Repetitive strain disorder: towards diagnostic criteria

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Abstract

Thirteen women (mean age 48.2 years; range 25-60 years) all of whom had developed musculoskeletal symptoms during employment in an industrial job with repetitive tasks were referred by their trade unions for adjudication on the cause of symptoms. One had rheumatoid arthritis. A study of the other 12 women provided an opportunity to document the natural history of repetitive strain disorder.

Early symptoms of weakness were diffuse but were always relieved by rest. Several months later localisation of symptoms at a tendon, nerve, or enthesis could be predicted from the analysis of the action required in the particular repetitive task. Six of the 12 women required an operation several years later, thus providing histological confirmation of the presence of a lesion.

Early loss of grip strength measured by a sphygmomanometer cuff compared with an unaffected control subject and improved by rest may be the most valuable sign in excluding compensation neurosis. The estimated prevalence of repetitive strain disorder defined by these strict criteria was at least 2% in conveyor belt workers.

(*Ann Rheum Dis* 1992; 51: 974-977)

Repetitive strain disorder is not new. The 'clerk's palsy' described by Ramazzini¹ in 1713 may have been one of the earliest occupational examples. Hobbies are not exempt and Poore's 1887 account of symptoms in 21 pianists² suggests that little has changed over the years except for medicolegal attention. This has allowed the disorder to reach epidemic proportions in Australia³ and has led to a wide range of terminology.

Repetitive strain injury remains the most popular lay term and this term has provided the name for a self help society of patients who consider themselves to have this disease. Repetitive strain injury is also used in published medical papers.^{4 5} Other workers have argued that 'injury' implies damage, which is not always present, and negligence and is best avoided. The terms repetitive strain syndrome⁶ or repetitive strain disorder⁷ are preferred. Workers who are most conscious of litigation have even preferred 'regional pain syndrome'³ though this seems to ignore the repetitive mechanical action that invariably induces symptoms and may even widen the field further to include primary fibromyalgia. Repetitive strain disorder appears to be the best compromise.

When 13 patients all participating in highly repetitive occupations were referred by their trade unions' solicitors for medicolegal adjudication an unusual opportunity arose to document symptoms and physical signs that might be of diagnostic value. An attempt was also made to clarify the natural history of the disorder and to estimate its prevalence in conveyor belt workers.

Subjects and methods

The 13 subjects were examined and their medical histories recorded on 27-28 March 1990. Before this copies of their general practitioner case notes and their hospital case notes where consultant or casualty referral had been made were obtained together with copies of investigations and histology reports. Each subject provided a typed statement that detailed their occupational history. A full medical history was then determined in conjunction with these documents. All subjects agreed to a full physical examination of the musculoskeletal system, nervous system, and other systems considered relevant. Grip strength in the hand was recorded on three occasions for each hand, alternating between the left and right hand with a sphygmomanometer cuff inflated to 30 mmHg. Hand dominance was also recorded. Subjects were asked to mime their jobs allowing for correlation between the repetitive mechanical acts they performed and their symptoms. Although permission had been requested to visit them at their place of work, this was not granted by their employers.

Results

Table 1 gives the demographic details of the 13 subjects. One subject (subject No 13) had clinical and serological evidence of severe rheumatoid arthritis affecting her wrists and ankles. Although the rheumatoid disease was worse in the left wrist which had been subject to more mechanical strain than the right wrist, this subject was not considered further.

The other 12 subjects had no evidence of musculoskeletal disease other than those that might reasonably have been acquired as a result of their occupation. Table 1 lists subjects in the order of duration of their symptoms (two to 10 years). Their mean age was 48.2 years (range 25-60 years) and their duration in employment ranged from six to 26 years. There was no consistent type of employment after which symptoms invariably occurred though most subjects were able to attribute the onset of symptoms to a change in technique or, more

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Accepted for publication
30 March 1992

