Heavy manual work, exposure to vibration and Dupuytren's disease? Results of a surveillance program for musculoskeletal disorders.

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Abstract

Introduction

In view of the debate about occupational factors in Dupuytren's disease, the aim of this study was to describe the prevalence of the disease in men and its relationship with work exposure, and especially to distinguish heavy manual work with and without significant use of vibrating tools by using data from a surveillance program for musculoskeletal disorders.

Method

This cross-sectional study was conducted in France between 2002 and 2004. Dupuytren's disease was diagnosed clinically by one of the 83 occupational physicians involved in the program. Exposure in relation to work status and occupational risk factors was assessed with a self-administered questionnaire, and was categorized according to vibration exposure (defined as *use of vibrating tools* ≥ 2h/day), heavy manual work without vibration exposure [defined as *use of hand tools* ≥2h/day (*use of vibrating tools* ≥*2h/day* excluded) and Borg scale ≥15/20] and no form of such exposure. Bivariate and multivariate associations using logistic models were recorded in men and also in those with over 10 years at the same job.

Results

Of the 2,161 men, 1.3% (n=27) suffered from Dupuytren's disease (mean age 47.1+/−6.7 years). Heavy manual work without vibration exposure was significantly associated with the disease (adjusted odds ratio - aOR- 3.9[1.3;11.5]) adjusted on age and diabetes), as was the *use of vibrating tools* (aOR 5.1[2.1;12.2]). These associations remained significant among subjects with over 10 years at the same job, with increases in aOR of 6.1[1.5;25.0] and 10.7[3.4;34.6], respectively.

Conclusion

Despite the limited number of cases, occupational exposure, including both vibration exposure and heavy manual work without significant vibration exposure, was associated with Dupuytren's disease.

MESH Keywords Adult ; Cross-Sectional Studies ; Dupuytren Contracture ; diagnosis ; epidemiology ; etiology ; France ; epidemiology ; Humans ; Logistic Models ; Male ; Middle Aged ; Occupational Diseases ; etiology ; Occupational Exposure ; adverse effects ; Occupations ; Population Surveillance ; Prevalence ; Questionnaires ; Risk Factors ; Vibration ; adverse effects ; Work

Author Keywords Dupuytren contracture ; observational study ; occupational factor ; manual work ; vibration exposure

Dupuytren's disease is characterized by chronic contracture of the fourth and fifth fingers of the hand toward the palm, usually accompanied by thickening of the palmar skin.[1]

Since its description by Guillaume Dupuytren in 1831 following Henry Cline Sr. and Sir Asteley Cooper, controversy has existed regarding whether acute traumatic injury or cumulative biomechanical work exposure might contribute to the development of this disorder.[2,3] To address this controversy, an exhaustive review was published in 1996 which concluded that there is good evidence of an association between vibration exposure and Dupuytren's disease, but a weak association with forceful work.[4] However, recent opinion still considers that exposure to forceful work and vibrations are not risk factors for Dupuytren's disease in manual workers.[5,6] Studies have been conducted on large populations but with exposure based only on job title or work status rather than on estimated amount of vibration exposure or specific working population.

The surveillance program for musculoskeletal disorders implemented in the Pays de la Loire region by the National Institute for Public Health Surveillance in 2002 [7,8] has allowed the development of epidemiological analyses of the risk factors for Dupuytren's disease in a large study sample exposed to various levels of work-related constraints. The study presented here aimed to assess the prevalence of Dupuytren's disease in the general male working population and the relationship with occupational risk factors, in order to distinguish risk factors associated with manual work with or without the use of vibrating tools.

Methods

Study population

This cross-sectional study was conducted in the Pays de la Loire region in west-central France.

Between April, 2002 and April, 2005, 83 occupational physicians, representing 18 % of the occupational physicians (OPs)of the region, participated in the study, and contributed data on the workers for whom they provided health surveillance.[7,8] Subjects were randomly selected from workers undergoing a regularly scheduled mandatory health examination.

