CARPAL TUNNEL SYNDROME SCREENING IN A WORKPLACE

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ABSTRACT

Objective: The aim of this study is to identify frequency of hand discomfort and probable carpal tunnel syndrome cases in order to create awareness among workers, also at trade union level.

Methods: A screening program for carpal tunnel syndrome was carried out at a medium-size workplace in the Industiral area of Umraniye Istanbul, from March to May in 1997.

Two hundred and thirty-nine workers at risk for carpal tunnel syndrome due to the nature of their occupation were screened using standardized physical examination, a hand pain diagram and a questionnaire. The response rate was 99.3%.

Results: Eighty-six of the workers were found to have positive hand symptoms. The cases were mostly people with occupations such as sewing machine operators. Seventeen cases with high priority for carpal tunnel syndrome were reported to the physician of the workplace to be referred to the hospital for further evaluation.

Conclusion: In order to observe to know the real dimensions of the problem, prevelance studies are necessary. Taking into account the working conditions and detected frequency of hand problems, an "ergonomic awareness program" could be introduced for employers, employees and trade union representatives at the Umraniye Organized Industry Area of Istanbul.

Key Words: Carpal tunnel syndrome, Screening, Hand discomfort.

INTRODUCTION

Carpal tunnel syndrome (CTS) is a major problem among MSDs, particularly in occupations requiring highly repetitive and/or forceful hand motions. Of the repetitive motion disorders associated with work-related exposures, "occupational" carpal tunnel syndrome (OCTS) is a commonly recognized example. In recent years, numerous articles have extensively reviewed the literature relating occupational factors to the development of CTS.

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Most of these reviews reach a similar conclusion—work factors are one of the important causes of CTS. It has been stated that the epidemiological studies revealed a fairly consistent pattern of observations regarding the spectrum and relative frequency of CTS (among other MSDs) among jobs believed to be hazardous (1, 2).

According to a report of the National Institute of Occupational Health and Safety (NIOHS) (1), there is evidence of a positive association between highly repetitive work alone or in combination with other factors and CTS based on currently available epidemiological data. Evidence of a positive association between forceful work and CTS has been demonstrated. There is also evidence of a positive association between work involving hand/wrist vibration and CTS. The strongest evidence is a positive association between exposure to a combination of risk factors (e.g., force and repetition, force and posture) and CTS.

Up to 15 percent of workers in the highest risk industries are affected annually, 100 times more than expected in an age and sex adjusted population. Costs per worker may exceed $15 000, including medical and indemnity expenses (3-6). Ergonomic factors believed to cause these disorders include rapid hand motions, repetitive bending and twisting of the hands and the wrist, fast work pace, repetitive grasping with the fingers, mechanical stress at the base of the palm, awkward hand postures and use of vibrating tools (3, 4, 6-10). CTS has been associated with a variety of occupations including meat packing, aircraft and bearing manufacturing, sewing, grocery checking, assembly workers, boot and shoe manufacturing, supermarket cashiers, use of video display terminals and many others.

The morbidity, lost productivity and medical costs associated with occupational CTS are likely to be substantial. A program aimed at disease prevention, particularly for workers in industries and occupations with a large number of cases, would be a valuable public health service to the workers and their employers (9).

Even though secondary prevention measures such as screening and early diagnosis of the work-related disorders have been emphasized in international literature for a long time, this approach has not yet been carried to the agenda of occupational health in Turkey. In Turkey, historically, occupational problems, including work-related disorders have received much less government, contractor and union interest than acute or fatal injuries. There is no regular data collection system in occupational health even though CTS like work related MSDs are commonly occurrences. An unpublished study held in a highly industrialized province of the Marmara region, Kocaeli, has shown that risk factors related to posture, ergonomics and repeated traumas were common, particularly in the food production industry (11).

