Musculoskeletal Diseases and Ergonomics in the Mining Industry

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Key Points

- Musculoskeletal diseases in mining are the most prevalent of any major occupational group
- Mining equipment is specialized offering opportunities for selective ergonomic and tool interventions
- Generic safety approaches may aggravate hand-arm problems

British Musculoskeletal Occupational Surveillance System (MOSS) – incidence of msd 1997-2000 by sector

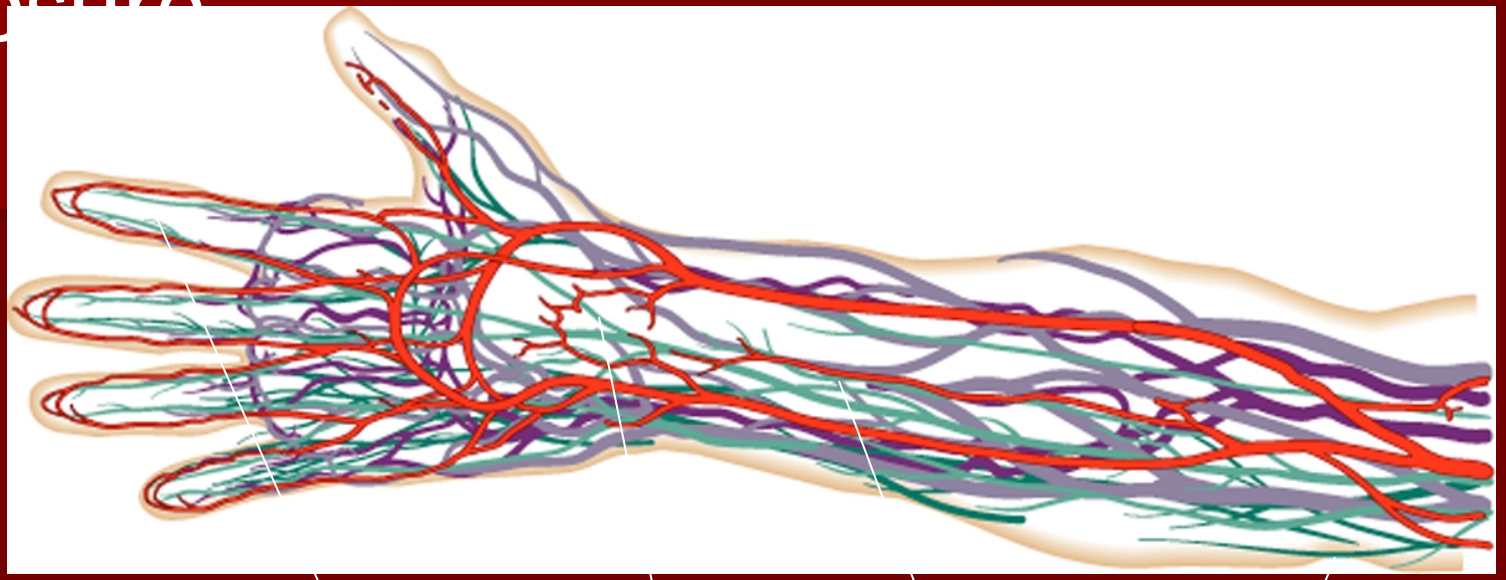
. . Estimated cases and rates by anatomical region and main industrial groups, October 1997–September 2000

						Rates/10 000/annum[a]		
Main industrial group (SIC)	*Upper limb*	*Lower limb*	*Neck/back*	*Other*	*Total*	*Male*	*Female*	*Total*
Mining (10–14)	174	12	18	–	204	7.08	–	6.31
Food/organic products (1–5, 15–22, 36)	690	57	192	12	948	1.09	1.76	1.33
Petrochemical (23–26)	144	–	51	–	195	0.48	1.69	0.79
Metals (27–33, 37)	228	36	30	12	306	0.46	0.93	0.56
Automotive (34,35)	201	12	12	3	228	1.05	4.17	1.43
Utilities/construction (40, 41, 45)	564	78	240	51	906	1.59	0.77	1.50
Transport/communication (60–64)	183	51	198	–	432	0.92	0.75	0.88
Financial/sales (50–52, 65–67, 70–74)	1212	48	282	51	1566	0.37	1.05	0.69
Public administration/defence (75)	285	12	207	24	504	0.89	1.22	1.04
Education (80)	150	15	126	–	276	0.34	0.51	0.45
Health/social services (85)	483	72	360	15	894	1.00	1.04	1.05
Social/personal services (55, 90–93)	408	72	111	24	612	0.82	0.71	0.76
Industry not codeable	666	75	282	12	999	–	–	–
Total	5388	540	2109	204	8070	0.89	1.16	1.03

