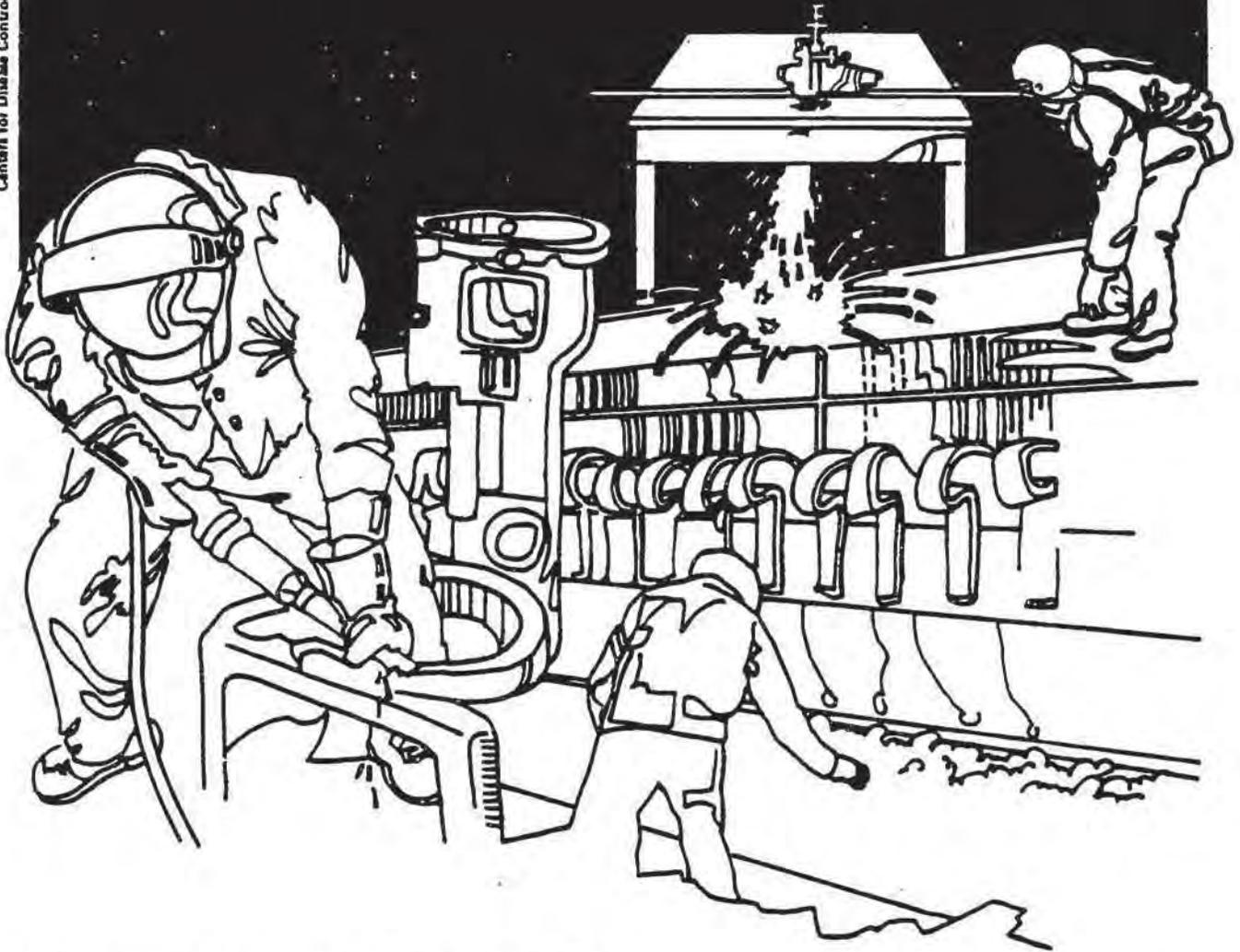


# NIOSH



## Health Hazard Evaluation Report

HETA 84-417-1745  
MINNEAPOLIS POLICE DEPARTMENT  
MINNEAPOLIS, MINNESOTA

## PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

HETA 84-417-1745  
November 1986  
MINNEAPOLIS POLICE DEPARTMENT  
MINNEAPOLIS, MINNESOTA

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## I. SUMMARY

On June 26, 1984, the National Institute for Occupational Safety and Health (NIOSH) received a request from the American Federation of State, County and Municipal Employees (AFSCME) Council No. 14 to evaluate diagnoses of carpal tunnel syndrome (CTS) and tendonitis of the wrist among clerical workers of the Minneapolis Police Department (MPD).

