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Pain, coping, emotional state and physical function in patients with chronic radicular neck pain. A comparison between patients treated with surgery, physiotherapy or neck collar—a blinded, prospective randomized study

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Abstract

Purpose: To describe and explore the relationships between pain, emotional state and coping strategies in patients with chronic radicular neck pain before and after surgery or conservative treatments.
Methods: We randomize 81 conseutive patients with cervical radicular pain and nerve root compression, verified by MRI, to either surgical decompression with fusion or physiotherapy or neck collar. Emotional state was both measured with Mood Adjective Check List, Hospital Anxiety and Depression Scale and with a Coping Strategies Questionnaire. Pain was measured with VAS and function with Disability Index Rating. Measurements were made before treatment, and follow ups after 3 and 12 months post treatment.
Results: We found generally a low emotional state with anxiety, depression and sleep-disturbances not only connected to pain. Pain improved faster in the surgery group but after one year no differences were seen. Surgery and physiotherapy improved function with heavy work compared to collar after 3 months. Many patients used active coping before treatment, but after treatment more passive coping strategies were found.
Conclusion: We recommend a multidisciplinary rehabilitation with cognitive behavioural therapy and psychological interventions.

Introduction

The aetiology and pathogenesis of neck-shoulder-arm pain is often unclear. It may include a broad spectrum of medical factors of physical, psychological and social nature. The presence of degenerative changes including disk disease does not necessarily indicate a causal relationship.[1] Most individuals with radiographic signs of cervical spondylosis and disk disease do not exhibit any symptoms.[2] Such changes therefore can only be regarded as a possible predisposing factor for the development of pain. The radiculopathy is a result of mechanical pressure on the nerve root exerted by disk protrusion or spondylotic spurring or a combination associated with an inflammatory component.[3] Chemical factors from extruded nucleus pulposus may contribute.[4] Extrinsic factors may be responsible as well. Muscular pain and connective tissue pathology or pain from cervical joints and disks may induce referred pain, obscuring the clinical picture. Some authors have stressed the importance of physical factors like faulty posture, monotonous work and unsuitable working positions.[5] Others have argued that psychological and social factors may be of significance.[6] Chronic pain patients with organic lesions may suffer mentally as a psychological reaction to the functional impairment associated with the physical illness.[7]

The most common treatments for cervical root compression with radicular pain are surgery or conservative treatment with physiotherapy or immobilization with neck collar. The rational for such treatments are based on clinical experience more than scientific research.

Assessing pain is notoriously difficult because of its subjective nature. Perception of pain may be evaluated in terms of intensity, distribution and quality. Reaction to pain is manifested by such symptoms as anxiety and frustration. In the same way, emotional factors such as influence of mental stress, depression and anxiety may increase the reaction to pain. The ability to cope with

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chronic neck pain is dependant on various individual characteristics, for example, thoughts and actions that emerge in peoples efforts to manage pain on a daily basis. The goal is to achieve psychological and physiological adaptation, with a positive self-image.[8–10] Coping is founded in individual personality, temperament and experience. Situation-based factors shape and mediate the individual's choices of coping responses. This means that we use a variety of coping responses depending on the nature of the stressful situation. The literature basically divides coping into two main dimensions; emotion-focused (passive) and problem-focused (active) coping.[9] The former could be described as activities related to the regulation of affect whereas the latter involves strategies attempting to solve, reconceptualize or minimize stress. Individuals using active coping strategies tend to adapt better to life stressors and display fewer psychological symptoms. Avoidance is yet another dimension. Such responses include both denial of the problem and social withdrawal. Individuals using avoiding strategies tend to display more psychological distress. It is thus irrelevant to evaluate pain states (including neck-arm pain) as an isolated pain phenomenon. Questions such as interference with social activities, duties, vital functions and coping strategies must also be answered and evaluated.

The aims of the current study were:

- To describe the coping strategies and function in patients with chronic radicular neck pain.
- To explore the relationship between coping strategies and pain intensity.
- To explore the relationship between coping strategies and emotional state.
- To compare coping strategies in such patients treated with either surgery, physiotherapy or a cervical collar.

