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Proceeding Paper

Dupuytren's Disease in Relation to the Exposure to Hand-Transmitted Vibration: A Systematic Review and Meta-Analysis †

Tohr Nilsson [1,*], Jens Wahlström [1], Eirik Reierth [2] and Lage Burström [1]

[1] Department of Public Health and Clinical Medicine, Faculty of Medicine, Umeå University, 90187 Umeå, Sweden; jens.wahlstrom@umu.se (J.W.); lage.burstrom@gmail.com (L.B.)
[2] Science and Health Library, University of Tromsø, UiT The Arctic University of Norway, 9037 Tromsø, Norway; eirik.reierth@uit.no
* Correspondence: tohr.nilsson@umu.se; Tel.: +46-(0)-702-140-955
† Presented at the 15th International Conference on Hand-Arm Vibration, Nancy, France, 6–9 June 2023.

Abstract: This systematic review covering publications in the Medline and Embase databases for the period 1946 to 2020 revealed a higher prevalence of Dupuytren's disease among men exposed to vibration compared to men not exposed to vibration. The risk assessment, also considering the risk of bias, corresponded to a roughly doubled risk of Dupuytren's disease when working with vibrating machines. The supplementary meta-analysis confirmed a more than doubled risk. A possible exposure–response relation was supported by the result from the meta-analysis, which showed a doubled risk for high exposure relative to low exposure.

Keywords: Dupuytren's disease; hand–arm vibration; systematic review; meta-analysis; vibration injury

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Citation: Nilsson, T.; Wahlström, J.; Reierth, E.; Burström, L. Dupuytren's Disease in Relation to the Exposure to Hand-Transmitted Vibration: A Systematic Review and Meta-Analysis. *Proceedings* **2023**, *86*, 30. https://doi.org/10.3390/proceedings2023086030

Academic Editors: Christophe Noël and Jacques Chatillon

Published: 17 April 2023

1. Introduction

Results from recent studies on workers exposed to manual work with vibrating machines has raised the question of whether there may be an association between vibration exposure and the contraction of the connective tissue in the palm and insides of the fingers. Such a fibroproliferative connective tissue disorder characterizes Dupuytren's disease. When the disease is localized to the palmo-digital fascia (aponeurosis) that lies between the dermis and flexor tendons of the hand, the result may include the formation of nodules and cords, whereupon the finger gradually loses extension, resulting in the irreversible flexion contracture of the digit, a condition called Dupuytren´s contracture. There is currently no evidence-based systematic overview of the relation between hand–arm vibration exposure and Dupuytren's disease/contracture, where vibration exposure levels were compared and for which vulnerability in terms of the predisposition and Dupuytren's diathesis were controlled.

The following systematic review aims to specifically study the risk of Dupuytren's disease in relation to the exposure to hand-transmitted vibration. Moreover, the aim was to estimate the magnitude of such an association using statistical synthesis (meta-analysis).

2. Materials and Methods

The following systematic literature review followed the PRISMA method [1], including a literature search, relevance assessment, assessment of the risk of bias, a descriptive synthesis of the results with a qualitative descriptive evidence evaluation (narrative synthesis) as well as a limited statistical synthesis (meta-analysis) for hand–arm transmitted vibration exposure and Dupuytren's disease.

In this report, vibration exposure was categorized into the following four levels:

- Level 1 = Estimate of the total number of years during the working life that involved exposure to vibrations from working with vibrating handheld machines;
- Level 2 = Estimate of the number of hours per day of exposure to vibrations from work with vibrating hand-held machines;
- Level 3 = Assessment of the daily vibration exposure through a combination of the daily exposure time and measured vibration level on the used machines;
- Level 4 = Assessment of the cumulative total vibration exposure over the entire working life through a combination of the daily exposure time, the measured vibration level of the used machines, and the number of years in which the various exposures occurred.

The review process was based on articles found in systematic database-based literature searches. The searches covered Ovid MEDLINE®, including online searching for articles under indexed and nonindexed references, from 1946 to July 2020, as well as the Embase® Classic and Embase® databases, from 1947 to July 2020. Established MESH search terms were used for MEDLINE® and terms from the search list for Emtree for EMBASE®, as well as a free text word search. An additional manual search was carried out on the reviews and reference lists of the identified articles. During the systematic review, repeated manual updates on PubMed® ensured that the literature up to 31 December 2020 was included.

To be included in the first selection, the articles were required to contain information about Dupuytren's disease or Dupuytren's contracture and include information on exposure to hand–arm transmitted vibrations. Duplicates and articles that did not meet the inclusion criteria were excluded manually, as well as articles published in a language other than English, and those lacking information on exposure to hand-transmitted vibrations.

The assessment of the risk of bias (lack of reliability) followed a predefined protocol with established criteria for: a. diagnostic reliability, b. exposure assessment reliability, and c. the methodological reliability and scientific quality of the studies. These were summed for the measure of quality, where high numerical values indicated a low risk of bias or high reliability (the details are presented in a full open-access report, in Swedish https://hdl.handle.net/2077/71843 (accessed on 30 May 2022)) [2]).

All meta-analyses were conducted with the statistical program Comprehensive Meta-analysis. Studies that reported a relative risk (Odds Ratio) were included in the meta-analyses, as well as studies that presented data that allowed calculation of an unadjusted odds ratio.

3. Results

The search provided a total of 75 references. After removal of duplicates, 48 articles remained. In addition, 13 articles were identified by manual search. The remaining 61 articles were thereafter reviewed in their entirety to determine whether each article met the inclusion criteria. Eleven articles fulfilled the pre-established criteria for inclusion (Table 1). Fifteen were excluded due to being in a language other than English, eleven were not peer-reviewed publications, eighteen contained a lack of information on vibration, and six were not original research (reviews).