On July 30-31, 1984, an initial questionnaire survey among 33 clerk/typists in the transcription, records, crime analysis, homicide, juvenile, and robbery departments of the MPD was conducted to determine the prevalence and distribution of wrist problems. Wrist problems clustered in the transcription department with six of ten police transcribers interviewed reporting having diagnoses of either CTS or tendonitis (Risk Ratio = 31.5,  $p = 0.001$ ) compared with one of twenty-two clerical staff from other departments. Medical diagnoses were confirmed through review of medical records or discussion with the treating physicians. Employees with shorter lengths of employment in the transcription department appeared to be at greater risk for wrist symptoms.

On October 31 - November 2, 1985, an ergonomic assessment of police transcribers and clerk/typists was conducted to quantify those factors potentially responsible for the observation of wrist problems among transcribers. This assessment consisted of measuring the frequency, positions, and force of hand and wrist movements, and an overall evaluation of the work stations and work environment. Problems related to workstation design requiring awkward positions of the hands and wrists appeared to be most strongly associated with complaints of wrist pain and diagnoses of cumulative trauma disorders. Recommendations are made to improve ergonomic factors of the workstation design.

Carpal tunnel syndrome and tendonitis of the wrist occurred more frequently among police transcribers compared with clerical staff from other departments. Factors that contributed to this observation were related to the positions of the hands and wrists during the typing of documents. Recommendations for improving workstations and the ergonomic environment of police transcribers are presented in Section VIII of this report.

**KEYWORDS:** SIC 9221 (Police Protection), carpal tunnel syndrome, tendonitis, cumulative trauma disorders of the wrist, police transcribers.

## II. INTRODUCTION

On June 26, 1984, NIOSH received a request from American Federation of State, County and Municipal Employees (AFSCME) Council No. 14 to evaluate diagnoses of carpal tunnel syndrome (CTS) and tendonitis of the wrist among clerical workers of the Minneapolis Police Department. Nine to ten employees had been diagnosed as having either CTS or tendonitis.

On July 30-31, 1984, an initial survey among 33 clerk/typists in the transcription, records, crime analysis, homicide, juvenile, and robbery departments was conducted to determine the prevalence and distribution of wrist problems. On October 31, 1984, a letter summarizing the results of the survey, along with recommendations to improve the ergonomic factors of the workstation and environment, was sent to the union and management.

On October 31-November 2, 1985, an ergonomic assessment of police transcribers and clerk/typists was conducted to quantify those factors potentially responsible for the observation of wrist problems among transcribers. On December 16, 1985, a letter describing the follow-up survey, along with additional recommendations to improve the workstations, ventilation, and lighting, was sent to the union and management.

## III. BACKGROUND

The Minneapolis Police Department is the primary law enforcement agency for the city of Minneapolis. All arrests made by officers of the department are accompanied by an arrest report. Police transcribers are responsible for typing all pertinent information relating to arrests made by law enforcement officers. This information is provided to the transcribers verbatim or in a hand-written form which is then typed on appropriate multi-carbon report forms. Upon completion, copies are separated by hand and distributed into mail boxes for subsequent dissemination to other departments and for proof-reading by the arresting officer.

At the time of our initial visit, there were 33 clerk/typists available for interview in the transcription, records, crime analysis, homicide, juvenile, and robbery departments. Of these 33, ten were full-time police transcribers covering three shifts, seven days a week.

For the period January through June 1984, approximately 49,000 documents were prepared in the transcription department. These 49,000 documents included 22,800 offense reports, 14,900 adult/juvenile arrest reports, 6,000 statements, and 5,700 supplementary reports. In addition, police transcribers were responsible for distributing, cross-referencing, logging and photocopying each document.

#### IV. METHODS

##### A. Initial Survey (July 30-31, 1984)

Following an opening conference attended by the risk manager and director of labor relations from the police department, and representatives from the union, a walk-through of the facility was conducted to obtain information on the normal operating procedures and to identify clerk/typist jobs which required frequent movements of the hands and wrists.