Methods

PATIENTS

The study included 81 consecutive patients of both sexes with cervico-brachial pain of more than 3 months duration (range 5–120). Of these 37 (46%) were women. The mean age was 47.5 years (SD 7.9) and ranged from 28–64 years. The patients had been referred to the outpatient clinic at the Department of Neurosurgery, University Hospital of Lund, Sweden, because of neck-shoulder-arm pain, for evaluation of possible surgical treatment. Patients with whiplash, traumatic injuries, pregnancy, serious somatic or mental diseases were all excluded. Plain X-rays and magnetic resonance tomography (MRT) of the cervical column or cervical myelography was performed in all and they had a full neurologic examination by a senior neurosurgeon. Reflex disturbances, motor and sensory deficits, together with the distribution of pain were evaluated to determine the clinical level of radiculopathy. The patients received written information about the study, which had been accepted by the Ethical committee of Lunds University. They were randomized by the use of sealed envelopes into three treatment groups: surgery, physiotherapy and cervical collar.

STUDY DESIGN

The patients were clinically examined according to a fixed protocol, before treatment (Control 1), 14–16 weeks after treatment had begun (Control 2), and after a further 12 months (Control 3). The same examiner (LP) performed all examinations, and did not take part in the treatment. At the clinical examination, the patients received written and verbal information about how to use the self-assessment inventories consisting of pain intensity (VAS), Hospital Anxiety and Depression scale (HAD), Mood Adjective Check List (MACL), general coping ('strategies in handling stress' questionnaire) and Disability Rating Index (DRI). The questionnaires could be filled in at the hospital or filled in at home and mailed back within a day in a coded envelope.

In the surgery group, 3 patients refused treatment because of subjective improvements at the time for surgery, but the allocation to the surgical group was retained, in accordance with the 'intention to treat' principle.[10] None other than the allocated treatment was given between Control 1 and 2. Between Control 2 and 3 some patients received other treatments than those determined by randomization. In the surgery group 8 patients underwent a new operation. One patient in the physiotherapy group and five in the collar group underwent surgery and 11 patients in the surgery group and 12 in the collar group received physiotherapy. Additionally a separate analyses of the pain intensity was done at Control 3 between all patients who had undergone surgery comparison to the conservatively treated patients.

TREATMENTS

Surgery

The surgery was performed in by eight neurosurgeons according to the anterior cervical discectomy technique described by Cloward.[12] The fragment of the protruded

Table 1 Demographic, social and pain data of the 81 patients divided into the different treatment groups

	Surgery (*n* = 27)	*Physiotherapy* (*n* = 27)	*Cervical collar* (*n* = 27)
Male (%)	16 (59)	11 (41)	17 (63)
Females (%)	11 (41)	16 (59)	10 (37)
Age (years) at examination			
Mean (median)	45 (47)	48 (48)	49 (50)
Range	28–56	31–61	36–64
Pain onset (age)			
Mean (median)	42 (43)	44 (45)	47 (49)
Range	20–56	28–58	36–63
Pain duration (months)			
Mean (median)	34 (15)	40 (31)	28 (21)
Range	5–120	6–120	8–120
Living arrangements (%)			
Living with others	18 (66)	22 (81)	23 (85)
Well-being at work			
Positive	19 (70)	21 (78)	20 (74)
Neutral	7 (26)	5 (18)	4 (15)
Negative	1 (4)	1 (4)	3 (11)
Transfer to another post because of neck/back pain	4 (15)	5 (19)	3 (11)
Months of sick-leave	(n = 22)	(n = 19)	(n = 19)
Mean (median)	15 (11)	16 (13)	13 (9)
Range	3–45	6–40	1–50
Sickness benefit	(n = 22)	(n = 19)	(n = 19)
100%	19 (85)	14 (78)	12 (57)
75%	1 (4)	0 (0)	1 (5)
50%	2 (9)	5 (22)	6 (28)

disk and the osteophytes were removed and a bone graft from purified cow bone™ was used for fusion. The patients were mobilized on the first post-operative day. A cervical collar was sometimes used post-operatively for 1–2 days. No physiotherapeutic treatment was given between Control 1 and 2.

