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Original article

Prevalence of pain and dysfunction in the cervical and thoracic spine in persons with and without lateral elbow pain

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Abstract

The purpose of this study was to survey the prevalence of pain in the cervical and thoracic spine (C2–T7) in persons with and without lateral elbow pain. Thirty-one subjects with lateral elbow pain and 31 healthy controls participated in the study. The assessment comprised a pain drawing, provocation tests of the cervical and thoracic spine, a neurodynamic test of the radial nerve, and active cervical range of motion. Seventy percent of the subjects with lateral elbow pain indicated pain in the cervical or thoracic spine, as compared to 16% in the control group ($p < 0.001$). The frequency of pain responses to the provocation tests of the cervical and thoracic spine was significantly higher ($p < 0.05$) in the lateral elbow pain (LEP) group, as was the frequency of pain responses to the neurodynamic test of the radial nerve ($p < 0.001$). Cervical flexion and extension range of motion was significantly lower ($p < 0.01$) in the LEP group. The results indicate a relation between lateral elbow pain and pain in the vertebral spine (C2–T7). The cervical and thoracic spine should be included in the assessment of patients with lateral elbow pain.

Keywords: Lateral epicondylalgia; Manual therapy; Pain; Tennis elbow; Cervical and thoracic spine

1. Introduction

Lateral elbow pain is a common disorder, which has been described in terms such as tennis elbow, epicondylitis, and lateral epicondylalgia. In this paper, the term lateral elbow pain is used.

According to Vicenzino and Wright (1996), the prevalence of lateral elbow pain was found to be 3% in a random population sample, and most frequent among persons in their mid-40s. There were no gender differences, although symptoms seemed more pronounced and chronic in females. Relapse rates ranged between 33% and 50% in an 18-month follow-up period. The relative simplicity of the clinical presentation belies the complexity of the underlying pathophysiological and aetiological processes, and the mechanism of pain production in chronic lateral elbow pain is probably multifactorial, involving local pathophysiological mechanisms as well as nociceptive system mechanisms (Vicenzino and Wright, 1996). Among the latter, somatic pain referral from the cervical and thoracic spine, and radial nerve involvement have been proposed as possible factors (Vicenzino and Wright, 1996). Painful disorders in the cervical and thoracic spine have been suggested by several authors as common causes of referred pain in the lateral elbow area (Iselin, 1977; Lee, 1986; McGuckin, 1986; Widenfalk et al., 1988; Butler, 1991; Haker, 1993; Noteboom et al., 1994; DeFranca and Levine, 1995). In a similar vein, Wright et al. (1994) suggested that clinical signs of lateral elbow pain such as tenderness, pain spreading beyond its primary location, guarding of the pain area, and changes in skin temperature may be explained by central sensitisation processes that could have arisen from structures in the

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lower cervical spine. Some uncontrolled studies have shown decreased pain intensity in the elbow when manual treatment was given to the cervical spine for patients with lateral elbow pain (Gunn and Mildbrandt, 1976; Maigne, 1988). In the studies by both Gunn and Mildbrandt (1976) and Maigne (1988), the participants had all obtained earlier treatment directed to the elbow without effect. The implication of the results in these two studies is that there may be a cervical factor in lateral elbow pain. However, the absence of a control group limits the conclusions that can be drawn from the results. Vicenzino et al. (1998) showed in a randomised and controlled study that manipulative therapy of the cervical spine produced hypoalgesic and sympathoexcitatory changes that were significantly greater than placebo and control treatments. Vicenzino et al. (1996) demonstrated increased pain-free strength and increased shoulder abduction during responses to a neurodynamic test of the radial nerve after manual treatment at the C5–C6 level. Clinical evidence of radial nerve involvement in lateral elbow pain was presented by Yaxley and Jull (1993), who found signs of less extensible neural tissue in the arm with unilateral lateral elbow pain, as compared to the unaffected arm during a neurodynamic test of the radial nerve in subjects suffering from unilateral elbow pain. However, a possible confounding factor in referred pain is that degenerative changes in the cervical spine is very common in asymptomatic subjects, the C5–C6 segment showing the highest frequency of all MRI findings (Matsumoto et al., 1998). Because none of the studies referred to above used pain-free subjects as controls, it is not known whether signs of disorders in the cervical spine are present to a greater extent in persons with lateral elbow pain than in persons without lateral elbow pain.