NIOSH investigators met with individual employees on all three shifts to explain and assist in the completion of a self-administered questionnaire. All employees identified as having primary responsibilities as clerk/typists were invited to participate: there were no refusants. The questionnaire asked for personal identifying information, occupational history, whether particular types of wrist symptoms had been experienced, and whether medical help had been sought for wrist complaints.

For those employees responding positively to having sought medical attention, a medical information release form was obtained. For each reported case of carpal tunnel syndrome or tendonitis, the individual's personal physician was contacted seeking clinical information to support either diagnosis. A report of numbness or pain in the median nerve distribution of the hand, a positive Tinel's or Phalen's maneuver, or an electromyographic (EMG) or nerve-conduction-velocity (NCV) study that revealed a disturbance of median nerve conduction across the carpal tunnel were considered supportive of the diagnosis of carpal tunnel syndrome.

##### B. Follow-up Survey (October 31-November 2, 1985)

During this survey, ergonomic measurements were obtained from 12 employees of the transcription, homicide, and juvenile departments during normal operation. The ergonomic assessment included: (1) an hour-by-hour measurement of keystrokes, (2) a measurement of keystrokes per second for differing typing operations, (3) a measurement of the force used by the typist to overcome the resistance from the keys, and (4) a videotape to determine hand and wrist positions during typing. The videotapes were reviewed in slow motion so that each type of posture (wrist flexion, wrist extension, ulnar deviation, and radial deviation) could be recorded by type and frequency of occurrence. Muscular force exerted was measured using a miniature accelerometer attached to the fingernail of the index finger of the left hand of each typist. For each job, the total number of movements per hand was tallied by counting the number of keystrokes contained in every document typed during the observed shift.

In addition, each employee completed a questionnaire detailing occupational history, medical history, and current medical problems. The chairs and tables used by the typists were evaluated, and a qualitative assessment of the work environment was made.

#### V. EVALUATION CRITERIA

There is evidence in the literature that cumulative trauma disorders (CTD's) are associated with repetitive and forceful movements of joints and muscles (1-4). Examples include tendonitis, tenosynovitis, carpal tunnel syndrome, ganglionic cysts, epicondylitis, myositis, and bursitis. These disorders affect the nerves, tendons, and tendon sheathes of the upper extremity. The reported causal factors of these ailments, particularly those found in the workplace, are the force of exertion, the posture of the hand during exertion, and the frequency of the movement. The postures most often associated with upper extremity CTD's are wrist extension and flexion, ulnar and radial deviation of the wrist, open-hand pinching, twisting movements of the wrist and elbow, and shoulder abduction. CTD's are considered in many cases to be work-related because these types of postures and movements are required in many manufacturing and assembly jobs in industry. Occupations for which a high incidence of CTD's is known to exist include electronic components assembly, textile manufacture, small appliance manufacturing and assembling, meat processing and packing, fish filleting, and buffing and filing. What is common to all of these jobs is repetitive, stereotyped movement of the hand, arm, and wrist coupled with varying degrees of muscular exertion. The incidence of CTD's among these and other industries has not yet been established, but incidences as high as 44 cases per 200,000 work hours are known to exist (5).

Occupational factors can play a major role in the development of these disorders. However, there are many non-occupational components of CTD's. Activities such as woodworking, tennis, weight lifting, knitting, and sewing may impose the same type of physical demands on the musculotendinous system as does job-related manual work. Carpal tunnel syndrome, an entrapment disorder affecting the median nerve, is associated with other common medical conditions such as pregnancy, menopause, diabetes, use of oral contraceptives, previous gynecologic surgery, rheumatoid arthritis, acromegaly, and gout (6). Carpal tunnel syndrome has been observed to occur 3 to 10 times more frequently in women than in men.

There are studies which indicate a level of risk associated with certain frequencies of movements (7-10). Reported number of movements for which an incidence of CTD's has occurred range from 5,000 to 50,000 per day. The variety of activities described, such as cutting poultry, hand sanding and filing, have made it difficult to quantitatively assess this variable.

For the twelve workers studied at the Minneapolis Police Department, a risk level was assigned using information contained in the above-mentioned literature. These criteria were:

posture - less than 7,500 movements/shift = low risk  
7,500 to 20,000 movements/shift = medium risk  
greater than 20,000 movements/shift = high risk

A movement was counted if it involved wrist flexion or extension. Frequency, force, and posture data were independently compared to symptoms and diagnoses of wrist problems. The number and types of documents prepared were counted, in particular, those involving direct dictation (DD) where the arresting officer dictated the report to the typist who typed the report directly, indirect dictation (ID) where the document was prepared from a tape recording made previously by the arresting officer, and hard copy (HC) documents where the document was typed from another document. The hypothesis that the pressure of direct dictation placed excessive burden on the typists and resulted in increases in reported symptoms was examined.

