Electrodiagnostic studies in workers Exposed to hand–arm vibration

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Abstract: Hand arm vibration syndrome (HAVS) is an occupational disease that may afflict workers who operate hand held vibrating tools. The risk of developing HAVS relates to a number of factors which include individual worker susceptibility, as well as the frequency, duration and amplitude of exposure. Vibration may cause damage to the vascular, neurological and musculoskeletal systems of the upper limbs which may manifest as HAVS, carpal tunnel syndrome (CTS) or both. ***Aim of the study***: To verify the electrodiagnostic pattern of different types of neuropathy among workers who using hand held vibrating tool in Damietta (Becatronics CNC machine). ***Patients and methods:*** The study included 100 subjects. Group A: (Exposure group) Manual workers exposed to hand-held vibrating tool (Becatronics CNC machine) more than 2 years (50 subjects). Group B: (Control group) who not exposed to hand-held vibrating tools (50 subjects). Group A divided into three groups with Stockholm Workshop scale (SWS), SN0 6(12%),SN1 29(58%) SN2 15(30%). All subjects underwent electrophysiological assessment of median, ulnar and radial nerves. The following parameters were observed; sensory and motor terminal latencies, conduction velocity, amplitude of SNAP (sensory nerve action potential) and CMAP (compound muscle action potential), F wave *latencies,* insertional activity, MUP (motor unit potential), and interference pattern. ***Results:*** In our case controlled comparative study, for both median and ulnar nerves there was significant prolonged motor and sensory latencies, increase F wave latency, while there was significant decrease of NCV and motor amplitude. In addition, EMG results of both median and ulnar nerves revealed that; there were significant denervation in exposure group when compared to control but right side more affected than left side. Furthermore, both radial nerves show no affection, and the duration of the work is the most common determinant factor for nerve conduction abnormalities detected in the present study. Finally, median nerve is the most nerve affected of workers who exposed to vibration then ulnar nerve less affected and radial nerve which not affected. ***Conclusion***: Cases expose to hand held vibration tool (Beca tronics CNC machine) had changes in the nerve conduction and EMG studies. And the most powerful determinant factor for these changes was the duration of exposure. In addition there was NCV (nerve conduction velocity) changes (demyelination) in cases without clinical symptoms. Thus, NCV can be used for early detection of nerve affection in cases with HAVS.

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1. Introduction:

Hand–arm vibration syndrome (HAVS) is associated with the use of hand-held vibrating tools. Affected workers may experience symptoms of tingling, numbness, loss of grip strength and pain, Vibration may cause damage to the vascular, neurological and musculoskeletal systems of the upper limbs which may manifest as HAVS, carpal tunnel syndrome (CTS) or both. The risk of developing HAVS relates to a number of factors which include individual worker susceptibility, as well as the frequency, duration and amplitude of exposure. (**Busi *et al.*, 2007**).

In vibration-associated neuropathy, conceivable target structures could be peripheral sensory receptors, large or thin myelinated nerve fibers, and the small-caliber, non-myelinated C fibers. **(Helena *et al.*, 2010).**

The specific pathological mechanism of the neurological component of HAVS has not been established, injury of the peripheral nerves could be attributed to either Wallerian degeneration or segmental demyelination or axonal atrophy or degeneration and primary disorders of cell bodies. Finger biopsy specimens have revealed fibrosis, and proliferation of Schwann cells and injury to sensory receptors may also occur. Nerve conduction studies (NCS) provide objective and quantitative assessment of peripheral nerve function independent of the subject's feedback. They are considered the gold standard by neurologists assessing peripheral nerve damage, The recovery may depend on the severity of the neurological damage at the time of intervention. (**Lander *et al.*, 2007**).