Taking into account the low prevalence of Dupuytren's disease among women, only men were selected in this study analysis. The population in this study comprised men employed in the private sector; the self-employed, civil servants and public sector employees (about 30% of the labor force) were excluded.

Outcomes

A subject was considered as having Dupuytren's disease if the occupational physician found: incomplete extension of the phalanx, permanent flexion deformity or fibrous nodules in one of the 4 fingers. All OPs were trained to perform a standardized physical examination.

Potential risk factors

Information on age, weight, height and diabetes mellitus were collected during the physical examination. Work status and occupational risk factors were assessed with a self-administered questionnaire including information on the characteristics of the job and tasks in a typical working day in the preceding 12 months. For vibration exposure, *use of vibrating tools* was classified as never, uncommonly (less than 2 hours/day), frequently or all the time (defined as ≥ 2 hours/day); for manual work, *use of hand tools* (any hand tools, including vibrating tools) was classified according to similar category definitions; in addition, the Borg Rating of Perceived Exertion Scale (6 to 20) was used [9,10], with three categories: <12 (more than the first quartile, due to the distribution of answers); 12–14; ≥15 (last quartile)..

In order to clarify whether heavy manual work without use of vibrating tools was a risk factor for Dupuytren's disease, exposure was also divided into three categories: (i) no exposure to vibration (defined as "*no use of vibrating tools*" or "*use of vibrating tools* for *less than 2 hours/day*) and no heavy manual work (defined as "*no use of hand tools*" or "*use of hand tools less than 2 hours/day* or Borg scale <15/20 "); (ii) no exposure to vibration (similar definitions) but exposure to heavy manual work [defined as *use of hand tools* ≥ *2h/day* (*use of vibrating tools <2hours/day* excluded) and Borg scale ≥ 15/20]; (iii) exposure to vibration (*use of vibrating tools* ≥ 2 hours/day).

Statistical analysis

The outcome was defined by subject, hence bilateral Dupuytren's disease counted as one, not two.

The associations between the outcome and the relevant exposure variables were studied with a logistic model controlling for age and diabetes. Models restricted to workers with at least 10 years at the same work (threshold from the original questionnaire) were also performed.

One individual with Dupuytren's disease did not fill out the whole questionnaire (only the beginning, not the exposure), and most analyses considered him as missing data. Taking into account the small number of cases, further analyses were performed to check the stability of the results, by recoding his exposure in all categories of manual work/vibration exposure. A Multiple Imputation by Chained Equations (MICE) was also used to check the stability of the results.[11]

Associations were considered significant if the p-value was less than 0.05. All analyses were performed with the SAS statistical software package (version 9.1, SAS Institute. Inc., Cary. NC. US), except the MICE study, which was performed with STATA software (Stata 10.0, StataCorp LP, College Station, US).

Results

The study population comprised 2,161 men aged from 20 to 59 years (mean age 38.5 years). Of these, 1.3% (n=27) suffered from Dupuytren's disease (mean age 47.1+/− 6.7 years, versus 38.4 +/−10.4 years for those without Dupuytren's disease, p<0.001). Blue collar

workers and those who suffered from diabetes mellitus, had a higher risk of Dupuytren's disease, (Table 1). All selected occupational variables were significantly associated with Dupuytren's disease, with a dose-response relationship. Exposure variables were closely associated with each other ($p<0.0001$).

The association between heavy manual work without exposure to vibration was significant, and it was also significant for exposure to vibration (Table 1). These associations remained significant for subjects with over 10 years at the same job, with an increase in adjusted odds ratio (aOR) of 6.1 [1.5;25.0] for manual work and 10.8 [3.4;34.6] for vibration exposure, again with a possible dose-response relationship.

The case with the missing data was a 56-year-old, blue collar worker with diabetes mellitus. Recoding his exposure did not modify the associations observed, such as the MICE results.