## VI. RESULTS

### A. Ergonomic Evaluation

Questionnaires and ergonomic evaluations were completed on twelve clerk typists. For the purposes of the ergonomic evaluation, five individuals were considered cases because of wrist symptoms consistent with CTS or tendonitis, and/or a previous diagnosis of either of these two conditions. These five individuals were compared with five individuals without any symptoms or previous diagnoses of wrist problems (four from transcription, one from juvenile). Data from two individuals were not used in reporting the ergonomic results because their upper extremity symptoms were not consistent with the diagnoses of CTS, tendonitis, or other CTD.

Cases were found to have significantly fewer keystrokes per hour (2,390 vs. 4,079) and per shift (17,793 vs. 34,529) than noncases (Table I). Based on the frequency of keystrokes, noncases fell into the high risk category as opposed to the cases which were at moderate risk for wrist problems. In addition, cases tended to type fewer direct dictation documents and more hard copy documents. In general hard copy documents were typed at a faster rate than direct dictation documents. Noncases were observed to type both hard copy and direct dictation documents at a faster rate than cases.

In general, cases typed with their wrists in extension ( $24.0^{\circ}$ ) beyond what would be considered a normal typing position ( $10^{\circ}$ - $15^{\circ}$ ) (Table II). No differences in ulnar deviation of the wrists were observed between cases and noncases.

Accelerometer output was recorded on 12 subjects. Recordings for five subjects were unintentionally destroyed making comparisons between cases and noncases impossible. However, for the seven remaining subjects, there was no evidence of increased typing force during direct dictation when compared to typing from hard copy (two-way analysis of variance on subjects with data for both HC and DD typing,  $F=0.59$ ,  $p=0.5$ ) (Table II).

#### B. Epidemiological Evaluation

The results from the initial survey and review of medical records are summarized in Table III. For purposes of this discussion, RR is defined as a risk ratio, where the proportion of cases of wrist problems or complaints among police transcribers is divided by the proportion of those with complaints among clerk/typists in other departments. An RR (risk ratio) of one would be obtained if the proportions of complaints among police transcribers and clerk/typists in other departments are the same. A "p" value less than or equal to 0.05 suggests that the observed RR truly differs from one although a small probability remains that the observed differences could be due to chance alone. A Fisher's one-tailed exact test was used to calculate all "p" values.

When compared with clerk/typists in other departments, police transcribers had an excessive number of diagnoses of carpal tunnel syndrome (two of nine,  $RR = 5.2$ ,  $p = 0.2$ ) and tendonitis (five of ten,  $RR = 21.0$ ,  $p = 0.006$ ). Six of ten police transcribers had either CTS or tendonitis ( $RR = 31.5$ ,  $p = 0.001$ ). In addition, police transcribers had increased complaints of hand numbness ( $RR = 2.7$ ,  $p = 0.1$ ), arm soreness ( $RR = 6.6$ ,  $p = 0.02$ ), nocturnal awakening with hand pain and numbness ( $RR = 4.5$ ,  $p = 0.06$ ), and complaints of wrist discomfort that interfered with daily activity ( $RR = 10.0$ ,  $p = 0.01$ ).

Table IV summarizes the demographic data of the initial survey sample. Cases of both CTS and tendonitis in the transcription department tended to occur in shorter term employees. For the six cases of CTS and/or tendonitis, the length of employment was  $5.3$  years  $\pm 4.3$  with a range of 2.9 to 14.1 years while the four individuals without wrist complaints had an average length of employment of  $11.8 \pm 8.9$  years with a range of 0.1 to 19.7 years.

#### VII. DISCUSSION

Each individual has a unique style of typing. A normal resting position for the wrists with the elbows at the side consisted of the wrist ulnar deviated between 15 and 20 degrees and the wrists extended between 10 and 15 degrees. The degree of wrist flexion or extension is controlled by the height of the chair relative to the height of the

keyboard. The degree of ulnar deviation is influenced by the size of the individual. Persons with small waist sizes are able to bring their elbows closer to the center of the body thereby decreasing ulnar deviation. Larger persons have their elbows further from the midline and, therefore, must deviate the wrist more to the ulnar side in order to approach the keyboard head-on.