2.Patients and methods:

The study was carried out on male manual workers, selected from different ornament timber industry workshops in Damietta governorate, who work at Becatronics CNC (computer numerical control) machine; model Beca R212 ,axis 4 ,acceleration 42 m/min , motor power 6 horses , rotation speed 18000 roll/min. (exposure group). We used case control study and take oral consent from them. They were subdivided into two groups according to their exposure to hand-held vibrating tools as follows: **Group A:** (Exposure group) Manual workers exposed to hand-held vibrating tool (Becatronics CNC machine) more than 2 years (50 cases). **Group B:** (Control group) who not exposed to hand held vibrating tools (50 cases). With the following Exclusion criteria: Patients with a history and/or symptoms consistent with cervical radiculopathy, brachial plexopathy, diabetes mellitus, rheumatoid arthritis, myxoedema, acromegaly, peripheral nerve trauma, fracture, toxic exposure, dislocation of upper limb bones, and any past history of neurological disorder before exposed to vibration. All individuals were subjected to the following: Full history taking, laying stress upon: Age, Duration of work (years), Working hours /day, and Stages of sensory neural symptoms by the Stockholm classification as: The Stockholm Workshop scale (SWS) for the sensori-neural stages of HAVs.

Stage	Symptoms and signs
SN0	Exposed to vibration but no symptoms
SN1	Intermittent numbness, with or without tingling
SN2	Intermittent or persistent numbness, reduced sensory perception
SN3	Intermittent or persistent numbness, reduced tactile discrimination and/or manipulative dexterity

(Bovenzi and Hulshof, 2007)

Nerve conduction study: Studies were performed via Nihon Kohden machine; Model UT-0800J. Box BOARD (2CH) For JB-942BK. Made in Japan. Which including: **Motor nerve conduction:** Motor NCS are performed by electrical stimulation of a peripheral nerves (median, ulnar and radial) and recording motor latency, amplitude and conduction velocity from a muscle supplied by this nerves (abductor pollicis brevis, abductor digitiminimi muscle and extensor indices) and the ground electrode: Placed on the dorsum of the hand between recording electrode and the stimulator. **Sensory nerve conduction (antidromic):** Sensory NCS are performed by electrical stimulation of a peripheral nerves (median ,ulnar and radial) and recording sensory latency, amplitude and conduction velocity from a purely sensory portion of the nerve, (2nd finger, 5th digit and dorsum of 1st web space) and the ground electrode: Placed on the dorsum of the hand between recording electrode and the stimulator. **EMG study:** It was done using intramuscular EMG needle electrode (concentric bi polar) and recording the insertional activity, spontaneous activity, motor unit potential morphology, recruitment and interference pattern from Lateral two Lumbricals, abductor digitiminimi and extensor indicis muscles . **Statistical analysis of data:** The collected data were organized, tabulated and statistically analyzed using statistical package for social science (SPSS), version 16, and running on IBM compatible computer.

3. Results

Demographical findings: The present study included 50 exposed to hand arm vibration (exposure group), and age matched 50 non exposed workers (control group). Age ranged from 24 to 46 years, while length ranged from 163 to 180 cm, and weight ranged from 71-91 kg. There was no significant difference between control and exposure groups as regard to age, length and weight.

As regard stage of disease in exposure group: it was SN0 in 6 cases (12.0%); SN1 in 29 cases (58.0%) and SN2 in 15 cases (30.0%) cases out of 50 cases.

As regard work duration of exposure group: it ranged from 6 to 28 years with a mean of 14.0±5.23 years, while working hours per day ranged from 10 to 13 hours with a mean of 11.20±0.85 hours/day.

Regarding both median nerves electrodiagnostic study, as showed in table (1) it revealed that, there was significant prolonged motor and sensory latencies. Increase F wave, while there was significant decrease of NCV and motor amplitude on both sides plus significant decrease of sensory amplitude of right one, in exposure group in comparison to control group.

As regard to EMG results of the both median nerves, as showed in table (1) it was found that, there was significant denervation cases in exposure group when compared to control group (20.0% vs. 0.0% respectively).

As regard to EMG results of both ulnar nerves*,* as showed in table (2) it was found that, there was significant denervation cases in exposure group when compared to control group ulnar (12.0% vs. 0.0% respectively).