Physiotherapy

The treatment was given by physiotherapists working in the patients' neighbourhood. They all had documented and had long experience with neck-shoulder-arm pain patients. The treatment extended over 3 months and was individual and divided into 15 sessions, with 1–2 sessions per week, each 30–45 minutes long, with individually adapted exercises and instructions.

Treatment procedures were recorded and notes returned to the Department of Neurosurgery.

Passive therapies for pain relief included transcutaneous electrical nerve stimulation, application of heat (moist pack, ultrasound) or cold and massage. Manual traction and gentle mobilization of the cervical spine was used, mostly combined with heat therapy or relaxation exercises. Active exercises were used, including neck and shoulder stretching and flexibility exercises, isometric neck exercises to increase the strength and endurance and aerobic exercises to increase the oxygen consumption. The patients were encouraged to reduce the load on the neck muscles by rest and relaxation exercises. Ergonomic instructions, postural corrections and co-ordination exercises aimed to reduce strenuous positions during work and leisure. Chiropractic manipulation was not used.

Cervical collar

In the cervical collar group the patients tried out the most comfortable, shoulder-resting rigid collar, intended to be used during the daytime (Lundakrage™, Miami Collar™, Necky rigid Collar™, Ortho-Collar. Philadelphia collar). A soft collar was supplied to be used during the night (Adam, Camp, Necky soft). The patients were instructed to wear the collar over a 3-month period. If they had any difficulties with the collar, they were supplied with another one, which occurred in two cases.

The collar was used to rest the neck and function as a reminder to avoid painful movements, to reduced mechanical stress on the nerve and thus reduce inflammation.

MEASUREMENTS

Social and demographic data

A history of pain duration, smoking habits, sleep disturbances, living arrangements, education and occupation, sense of well-being at work and sick-leave, were all recorded at the clinical examination (table 1).

Pain-intensity

The pain intensity in the neck, shoulder and arm was assessed on two occasions with an interval of one week to get a baseline. Together with notice of the appointment the patients were mailed a form for pain-drawing to describe the distribution and quality of pain including an intensity-assessment. The pain intensity was rated on a visual analogue scale (VAS), by use of a 100 mm straight line where the patient marked his pain.[13] 'Present pain' and the 'worst pain last week' had to be filled in on two different scales. The VAS is commonly used and validated[14] and reliability tested.[15]

Table 2 MACL variables in the study group (n = 81) at Control 1

Variables	*Mean*	*Median*	*SD*
Pleasantness/unpleasantness	2.85	2.83	0.63
Activation/deactivation	2.80	2.84	0.61
Calmness/tension	2.65	2.67	0.70
Extroversion/introversion	2.82	2.85	0.54
Pos./neg. social orientation	3.26	3.40	0.49
Confidence/lack of confidence	2.93	2.99	0.51
Overall MACL	2.89	2.98	0.54

Pain intensity assessment was repeated at the appointment with the physiotherapist 8–12 days after the patients had received the forms by mail. Both pain-ratings with VAS were coded and filed. The mean value of 'present pain' and the mean value of the 'worst pain last week' between the two occasions were used for statistics.

The Mood Adjective Check List (MACL)

Emotional state and mental well-being were quantitatively measured with the Mood Adjective Check List (MACL).[16] The instrument has been tested for Swedish conditions and is frequently used.[17] It consists of 71 adjectives describing mood and relative feeling. The patients answer about their current emotional status by marking on a bipolar factor, i.e. two negative or two positive directions, for each mood adjective (1–4 scales). The higher scores indicate more positive emotional states. The adjectives are distributed on six bipolar dimensions. They are: pleasantness/unpleasantness, activation/deactivation, calmness/tension, extroversion/introversion, positive/negative social orientation, confidence/lack of confidence (table 2). The mean values of the six dimensions as well as an overall mood index were calculated.