It is to be expected that cases, defined by the presence of wrist symptoms or a history of wrist problems, would type slower than asymptomatic individuals. Nevertheless, measures of frequency of hand movements as determined by the number of keystrokes per shift among noncases indicates that police transcribers are at high risk (greater than 20,000 movements per shifts) for the development of cumulative trauma disorders of the wrist. The finding of an increased risk of CTD's of the wrist in police transcribers compared with other clerk typists supports this ergonomic observation.

Cases were noted to have excessive wrist extension (greater than  $10^{\circ}$ - $15^{\circ}$ ). It is impossible, however, to determine whether the frequency of wrist movements coupled with excessive wrist extension results in the problems the cases experienced, or whether the current wrist positions are a result of the symptoms. The degree of extension is controlled by the height of the chair relative to the keyboard surface. The excessive extension of the wrist indicates improper heights of the chair and/or the keyboard surfaces.

No measureable differences were observed in the forces with which cases and noncases struck the keyboard during typing. The force used in typing is low compared to occupations where hand tools are used or where heavy materials are handled. It is most likely that high frequency of hand and wrist movements in awkward positions account for the observed problems.

#### VIII. RECOMMENDATIONS

Based on our assessment of the work environment, we make the following recommendations:

##### A. WORKSTATIONS

1. Wrist rests should be provided. Many of the typists were noted to rest their hands on the near edge of the typewriter, and several of the typewriters showed wear on this edge. The near edge of the typewriter is square and crossed the palm in a manner that may irritate tendons. A wrist rest would support the fleshy heel of the hand on a flat surface with a rounded near edge. Such rests are available commercially, or can be made from firm foam rubber and covered with fabric.

2. Chairs should allow for quick adjustment of the seat height and the height and angle of the back support. Chairs with older, screw-type, adjustment of height allow adjustment for each worker, but are too inconvenient to allow the frequent changes of posture during a work shift necessary to avoid fatigue.
3. Typing tables should be adjustable in height, have adequate knee clearance horizontally and vertically, and adequate surface area for the typewriter and documents that are being processed. The knee clearance in the transcription department is currently not adequate. If appropriate tables with more ample knee space cannot be provided now, then the drawers underneath the typing tables should be removed to allow for increased knee clearance. Foot rests should be provided so that shorter workers can set their chairs high enough to allow a comfortable arm position, and rest their feet above the floor level.
4. Employees should be educated as to the proper use and adjustment of chairs and work surfaces in order to achieve the best ergonomic position for the performance of their jobs.

B. VENTILATION

We observed open doors and the use of fans in the transcription department indicating that deficiencies probably exist in the ventilation system. To assure acceptable indoor air quality, the American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc. recommend that outdoor (fresh) air be provided to this office area at a rate of 20 cubic feet per minute (CFM) per person since it is an area where smoking is allowed. The fresh air requirement would be less (5 CPM/person) for office areas where smoking is not permitted. Because the number of people in the transcription department varies during the workshift, we recommend that the outdoor air requirement should be based on the maximum number of occupants present in the office at any given time. This recommendation is not related to the finding of excessive wrist problems.

C. LIGHTING

We observed that all of the clear plastic carriage covers for the Panasonic typewriters had been removed. Workers indicated that they encountered an excessive amount of reflective glare from the overhead lighting when the covers were used. Disuse of the covers, while eliminating the glare problem, has increased the amount of noise generated by the machines as the cover served to muffle much of the noise. Based on our observations we recommend that the illumination in the transcription office area should be at a level

and of a quality to minimize reflective glare. Modifications may include using a translucent rather than a clear lens for the overhead lights. Supplementation of the existing lighting with indirect lighting should also be considered. This recommendation is not related to the finding of excessive wrist problems.

