

Repeated Mechanical Trauma to the Hands: The Use of Anti-Impaction Gloves for Treatment and Return to Work

Tiffany Kwok, Victoria Arrandale, and Sandy Skotnicki-Grant

Background: Repeated mechanical trauma to the hands can result in frictional hand dermatitis (FHD) and (in some cases) hyperkeratotic hand dermatitis (HHD), forms of irritant contact dermatitis. These conditions can be chronic and debilitating and are often refractory to many therapies. Most case reports of FHD describe avoidance of frictional trauma as a management solution. This is the first study to examine anti-impaction gloves as a treatment for FHD.

Objective: To determine whether anti-impaction gloves are effective in helping patients with FHD and HHD return to work.

Methods: We describe a small case series of a subset of patients who presented to our occupational contact dermatitis clinic between January 2004 and June 2008 with either HHD or FHD. Of the 11 patients evaluated, 9 had a diagnosis of FHD and 2 were diagnosed with HHD. They were all treated with anti-impaction gloves, tazarotene cream (Allergan, Inc., Irvine, CA), and clobetasol propionate ointment (Taro Pharmaceuticals Inc., Brampton, Ontario, Canada) and were followed over the long term to determine the impact of treatment on their ability to maintain their jobs. All but one began use of anti-impaction gloves in the workplace.

Results: All patients with FHD were able to return to work with the use of anti-impaction gloves, topical treatments, and (in some cases) modified work duties. Neither of the two cases of HHD resolved with treatment or with discontinuation of work.

Conclusion: Anti-impaction gloves are shown to aid in the return-to-work process for those with FHD but not for those with HHD.

THIS STUDY is the first to investigate anti-impaction gloves as a treatment for frictional hand dermatitis (FHD) and examines, through the clinical study of 11 patients for 4 to 52 months, whether anti-impaction gloves help those with hyperkeratotic hand dermatitis (HHD) and frictional hand dermatitis return to work. Reports on the treatment and prevention of HHD and FHD, which are forms of irritant contact dermatitis (ICD) caused by repeated mechanical trauma to the hands, are sparse.

In 1983, the US National Institute of Occupational Safety and Health held an international symposium on ICD treatment and prevention. A commentary from Dr. Albert Kligman stated the following: "Few dermatologists have made repeated mechanical trauma a focus of their professional interest. This neglect is curious, since contact dermatitis from chemicals is a subject that has received vast attention. After all, skin disorders provoked by physical stress can be viewed as another category of

'contact' dermatitis and are probably of equal prevalence and importance."¹

HHD was first described by Sutton and Ayres in 1953.² In two different studies, it was found to represent about 2% of all hand dermatoses.^{3,4} Most common in males aged 40 to 60 years, this condition is characterized by symmetrical hyperkeratotic plaques on the proximal or middle parts of the palms, the soles, or both. Itching can be a factor, and painful fissures usually develop. There is typically an absence of psoriatic nail or scalp changes.

A pivotal study by Hersle and Mobacken in 1982 attempted to classify this condition.⁵ For 10 years, they studied 32 patients with a mean age of 57 years. Included patients had palmar, circumscribed, infiltrated, and often scaling plaques and an absence of psoriasis on the rest of the body at the initial visit. Approximately one-third of the patients were employed in hard manual labor at enrollment. Fungal scrapings were completed on 20 patients and were found to be negative. Biopsy specimens from nine patients showed spongiotic dermatitis. Patch-test results were negative, serum immunoglobulin E levels were normal, and determinations of human leukocyte antigens were nonspecific when compared to controls.

During the 10-year follow-up, only one patient developed psoriasis elsewhere on the body; lesions were consistently present in 26 patients despite discontinuation of work duties for some. Hersle and Mobacken concluded

From the James R. Nethercott Occupational Health Clinic, Occupational Disease Specialty Program, St. Michael's Hospital, University of Toronto, Toronto, Ontario, Canada.

Address reprint requests to Sandy Skotnicki-Grant, MD, Occupational Health Clinic, St. Michael's Hospital, Shuter Wing, 4th Floor, 30 Bond St., Toronto, Ontario. E-mail: sandyskotnicki@baydermatologycentre.com

DOI 10.2310/6620.2009.09030

© 2009 American Contact Dermatitis Society. All Rights Reserved.