Table (1): Comparison between exposure and control groups as regard both median nerves electrodiagnostics:

		left median nerve						Right median nerve					
		Control group		Exposure group		t	*p*	Control group		Exposure group		t	*p*
		Mean	SD	Mean	SD			Mean	SD	Mean	SD		
Motor	Latency at wrist	3.26	0.34	4.39	0.86	8.56	<0.001*	3.23	0.19	4.47	0.77	8.81	<0.001*
	Latency at elbow	7.37	0.35	8.25	0.92	6.29	<0.001*	7.47	0.23	8.76	1.22	5.09	<0.001*
	Amplitude at wrist	8.90	0.74	7.49	3.22	3.01	<0.003*	8.86	1.63	7.30	1.83	8.21	<0.001*
	Amplitude at elbow	8.98	0.83	7.34	2.88	3.85	<0.001*	8.94	1.72	7.12	1.56	8.57	<0.001*
	NCV	63.39	3.74	56.55	7.83	5.56	<0.001*	61.52	3.73	50.71	5.95	5.07	<0.001*
	F wave	25.10	2.58	28.83	5.88	4.10	<0.001*	25.08	1.86	29.80	2.71	7.98	<0.001*
Sensory	Latency at wrist	2.48	0.29	3.38	0.63	4.14	<0.001*	2.55	0.17	3.68	1.31	4.94	<0.001*
	Amplitude at wrist	24.10	3.91	24.07	6.61	0.03	0.97(NS)	23.61	3.21	20.70	6.76	2.73	0.007*

Table (2): Comparison between exposure and control groups as regard both ulnar nerves EMG:

	left ulnar						Right ulnar					
	Control		exposure		Total		Control		exposure		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
Normal	50	100.0%	44	88.0%	94	94.0%	50	100.0%	44	88.0%	94	94.0%
Denervation	0	0.0%	6	12.0%	6	6.0%	0	0.0%	6	12.0%	6	6.0%
Statistics	$X^2 = 6.38$, $p = 0.012$*						$X^2 = 6.38$, $p = 0.012$*					

As regard results of both radial nerves electrodiagnostics, as showed in table (3) it was found that, no significant differences in exposure group when compared to control group, all parameters showed non significant difference.

Table (3): Comparison between exposure and control groups as regard both radial nerves electrodiagnostics:

		left radial nerve						Right radial nerve					
		Control group		Exposure group		T	*P*	Control group		Exposure group		t	*p*
		Mean	SD	Mean	SD			Mean	SD	Mean	SD		
Motor	Latency at wrist	3.32	0.54	3.31	0.49	0.03	0.989(NS)	3.43	0.68	3.39	0.61	0.29	0.76(NS)
	Latency at elbow	6.66	0.74	6.82	0.79	2.29	0.624(NS)	6.08	0.58	6.28	0.70	3.05	0.003(NS)
	Amplitude at wrist	6.73	0.70	6.67	0.69	0.35	0.722(NS)	4.89	0.45	5.02	0.48	1.39	0.17(NS)
	Amplitude at elbow	5.94	0.45	5.99	0.48	0.56	0.572(NS)	6.21	0.44	6.25	0.55	0.40	0.68(NS)
	NCV	60.95	2.86	60.70	2.87	0.42	0.669(NS)	63.46	9.61	64.97	9.66	0.78	0.43(NS)
Sensory	Latency at wrist	2.43	0.15	2.46	0.15	0.97	0.332(NS)	2.46	0.19	2.41	0.18	1.12	0.26(NS)
	Amplitude at wrist	23.59	1.70	23.81	1.88	0.63	0.527(NS)	25.14	2.89	24.86	2.12	0.55	0.58(NS)

As regard correlation between stages of disease, as showed in table (4) it was found that, with increased stage, there was significant increase of work duration.

Table (4): Correlation relation between stages of disease work duration:

		Mean	S. D	Minimum	Maximum	F	*p*
Work Duration	SN0	10.00	0.89	9.00	11.00	19.96	<0.001*
	SN1	12.10	3.82	6.00	19.00		
	SN2	19.26	4.71	12.00	28.00		

Regarding correlation between disease stages and median nerve electrodiagnostics, as showed in table(5) it was found that with increasing stage, prolonged motor and Sensory latencies, while there were significantly decreased motor amplitude of the left median nerve and motor and sensory amplitudes at on the right median nerve. In addition, NCV significantly decrease and F wave increased.

