



## The prevalence of frozen shoulder in patients with limited Dupuytren disease

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Evidence from the literature suggests an association between Dupuytren disease and frozen shoulder syndrome, both clinically and histologically. An increased tendency for fibrotic healing after repetitive microtrauma could be an underlying mechanism. However, it remains unclear how strong this association is and if only mild signs of Dupuytren disease would also increase the risk of frozen shoulder. In 61 patients, we examined the hands for signs of Dupuytren disease and the shoulders for pain and limited motion. We found a 21,7% prevalence of frozen shoulder syndrome in patients with signs of Dupuytren disease versus 13,9% in those without. The other way around, in patients with frozen shoulder syndrome the prevalence of Dupuytren disease was 50% versus 36,7% in those without frozen shoulder syndrome. These differences were not statistically significant, contrary to similar research in the literature. However, methodological issues, especially the choice of control group, may explain the differences between our findings and previous studies. We conclude that the clinical association between Dupuytren disease may not be so strong as previously thought, especially in patients with only limited signs of the disease.

**Keywords:** Dupuytren disease; frozen shoulder syndrome.

### INTRODUCTION

Dupuytren disease (DD) is a benign fibroproliferative condition, common among older men of

Western or Northern European decent. It results in subcutaneous fibrosis of the palmar fascia of the hands, leading to the development of nodules and cords in the palms. In time, these cords can cause contractures of the digits, leading to functional limitations.

The occurrence of more aggressive forms of DD with bilateral and radial side involvement, onset at an early age, a positive family history and association with ectopic lesions of fibrosis like on the knuckles (Garrod's pads), the plantar fascia of the feet (Lederhose's disease) and the penis (Peyronie's disease) has brought about the concept of 'fibrosis diathesis' (1). This term refers to an increased tendency to develop fibrosis. Not only is it an important predictor for recurrence after treatment of DD lesions. It might also be associated with an

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increased risk for joint stiffness or arthrofibrosis. In particular, a relationship between DD and frozen shoulder syndrome (FS) has been documented (2). As DD seems to be significantly more frequent in patients with frozen shoulder, the two might share a common pathophysiology.

The etiology and biomechanical pathways for either DD or FS remain largely unrevealed. Several studies however have elucidated the link between the two pathologies. Most notably there are clear histological similarities: with active fibroblastic proliferation, myofibroblastic transformations and a dense mass of collagen (3). These studies demonstrated the fibrotic nature of frozen shoulder and a relative absence of inflammation. The plausibility of this association is further reinforced by similarities in immunohistochemistry, genetics and metabolism, where both conditions display a significantly increased incidence of diabetes mellitus and hyperlipidemia.

If patients with only mild signs of DD would also have a higher risk of developing FS or joint stiffness in general, this could have major implications for the outcome of surgical interventions. Assessing this increased risk beforehand could enable the treating surgeons to propose a more aggressive rehabilitation to decrease the risk of a bad outcome. The high prevalence of DD in certain populations certainly makes this very relevant question.

The hypothesis of this study was that patients who show signs of DD, i.e. palmar nodules, cords or finger contractions, have a higher chance of developing FS syndrome than patients who have none of these clinical signs.

## MATERIALS AND METHODS

We set up a single center retrospective observational study. The study was approved by the institutional ethical committee (S57376) and all patients provided written informed consent.

Sixty-one patients with a minimal age of 50 years were recruited in the outpatient clinic for knee pathology. All patients had undergone a total knee arthroplasty one year earlier. The impact on the outcome of their knee surgery has been described previously.

We performed a chart review in order to collect the demographic data of the participants: Mean age at surgery in years, Sex, Diabetes mellitus and Body Mass index (BMI).

The hands of all patients were clinically evaluated. Patients showing palmar nodules, cords or finger contractions were included in the DD group, while patients who did not show any signs of DD served as the control group.

Risk factors associated with increased severity and risk of recurrence of DD were also recorded. These included family history, bilateral DD, first ray involvement, multiple ray involvement and ectopic lesions. Other risk factors which influence the development of DD were also retrieved: age of onset less than 50 years, male gender, diabetes (chart diagnosis), smoking habits, epilepsy and previous hand surgery and/or trauma. In the group with signs of DD the diathesis score as published by Abe et al was calculated and any subjective increase in the presence or severity of nodules or contractures of the fingers was recorded (4) (Table I).