DECKER_X



it was conceivable that chronic mechanical trauma contributed to the pathogenesis of this disease; however, there was no indication of ongoing mechanical trauma in almost two-thirds of the patients in this study.

FHD can be defined as an eczematous process in which physical frictional trauma on the hands primarily causes or secondarily contributes to the induction of a dermatitis process.⁶ It is similar to HHD but is distinguished by a mechanical factor (such as trauma, friction, pressure, or vibration) to which disease activity is closely correlated. This condition is frequently seen in patients who repeatedly handle paper, cardboard, fabric, or small metal or plastic components.⁷ Cases have been reported among carpet installers and among workers who handle pressure-sensitive carbonless paper, repeatedly use paper tissues, are rubbed by clothing, or repeatedly handle plastic bags.^{8–11}

Work-related FHD may take years to develop. The clinical findings depend on the intensity and chronicity of the mechanical stimulus. Clinically, hyperkeratotic non-itchy plaques develop on the lateral index finger, the thumbs, the palms, and the pads of the fingers. Painful fissures can develop. Unlike patients with HHD, patients with FHD generally improve when removed from the repeated frictional activities.

Treatment of HHD and FHD is notoriously difficult. Topical therapies include emollients, glucocorticoids, oral retinoids, methotrexate, and psoralen plus ultraviolet A (PUVA).¹² A recent double-blind placebo-controlled study including 30 patients with HHD statistically showed retinoids to be significantly more effective than placebo.¹³

Our specialty clinic serves patients with suspected occupational skin diseases. Patients presenting with HHD and FHD are patch-tested, generally with negative results. They tend to do poorly upon return to work, even with modified work duties. Owing to this, we decided to shift our focus to personal protective equipment. Our clinic also treats patients suffering from hand-arm vibration syndrome as a result of hand-arm vibration exposure. In these cases, anti-impaction gloves filled with air or gel are often used with favorable results.

As HHD and FHD often result from microtrauma due to vibrational or frictional forces, we hypothesized that patients might improve with the use of an anti-impaction glove (filled with a light gel) providing coverage of at least the palms and (in some cases) the proximal section of the fingers.

Methods

All patients gave verbal consent to be included in the study. Between November 2004 and April 2008, 11 patients

with a diagnosis of HHD or FHD were prescribed various styles of gel anti-impaction gloves as described below. The choice of glove was dictated by the type of work activity and the distribution of dermatitis on the hands.

Six cases were referred from the Ontario Workplace Safety and Insurance Board for evaluation in our clinic. Complete skin evaluation was completed in all patients. In addition, personal, family and occupational histories (including information on hobbies) were taken. Patch testing with the North American Standard and relevant occupational trays was completed on five patients. All patients were prescribed morning tazarotene 0.1% cream and nightly clobetasol propionate ointment. Because of the hyperkeratotic component and the generally favorable response to oral retinoids, it was felt that a topical retinoid might be useful.¹³ One patient with a concurrent diagnosis of psoriasis was also treated with methotrexate (22 mg weekly).

Four different types of anti-impaction gloves were used, all manufactured by Impacto Protective Products, Inc. (Belleville, Ontario, Canada). Impacto Model 501-00 is a fingerless cotton/Lycra glove liner with viscoelastic polymer (VEP) padding, usually used under nitrile gloves (Fig 1). Model BG600 is a type of nitrile-dipped full-finger glove using patented Air Bubble technology (Fig 2). Model 525-20 is a three-quarter-finger nylon/Lycra leather glove with VEP padding in the fingers, palms, and webs. Model 601-00 is a full-finger cotton/Lycra glove liner with VEP padding.

Results

The demographic characteristics of the 11 patients evaluated are summarized in Table 1. Five patients (45.5%) were female. The mean age at the onset of hand



Figure 1. Impacto 501-00 Glove Liner worn by patient 10.

