (0–34)	22 (0–77)	31 (0–80)	79 (43–100)	80 (20–169)	12 (0–50)	68 (20–104)	85 (55–100)

No = number; Ray = operated finger included in the measurements; MCP = metacarpophalangeal joint; PIP = proximal interphalangeal joint; SD = standard deviation.

Table IV. Group 2 without the implant: goniometric data before and after operation. A relative total goniometric gain of 51% is seen (% gain).

Case No.	Ray	Before MCP	Before PIP	After MCP	After PIP	Gain MCP	Gain PIP	Gain% PIP	Total short before	Total short after	Total gain	% gain
16	5	0	64	0	58	0	6	9	64	58	6	9
17	5	62	84	0	38	62	46	55	146	38	108	74
18	3	25	28	5	21	20	7	25	53	26	27	51
19	5	30	12	10	24	20	-12	0	42	34	8	19
20	5	60	40	25	24	35	16	40	100	49	51	51
21	5	48	80	0	62	48	18	23	128	62	66	52
22	5	24	90	0	80	24	10	11	114	80	34	30
23	5	0	58	0	30	0	28	48	58	30	28	48
24	5	48	78	0	35	48	43	55	126	35	91	72
25	5	0	58	0	54	0	4	7	50	54	4	8
26	5	68	10	28	10	40	0	0	78	38	40	51
27	5	33	90	43	76	-10	14	16	123	119	4	3
28	5	28	17	0	17	28	0	0	45	17	28	62
29	5	50	72	0	38	50	34	47	122	38	84	69
30	5	50	63	0	32	62	41	65	135	32	103	76
31	5	25	36	0	0	25	36	100	61	0	61	100
32	4	20	31	10	0	10	31	100	51	10	41	80
33	5	0	90	0	40	0	50	56	90	40	50	56
Median (range)		29 (0–68)	61 (10–90)	0 (0–43)	34 (0–80)	25 (0–62)	17 (-12–50)	33 (0–100)	84 (42–146)	38 (0–119)	41 (4–108)	52 (3–100)

No = number; Ray = operated finger included in the measurements; MCP = metacarpophalangeal joint; PIP = proximal interphalangeal joint, SD = standard deviation.

different patients [9]. Of the numerous techniques that are still being used, the minimally invasive one with segmental interruptions of the fibroproliferative strands for the correction of the contractures results in the easiest rehabilitation [1,10]. Although with this technique the resection of the fibrous tissue is incomplete, no greater risk of recurrence has been reported [7,17,18].

The presence of multiple clinical risk factors point to Dupuytren diathesis, and recurrence or extension of the contracture is common in those patients [3,8,19]. A young age of onset, bilateral

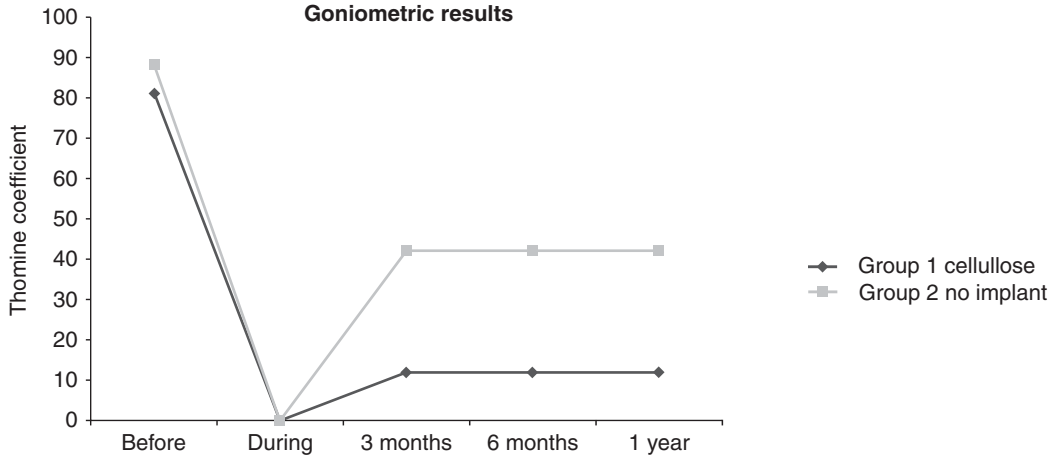

Figure 3. Goniometric evolution of the total lack of extension in metacarpophalangeal and in proximal interphalangeal joints in both groups. Although the mean preoperative lack of extension is similar in both groups as was the full intraoperative correction, in group 1 with the cellulose implant there was a significantly improved goniometric correction, which was maintained after one year of follow-up.