Table (5): Correlation between disease stages and left and right median nerve electrodiagnostics:

			Left median nerve								
			Control		SN0		SN1		SN2		*p*
			Mena	SD	Mean	SD	Mean	SD	Mean	SD	
Left median nerve	Motor	Latency at wrist	3.26	0.34	3.50	0.42	4.13	0.73	5.23	0.45	<0.001*
		Latency at elbow	7.37	0.35	7.59	0.33	7.93	0.62	9.12	0.97	<0.001*
		Amp. at wrist	8.90	0.74	8.40	0.84	7.78	3.21	6.57	3.08	<0.001*
		Amp. at elbow	9.98	0.83	9.43	3.05	9.03	2.90	7.60	2.82	<0.001*
		NCV	63.39	3.74	59.00	6.57	55.15	7.47	52.47	7.86	<0.001*
		F wave	25.10	2.58	27.28	0.77	28.23	6.61	32.23	2.72	<0.001*
	Sensory	Latency at wrist	2.48	0.29	3.71	0.38	4.44	0.61	5.84	0.15	<0.001*
		Amp. at wrist	27.10	3.91	25.66	11.40	24.10	5.11	22.58	6.81	<0.001*
right median nerve	Motor	Latency at wrist	3.23	0.19	3.60	0.20	4.34	0.65	5.46	0.28	<0.001*
		Latency at elbow	7.47	0.23	7.80	0.49	8.01	0.96	9.48	1.07	<0.001*
		Amp. at wrist	8.86	1.63	8.05	1.90	7.81	1.64	6.01	1.59	<0.001*
		Amp. at elbow	8.94	1.72	7.75	2.19	7.42	1.51	6.28	1.03	<0.001*
		NCV	61.52	3.73	58.76	8.51	54.25	6.25	50.56	2.67	<0.001*
		F wave	23.08	1.86	24.14	3.24	29.57	1.71	33.11	1.01	<0.001*
	Sensory	Latency at wrist	2.55	0.17	3.85	0.11	4.75	0.48	5.99	1.92	<0.001*
		Amp. at wrist	25.61	3.21	24.29	3.51	23.33	4.44	13.79	6.46	<0.001*

Regarding correlation between disease stages and ulnar nerve electrodiagnostics, as showed in table (6) it was found that with increasing stage, prolonged motor and sensory latencies, F wave significantly increased, while NCV and sensory amplitude of right ulnar nerve significantly decreased with increased stage of disease.

Table (6): Correlation between disease stages and left and right ulnar electrodiagnostics:

			Control		SN0		SN1		SN2		*p*
			Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Left Ulnar nerve	Motor	Latency at wrist	2.55	0.29	2.68	0.36	2.94	0.43	3.96	0.59	<0.001*
		Latency at elbow	6.44	0.30	6.79	0.08	7.38	1.34	8.16	1.35	<0.001*
		Amp. at wrist	6.91	0.63	6.88	2.21	6.03	1.82	5.66	1.49	<0.001*
	sensory	Amp. at elbow	8.66	0.61	7.87	1.23	7.38	1.77	6.31	1.94	<0.001*
		NCV	67.20	3.94	62.15	5.50	59.93	7.58	54.11	6.87	<0.001*
Right ulnar	motor	Latency at wrist	2.77	0.34	2.91	0.33	3.14	0.35	4.19	0.33	<0.001*
		Latency at elbow	6.15	0.64	6.87	0.20	7.92	0.56	8.77	0.68	<0.001*
		Amp. at wrist	7.21	1.26	6.33	0.17	6.00	0.73	5.58	1.20	<0.001*
		Amp. at elbow	7.58	1.62	7.47	1.07	7.39	1.74	6.11	1.36	<0.001*
		NCV	62.67	2.08	61.66	6.22	59.13	5.19	53.39	9.14	<0.001*
		F wave	25.87	1.68	28.81	1.00	29.21	1.20	32.70	1.62	<0.001*
	sensory	Latency at wrist	2.75	0.29	3.88	0.22	4.94	0.51	5.81	0.21	<0.001*
		Amp.at wrist	23.53	2.02	20.82	8.25	20.02	3.06	19.94	5.94	<0.001*

As regard both radial nerves, as showed in table (7) there was no significant correlation between disease stages and nerve electrodiagnostics.