In sum, there is some support for both painful disorders in the cervical and thoracic spine and radial nerve involvement as aetiological factors in lateral elbow pain. Because comparison of symptoms and signs of spinal disorders such as pain intensity, restricted cervical range of motion, positive responses to pain provocation tests of the cervical and upper thoracic spine, or radial nerve involvement with subjects without lateral elbow pain is lacking in the literature, no firm conclusions can be drawn regarding the role of these disorders in the aetiology of lateral elbow pain.

Thus, the purpose of the present study was to (1) survey the prevalence of self-reported pain in the cervical and thoracic spine (C2–T7) in persons with and without lateral elbow pain, and (2) compare persons with and without lateral elbow pain regarding (a) responses to several pain provocation tests in the cervical and thoracic spine, (b) responses to a neurodynamic test of the radial nerve, and (c) cervical active range of motion (ROM).

2. Methods

2.1. Design

The study was descriptive and comparative, involving a group of persons with ongoing lateral elbow pain (LEP) and a pain-free control (C) group.

2.2. Subjects and setting

All subjects were recruited from a large paper mill in the south of Sweden.

The criterion for being included in the LEP group was lateral elbow pain for at least 6 weeks prior to the study, in order to avoid subjects with acute and possibly self-limiting pain. Exclusion criteria were ongoing treatment due to lateral elbow pain or treatment within the last month, any known systemic disease affecting joints and/or muscles, or lateral elbow pain caused by external trauma. Subjects in the C group were required to have had no lateral elbow pain for at least 6 months prior to the study, and no known systemic disease affecting joints or muscles.

The subjects in the LEP group were recruited from the company's occupational healthcare centre. The subjects in the C group were recruited by advertising within the company and those who volunteered were selected consecutively so that eventually there were equally many males and females in each group, making it less likely that gender would be a confounding variable. There were 31 subjects in each group, 23 males and 8 females. The mean age was 49 years in the LEP group and 47 years in the C group. The mean duration of elbow pain in the LEP group was 36 months. Twenty-three of the subjects in the LEP group had received treatment directed to the elbow. All subjects completed the study.

2.3. Measures

The tests used in his study were selected because of their frequent use in clinical assessment of patients with neck disorders. They are well described in the literature and are simple to perform. The purpose of the tests was to record painful responses only (Sandmark and Nisell, 1995). The sensitivity (the proportion of subjects reporting neck/thoracic pain who had a positive outcome of the test) and specificity (the proportion of subjects without neck/thoracic pain who had a negative outcome of the test) of the tests for cervical and thoracic pain of the radial nerve were assessed as described by Sandmark and Nisell (1995) by setting up 2×2 contingency tables and calculating the proportions of true positives and true negatives.

Pain location was recorded with a pain drawing where subjects were asked to indicate the area/s where they felt pain. Pain drawings have been reported to be reliable and valid measures of pain location (Jensen and Karoly, 1992).

Cervical active ROM was measured with a Myrin goniometer (Hagen et al., 1997), and comprised flexion, extension, lateral flexion, and rotation, using the procedure described by these authors. Hagen et al. (1997) reported test–retest reliabilities ranging between $r = 0.75$ and 0.93.

A *neurodynamic test of the radial nerve* was conducted in conformity with Butler (1991). The subjects were examined in the supine position. A positive response was recorded if a subject reported pain in the forearm at less than 40° of shoulder abduction. Yaxley and Jull (1991) reported that no significant variation between two raters was found, and that there was no significant difference between trials in a repeatability test.