Meniscus disorders a common source of knee pain and knee arthritis in miners –

- Frequency
  - 6-24% of miners
  - 3-6 x higher than comparative light manufacturing
  - Little new work in past 50 years
- Causes
  - Slips and fall (>50% of knee injuries)
  - Direct pressure from kneeling
  - Shear force (shoveling)
- Interventions
  - Selective mechanization
  - Non-surgical management

Muscle, Vessel, and Nerve: Injury and Exposure



Problem	Damage of finger nerves and blood vessels	Compression of the median nerve	Decreased blood circulation	Compression of nerves and blood vessels between the neck and the shoulder
Cause	High local forces and vibrations.	Bent wrist and high finger forces. Pinched grip. Repetitive work.	Cold handles, and handles that are too small.	Work that requires frequent reaching above shoulder level
Ergonomics	Avoiding sharp edges and reduction of vibrations.	Avoiding bent wrist.	Improving insulation. Better handle design.	Improving workstation design to reduce frequent reaching above shoulder level.

Filtering System

- <50 Hz passes hand filter
- >400 Hz is absorbed at MCPs
- >60 Hz absorbed at CMC Joint
- Resonance 25 Hz at MCP
- Resonance 63 Hz at wrist
- Coupling ↑ wrist absorption; ↓digit absorption

Sense of Touch

- Sensations of pressure, movement, gap (space)
- Senses of hot, cold, pain
- Symptoms of burning, tingling, numbness
- Key component of strength and control
- Function of the organ system of the skin
- Direct contact and indirect contact (hand-tool function)

Anatomy of Human Mechanoreceptors

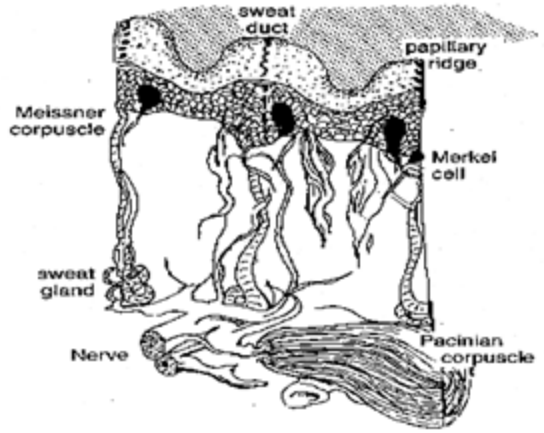


FIGURE 1-6. Cross section of skin illustrating site of mechanoreceptors.

AV gloves and materials

Some materials decrease transmissability

Other Materials amplify transmissability

transmissibility on chainsaw

Glove	Chain saw			
	T_F	T_F	T_F	T_F
Ansell – Edmont	0,5	0,4	0,5	0,5
Atlas Copco	0,5	0,5	0,5	0,5
Impacto U2	0,6	0,4	0,6	0,3
North – Zorber	0,5	0,7	0,7	0,5

Natelletti et al., 2004

transmissibility on rock drills

Glove	Rock drill			
	T_F	T_F	T_F	T_F
Ansell – Edmont	1,3	1,6	1,5	1,7
Atlas Copco	1,2	1,2	1,9	1,6
Impacto U2	1,1	1,1	1,3	1,3
North – Zorber	1,1	1,1	1,3	1,3

Transmissability Index ($T_{m,h}$). $TR_M < 1.0$ and $TR_H < 0.6$, where TR_M and TR_H are, respectively,
the overall average transmissibility at medium (31.5÷200 Hz) and high (200÷1 kHz) frequencies.

