Work practices and histopathological changes in the tenosynovium and flexor retinaculum in carpal tunnel syndrome in women

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Patients and Methods

Over a period of six months, we recruited 58 women with end-stage carpal tunnel syndrome into the study. Patients were excluded if the syndrome had developed as a complication of trauma, pregnancy, diabetes, thyroid disease or inflammatory arthropathy, or was recurrent. The mean age of the women was 46 years (27 to 60), and 50 (86%) were right-handed. In 41 (70%) the right hand was involved. The duration of their symptoms ranged from three months to 15 years.

We divided the patients into two main groups; those who were employed outside the home and those who were housewives. Hand dominance, height, weight, duration of symptoms, occupation, duration of employment, main work activity and leisure activities were recorded. Patients in employment were assigned to one of four groups according to whether they described the level of force and repetition of their work as high or low (Table I). ‘High-force’ work was defined as work requiring a force of more than 6 kg as, for example, in print finishing, and ‘high-repetition’ work as jobs with a cycle time of less than 30 seconds, as in packing or machining.

All patients underwent open decompression of the carpal tunnel under local anaesthesia. When bilateral releases were carried out, only the dominant hand was included in the study. During surgery, the macroscopic appearance of the tenosynovium was recorded. A small, full-thickness wedge of flexor retinaculum and a strip of the tenosynovium surrounding the flexor tendons were taken as biopsies. These were fixed in formalin without orientation and routinely processed in paraffin wax. At multiple levels sections were stained with haematoxylin and eosin, and van Gieson stain was used to demonstrate elastin and collagen.

Using samples taken from two cadavers, and from the surgically-amputated hand of a 52-year-old man, to represent the normal features of the flexor retinaculum and tenosynovium lining the carpal tunnel in a group of women with idiopathic carpal tunnel syndrome.

Compressi

We studied 58 women of employable age with the carpal tunnel syndrome in order to determine whether the histological appearances of the carpal tunnel, tenosynovium and flexor retinaculum are influenced by work practices. Age, body mass index and the duration of symptoms did not correlate with the extent of oedema or fibrosis within the tenosynovium. The incidence of abnormality on histological examination of the tenosynovium was the same in employed and unemployed patients \( p = 1.0 \), and was not influenced by the level of repetition \( p = 0.89 \) or force \( p = 0.29 \) of work. Myxoid degeneration within the flexor retinaculum was, however, more common in women undertaking ‘high-force’ work. Apart from this finding, the results suggest that work practices do not affect tenosynovial thickening, fibrosis or oedema in patients with carpal tunnel syndrome.

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Results

There were minimal changes in the flexor retinaculum, with only occasional areas of focal myxoid degeneration and formation of new vessels. Minor changes found in the flexor tenosynovium included scanty lymphocytic infiltrate, vascular proliferation, loss of elastic fibres and myxoid degeneration. The major histological change was thickening. Using empirical microscopic assessment, we categorised the extent of thickening as abnormal, mild, moderate or severe. Since vertical sectioning of the synovial sheet could not be guaranteed, we were not able to quantify these changes. Moderate or severe thickening was due either to oedema or to fibrosis; few samples showed both changes.

Release of the carpal tunnel led to complete resolution of symptoms in all except one patient, a horse-handler doing heavy manual work. This was the only patient in whom we found marked inflammatory cell infiltrate and hypervascularity within the tenosynovium.

Table I shows the histological findings in the tenosynovium according to work category. There were no significant differences between employed women and housewives in terms of the extent of synovial thickening (p = 1.0), fibrosis (p = 0.42) or oedema (p = 0.81). To analyse the effects of work practices further, we combined into one group the housewives and the women in jobs with low levels of force and repetition. We found no significant difference (p = 0.29) in the extent of synovial thickening between patients in high- or low-force jobs. Further, synovial thickening did not differ significantly (p = 0.89) between women in high- and low-repetition jobs. There was also no significant difference (p = 0.65) in synovial thickening between those in low-force and low-repetition jobs and the other three groups. Similarly, between women in low-force and low-repetition jobs and the other three groups, the severity of fibrosis (p = 0.56) and oedematous change (p = 0.2) in the tenosynovium did not differ.

We also assessed the effects of leisure activities. Nearly half the patients (42%) said that they knitted, gardened or sewed more than three times a week and that this aggravated their symptoms. The total number of patients who engaged in these activities is not known. Complaints that leisure activities aggravated carpal tunnel symptoms were equally distributed between housewives and those in the four work categories. There was a significant association between these hobbies and the presence of tenosynovial fibrosis (p = 0.03), but not with the other histological variables (Table III).