Spinal cervical pain was assessed by two tests for the cervical spine (C2–C7). Firstly, palpation of the nerve trunk just beyond its exit from the vertebral foramen was performed with subjects in the supine position, according to Cyriax (1982). Secondly, compression of the vertebral foramina was performed with subjects in the sitting position. The subject's head was placed passively in dorsal flexion, rotated, and laterally flexed to the same side, according to Kaltenborn (1989). Responses to the tests were recorded as no pain, local pain, or pain referred to the elbow. Strender et al. (1997) reported an inter-rater agreement of 76% and $\kappa = 0.43$ for the foramen compression test. Sandmark and Nisell (1995) reported a sensitivity of 77% and a specificity of 92% for the foramen compression test.

Spinal thoracic pain (T1–T7) was assessed by the Springing test, which was performed according to Kaltenborn (1989). The subjects were examined in the prone position. Responses to the test were recorded as no pain, local pain, or pain referred to the elbow.

All tests were performed bilaterally.

2.4. Procedure

Two physiotherapists with long clinical experience and formal education in manual therapy made the assessments. Before the assessments took place, the first physiotherapist (KB) gave code numbers to each subject. The subjects chose appointment times from a list provided by the first physiotherapist. In this way, the sequence of subjects was not influenced by any of the physiotherapists. The sequence of subjects was not available to the second physiotherapist (HP), who was thus blinded to group affiliation.

Pain drawings were collected by the first physiotherapist. Then, in a separate room, the second physiotherapist first measured active cervical ROM. Then, the neurodynamic test of the radial nerve was performed. Finally, the tests for spinal pain were performed. The assessments were completed in about 50 min.

The local ethics committee approved the project.

2.5. Data analysis

Positive responses to the tests (local pain or pain referred to the elbow) were collapsed into one category. Statistical analyses were performed in Statistica™ for Macintosh. Differences between groups based on frequencies were analysed with χ^2 tests. Differences between groups based on means and standard deviations of cervical ROM were analysed with unpaired *t*-tests. The level of significance was set at $p < 0.05$, two-tailed.

3. Results

Twenty-two subjects (70%) in the LEP group and 5 subjects (16%) in the C group indicated pain in the cervical and/or thoracic areas as measured by the pain drawing ($\chi^2 = 18.96$, $p < 0.001$).

There were significant differences between the groups in the frequency of positive responses to both tests of cervical pain, and the Springing test (Table 1). The sensitivity and specificity for the nerve trunk palpation test were 40% and 68%, respectively, and for the foramen compression test the corresponding figures were 67% and 68%. The sensitivity and specificity for the Springing test were 62% and 85%, respectively.

Eighteen subjects (58%) in the LEP group and 4 subjects (13%) in the C group reported pain in the forearm during the neurodynamic test of the radial nerve ($\chi^2 = 14.84$, $p < 0.001$).

There were significant differences between the groups in cervical flexion and cervical extension, but not in any of the other measured directions (Table 2).

4. Discussion

The results of this study show that 70% of the subjects in the LEP group indicated pain in the cervical

Table 1
The frequency of painful responses to the tests for cervical and thoracic pain

	Elbow pain group ($n = 31$)	Comparison group ($n = 31$)	p
Nerve trunk palpation test	15	6	<0.05
Compression of cervical vertebral foramina	17	8	<0.05
Springing-test of T1–T7	14	5	<0.05

Table 2
Means (M) and standard deviations (SD) for active cervical ROM in the two groups