Discussion

The study revealed that the prevalence of Dupuytren's disease in the general male working population in France was around 1%. Vibration exposure affecting the hand using the vibrating tool was an occupational risk factor associated significantly and strongly with the prevalence of Dupuytren's disease. Manual work without the *use of vibrating tools* was also significantly associated with Dupuytren's disease.

The limitations of the study include the cross-sectional design, with assessment of exposure by questionnaire and from the diagnosis. Workers with Dupuytren's disease may be more likely to describe their work as strenuous. However, the relative precision of the questions should have limited misclassification. A recent review revealed that self-reported answers to questions concerning physical work demands showed good reproducibility when using the Borg scale and use of handheld vibrating tools.[12]

The threshold used to categorize and classify exposure to vibration is a matter for discussion. Here, daily exposure to vibration of less than two hours was considered “not exposed” or “no significant exposure”. We could not define a threshold at one hour of exposure, which is frequently recommended.[10] The alternative would have been to have a category “heavy manual work only”, limited to those who were never exposed to vibration. However, the number of subjects in this category was too small for a reliable estimate of the frequency of Dupuytren's disease, since fewer than 6% of the sample were in this situation. The OPs were aware of the exposure of the study subjects, since they are responsible for the general medical surveillance at the workplace according to the French system for surveillance. However, misclassification (such as whether an individual has Dupuytren's disease or not) is expected to have been minimal: the OPs were enrolled in a specific surveillance project focusing on musculoskeletal disorders, with precise definitions and training in the whole range of diagnoses. In addition, early stages of Dupuytren's disease with palmar thickening were not considered, since these cases are probably more prone to misclassification or observer bias.

The missing data on exposure might have led to a selection effect: however, fewer than 1% of subjects had missing exposure data or results from missing data analyses including MICE results, thus suggesting that this effect is probably low.

A possible residual confounding effect should also be discussed, considering that among the personal and medical variables, only age and diabetes mellitus were available. Alcohol intake, smoking, genetic factors (family history of Dupuytren's disease), and epilepsy and anticonvulsant drug intake are associated with Dupuytren's disease and should be considered.[13,14] However, an association with the specific occupational exposure considered here is unlikely for genetic factors, or for epilepsy and anticonvulsant drug intake. Alcohol intake and smoking may be associated with social position and manual work. Nevertheless, a previous study found that work exposure was independently associated with Dupuytren's disease without any interaction with non-occupational factors:[13] the crude ORs for work exposure were compared with the ORs adjusted on alcohol consumption, epilepsy, and previous trauma. For a medium level of exposure the crude OR was 1.83, and the adjusted OR was 2.20 (+20%). For a high level of exposure, adjustment led to a decrease of 31%, from 4.49 (crude OR) to 3.10 (adjusted OR).

The main strength of the study was estimation of the prevalence in a sample representative of the working population with a high participation rate. Comparison of the socio-economic status in the sample with the last available French census (1999 [7]) showed no major differences for either gender. The distribution of occupations in the study sample was relatively close overall to that of the regional workforce, except for some occupations not monitored by OPs (e.g., shopkeepers and self-employed workers). The prevalence in the literature varies from 0.2% to 56%, depending on the characteristics of populations, exposure to risk factors and methods [3,5]. The prevalence found in this study (1%) was consistent with the literature. The prevalence in the general population (as in this study) is expected to be lower than in samples of exposed subjects; in addition, the criteria for diagnosis were fairly restrictive.

Despite the comprehensive review by Liss and Stock in 1996 that concluded that there is good evidence of an association between exposure to vibration and Dupuytren's contracture,[4] this relationship is still a matter of debate.[1,5,15] This study clearly identified vibration exposure as a risk factor, with a dose-response relationship, in agreement with other authors.[16,17] The association observed with heavy manual work was also consistent with previous literature reports.[13,18–20]

The role of high levels of repetitive strain with cumulative microtraumatism is plausible, especially as a result of the local hypoxia and chronic ischemia hypothesized in Dupuytren's contracture.[14,21]

In conclusion, despite the limitations discussed, this study emphasized that occupational exposure is associated with Dupuytren's disease, including heavy manual work without significant exposure to vibration. The possibility for compensation in some cases with documented high levels of exposure (vibration and/or heavy manual work) should be discussed, as should improvement of working conditions with a view of prevention.