In the present work, as showed in tables (5,6 & 7) there was positive significant correlation between work duration, motor latency and F wave of both median nerves. In addition, there was negative significant correlation between work duration and NCV of both sides. And there was positive significant correlation between work duration and sensory latency on both sides; and negative significant correlation between work duration and sensory amplitude on the right median nerve. At ulnar nerve, there was positive, significant correlation between work duration and motor latencies, F wave and sensory latencies, while there was negative significant correlation between work duration and NCV and sensory amplitude of both sides, At radial nerve, there was no significant correlation between length, working hours per day and Work duration from one side and electrodiagnostic studies at other side.

Table (7): Relation between disease stages and left and right radial electrodiagnostics:

p	SN2		SN1		SN0		Control				
	SD	Mean	SD	Mean	SD	Mean	SD	Mena			
0.22(NS)	0.49	3.17	0.43	3.40	0.75	3.27	0.54	3.32	Latency at wrist	Motor	Left Radial nerve
0.40 (NS)	0.79	6.70	0.79	6.67	0.94	6.52	0.74	6.66	Latency at elbow		
0.07(NS)	0.63	6.52	0.71	6.84	0.61	6.29	0.70	6.73	Amp. at wrist		
0.12(NS)	0.42	6.02	0.53	5.97	0.44	6.04	0.45	5.94	Amp. at elbow		
0.37(NS)	2.49	60.00	3.21	61.12	1.85	60.47	2.86	60.95	NCV		
0.23(NS)	0.14	2.50	0.16	2.44	0.10	2.45	0.15	2.43	Latency at wrist	Sensory	
0.13(NS)	1.75	23.24	1.75	23.98	2.69	24.41	1.70	23.59	Amp. at wrist		
0.19(NS)	0.49	3.32	0.60	3.45	0.94	3.27	0.68	3.43	Latency at wrist	Motor	right radial nerve
0.34(NS)	0.76	6.53	0.71	6.46	0.63	6.43	0.58	6.08	Latency at elbow		
0.06(NS)	0.53	5.03	0.47	5.08	0.28	4.66	0.45	4.89	Amp. at wrist		
0.12(NS)	0.51	6.37	0.57	6.25	0.56	6.00	0.44	6.21	Amp. at elbow		
0.22(NS)	5.20	66.54	11.82	64.53	6.60	63.18	9.61	63.46	NCV		
0.72(NS)	0.17	2.40	0.19	2.41	0.21	2.44	0.19	2.46	Latency at wrist	Sensory	
0.09(NS)	2.82	25.66	1.78	24.58	0.98	24.18	2.89	25.14	Amp.at wrist		