Table 1. The included studies, reference, and assessed risk of bias according to the predefined criteria, summarized for diagnosis, exposure, methodology, and summed as a total. The articles are sorted in descending order based on the summed risk of bias. A high total number implies high reliability or an expected small impact on the result from the interfering factors.

Study	Ref.	Diagnosis	Exposure	Methods	Total
Bovenzi (1994)	[3]	5 *	7	6	18
Morelli et al. (2017)	[4]	7 **	1	8	16
Haines et al. (2017)	[5]	5 **	2	8	15
Murinova et al. (2021)	[6]	5 **	3	6	14
Palmer et al. (2014)	[7]	2 *	7	4	13

Table 1. *Cont.*

Study	Ref.	Diagnosis	Exposure	Methods	Total
Descatha et al. (2012)	[8]	5 **	1	4	10
Burke et al. (2007)	[9]	4 **	1	4	9
Lucas et al. (2008)	[10]	4 **	1	4	9
Dasgupta and Harrison (1996)	[11]	3 *	1	4	8
Descatha et al. (2014)	[12]	1 **	1	6	8
Thomas and Clarke (1992)	[13]	4 **	1	2	7

* Dupuytren´s contracture only. ** Dupuytren´s contracture or Dupuytren´s disease without information on contracture.

3.1. Meta-Analysis of the Studies of the Groups "Exposed" versus "Not Exposed" to Vibration

A risk of 2.3 (95% CI 1.6–3.3) for Dupuytren's disease was obtained when the groups exposed to vibration were compared to the unexposed reference groups (Figure 1). In the forest plot, the studies are ranked in descending order with respect to the reliability (risk of bias).

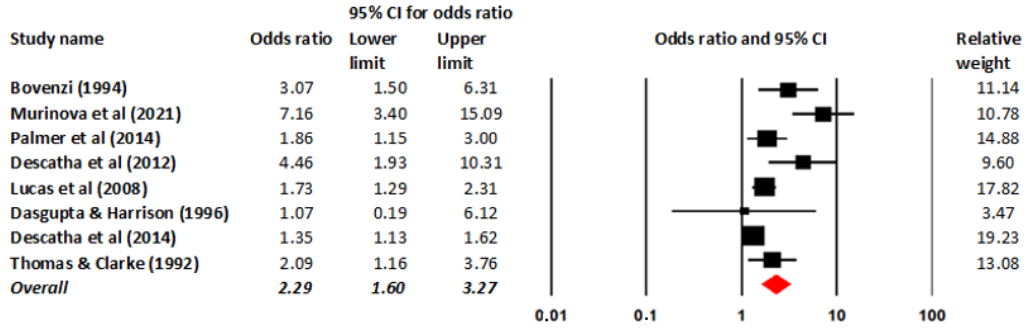

Figure 1. Statistics and the "forest plot" with the "random—effect" meta-analysis of the odds ratios of Dupuytren's disease in the vibration-exposed and non-vibration-exposed groups. The studies [3–13] are sorted in order from the highest to the lowest reliability score, according to risk of bias shown in Table 1.

3.2. Meta-Analysis of the Studies of "Low Exposure" Compared to "High Exposure"

Figure 2 shows the results of the meta-analysis for the studies that compared the risk of Dupuytren's disease between groups exposed to different levels of vibration. The analysis compared similar groups of men exposed to vibration at different exposure levels. The lowest exposure group was defined as "low exposure" and the highest exposure group as "high exposure" (Figure 2). A risk of 2.2 (95% CI 1.2–3.9) for Dupuytren's disease was obtained when the groups with "low" vibration exposure were compared to the "high"-exposure groups (Figure 2).

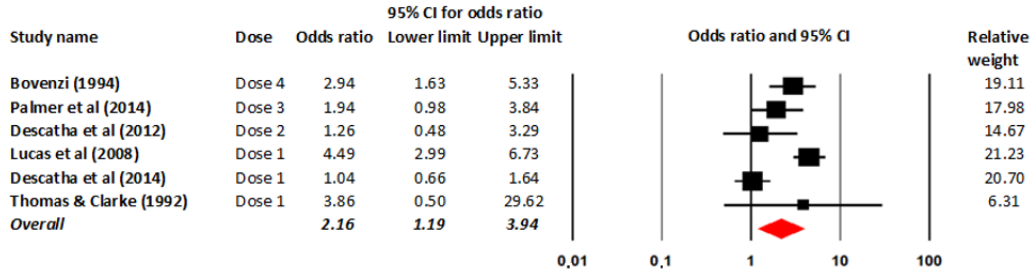

Figure 2. Statistics and the "forest plot" with "random—effect" meta-analysis of the odds ratios of Dupuytren's disease in the vibration-exposed and non-vibration-exposed groups. The studies [3,6–8,10–13] are sorted in decreasing order from the highest to the lowest reliability score, according to the rated risk of bias (Table 1).

4. Discussion

The combined results from the narrative and statistical synthesis support the conclusion that work with vibrating machines may constitute a single risk factor for Dupuytren's disease, given that the scientific basis is small, that there is an interaction between age and exposure, and that there may be individual differences in predisposition. The findings support an association between vibration and Dupuytren's disease.

Author Contributions: Conceptualization, T.N., J.W., E.R. and L.B.; methodology, T.N., J.W., E.R. and L.B.; literature search, E.R.; formal analysis, T.N., J.W., E.R. and L.B. writing—review and editing, T.N., J.W., E.R. and L.B. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by Swedish AFA Insurance (Dnr: part of project 090326).

Data Availability Statement: Additional information is presented in reference [2].

Conflicts of Interest: The authors declare no conflict of interest.

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