Table 1 Demographic details of subjects

Case No	Age (years)	Type of factory	Duration of employment (years)	Duration of symptoms (years)	Clinical diagnosis	Findings at operation or histological examination
1	35	Electrical	14	2	Left carpal tunnel syndrome	Yes
2	57	Biscuits	13	2	Repetitive strain disorder, left wrist	No
3	38	Biscuits	11	2	Repetitive strain disorder, left then right thumb, ganglion left wrist	No
4	50	Biscuits	6	2	Tenosynovitis left thumb	Yes
5	42	Biscuits	26	2	Repetitive strain disorder, right hand, repetitive strain disorder, left hand	No
6	52	Biscuits	16	3	Repetitive strain disorder, left wrist, repetitive strain disorder, right wrist	No
7	60	Biscuits	6	4	De Quervains tenosynovitis, left thumb	Yes
8	49	Biscuits	11	4	Triggering left thumb, early trigger right thumb	Yes
9	58	Biscuits	13	5	Ganglion left wrist tethering left thumb, left frozen shoulder, cervical spondylitis	Yes
10	25	Electrical	8	6	Right carpal tunnel syndrome, repetitive strain disorder right wrist	No
11	55	Biscuits	21	10	Repetitive strain disorder left then right thumb, ganglion left wrist	No
12	46	Biscuits	14	10	Left tennis elbow, right tennis elbow, left frozen shoulder	Yes
13	60	Biscuits	46	12	Rheumatoid arthritis affecting right and left wrists and right and left ankles aggravated by repetitive strain disorder left wrist	No

often, the move to a different conveyor line. Two subjects (subject Nos 1 and 10) worked in an electrical factory. All the others worked in the packing house of a biscuit factory.

Clinical diagnoses are listed for each subject. Six of the 12 subjects had had an operation and in each subject the findings at the operation and subsequent histology confirmed the clinical diagnosis. In every subject for whom the diagnosis of tenosynovitis, epicondylitis, or nerve compression was substantiated, a classical localisation of symptoms resulting from these pathologies had always been preceded by a period of vaguer symptoms typical or those described in repetitive strain disorder.

In four subjects (subject Nos 2, 5, 6, and 11) the only symptoms had been those of this prodromal phase.

Additional clinical features were then sought that might be of aid in diagnosis. All workers in the biscuit factory worked the same hours. The eight hour shift was punctuated by two 10 minute breaks for tea and one break of 30 minutes for a meal. Workers could leave their post to visit the toilet by raising their hand so a deputy could be substituted but otherwise they

were committed to pack constantly at a rate predetermined by management. In no subject were the symptoms relieved by the 10 minute tea break or 30 minute meal break, though in the early stages symptoms were invariably relieved by a night of rest. Later, usually after three to four months, symptoms were not even relieved by the two day break each weekend. Ultimately, usually after one or two years, symptoms were not relieved by two or four week periods of annual holiday. This progressive resistance to relief by rest appeared to be characteristic.

Analysis of the particular task performed by each worker invariably correlated with the site of symptoms. Lifting of heavy boxes caused shoulder symptoms, twisting of relatively large packs of biscuits caused forearm symptoms, and repeated use of the fingers to hold packs of biscuits together caused symptoms at the wrists and fingers. Specific pathologies later emerged: flexor and extensor tendon tenosynovitis for those using fingers, epicondylitis for those twisting the forearm, and frozen shoulder for those lifting the heaviest weights.

Two subjects (Nos 1 and 10) worked in a factory packing electrical accessories. Here a repetitive punching action with a stapler was much more common. The two subjects had the same prodromal symptoms as the biscuit workers but later localisation indicated a carpal tunnel syndrome.

Symptoms described by all subjects in the prodromal phase invariably included weakness and pain. Less often paraesthesiae or tremor were noted. Sometimes biscuits were dropped at work but it was more common for kitchen utensils to be dropped at home, often after a period of rest. Table 2 shows that a consistent clinical finding once symptoms were present was of reduced grip strength, measured with the sphygmomanometer cuff, in the hand that had been strained. When compared with a control group of women matched for age but without repetitive strain symptoms or an occupation that might predispose to this, there was a highly significant difference ($p < 0.001$) when left and right hand grip strengths were compared using

Table 2 Diagnostic value of grip strength. Results are mean of three readings for each hand (mmHg)

Patients*			Control subjects†		
Subject No	Left hand‡	Right hand§	Subject No	Left hand‡	Right hand§
1	168	277	1	300+	300+
2	122	290	2	300+	300+
3	67	48	3	300+	300+
4	184	139	4	260	260
5	182	223	5	300+	300+
6	126	173	6	300+	300+
7	87	139	7	296	282
8	143	167	8	300+	300+
9	92	187	9	300+	300+
10	297	119	10	300+	300+
11	122	102	11	300+	300+
12	75	122	12	300+	300+
			13	300+	300+
Mean	139	166		294	197

*Mean age 48 years (range 25–60 years); all women.