Table I. Work categories of the 58 women and histological findings by work group

<table>
<thead>
<tr>
<th>Number of patients</th>
<th>Not working</th>
<th>Low force/ low repetition</th>
<th>High force/ low repetition</th>
<th>Low force/ high repetition</th>
<th>High force/ high repetition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>13</td>
<td>15</td>
<td>8</td>
<td>15</td>
<td>7</td>
</tr>
<tr>
<td>Severity of tenosynovial thickening</td>
<td>Normal</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>3</td>
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<tr>
<td>Mild</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Moderate</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Severe</td>
<td>5</td>
<td>6</td>
<td>6</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>Synovial fibrosis</td>
<td>Normal</td>
<td>8</td>
<td>8</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Grade 1</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Grade 2</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Grade 3</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Synovial oedema</td>
<td>Normal</td>
<td>5</td>
<td>9</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Grade 1</td>
<td>5</td>
<td>2</td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Grade 2</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Grade 3</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Change in retinaculum</td>
<td>Normal</td>
<td>11</td>
<td>13</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>Myxoid</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

Table II. Details of the 58 women with carpal tunnel syndrome

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Mean</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height (cm)</td>
<td>157.6</td>
<td>138 to 175</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>69.5</td>
<td>50 to 111</td>
</tr>
<tr>
<td>BMI</td>
<td>28.1</td>
<td>20.8 to 43.1</td>
</tr>
</tbody>
</table>

Table III. Correlation between participation in regular hobbies and histological change

<table>
<thead>
<tr>
<th>Histological findings</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexor retinacular changes</td>
<td>0.89</td>
</tr>
<tr>
<td>Tenosynovial thickening</td>
<td>0.35</td>
</tr>
<tr>
<td>Tenosynovial oedema</td>
<td>0.02</td>
</tr>
<tr>
<td>Tenosynovial fibrosis</td>
<td>0.05</td>
</tr>
</tbody>
</table>
In the flexor retinaculum, myxoid degeneration was found in nine patients. There was a significant correlation with high- or low-force work (p = 0.04), but not with any other variable (Table I).

Discussion

Several studies have shown that personal variables such as age, BMI, smoking, a history of gynaecological surgery, and the cross-sectional area of the carpal tunnel influence the development of the carpal tunnel syndrome or of increased susceptibility of the median nerve at the wrist. In our study, there was a significant inverse correlation between weight and BMI and the severity of thickening of the tenosynovium. Some authors have reported an increased incidence of these conditions in certain occupations.

Weight and BMI may predispose to the development of the condition. Several authors have assessed histological changes in the tenosynovium and the flexor retinaculum in patients with carpal tunnel syndrome. Some found no abnormalities in the flexor retinaculum, while others observed evidence of type-II collagen changes. We found mild myxoid degenerative changes in nine of 58 patients (16%), all of whom were involved in high-force jobs such as packing, catering and printing. This suggests that work practices cause pathological, rather than adaptive, histological changes in the flexor retinaculum. Whether these changes are related to the pathogenesis of carpal tunnel syndrome is not known.

Neal, McManners and Stirling found no inflammation of the tenosynovium. They observed that tenosynovial histological change was associated either with vascular changes or with thickening, which was often due to oedema or deposition of collagen. This contrasts with the fibrous hyperplasia found by others. Some authors have reported that oedema is the most common tenosynovial abnormality. Scelsi, Zanlungo and Tenti suggested that inflammatory changes may be present in the acute phase of carpal tunnel syndrome, although fibrosis is the predominant feature in the end stage. In our study, 21% of the tenosynovial biopsies were histologically normal, 21% showed only fibrosis, 30% had oedematous changes, and 28% had a mixture of these two. Neither duration of employment nor duration of symptoms influenced the development of the condition. Several authors have assessed histological changes in the tenosynovium and the flexor retinaculum. All our patients had end-stage carpal tunnel syndrome and therefore this finding does not necessarily show that tenosynovial changes predispose to the development of the condition.

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Many studies have assessed the effect of work practices on the carpal tunnel syndrome and impaired conduction of the median nerve. Some authors have reported an increased incidence of these conditions in certain occupations, but others have found no correlation with repetition, force of work, or duration of employment. The association between the carpal tunnel syndrome and certain occupations may simply indicate that, if the pathology is already present, some activities may exacerbate symptoms.

Silverstein et al assessed work activity according to repetition and force, and we used their criteria to categorise our subjects. We found no significant differences in histopathology in the tenosynovium of the carpal tunnel between those who were working and the unemployed. There was no significant difference according to work repetition or force. Our assessment of force and repetition, however, was based only on job titles and brief descriptions of work practices rather than on observation of work content. All our patients were women and none had jobs requiring very high levels of force. Although we found no correlation with work content, we did find an excess of tenosynovial fibrosis in women who regularly pursued hobbies which aggravated their symptoms. The relevance of this to the pathogenesis of carpal tunnel syndrome is not yet clear.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

References


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