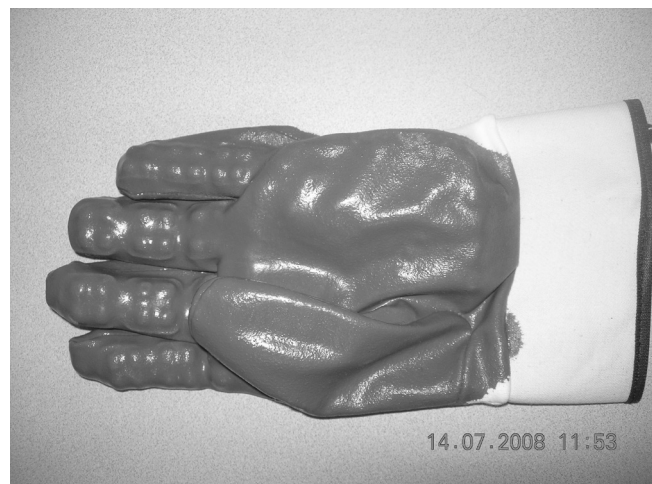


Figure 2. Impacto BG600 nitrile-dipped Anti-Vibration Air Glove.

dermatitis was 48 years. Nine patients (81.8%) were diagnosed with FHD, and 2 patients (18.2%) were diagnosed with HHD. One patient (9.1%) had a history of psoriasis, and no patients had a history of atopy. The patients had spent an average of 11.8 years in their occupations and a maximum of 2 years with active disease

before receiving a diagnosis of HHD or FHD. Patch testing with the North American standard and relevant occupational trays was completed in 5 patients and yielded negative results in 4 patients.

The occupational characteristics of these patients are described in Table 2 (the patient numbers correspond to those in Table 1). The Impacto glove models recommended to patients were 501-00 (see Fig 1) for 6 patients, BG600 (see Fig 2) for 4 patients, and 525-20 and 601-00, used for 1 patient each. Each patient's occupational status was followed up for 4 to 52 months. The majority of patients were able to return to work by using anti-impaction gloves, tazarotene and clobetasol topical treatment, and varying degrees of job modifications. The two patients for whom gloves, topical treatments, and modified duties failed to allow a return to work were those with a diagnosis of HHD.

Discussion

A return-to-work (RTW) protocol consisting of anti-impaction gloves, topical treatments, and modified duties

Table 1. Demographic Characteristics of Study Patients

Patient	Age	Sex	Duration of Disorder (yrs)	Time in Job before Diagnosis (yrs)	Diagnosis	History of Psoriasis	History of Atopy	Patch-Test Reactions
1	61	F	1	7	FHD	—	—	— to NAS, oils/coolants
2	34	M	2	8	HHD	—	—	— to NAS, oils/coolants, mechanic series
3	58	M	2	7	FHD	—	—	— to NAS, d-limonene, triethanolamine, wood mix, benzalkonium chloride
4	48	F	1	14	FHD	—	—	(Not tested)
5	38	M	2	0.5	FHD, ACD	—	—, history of ACD	NAS, rubber tray; + to formaldehyde, quaternium-15, diazolidinylurea, ethyleneurea/melamine formaldehyde, dimethylol dihydroxyethyleneurea, nickel, neomycin
6	38	M	< 1	10	HHD	—	—	(Not tested)
7	51	F	< 1	29	FHD	—	—	(Not tested)
8	39	M	2	12	FHD	—	—	— to NAS, oils/coolants
9	50	F	2	2	FHD	+	—	(Not tested)
10	60	F	< 1	10	FHD	—	—	(Not tested)
11	50	M	2	30	FHD	—	—	(Not tested)

ACD = allergic contact dermatitis; F = female; FHD = frictional hand dermatitis; HHD = hyperkeratotic hand dermatitis; M = Male; NAS = North American Standard series.

Table 2. Occupational Characteristics of Study Patients

<i>Patient</i>	<i>Diagnosis</i>	<i>Job</i>	<i>Impacto Glove Used</i>	<i>Length of Follow-Up (mo)</i>	<i>Long-Term Results</i>
1	FHD	Automotive assembly worker	501-00 plus nitrile glove	22	Continues to work (with gloves, topicals) Modified duties (less repetitive handling of parts)
2	HHD	Automotive die setter	BG600	19	RTW failed with gloves and Rx Labor market reentry Persistent chronic hand dermatitis
3	FHD	Custodian	525-20	11	Continues to work (with gloves, topicals) Modified duties (decreased repetitive friction)
4	FHD	Paramedic	501-00 plus nitrile glove	18	Continues to work (with cheaper gloves, topicals) Modified duties (partner moves stretcher, foam tubing on stretchers)
5	FHD, ACD	Machine operator	BG600, 601-00	4	Continues to work (with gloves) Positive patch-test results may be relevant; Patient avoiding positive patch tests allergens
6	HHD	Shipper/receiver	BG600*	16	RTW, PUVA, MTX failed Persistent chronic hand dermatitis Chronic disability claim accepted
7	FHD	Dental hygienist	501-00 plus nitrile glove	24	Continues to work (with gloves, topicals) Modified duties (decreased handling of vibrational tools)
8	FHD	Machine operator	BG600	11	Continues to work (with gloves) Little to no modification of duties
9	FHD	City bus driver	501-00 plus gel sleeve	52	Continues to work (with gloves, gel sleeve, and MTX 22 mg weekly) No modification of duties
10	FHD	Office worker/government clerk	501-00	6	Continues to work (with gloves, topicals) No modification of duties
11	FHD	Letter carrier	601-00	4	Continues to work (with gloves, topicals)