4. Discussion

Hand-held vibrating tools are commonly used in different occupations**.** Repetitive vibration exposure may cause a variety of symptoms, depicted as the hand-arm vibration syndrome (HAVS) which occupationally induced neurovascular syndrome. The symptoms may be digital vasospasm (vibration white fingers), sensorineural disturbances and/ or muscular weakness and fatigue **(Gerhardsson *et al.,* 2013).** This syndrome arises by continued use of vibrating handheld machinery (oscillation rate between 20 and 1000 Hz) **(Voelter-Mahlknecht *et al.,* 2008).** Prevalence among vibration exposed workers differs between 8.4% and 18.1% depending on the occupational environment. Classification is based on a graded vascular and sensorineural score (0 = no symptoms to 4 = permanent symptoms) **(Sauni *et al.,* 2009).** Pathophysiology includes sympathetic hyperactivity, changes in alpha-adrenergic receptor mechanisms, deficient function of endothelial-derived relaxing factor, nitric oxide involved in abnormal vascular tone and vasodilatation, and increased levels of the cell adhesion molecule sICAM-1 inducing leucocyte adhesion including inflammatory responses **(Harada and Mahbub, 2008).** An animal model indicates an initially reversible damage of myelinated rat tail fibers. However, the characteristics and mechanisms of the sensorineural deficits in HAVS are not yet understood **(Rolke *et al.,* 2013).** The hallmark of symptoms of HAVS is cold-induced vasospasms, loss of tactile sensitivity in finger and hand, pain, reductions in manual dexterity and grip strength, joint injuries and muscle atrophy **(Griffin and Bovenzi, 2002).** It had been hypothesized that, a sensory deficit pronounced for large fiber functions. Moreover, it is not clear, whether this sensorineural damage is due to the vascular disturbance, result of the vibratory impact of the used devices, or a carpal tunnel syndrome (CTS) **(Cherniack *et al.,* 2003; House *et al.,* 2009).** The present study was designed to verify the electrodiagnostic pattern of different types of neuropathy among workers who using hand-held vibrating tools. This study was conducted at neurology department, faculty of medicine, Damietta, Al-Azhar University. In included manual workers, who's age more than twenty years old, and workers were divided into two groups according to exposure to hand held vibrating tool (Beca tronics CNC machine): group A included fifty male manual workers selected from different ornament timber industry workshops in Damietta governorate, who work at this machine for more than two years (exposure group) and group B, included fifty age matched normal subjects who not exposed to any hand held vibrating tools (control group). All participants were subjected to full history and clinical examination especially neurological examination; electro-physiological study of median, ulnar and redial nerves as nerve conduction study (motor and sensory), late response (F wave) and EMG. In addition, complete routine laboratory work was done. In the present study, age ranged from 24 to 46 years, while length ranged from 163 to 180 cm, weight ranged from 71-91 kg and there was no significant difference between control and exposure groups as regard to age, length and weight. These results are comparable to those reported by **Yoo *et al.* (2005)** who reported that, the majority of workers with HAVS were in their 40s. In addition, results of the present study are in accordance with **Kao *et al.* (2008)** who reported that, the control group 20 to 50 years old (mean=38.5 years). This group included cases with no history of frequent vibrating tool use. The vibration group consists of construction workers, aged between 17 and 65 years (mean=39 years) with a history of frequent vibrating tool use varying from 3.5 to 35 years (mean=12.2 years). On the other hand, in work reported by **Chao *et al.* (2013)**, the average height of the participants was 169±7.0 cm; the average weight was 72.4 ± 20.5 kg. In the present study, stage of disease in study group was SN0 (no clinical manifestations) in 6 cases (12.0%); SN1 (Intermittent or persistent numbness with or without tingling) in 29 cases (58.0%) and SN2 (continuous tingling and numbness) in 15 cases (30.0%) out of 50 cases and these results indicated that, more than 50% of cases had mild affection, while 30% of cases had moderate affection. These results are comparable to those reported by **Kao *et al.* (2008)** who reported that, control subjects with no symptoms, whereas each vibration subject had at least four symptoms associated with vibrating tool use, including finger numbness, tingling, weakness, and pain, coldness, and color changes. All subjects were classified according to the Stockholm workshop scale (SN, sensorineural, and V, vascular). All subjects in the control group were SN0 V0. In the vibration group, 7 out of 11 (64%) subjects were SN1 V1 and 4 out of 11 (36%) were SN1 V2. Results of the present study also comparable to those reported by **House *et al.* (2009)** who reported that, workers with the neurological component of HAVS usually complain of numbness and tingling in the fingers and hands. These results are in agreement with previous study **(Griffin, 2008).** These symptoms, along with the presence of sensory abnormalities on physical examination, have been used as the basis for the classification system referred to as the Stockholm sensorineural scale. **House *et al.