The Hospital Anxiety and Depression Scale (HAD)

The HAD Scale has been developed and found to be a reliable instrument in detecting states of depression and anxiety and also valid to measure severity of emotional disorders.[18] The HAD was used to supplement the MACL. It is valid to screen psychiatric morbidity in somatically ill patients[19] and has been validated also in Swedish conditions.[16, 20] It consists of 14 items measuring the severity of emotional stress in two separate subscales, 7 items measuring the level of anxiety and 7 the depression. Each item has 4 response categories, reflecting a continuum of increasing level of emotional distress. The scale ranges from no symptoms (0) to maximum of distress (3) in total ranging to 21. Two cut-off points are provided regarding normal (0–7), possible psychiatric morbidity (8–10) and score above 10 probably indicates psychological and psychiatric morbidity.[18]

Coping

General coping strategies were evaluated with the 'Strategies for Handling Stress' questionnaire.[21] The scale consists of 61 items divided in 13 dimensions. The score was measured with a four-points rating scale, from 'I definitely act in this way' (1) to 'I definitely do not act in this way' (4). A second-order factor analysis of the score of the 13 dimensions of coping had earlier been performed, in patients with a hearing handicap,[10] with three factors retained and rotated according to Kaiser's criterion.[22] The factors were labelled 'active coping', 'escape coping' and 'passive acceptance'.[10] The items in the factors are described in table 4.

The Disability Rating Index (DRI)

Disability Rating Index is a questionnaire, covering 12 items concerning physical function, using visual analogue scale (VAS) measuring the patient's rated performance in daily physical activities.[23] The anchor points are 'without difficulty' (0) and 'not at all' (100). The items are divided into three sections: common basic activities of daily life (items 1–4), more demanding daily physical activities (items 5–8) and work-related or more vigorous activities (items 9–12) (table 4). The items are in increasing order of physical demand. The questionnaire has been tested for validity and reliability in neck and back patients.[23]

STATISTICAL METHODS

The protocols of the self-assessment inventories were coded and blinded to the investigator. Non-parametric test were chosen. Correlation between variables were analysed with Spearman rank correlation coefficients. For inter-group comparison a Kruskal-Wallis one-way analysis of variance was used. If the results were significant, pair-wise comparisons with Mann-Whitney's U-test were performed. A difference with $p < 0.05$ was considered statistically significant.

Results

HISTORY

Pain in the neck-shoulder-arm was reported as the most prominent symptom and as the primary stressor in

(a)