Patients were questioned and examined for shoulder pathology to detect the presence of frozen shoulder syndrome. This was clinically investigated by assessing external rotation, after which frozen shoulder syndrome was diagnosed if patients had a history of shoulder pain and the external rotation was less than 30°. Obvious causes for limited motion of the shoulder such as glenohumeral osteoarthritis or complications after previous shoulder surgery

Table I. — Scoring System for Fibrosis Diathesis as Designed by Abe et al. (4)

Variable	Points
Bilateral hand involvement	1
Little finger surgery	1
Early onset of disease	1
Knuckle pads	2
Radial side involvement	2
Plantar fibrosis	2

The score is calculated by adding up the points attributed to the respective variables. A sum of more than 4 is considered a high fibrosis diathesis.

Table II. — Demographic data

	Total	DD-group	Non DD-group	P-value
Number of patients	61	25 (41%)	36 (59%)	
Mean age at surgery in years (mean ± standard deviation)	71.7 (±9.3)	71.6 (±9.4)	71.8 (±9.4)	0.929
Male (n, %)	13 (21%)	6 (24%)	7 (19%)	0.0581
Diabetes mellitus (n, %)	3 (4,9%)	2 (8%)	1 (2,8%)	<b>0.0237</b>
BMI (mean ± standard deviation)	29.4 (±6.0)	28.0 (±5.1)	30.3 (±6.5)	0.0715
BMI>30 (n, %)	30 (49%)	11 (44%)	19 (53%)	<b>0.0483</b>

were excluded through chart review and shoulder radiography and/or ultrasound (5).

Demographic data were evaluated with Student's t-test for continuous variables and Chi-square test for categorical variables. A 1-sided Fisher exact test was used to detect any difference between the groups and relative risk and Cramér's *V* were calculated as a measure of association. Logistic regression analysis was performed to calculate the Odds Ratios. For all tests, a P value of < 0.05 was considered significant. Statistical analysis was conducted with Stata version 17 statistical software (StataCorp, College Station, Texas).

## RESULTS

Demographic criteria are summarized in table II. In the DD group, the mean diathesis score was 1,52 (range 0-4). None of the patients in the DD group presented with contractures warranting surgical treatment at the time they were examined.

In both groups, 6 patients met our criteria of frozen shoulder, but one patient in each group demonstrated clear radiological signs of glenohumeral osteoarthritis. Therefore, these 2 patients were excluded from further analysis. The prevalence of frozen shoulder was 21,7% in the DD group and 13,9% in the non-DD group. This difference proved to be not significant (P= 0.330). The relative risk was 1.57 (95% confidence interval 0.509-4.82).

When the prevalence of DD was compared between patients with and without FS, a prevalence of 50,0% DD in the FS group was observed versus 36.7% in the non-FS group. This difference was not

significant (P=0.330) and the relative risk was 1.36 (95% CI 0.662-2.80). Given the symmetry of the measures, Cramér's *V* was 0.102 for the associations in both directions. The odds ratio was 1.72 in favor of the DD and FS group (95% CI 0.438-6.77), with a P-value of 0.436.

There were 11 patients in both groups who indicated shoulder pain in general, with or without limitation in exorotation, excluding again those with clear osteoarthritis. This means the prevalence of shoulder pain was 47.8% in the DD group and 30.6% in the non-DD group, a difference that was not significant (P=0.18). The relative risk was 1.57 (95% CI 0.816-3.00). Cramér's *V* was 0.174 and the odds ratio was 1.92 in favour of the DD group. However, the P value for the odds ratio was 0.276. None of the other factors (obesitas, diabetes mellitus and age) demonstrated any significant association or odds ratio (data not shown).