501-00 = Impacto Anti-Impact Glove Liner; 525-20 = Impacto Palm/Web Glove Liner (leather with gel and three-quarter-finger glove); 601-00 = Impacto full-finger gel gloves; BG600 = Impacto Anti-Vibration Air Gloves (nitrile-dipped) bubble glove; FHD = frictional hand dermatitis; HHD = hyperkeratotic hand dermatitis; MTX = methotrexate; PUVA = psoralen plus ultraviolet A; RTW = return-to-work process; Rx = treatment.

*Prescribed.

was shown to benefit all individuals diagnosed with FHD but was not helpful for those diagnosed with HHD. Given that frictional trauma has been shown to be directly associated with the onset of FHD, the wearing of anti-impaction gloves helps lessen the trauma to the hands and therefore decreases the resulting dermatitic changes. In a few cases, the use of anti-impaction gloves alone was able

to relieve the patient's FHD without any job modifications. Figure 3 shows a case of FHD in a postal office worker. The FHD has resolved since the worker has been wearing Impacto 501-00 gloves (see Fig 1) at work and using topical retinoids and glucocorticoid creams as needed. Whereas most case reports of FHD prescribe avoidance of frictional trauma as a management solution, this study



Figure 3. Frictional hand dermatitis in patient 10 before use of Impacto 501-00 Glove Liners and topical therapy.

indicates that prevention and management of the condition may be possible without complete removal of the occupation-related frictional trauma.

None of the RTW efforts, however, was able to improve a patient's HHD. This is consistent with prior investigations, in which only 6% of individuals with HHD were clear of skin changes at a 10-year follow-up, and 80% of individuals had ongoing lesions (with no lesion-free periods).⁵ Both individuals with HHD in our study were unable to complete the RTW process, and their hyperkeratotic lesions remained on their hands even in the absence of work. One patient was accepted into a Workplace Safety and Insurance Board program that retrain workers for another occupation. The other patient obtained a chronic disability claim. Figure 4 shows HHD on patient 6, who worked in shipping and receiving. He was prescribed model BG600 gloves but did not return to work; he successfully applied for chronic disability status and remained with unresolved HHD while off work.

As insurance boards learn about the distinction between FHD and HHD and particularly about the lack of improvement in HHD after its onset, we hope that more cases will be properly diagnosed and appropriately managed.

The occupations of the individuals in our study varied greatly; however, occupation-related frictional exposures were identified in all patients. These frictional exposures were similar to those reported in a past study; they included exposure by handling metal parts, handling paper, and driving.⁷ Hobby-related frictional activities contributing to the diagnosis were found to be relevant for



Figure 4. Hyperkeratotic hand dermatitis in patient 6.

one patient, who participated in woodworking. Regardless of the type of frictional exposure, all cases of FHD improved with anti-impaction gloves, topical treatments, and (in a subset) modified work duties.

The association between FHD or HHD and other dermatologic comorbidities, such as atopic dermatitis or psoriasis, has not been well established. In our study, none of the patients reported a personal history of atopy, and just one patient (9.1%) had a significant family history of atopy. This is in contrast to past studies, in which 41% of subjects had a history of atopic dermatitis, and 29% had a history of other atopic disorders.⁷ In a study of HHD, 6.9% of patients were found to have current or past atopic dermatitis.¹³ Likewise, only 1 of 9 patients (11.1%) in our study population with FHD described a history of psoriasis, compared with 15% of patients with FHD and 14.8% of patients with HHD in previous studies.^{7,13}

The Koebner effect has been shown to worsen friction-related dermatitis in those with psoriasis.^{6,7} However, the individual with psoriasis in our study was well controlled with long-term methotrexate therapy. This may have diminished the effects of psoriasis on the patient's FHD, allowing a more straightforward management of the dermatitis. This patient successfully returned to work, with no work modifications, using anti-impaction gloves and topical treatments.