†Mean age 49 years (range 25–69 years); all women.

‡Left hand: patients *v* controls, $t = 8.48$; $p < 0.001$.

§Right hand: patients *v* controls, $t = 6.62$; $p < 0.001$.

Natural history of repetitive strain injury.

Student's *t* test. Grip strength in the subject with rheumatoid arthritis was 61 for the more affected left and 214 for the less affected right hand.

We formed a strong impression that this was worse after a period of employment and improved after a period of rest but further study is necessary to confirm that these changes were more pronounced in this group of subjects than the normal diurnal variation that is known to occur in grip strength. Dominance can also cause variations in muscle weight, strength, and in joint laxity⁸ though the changes observed appeared to be much more marked than the variation expected between the hands of normal control subjects.

Discussion

Although this series of subjects was highly selected by trade union referrals it was interesting that few of them had thought of litigation themselves or attempted to instigate it. On the basis that most had physical signs and some had required an operation, we think it unlikely that they had 'compensation neurosis'. Even the two subjects with the least clinical signs (subject Nos 5 and 6) would have been unlikely to reproduce the characteristic reduced grip

strength that appeared consistently throughout the group. On this basis we judged that most if not all of the subjects had a classical repetitive strain disorder. In turn this allowed delineation of the natural history of the disease as shown in the figure. For the period of this natural history before pathological change the subject could be described as having repetitive strain disorder. We suggest that all the symptoms and signs described may be needed to distinguish repetitive strain disorder from compensation neurosis, which is the most likely differential diagnosis.

Further confirmation of a true repetitive strain disorder is likely to come from a close correlation between the offending repetitive task, often anatomically and physiologically unsuited to the patients body build, and the distribution of the symptoms described which should have a logical relation to the strain imposed. A repetitive stamping movement of the hand would be unlikely to precipitate epicondylitis at the elbow, just as a repetitive supination-pronation of the forearm while weightbearing would be unlikely to precipitate a carpal tunnel syndrome.

Sociological factors undoubtedly also contribute to the disease. The biscuit factory was almost a monopoly employer in an area where there was little other work for women. Men employed in the factory tended to be employed on cleaning and maintenance tasks; only women worked on the conveyor belts. Several subjects would have retired earlier given the financial opportunity to do so. Many of the women were widowed or not living with their husbands. Some of the women had to work until retirement age to guarantee a pension on which to live.

The two subjects working at the electrical appliances factory were less dependent on a preset conveyor belt speed. They worked at a bench with unlimited supplies of raw materials. Although apparently working at the speed they chose, they were paid a low basic wage with a high supplement for performance. In practice this meant an adequate working wage could only be achieved by 'performing in the 120% category' so the option of reducing working speed was not really available to them. The smaller electrical appliances factory also allowed less variation in working practices. To their credit management at the larger biscuit factory invariably attempted to move disabled employees to the lighter production line that produced mini-packs of crackers for airline meals rather than the larger packs for supermarket shelves. Ergonomic comparison of these two tasks suggested that the speed of the cycle for packing airline biscuits was faster so though the weight was lighter, this well intentioned move simply transferred strain from the forearm to the fingers.

The estimate of prevalence is difficult. Two of 100 employees were seen from the electrical appliance factory, though one more with comparable symptoms was known to the subjects. From the biscuit factory, 11 of 1500 workers were referred. Anecdotally up to 40 more subjects had similar symptoms though none was known to have required an operation. This

gives an approximate estimate of around 2% of conveyor belt workers affected at any one time though it is not known how many women with husbands in employment had opted to leave the factory after the first onset of their symptoms.

Assuming this to be the actual prevalence it is not clear why 98% of workers at conveyor belts do not develop symptoms. Further ergonomic analysis is required to determine whether certain body shapes might be at risk in certain occupations. Our results are similar to the reported prevalence rates of carpal tunnel syndrome, epicondylitis, and tenosynovitis in a population not at risk of repetitive strain disorder though in this series of subjects the close match between precipitating mechanical stimulus and localisation of symptoms suggests that the association is not coincidental.

We thank Mrs J L Childs for secretarial assistance. The clinical pharmacology unit is supported by Roche Products Limited. We also thank Dr I D L Brewis and his colleagues, both orthopaedic surgeons and general practitioners, for allowing us access to patient records.

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