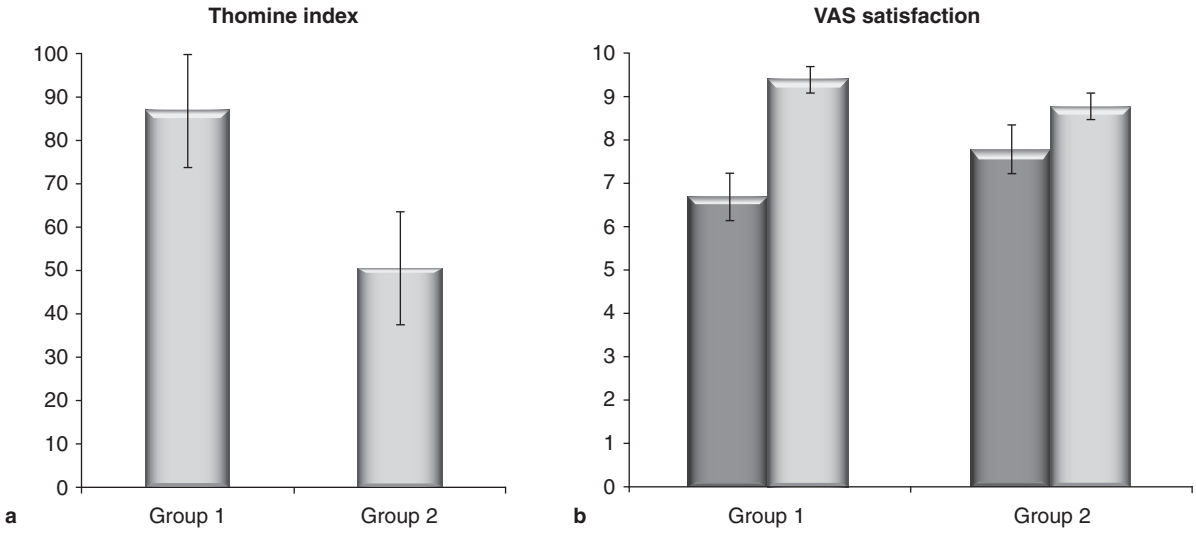

Figure 4. (*a*) The relative goniometric result calculated with the Tubiana coefficient showed a relative decrease in lack of extension in group 1 with the implants of 87 (27)% and 51 (30)% in group 2 [16]. (*b*) Although preoperative visual analogue scores for satisfaction were somewhat worse in group 1, they improved towards 9.4 (1.2), showing that patients were satisfied with the technique. (VAS = visual analogue scale, range 1–10 points). Dark columns = before, and shaded columns = after, operation.

presentation, and radial involvement, little finger surgery, knuckle pads, Ledderhose syndrome, and a family history all seem to have an important predictive role [4]. In patients with Dupuytren diathesis recurrence can be fast, within months of the operation. This is the postoperative period during which scar tissue forms, which is a similar fibroproliferative process to that of the disease itself. To see if there was a possible different outcome within a relatively small group of patients, only patients with Dupuytren diathesis were included in this study.

The hypothesis in this population with a high risk for recurrence was that we could improve the effects

Table V. Patients' reported satisfaction score on a 1 to 10 point graded visual analogue scale (VAS), preoperatively and 3 months postoperatively in group 1 with the cellulose implant (numbers 1 to 15) and group 2 without the implant (numbers 16 to 33).

Group 1 Case No.	VAS before	VAS after	Change	Group 2 Case No.	VAS before	VAS after	Change
1	6	8	2	16	7	10	3
2	7	10	3	17	9	10	1
3	6	10	4	18	6	10	4
4	5	10	5	19	8	6	-2
5	7	10	3	20	9	10	1
6	4	10	6	21	7	8	1
7	7	10	3	22	9	10	1
8	8	10	2	23	10	10	0
9	7	8	1	24	8	8	0
10	8	10	2	25	6	6	0
11	9	10	1	26	7	9	2
12	9	9	0	27	6	8	2
13	4	6	2	28	10	10	0
14	5	10	5	29	7	9	2
15	8	10	2	30	10	10	0
				31	8	9	1
				32	9	10	1
				33	4	6	2
Median (range)	7 (4–9)	10 (6–10)	2 (0–6)		8 (4–10)	9.5 (6–10)	1 (-2–4)

of this minimal invasive technique by increasing the effect with an absorbable cellulose implant. It may also exert a barrier role between the wound bed and the myofibroblast-inducing overlying skin, which often retracts towards the underlying fibrous tissue in Dupuytren disease [11,20]. The use of these cellulose implants has been successful in gynaecological adhesiolysis, and more recently in tenolysis in hand surgery [12,13].

In this case-control study of patients who had primary operations and multiple risk factors for recurrence, we found improved goniometric results when the cellulose was implanted (Figure 4). Surgical results may also improve in low risk patients, as these better goniometric results emphasise the effect of interrupting segmental strands which ought to be achievable in all patients.

Cellulose absorbs relatively fast after implantation, so no direct long term benefit of the cellulose implants in risk of recurrence was expected. The only goal was to improve outcome. However, better finger extension at three months postoperatively (in this study unchanged after one year) does provide a better starting position whenever recurrent contractures should develop. The subjective evaluation of patients' satisfaction with a visual analogue scale showed more improvement in the group with the implant, where it was almost maximal, which confirmed that patients were well satisfied by this procedure.

The absence of double blinding and serial randomisation is a weakness of the study, but including patients in a random manner, and blinding follow-up, seemed impossible for correct inclusion, treatment, and follow-up of the patients. However, prejudgment was reduced to a minimum as none of the patients who did not have an implant knew of its existence, and all were motivated and convinced that they received the best operation with a straightforward rehabilitation. Measurements were also made by an observer unaware of the treatment on digital photography. The 1 year follow-up confirmed the implants' safety, and measurements were compared at similar time intervals.

We conclude that absorbable cellulose implants may improve the outcome of segmental fasciectomy in Dupuytren disease by achieving better finger extension and good patients' satisfaction. Cellulose implantation should therefore be considered in this minimal invasive surgical technique.

Declaration of interest: The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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