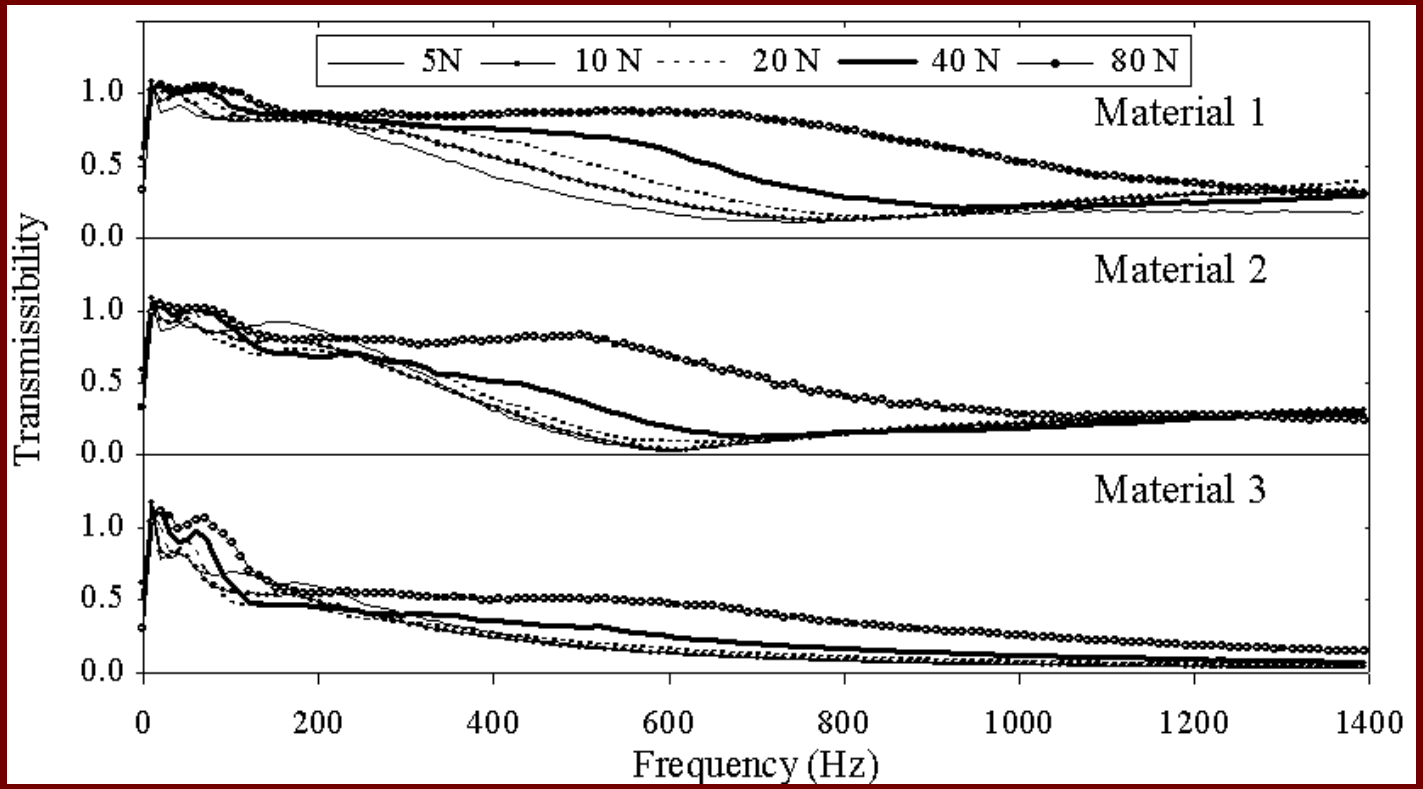
ISO, 1999: 13753

Glove Type	TM Reduction	Grip Reduction
A	17	42
D	17	41
B	21	34
C	20	38
E	19	38
F	20	37
G	20	41
O	18	26
P	19	30
Q	17	31
N	19	35
I	22	31
J	10	14
K	10	17
L	3	15
M	13	26

Grip Force Increases Transmissibility

Most Reduction Occurs at Higher Frequencies

There is a Significant Difference Between Materials



O'Boyle and Griffin, 2004

Intended Use and Actual Use May Differ