What this paper adds

What is already known on this subject

- Studies over many years have suggested that Dupuytren's contracture could be associated with certain occupations, with conflicting results especially with regard to manual work.

What this study adds

- The prevalence of Dupuytren's disease was 1% among men in a large working population.
- Heavy manual work, with and without significant exposure to vibration, was significantly associated with Dupuytren's disease.

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Footnotes:

Competing Interest: None to declare.

The protocol was approved by the French Commission on Individual Freedom and Data Storage (CNIL).

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Table 1

Description of the sample and association between Dupuytren's disease and relevant factors.

		Total	Cases of Dupuytren's disease	Percentage of cases	Crude OR	Adjusted OR*
Age	***< 30 years***	491	0	0.0%		
	30–39 years	651	4	0.6%		
	40–49 years	621	12	1.9%	1.1 [1.05 ; 1.15] **	
	≥ 50 years	397	11	2.8%		
Body Mass Index	***< 25kg/m***	1207	11	0.9%	1	
	25–30 kg/m	755	13	1.7%	1.9 [0.8 ; 4.3]	
	≥ 30 kg/m	175	3	1.7%	1.9 [0.5 ; 6.9]	
Diabetes Mellitus	***No***	2221	25	1.2%	1	
	Yes	40	2	5.0%	4.4 [1.01 ; 19.3]	
Over 10 years at the same job	***No***	1329	8	0.6%	1	
	Yes	809	19	2.4%	4.0 [1.7 ;9.1]	
Social Position	***Managers, professionals, technicians***	763	4	0.5%	1	1
	Low skilled white collar	187	2	1.1%	2.1 [0.4 ; 11.3]	2.6 [0.5 ; 14.3]
	Blue collar	1209	21	1.7%	3.4 [1.1 ; 9.8]	4.0 [1.4 ; 11.7]
Borg Scale	***<12***	838	4	0.5%	1	1
	12–14	810	11	1.4%	2.9 [0.9 ; 9.1]	3.2 [1.02 ; 10.2]
	≥15	503	12	2.4%	5.1 [1.6 ; 15.9]	5.3 [1.7 ; 16.6]
Use of hand tools ***	***Never***	668	2	0.3%	1	1
	<2 hours/day	323	2	0.6%	2.1 [0.3 ; 14.8]	2.5 [0.3 ; 17.8]
	≥ 2hours/day	1159	22	1.9%	6.4 [1.5 ; 27.5]	7.7 [1.8 ; 32.9]
Use of vibrating tools ***	***Never***	1423	8	0.6%	1	1
	<2 hours/day	325	7	2.2%	3.9 [1.4 ; 10.8]	4.8 [1.7 ; 13.5]
	≥ 2 hours/day	407	11	2.7%	4.9 [2.0 ; 12.3]	6.2 [2.5 ; 15.7]
Manual work and vibration exposure ***	***No exposure***	1528	10	0.7%	1	1
	Heavy manual work only ****	204	5	2.5%	3.8 [1.3 ; 11.3]	3.9 [1.3 ; 11.5]
	Vibration exposure *****	407	11	2.7%	4.2 [1.8 ; 10.0]	5.1 [2.1 ; 12.2]
	Total	**2161**	**27**	**1.3%**		

* adjusted on age and diabetes mellitus, five different models separately
** crude OR on age (continuous)
*** one case had no exposure data available.
**** Heavy manual work only=use of hand tools ≥2hours/day (use of vibrating tools ≥2hours/day excluded) AND Borg scale ≥15
***** Vibration exposure= use of vibrating tools (≥2hours/day)