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XI. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Publications Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal, Springfield, Virginia 22161. Information regarding its availability through NTIS can be obtained from NIOSH Publications Office at the Cincinnati address. Copies of this report have been sent to:

1. Minneapolis Police Department (Minneapolis, Minnesota)
2. American Federation of State, County and Municipal Employees (AFSCME) Council No. 14.
3. NIOSH, Region V
4. OSHA, Region V

For the purpose of informing affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

TABLE I  
 ERGONOMIC EVALUATION  
 OF TYPISTS  
 Minneapolis Police Department  
 Minneapolis, Minnesota  
 November 1985

<u>Frequency</u> <u>Mean (range)</u>	<u>CASES (N=5)</u>	<u>NONCASES (N=5)</u>
Keystrokes/hour ( $\times 10^3$ )	2.39 (1.58-3.54)	4.08 (3.48-4.52)*
Keystrokes/shift ( $\times 10^3$ )	17.79 (9.48-27.7)	34.53 (27.8-42.5)**
DD documents/shift	10.8 (5-15)	15.4 (7-27)
HC documents/shift	17.8 (0-57)	14.8 (7-24)
Keystrokes/second (DD document)	3.91 (1.99-5.73) N=25	4.68 (2.36-11.27) N=39
Keystrokes/second (HC document)	4.87 (2.00-7.74) N=2	7.10 (3.56-15.24) N=18

DD = direct dictation document  
 HC = hard copy document

- \* - one-way analysis of variance,  $F=20.6$  for  $df$  8,  $p$  less than 0.01.  
 \*\* - one-way analysis of variance,  $F=22.8$  for  $df$  8,  $p$  less than 0.01.  
 \*\*\* - one-way analysis of variance,  $F=4.1$  for  $df$  62,  $p$  less than 0.05.

TABLE II  
 ERGONOMIC EVALUATION  
 OF TYPISTS  
 Minneapolis Police Department  
 Minneapolis, Minnesota  
 November 1985

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<u>Wrist Position</u> <u>Mean (range)</u>	<u>CASES (N=5)</u>	<u>NONCASES (N=5)</u>
Ulnar deviation (maximum)		
Right hand	19.4° (16-21)	19.0° (15-30)
Left hand	22.4° (20-30)	20.0° (10-35)
Extension (maximum)	24.0° (15-30)	16.6° (0-25)

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Force measurements as determined by  
Greatest deviation from baseline in each burst

<u>Subject</u>	<u>Type of document</u>	
	<u>Direct Dictation</u>	<u>Hard copy</u>
1	13.09 g	13.42 g
2	NA	13.61
3	16.59	12.49
4	11.61	NA
5	NA	11.71
6	17.60	16.29
7	<u>11.00</u>	<u>12.20</u>
Mean	13.98 g	13.29 g
Mean (pairs)	14.57 g	13.60 g

TABLE III  
 PREVALENCE OF SYMPTOMS  
 AND  
 DIAGNOSES OF WRIST DISORDERS  
 Minneapolis Police Department  
 Minneapolis, Minnesota  
 July 1985

<u>SYMPTOM</u>	<u>Police transcribers</u> <u>% with complaint</u>	<u>Other clerk/typists</u> <u>% with complaint</u>	<u>Risk</u>	<u>Significance</u>
Hand numbness	50% (5/10)	27.3% (6/22)	2.7	p = 0.1
Arm soreness	70% (7/10)	26.0% (6/23)	6.6	p = 0.02
Nocturnal awakening with hand pain and/or numbness	50% (5/10)	18.2% (4/22)	4.5	p = 0.06
Wrist discomfort that interferes with daily activity	60% (6/10)	13.0% (3/23)	10.0	P = 0.01
<u>DIAGNOSIS</u>				
Carpal tunnel syndrome (CTS)	20% (2/10)	4.5% (1/22)	5.3	p = 0.2
Tendonitis of wrist	50% (5/10)	4.5% (1/22)	21.0	p = 0.006
CTS and/or tendonitis	60% (6/10)	4.5% (1/22)	31.5	p = 0.001

TABLE IV  
 DEMOGRAPHIC DATA OF SAMPLE  
 Minneapolis Police Department  
 Minneapolis, Minnesota  
 July 1985

	<u>Police transcribers</u>		<u>Other departments</u>
	<u>Cases</u> (N=6)	<u>Noncases</u> (N=4)	(N=23)
<u>Sex</u>	Female 100%	Female 100%	Female 87% Male 13%
<u>Race</u>	White 100%	White 100%	White 87%
<u>Age</u>	37.3 ± 11.4 yrs.	39.8 ± 16.4 yrs.	38.4 ± 13.1 yrs.
<u>Length of employment</u>	5.3 ± 4.3 yrs.	11.8 ± 8.9 yrs.	6.7 ± yrs.

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