Although surgical treatment of CTS will remain the responsibility of other specialties, diagnosis, initial treatment and occasionally definitive treatment will increasingly be managed by the primary care physician (12). Nerve conducting testing is generally regarded as the gold standard for the diagnosis of carpal tunnel syndrome, which is approximately 90% sensitive and 60% specific. However it costs $ 150 to $ 500, causes discomfort and also requires 30 to 60 minutes, expensive equipment and experienced personnel. Thus it may be inappropriate for many occupational surveillance efforts. The clinical history and physical examination are inexpensive and simple to administer but are of limited value in the diagnosis of carpal tunnel syndrome. Tinel's and Phalen's signs, traditionally considered valuable in the diagnosis of CTS, have been shown to have sensitivities in the range of 20% to 70% and specificity of 70% to 80% (5).

NIOSH recently approved a surveillance case definition for work-related carpal tunnel syndrome, which has 67% sensitivity and 58% specificity (4).

Interventions to improve physical functional status may be successful in some work settings and not in others. It would be inappropriate to focus on the individual side of the equation (functional status) to the exclusion of the workplace, especially if function cannot be improved in a particular work setting. Thus, the worker's ability must be viewed in its workplace

context, and intervention strategies must be tailored accordingly to address worker and workplace factors (13).

In this study, 239 workers accepted to be at risk for CTS, due to the nature of their occupation, were screened using standardized physical examination, hand diagram and questionnaire.

The aim of this study was to identify possible cases of CTS, give guidance for further diagnostic and therapeutic procedures, create awareness not only among these possible cases, but among all workers, also at trade union level, in order to develop preventive strategies.

MATERIALS AND METHODS

Study Area. A screening program for carpal tunnel syndrome was carried out at a medium size workplace in the industrial area of Umraniye, Istanbul, from March to May in 1997. Umraniye is a distict of Istanbul, which has developed very rapidly. The population is almost 700.000 and the age structure of the population is very young due to the high fertility and high immigration rate. There is a large 'organized industrial area' consisting of hundreds of small and medium-size work place. These workplaces include various industries like clothing and shoe industry, assembly industry, textile, food and metal industry. The manufacturing processes are generally based on working with the hands and require repetitive and/or forceful hand motions e.g. machine operators, sewing, packaging and pressing.

Data collection. Two researchers interviewed the workers using a face-to-face questionnaire. The response rate was 99.3%. Permission was asked from the employer by the general practitioner who was in charge of workplace health services. The general practitioner was also involved in the planning and analyzing of the study.

The questionnaire included routine questions for demographic data and questions on known risk factors for CTS (14), including history of carpal tunnel syndrome, diabetes, thyroid disease, alcohol consumption, chronic renal disease, inflammatory arthritis of the wrist and occupation. The duration and character of the symptoms were also recorded.

The workers who reported hand and/or wrist discomfort during the previous month were tested by the hand diagram method. Workers were asked to shade in the areas of their different symptoms on the diagram. Different colors were used for different symptoms such as pain, tingling, etc.

A standardized physical examination was also performed. Tinel and Phalen provocative tests were applied to the all workers by other researchers who were blind to the results of questionnaire and the hand diagram.

All members of the research group attended one-day training programs in order to become competent in the application of provocative tests. After completion of the data collection, diagrams were rated blindly by another investigator.

This study design is presented in Fig. 1.

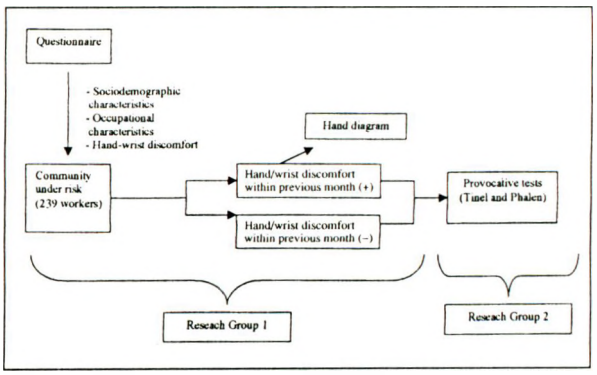

Fig.1 : The study design

Case definitions. Cases were defined according to the NIOSH surveillance case definition of CTS (3). This definition is intended to assist health care providers and health department personnel in identifying cases of CTS that may be work-related so that further investigation and preventive activities can be directed at selected high-risk workplaces (15).