Of the five individuals who were patch-tested, only one showed positive reactions to an allergen. This is confirmatory evidence of FHD and HHD as distinct from an allergic contact dermatitis, as delineated in previous studies.^{5,7,12} The individual who tested positive had reactions to formaldehyde, quaternium-15, diazolidinylurea, ethyleneurea/melamine formaldehyde, dimethylol

dihydroxyethyleneurea, nickel, and neomycin. It was not determined whether these allergies were relevant to the onset of the patient's disease and to his workplace. The patient nevertheless received education in the avoidance of these allergens.

In our case series of those with FHD, employer compliance with RTW job modification has been shown to aid patients' recovery from occupational skin disease. Many patients were able to return to work but still needed a modification of job duties to reduce the amount of trauma to the hands; such a change requires a flexible and accommodating employer. In addition, cost is an issue with the gloves that were recommended to our patients. One paramedic found that the anti-impaction gloves were being soiled with human fluids too frequently to be constantly replaced without incurring high costs. This patient has since switched to N-DEX NightHawk disposable nitrile gloves (Best Glove Manufacturing Ltd., Coaticook, Quebec, Canada). In addition, the patient used tazarotene and clobetasol creams, and the patient's job was modified to decrease the transportation of stretchers. The employer may also elect to pay for the expensive anti-impaction gloves required. The company that employed one patient (a machine operator) bought and supplied the patient with the BG600 bubble glove, contributing to the patient's successful RTW process. However, because HHD is not clearly associated with occupation-induced mechanical trauma and tends to persist despite changes in occupational duties, the efforts of employers to aid in the RTW process of workers with HHD have not been successful.

Conclusion

Frictional hand dermatitis and hyperkeratotic hand dermatitis remain challenging entities to manage. In individuals with frictional hand dermatitis, however, the use of anti-impaction gloves, along with topical retinoids and glucocorticoids and modified work duties, has been

shown to improve prognosis in the return-to-work process. Conversely, hyperkeratotic hand dermatitis has been shown to persist despite minimization of the frictional trauma incurred by the patient.

Acknowledgments

Financial disclosures of author(s) and reviewer(s): None reported.

References

1. Kligman MA. The chronic effects of repeated mechanical trauma to the skin. *Am J Ind Med* 1985;8:257–64.
2. Sutton RL, Ayres S Jr. Dermatitis of the hands. *Arch Dermatol Syph* 1953;68:266–85.
3. Meding B, Swanbeck G. Epidemiology of different types of hand eczema in an industrial city. *Acta Derm Venereol* 1989;69: 227–33.
4. Menne T, Bachman E. Permanent disability from skin diseases. *Dermatosen* 1979;27:37–42.
5. Hersle K, Mobacken H. Hyperkeratotic dermatitis of the palms. *Br J Dermatol* 1982;107:195–202.
6. Samitz MH. Repeated mechanical trauma to the skin: occupational aspects. *Am J Ind Med* 1985;8:265–71.
7. McMullen E, Gawkrödger DJ. Physical friction is under-recognized as an irritant that can cause or contribute to contact dermatitis. *Br J Dermatol* 2006;154:154–6.
8. Menne T, Hjorth N. Frictional contact dermatitis. *Am J Ind Med* 1985;8:401–2.
9. Menne T. Frictional dermatitis in post-office workers. *Contact Dermatitis* 1983;9:172–3.
10. Inui S, Itami S, Katayama I. Frictional dermatitis due to paper tissues. *Contact Dermatitis* 2004;50:374–5.
11. Tan HH, Tsu-Li Chan M, Goh CL. Occupational skin disease in workers from the electronic industry in Singapore. *Am J Contact Dermat* 1997;8:210–4.
12. Mobacken H, Rosen K, Swanbeck G. Oral psoralen photochemotherapy (PUVA) of hyperkeratotic dermatitis of the palms. *Br J Dermatol* 1983;109:205–8.
13. Thestrup-Pedersen K, Andersen KE, Veien NK, et al. Treatment of hyperkeratotic dermatitis of the palms with retinoid. A double-blind, placebo-controlled study. *Acta Derm Venereol* 2001;81: 353–5.