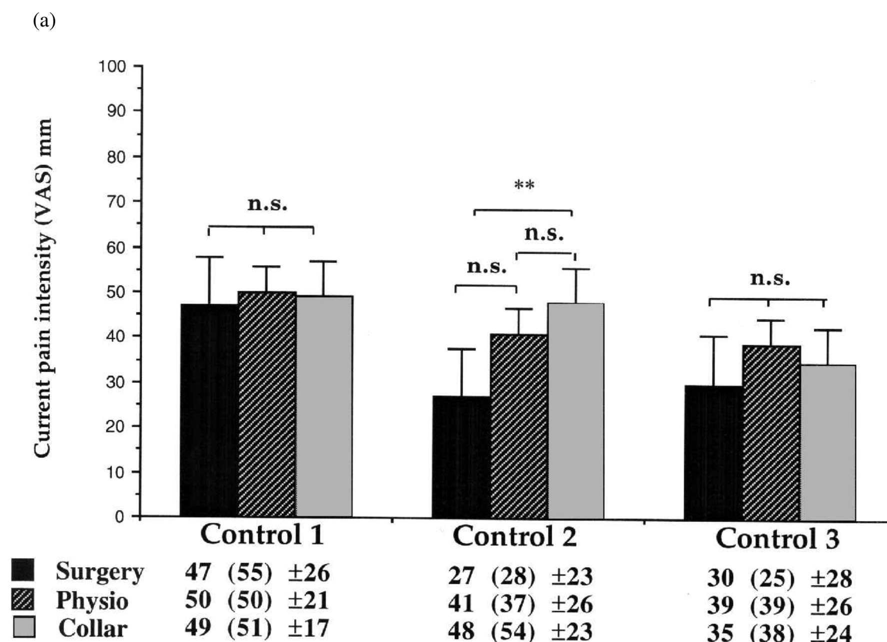

Figure 1*a* The histogram illustrates 'current' pain at the three controls in patients treated with surgery, physiotherapy or a cervical collar (n.s. = not significant, ** = $p < 0.01$).

all patients (100%). All patients had pain for more than 5 months (mean 34, median 21, range 5–120). The onset was reported by 45 patients as sudden, while the other 35 patients had a slow onset. The pain was more or less constant. Provocative factors for pain were working, arms over 90°, sitting for a long time, the head unsupported and movements of the head. Alleviating factors were rest, a neck pillow, heat, gentle neck and shoulder movements forward bending of the head, massage and traction of the neck. Sleep disturbances was reported as the second prominent disability (n = 63, 78%), followed by headache (n = 54, 67%). The occurrence of sleep disturbances correlated significantly with both 'current pain' ($r = 0.40$, $p = 0.003$) and 'worst pain last week' ($r = 0.21$, $p = 0.045$) after treatment (Control 2).

The number of smokers was high (65%). The mean daily consumption among the smokers in the surgery, physiotherapy and collar groups was 18,15,15 cigarettes respectively. No significant correlation was found between smoking habits (number of cigarettes/day) and pain intensity before (Control 1) or after treatment (Control 2 and 3). However, non-smokers (n = 28) compared to smokers (n = 53) had significant less pain intensity in 'worst pain last week' before treatment ($p = 0.01$) and in 'current pain' after treatment ($p = 0.03$). This was especially seen in the surgery group, where non-smokers had less pain than smokers after surgery at Control 2 ($p =< 0.05$).

There were no differences between the groups in education or work. Of the 81 patients 60 (74%) were on sick-leave. Forty-five (55%) had 100% sickness benefits and 15 (19%) part-time benefits. The sick leave was in mean 7 months (median 6, range 0–50). Most patients (n = 69, 71%), reported a positive attitude of well-being at work, 16 (20%) neutral and 5 (6%) negative attitude. Eleven of the 81 (14%) patients had been transferred to another post of work because of the neck-shoulder-arm pain. Demographic data and pain history in the different treatment groups are described in table 1.

PAIN INTENSITY

Before treatment, no differences were seen between the treatment groups (Figure 1*a*, *b*). At Control 2, the surgically treated patients reported significantly less pain than the collar group both concerning present and worst pain last week. At Control 3, 12 months later, there were no differences between the treatment groups (figure 1*a*, *b*). The separate analyses between all the surgically treated patients and all not-surgically treated patients at Control 3, did not show any significant differences (current pain $p = 0.2$, worst pain $p = 0.95$ respectively).

High pain intensity correlated with long pain duration at Control 2 ('current pain' $r = 0.40$, 'worst pain' $r = 0.34$) and at Control 3 ('current' and 'worst pain' $r = 0.43$).