Data analysis. SPSS for Windows program was used for the data analysis. A significance level of 0,05 was used for chi-square test. The results of the hand diagram were classified as "classic carpal tunnel syndrome" "probable", or "unlikely"

(16). The reproducibility of the classification system was evaluated by another study and found to be 84% (7).

Provocative tests were considered positive if a positive finding was noted in one or both hands (14).

RESULTS

Two hundred and thirty nine workers were evaluated in this study: 60.3% of the workers were male. Other baseline demographic features of the workers are summarized in Table I.

Table I.: Demographic characteristics of the workers (Istanbul, 1997)

	(n=239)	%
Sex		
Male		60.3
Female		39.7
Age Group		
15-19		42.3
20-24		26.8
25-29		15.9
30-34		8.8
35 and above		6.2
Education		
Illiterate		5.0
Primary school		66.5
Secondary school		17.2
High school and higher education		11.3

The mean duration of the current work was found to be 21.3 months. Current occupations of workers are presented in Table II. The majority of the workers (57.3%) were sewing machine operators, followed by workers (ortacı) who collect and carry away the products as well as distribute the materials used for production (24.7%). 32.2% of the workers reported that they were unemployed before their current work; 24.4% of the workers were used to having a job requiring highly repetitive and/or forceful hand motions.

Fifteen percent of the 239 workers had experienced hand or wrist discomfort such as numbness, pain or tingling in at least one extremity during the previous month. The females reported higher discomfort rates than males, and the difference was found statistically significant (Table III). 63.9% of those indicated that their symptoms were worse during daytime at work. Other features of the workers who had discomfort are presented in Table III.

Table II.: Distribution of the workers according to their current occupations (Istanbul, 1997)

Current occupation (n=239)	%
Sewing Machine Operator	57.3
"Ortacı"*	24.7
Administrator	8.4
Press	3.8
Cleaning	2.5
Other	3.4

* Personnel responsible for distribution and collection of pre and post-production materials to the workers.

Table III.: Characteristics of the workers who reported Hand/Wrist discomfort (Istanbul, 1997) (n=36)

	n	%
Sex[a]		
Male	16	44.4
Female	20	55.6
Age Group[b]		
14-24	29	80.6
25-55	6	19.4
Occupation[b]		
Sewing machine operators	22	61.1
Administration	13	36.1
Duration of current work (month)		
3 and below	5	13.9
4-6	7	19.4
7-12	16	44.4
13 and above	8	22.3
Time at which symptoms occur[b]		
Day time (at work)	23	63.9
During sleep	10	27.7
In the evening	2	5.6
Duration of the symptoms (month)		
2<	11	30.6
2-12	21	58.2
>12	2	5.6
Not specified	2	5.6

[a] x^2= 4,42; df=1; p<0,05
[b] Data missing for one patient

The workers who reported hand/wrist discomfort were tested by the hand diagram method. Five of these workers were classified as'classic CTS'

according to the result of the hand diagram in at least one hand. One of the 5 workers reported thyroid disease. The others were classified as 'probable CTS' and 6 of them had had arm or wrist fractures in the past.

We assessed the results of different tests in various combination in order to increase the diagnostic value and decide which groups of workers had priority for further evaluation (17). We classified the workers as "having positive hand symptoms" if they reported hand/wrist discomfort and/or if they showed positive results in at least one of the provocative tests. From the results, the proportion of the workers having positive hand symptoms was found as 35.9% (86 workers). There were more women with positive hand symptoms than men and the difference was significant (Table IV).