* (2009)** also reported that, the number (per cent) of subjects at the Stockholm sensorineural scale stages was as follows: right hand: Stage 0: 51 (33%), Stage 1: 81 (52%), Stage ≥2: 23 (15%) and left hand: Stage 0: 52 (34%), Stage 1: 83 (54%), Stage ≥2: 20 (13%). There was a statistically significant association between being at Stage≥1 in comparison to Stage 0 and both years of vibration exposure and daily vibration exposure (mining versus non-mining) in each hand. **Busi *et al.* (2007)** reported that, vibration-exposed South African gold miners were three times more likely to report symptoms compatible with HAVS than non-exposed workers. The prevalence of HAVS in the exposed group was 15%, and in all cases this was associated with exposure to rock drills. The mean latency between first exposure to vibration and first symptoms was 5.6 years, and regardless of the percentage of HAVS, their results go in agreement with that of the present work. As regard work duration, it ranged from 6 to 28 years with a mean of 14.0±5.23 years, while working hours per day ranged from 10 to 13 hours with a mean of 11.20±0.85 hours/day. **Rolke *et al.* (2013)** reported that, the mean time of exposure to vibrating devices such as chain saws, was 28 ± 10 (mean ± SD) years; and this is increased than the present study and can explained by older age group in their study (54 ± 11 years) compared to 34.06±4.86 years. In the present work, left median nerve electrodiagnostic study, it revealed that, there was significant prolonged of motor and sensory latencies (35% vs 36% respectively). Increase F wave (15%), while there was significant decrease of NCV (11%) and motor amplitude (16%), in exposure group in comparison to control group. In addition, EMG results of the left median nerve revealed that; there were significant denervation cases in exposure group when compared to control group (20.0% vs. 0.0% respectively). Results of the right median showed that there was significant prolonged of motor and sensory latencies (38% vs. 44% respectively) and increase of F wave (19%). While there was significant decrease of motor, sensory amplitudes (17% vs. 13% respectively) and NCV (17%) in exposure group in comparison to control group. EMG results of the left median nerve revealed that; there were significant denervation cases in exposure group when compared to control group (20.0% vs. 0.0% respectively).This mean there is demyelination neuropathy of both median nerves in workers who exposed to vibration but right side more affected than left side and most probably due to many workers are right handed. In the present work, left ulnar nerve electrodiagnostic study showed that. Significant prolonged of motor and sensory latencies (29% vs. 30% respectively) and increase of F wave (12%) while there was significant decrease sensory amplitudes (11%) in the exposure group when compared to control group. EMG results of the left ulnar nerve, it was found that, there were significant denervation cases in exposure group when compared to control group ulnar (12.0% vs. 0.0% respectively). Result of the right ulnar nerve showed that significant prolonged of motor and sensory latencies (32% vs. 33% respectively), increase F wave (14%); and significant decrease of NCV (8%) and sensory amplitude (11%) in the exposure group when compared to control group. EMG results of the right ulnar nerve, it was found that, there were significant denervation cases in exposure group when compared to control group (12.0% vs 0.0% respectively). This mean there is demyelination neuropathy of both ulnar nerves in workers who exposed to vibration but right side more affected than left side and most probably due to many workers is right handed. Furthermore, both right and left radial nerves show no affection. The duration of the work is the most common determinant factor for nerve conduction abnormalities detected in the present study. Finally, median nerve is the most nerve affected of workers who exposed to vibration then ulnar nerve less affected and radial nerve which not affected. As neurologists, we consider nerve conduction tests the best method for evaluation of peripheral nerve function, as reported previously in literature **(Midroni, 1996).** Nerve conduction tests are more objective than quantitative sensory tests, requiring no feedback or active participation **(House *et al.,* 2009).** Results of the present study are agreement to those reported by **Rolke *et al.* (2013)** who reported that, HAVS patients showed a distally distributed motor and sensory neuropathy. Quantitative sensory testing (QST) demonstrated a sensory deficit at the finger tips, most pronounced for large fiber sensory function. They concluded that: "HAVS involves a distal neuropathy that is more pronounced for large than small fiber functions, and that is independent of carpal tunnel syndrome (CTS)". There is finding, comparable to results of the present study, were reported by **Gerhardsson *et al.*(2013)** who reported that, although, the vibration exposure was fairly short a tendency to raised vibrotactile perception thresholds (VPTs) as well as pathologic monofilament test results was observed. Thus, early neurophysiologic symptoms and signs of vibration exposure may appear after short-term exposure (median exposure time two years) also in young workers. In addition, different previous studies confirmed that, repetitive exposure to vibration has been shown to induce peripheral vascular injury and nerve dysfunction in the hands and fingers **Pelmear and Wills, 1997, Aiba *et al.,* 2012.