## DISCUSSION

In this study, no significant difference in prevalence of FS or shoulder pain was observed between a group of patients showing signs of DD and a control group without DD signs. Although there was a trend for a higher prevalence of FS and shoulder pain in the DD group, this was not significant. Also, the higher prevalence of DD in the group with FS was not significant. This is of course a logical consequence of the symmetric nature of the Chi-Square test and Cramér's *V*. Interestingly, the DD incidence of 50% we observed in the FS group, is very close to the 52% reported by Smith

et al. The definition of DD in that study was very similar to ours, namely direct observation of the hands for nodules, cords or contractures, not merely patient presentation or surgical treatment of DD (2). However, in their study they compared the incidence to results from the literature, more specifically the study by Early from 1962. They reported a DD prevalence of 6.2%: 156 in 2524 persons between the ages of 46 and 64, also based on direct observations and including those without contractures (6). Theoretically, if we used this historical cohort as the control population in the same way as in Smith's study, we would yield a P-value of  $< 0.001$ , making the difference highly significant. However, in the control (non-FS) group in our study, the prevalence of DD was 37%, slightly higher than the overall prevalence of 32% in Flanders as reported by Degreef and De Smet. They also performed direct observation of asymptomatic people over the age of 50 in a non-hospital environment (7). We feel that this is of course a far more accurate comparison than using historical data. The explanation for this high prevalence is most likely the methodology of direct observation, resulting in a DD group that mainly consisted of patients in whom the diagnosis of DD was an incidental finding. None of them had any contracture or the need for treatment, but even discrete nodules or cords were sufficient to include them in the DD group. This is also reflected in the diathesis score: the mean diathesis score in the patients with DD in this study was 1,52, indicating a milder form of fibrosis diathesis (4), and no patients had a score of more than 4.

A proportionate relation between the diathesis score and the prevalence of fibrotic conditions seems likely, but proves hard to confirm. Thus, a higher score would give a more significant difference in prevalence of fibrotic conditions, in our example FS. This might be of use for patient selection in future studies regarding this topic. On the other hand, the number of patients in our population may be too low to demonstrate this rather subtle association. Further research conducted in larger study populations, including patients with more severe form of DD, will give us a clearer view of the relation between FS and DD.

The possible association between DD and FS has been a topic of discussion for decennia. Lundberg linked the two pathologies as early as in 1969 when he reported histological similarities, noting that the capsule in FS was dense with an increase in cells. This hypercellularity was mainly due to fibroblasts (8). Reinforcing this idea, Kay and Slater described the histology of the shoulder capsule in one diabetic patient in 1981. They confirmed that there were striking similarities between the FS capsule and fibromatosis tissue as seen in DD (9). In 1989 Ozaki et al reported histological signs of fibrosis in some of the 17 cases of FS (10). Hannafin et al published their findings of arthroscopic biopsies of the capsule in patients with FS in 1994, confirming previous findings of fibrosis and fibroplasia (11).

In 1995 T.D. Bunker performed a surgical release in 12 patients with FS who failed to improve after manipulation under anesthesia (3). The technique, described by Ozaki et al, consists of excision of the coracohumeral ligament (10). These tissue samples were then prepared for histological examination and immunohistochemistry. For comparative purposes, excised tissue from Dupuytren lesions of 6 participants was similarly treated. Bunker found there was a striking histological resemblance between the frozen shoulder tissue and the Dupuytren tissue. Immunohistochemistry confirmed this constation with both types of tissue showing signs of a fibrosing condition, not an inflammatory one: presence of myofibroblasts, alpha-smooth muscle actin (a-SMA) and vimentin. The same authors later found that in a population with a history of FS, DD was more than 8 times more likely to develop and that an incidence of DD of more than 50% was seen in patients with frozen shoulder syndrome (2).

But not only in terms of histology there is increasing evidence suggesting a relationship between DD and FS: Hutchinson et al reported on a series of 12 patients with inoperable gastric carcinoma, treated with a synthesized broad-spectrum matrix metalloproteinase inhibitor (TIMP), Marimastat. Peculiarly, 6 out of the 12 patients developed bilateral FS and 3 of these 6 developed clinical features of DD within 4 months of treatment (12). More recently it has also been shown that  $\beta$ -catenin levels and IGF2 expression are elevated in FS, as

was documented in DD (13). These two examples support the idea that DD and FS share a common pathophysiology.

A relationship between DD and obesity was also suggested, since an increased prevalence of diabetes mellitus and hyperlipidemia in DD patients compared to non-DD patients has been reported. However, this link remains unclear (14,15).

### CONCLUSION

We demonstrated a trend of higher prevalence of frozen shoulder syndrome in patients with only mild signs of DD, but this was far from significant. Thus, at this point we cannot advice to use assessment of the hands for signs of DD as a risk factor for developing frozen shoulder syndrome. Research in larger populations is needed to further elucidate this relationship.

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