Results of the screening and the validity of combinations of clinical findings are shown in Table V (14). The presence of both a positive Tinel sign and a probable or classic hand diagram was associated with impressive specificity (0.89). The presence of a positive Phalen sign and a probable or classic hand diagram rating was also valuable. These data illustrate that the optimal choice of tests or combination of tests depends on whether the goal is to establish diagnosis of the carpal tunnel syndrome or to exclude it. In this study specificity was taken into account in order to exclude the healthy workers and refer the problematic cases to secondary care for further diagnostic and therapeutic evaluation. Therefore 17 of 86 workers found to "have discomfort and positive results of Tinel or Phalen"; or "positive results of Tinel and Phalen" were selected as priority groups to be referred to the hospital.

DISCUSSION

It has been shown that screening studies of high-risk groups may provide benefits for early detection and treatment (2), so that early detection conservative therapy can be selected. Early detection can also be used to define occupational risk factors and identify intervention strategies. Such a program aimed at disease prevention, particularly for workers in industries and occupations with a large number of cases, is a valuable public health service to the workers and their employers. Also the development of engineering and administrative controls for the prevention of work-related musculoskeletal disorders requires knowledge of occupational risk factors for the development of such disorders (10).

Such studies provide a limited prevalence data, which is necessary to develop common screening policies and programs.

It is reasonable to conclude that a substantial proportion of these conditions are occupational in origin among groups with the highest prevalence estimates. Therefore, the prevalence estimates reported here identify occupation in which efforts are needed to reduce and prevent these common occupational conditions.

Work related CTS can be prevented through careful evaluation of workplace ergonomic risk factors and redesigning the tools, workstations, and job tasks potentially responsible for the problem (18). Although CTS is a multifactorial condition, occupational risk factors are particularly remediable. Timely recognition of cases, appropriate clinical management, and reporting of work-related cases can help limit

Table IV.: Sex distribution of workers detected as having "Positive Hand Symptoms"* and who were not (Istanbul, 1997)

SEX	Positive hand symptoms (+)		Positive hand symptoms (-)		Total**	
	n	%	n	%	n	%
Male	41	28.5	103	71.5	144	60.2
Female	45	47.4	50	52.6	95	39.8
Total	86	35.9	153	64.1	239	100.0

* Reported discomfort and/or (+) Tinel and/or (+) Phalen results
** Column percent; the others row percent.
(x^2= 8,87; df=1; p<0.05)

Table V.: Results of the screening and validity of the combination of clinical findings – (Istanbul, 1997)

Results of the screening	n	%	Sensitivity*	Specificity*
Reported hand discomfort	36 workers	15.0	-	-
Hand diagram rating or positive test result	86 workers	35.9	-	-
Hand diagram rating and [(Tinel +) or (Phalen +)]	17 workers**	7.5	-	-
Hand diagram rating, Tinel (+) and Phalen (+)	9 hands (8 workers)	3.3	-	-
Tinel (+) and Phalen (+)	33 hands (21 workers)	8.8	0.46	0.73
Hand diagram rating and Tinel (+)	20 hands (16 workers)	6.7	0.39	0.89
Hand diagram rating and Phalen (+)	12 hands (10 workers)	4.1	0.49	0.83
Tinel (+) or Phalen (+)	100 hands (71 workers)	29.7	0.88	0.41

* Reference number: (14)
** They were referred to the hospital for further evaluation

morbidity among existing patients. Physicians working in partnership with public health agencies can also help to prevent future cases. Diagnostic criteria, when appropriately designed, can be a valuable tool in both managing and preventing this condition (15).

The typical patient with CTS as originally described by Phalen is a late middle-aged woman who suffers from pain and parenthesis in the thumb, index finger, long finger and radial half of the ring finger, most often at night (19). Also in this study the prevalence of both hand discomfort and positive hand symptoms were found to be higher among women, probably because of their home-related work such as cleaning, sewing etc.

The workers with hand discomfort reported that their symptoms got worse during daytime, especially at work (Table III). This finding is more likely to be due to the workers' desire to signify unpleasant job conditions as worsening factors of their discomfort.