	Elbow pain group ($n = 31$)		Comparison group ($n = 31$)		p
	M	SD	M	SD	
Cervical flexion	60.2	11.1	66.9	8.6	<0.01
Cervical extension	62.4	11.9	70.6	9.3	<0.01
Right lateral flexion	38.1	8.9	41.0	7.6	NS
Left lateral flexion	39.7	8.3	40.5	7.6	NS
Right rotation	68.6	13.6	73.7	9.7	NS
Left rotation	69.7	12.0	74.4	11.0	NS

and/or thoracic spine, as compared to 16% in the C group. The frequency of positive responses to provocation tests of the cervical and thoracic spine was significantly higher in the LEP group, as well as the frequency of positive responses to a neurodynamic test of the radial nerve. Finally, active cervical flexion and extension ROM were significantly lower. Since the two groups were comparable in age, degenerative and age-related changes are not likely explanations of these differences. The 1-year prevalence of neck pain in a normal population has been estimated to about 43% (Bovim et al., 1994), which is clearly lower than the 70% in the LEP group of this study.

The main difference between the groups was noted for the neurodynamic test of the radial nerve. Positive responses to this test have been shown in previous studies regarding lateral elbow pain that did not include a pain-free control group (Yaxley and Jull, 1993; Wright et al., 1994; Vicenzino and Wright, 1996). Yaxley and Jull (1993) recommended inclusion of tests of neural structures as routine for patients with lateral elbow pain. Although the neurodynamic test does not reveal the origin of symptoms (Moses and Carman, 1996), the results of the present, controlled study support the findings reported in previous studies (Yaxley and Jull, 1993; Wright et al., 1994; Vicenzino and Wright, 1996).

The frequency of positive responses to the provocation tests of the spine (C2–T7) differed significantly as well. Again, these results support findings of cervical and/or thoracic disorders in patients with lateral elbow pain reported in previous uncontrolled studies (Gunn and Mildbrandt, 1976; Maigne, 1988; Haker, 1993; Vicenzino et al., 1998). Wright et al. (1994) proposed that the nociceptive trigger activating the process of central sensitisation in patients with lateral elbow pain could have arisen from structures within the lower cervical spine. The findings in the present study support the presence of nociceptive processes in the cervical spine in patients with lateral elbow pain. However, because data regarding signs of central sensitisation were not obtained, no conclusions can be drawn concerning relations between cervical pain and signs of central sensitisation.

The active cervical flexion and extension were significantly lower in the LEP group, which is in line with the findings of Vicenzino and Wright (1996), who noted that 90% of subjects participating in studies of lateral elbow pain had segmental hypomobility in the lower cervical spine.

Relapse is common in patients with lateral elbow pain, and Vicenzino and Wright (1996) reported relapse rates of 33–50%. In the present study, 23 of the 31 subjects (74%) in the LEP group had been given earlier treatment directed to the elbow.

As for the interpretation of the results in this study, some important limitations should be noticed. Firstly, the sample was self-selected, which means that the population of patients with lateral elbow pain may not be well represented. However, the results reported here are in good accordance with previously reported results. Secondly, there is a lack of published data regarding the reliability and validity of the nerve trunk palpation test and the provocation test of the thoracic spine (the Springing test) that were used in the present study. However, the tests were used only to record painful responses, not hypo- or hypermobility (the Springing test). Sandmark and Nisell (1995) argued that pain is the most relevant parameter in clinical studies of musculoskeletal problems, not hypo- or hypermobility, which is not so uniquely tied to a syndrome that it could serve as a standard by which a condition is judged to be present or absent. In the present study, sensitivity and specificity were used to indicate the validity of the three provocation tests for the cervical and thoracic spine. While specificity was fair in all three tests, the nerve trunk palpation test showed low sensitivity, which means that the test may yield false negatives. Thus, some caution is warranted concerning the nerve trunk palpation test.

5. Conclusion

The results of this controlled study show that pain in the cervical and/or thoracic spine was more common in subjects with lateral elbow pain than in healthy controls, and that the frequency of positive responses to provocation tests of the cervical and thoracic spine was significantly higher. The frequency of positive responses to a neurodynamic test of the radial nerve was significantly higher and active cervical flexion and extension was significantly lower. The results support findings in previous studies that did not include a pain-free control group and suggest that the cervical and thoracic spine should be included in the assessment of patients with lateral elbow pain.

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