** Furthermore, results of the present study are in agreement with **Pelmear (1997)** who reported that, almost all hand-held vibrating tools can affect the vascular, sensorineural, and musculoskeletal structure of workers' upper limbs. Slight variations between right and left nerves was in accordance with **Lindsell and Griffin (2002)** who reported that there are some differences between the various measurement sites assessed. It is likely; however, that differences between hands can arise from occupation exposures to hand transmitted vibrations. The same authors added, for vibrotactile threshold measurements, there were no differences between digits innervated with the median nerve and digits innervated with the ulnar nerve. Differences between these measurements in an individual might be suggestive of a nerve compression injury. **Fathy *et al.* (2012)** reported that, in their work, there was significant decrease in peripheral nerve conduction speed which is related to duration of exposure and the presence of Raynaud's phenomenon of workers exposed to vibration. These results are in agreement with the present work. On the other hand, **Sandén *et al.* (2010)** reported that, there were no significant differences in median or ulnar nerve distal latencies in either arm between exposed and unexposed subjects, or between classes with cumulative lifetime exposure or current daily exposure. Neither the cumulative lifetime exposure nor the current daily exposure contributed to explaining the distal latencies in the multiple linear regression models. They added, there were no significant differences in sensory latencies in either arm between exposed and unexposed subjects, or between classes with cumulative lifetime exposure or current daily exposure. These results are in contradiction to results of the present study and this can be explained to different protocol before electrodiagnostic measurements, as they elevated temperature of the hand before they did the nerve conduction studies. In addition, their sample size were more that of the present study. In addition, the authors themselves tried to explain their non positive results as the following: one must bear in mind that only the fastest of the large myelinated fibers, and thus a limited portion of the whole nerve fiber population, are examined in nerve conduction studies. Another possibility for the non-positive result in the present study could be that the exposed population is mixed with currently and formerly exposed manual workers and if there exists a recovery factor the mixed population would contribute to diluting the difference between the exposed and the unexposed groups. As regard correlation between stages of disease, it was found that, with increased stage, there was significant increase of work duration, while length and working hours showed non-significant changes with increased stages of disease. These results are in agreement with **Griffin and Bovenzi (2002)**, who reported that, the duration of the exposure, appears to be the primary factor associated with the development of HAVS with usage of hand-held vibrating tools. As regarding correlation between disease stages and median nerve electrodiagnostics, it was found that with increasing stage, motor and sensory latencies were prolonged, while sensory amplitude was significantly decreased on the right median nerve and significantly decreased motor amplitude left median nerve. In addition, NCV significantly decrease and F wave increased. When calculating percentage of difference between control and SN0 stage, we found, motor latency was increased by 8% at left wrist and 11% on right wrist; sensory latency was increased by 48% on left side and 51% on right side; amplitude at wrist was decreased by 5% at left and 12% on the right side. In addition, NCV decreased by 7% on the left and 8% at right side. As regard this correlation, it can be said that, the demyelination neuropathy increase with increase of disease stages and work duration, and it was found that NCV changes (demyelination) occurred before clinical appearance of symptoms. As regarding correlation between disease stages and ulnar nerve electrodiagnostics, it was found that prolonged motor and sensory latencies, F wave significantly increased, while NCV and sensory amplitude of right ulnar nerve significantly decreased with increased stage of disease. When calculating percentage of difference between SN0 and control, we found increased motor latency by 5% on left wrist and by 6% at right wrist; increased sensory latency by 35% at left wrist and by 41% of the left wrist. As regard this correlation it can be said that, the demyelination neuropathy increase with increase of disease stages and work duration. In addition, found that NCV changes (demyelination) occurred before clinical appearance of symptoms. Finally median nerve showed the powerful correlation, followed by ulnar nerve; while radial nerve showed no such correlation. ***Conclusion***: Cases expose to hand held vibration tool (Beca tronics CNC machine) had changes in the nerve conduction and EMG studies. And the most powerful determinant factor for these changes was the duration of exposure. In addition there was NCV (nerve conduction velocity) changes (demyelination) in cases without clinical symptoms. Thus, NCV can be used for early detection of nerve affection in cases with HAVS.

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