The findings of this study should be confirmed in an independent population in order to evaluate whether patients might be managed without nerve conduction studies or not.

REFERENCES

1. *Musculoskeletal Disorders (MSDs) and Workplace Factors, A Critical Review of Epidemiologic Evidence for Work-Related Musculoskeletal Disorders of the Neck, Upper Extremity, and Low Back, U.S. Department Of Health And Human Services, Public Health Service Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Cincinnati, OH, July 1997, page iii.*
2. *Rossignol M, Stock S, Patry L, Armstrong B. Carpal tunnel syndrome: What is attributable to works? The Montreal Study. Occup Environ Med 1997; 54: 519-523.*
3. *Lerclec A, Franchi P, Cristofari MF, et al and the Study Group on Repetitive Work. Carpal tunnel syndrome and work organization in repetitive work: A Cross-sectional study in France. Occup Environ Med 1998; 55: 180-187.*
4. *Katz J, Larson M, Fossel AH, Liang MH. Validation of a surveillance case definition of Carpal tunnel syndrome. Am J Public Health 1991; 81: 189-193.*
5. *Katz J, Stirrat C. A self-administered hand diagram for the diagnosis of Carpal tunnel syndrome. J Hand Surgery 1990; 15A: 360-363.*

6. Werner R, Franzblau A, Albers J, Buchele H, Armstrong T. Use of screening nerve conduction studies for predicting future carpal tunnel syndrome. Occup Environ Med 1997; 54: 96-100.
7. Rossignol M, Patry L, Sacks S. Carpal tunnel syndrome; Validation of an interview questionnaire on occupational exposure. Am J Ind Med 1998; 33: 224-232.
8. Gemne G. Diagnostic of hand -arm system disorders in workers who use vibrating tools. Occup Environ Med 1997; 54: 90-95.
9. Korrick S, Rest K, Davis L, Christiani D. Use of State workers' compensation data for occupational carpal tunnel syndrome surveillance: A feasibility study in Massachusetts. Am J Ind Med 1994; 25: 837-850.
10. Huhges R, Silverstein B, Evanoff BA. Risk factors for work-related musculoskeletal disorders in an aluminum smelter. Am J Ind Med 1997; 32: 66-75.
11. Şeref B, Beşer E, Erbek S, Beşer A, Tek N.Status analysis of occupational health in food production industry in Kocaeli. 5th National Public Health Congress, Istanbul. Proceedings, 12-16 October 1996: 505-508.
12. Kasten SJ, Louis DS. Carpal tunnel syndrome: A case of median nerve injection injury and a safe and effective method for injecting the Carpal tunnel. J Fam Pract 1996; 43: 79-82.
13. Katz JN, Lew RA, Bessette L, et al. Prevalence and predictors of long term work disability due to carpal tunnel syndrome. Am J Ind Med 1998; 33: 543-550.
14. Katz JN, Larson GM, Sabra A, et al. The carpal tunnel syndrome: Diagnostic utility of the history and physical examination findings. Ann Intern Med 1990; 112: 321-327.
15. Editorials. Preventing the work-related carpal tunnel syndrome: Physician reporting and diagnostic criteria. Ann Intern Med 1990; 112: 317-319.
16. Sheon RP. Peripheral nerve entrapment, occupational-related syndromes and sport injuries. Curr Opin Rheum 1992; 4: 219-225.
17. Galen RS, Gambino SR. Beyond Normality: The Predictive Value and Efficiency of Medical Diagnoses. New York: John Wiley and Sons; 1975.
18. Silverstein BA, Fine LJ, Armstrong TJ. Carpal tunnel syndrome: Causes and a prevention strategy. Semin Occup Med 1986; 1: 213-221.
19. Szabo RM, Madison M. Carpal tunnel syndrome. Common Hand Problems Orthop Clin N Am 1992; 23: 103-122.