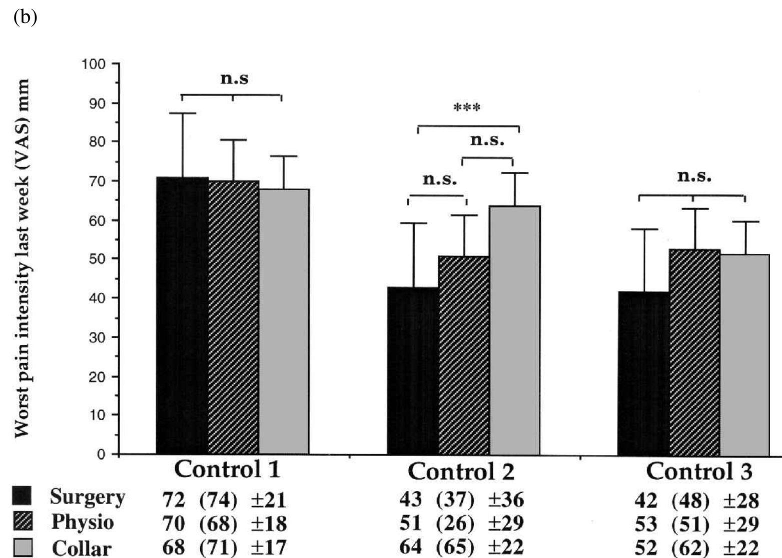

Figure 1*b* The histogram illustrates 'worst' pain last week at the three controls in patients treated with surgery, physiotherapy or a cervical collar (n.s. = not significant, ** = $p < 0.01$, *** = $p < 0.001$).

Table 3 Number and (%) of patients in each category according to subscale in the Hospital and Anxiety Depression Scale at Control 1, 2, and 3 (n = 81)

	Anxiety			*Depression*		
Scale score	*Control 1*	*Control 2*	*Control 3*	*Control 1*	*Control 2*	*Control 3*
0–7	48 (59)	48 (61)	46 (59)	56 (69)	62 (78)	63 (81)
8–10	14 (17)	12 (15)	17 (22)	9 (24)	11 (14)	9 (11)
11–14	19 (24)	19 (24)	15 (19)	6 (7)	6 (8)	6 (8)

EMOTIONAL STATE

The Mood Adjective Check List (MACL)

Patients with chronic radicular neck pain have a low positive mood state (table 2). In the MACL measurements there were no significant differences between groups at any control and no improvement over time.

At Control 2, after treatment, 'current pain' and 'worst pain' showed a significant relationship with the categories 'unpleasantness' (r = 0.27, r = 0.25, respectively), 'deactivation' (r = 0.23, r = 0.27, respectively), tension (r = 0.28, r = 29, respectively), and 'introversion' with current pain (r = 0.22) in the MACL. There was no correlation between MACL and pain duration or age.

The Hospital and Depression Scale (HAD)

In all patients with long-lasting pain in the neck, 41% had an anxiety score and 31% depression score over 8, indicating slight psychiatric morbidity (table 3). Patients with high anxiety score correlated with high depression score (r = 0.61), low mood level, as measured with MACL, correlated with high anxiety (r = 0.66), and high depression (r = 0.81).

No correlation's were seen between the HAD scores (anxiety, depression) and pain intensity, duration, sex or age (n = 81) before treatment (Control 1).

At Control 2, after treatment, relations were found between high depression score and high 'current pain' (r = 0.31) and high 'worst pain last week' (r = 0.25). This was especially seen in the surgery group ('current pain' r = 0.39, 'worst pain' r = 0.34, respectively). The surgery group also showed a correlation between high anxiety and high 'current pain' (r = 0.41) and 'worst pain last week' (r = 0.37) and between high anxiety and long pain duration (0.048).

At Control 3, after further 12 months, in all patients (n = 81), the relation between high 'current pain' and high anxiety (r = 24) was still seen, and also between 'current pain' and depression (0.23). A relation between current pain and depression was seen in the collar group (r = 0.61).

Table 4 General coping strategy in patients with chronic cervical radiculopathy (n = 81) before treatment (Control 1). Mean, standard deviation, median and range are given

Dimension of coping	*Mean*	*Std. Dev*	*Median*	*Range*
Active Coping	2.65	0.34	2.66	1.52–3.70
D1: Cognitive reappraisal (8 items)	2.78	0.58	2.88	3.00–4.00
D2: Substitution (7 items)	2.18	0.56	2.14	1.00–3.71
D4: Problem-solving (6 items)	2.83	0.58	2.83	1.50–4.00
D5: Self-confidence/humour (7 items)	2.70	0.35	2.71	1.85–3.00
D10: Catharsis (5 items)	2.80	0.57	2.80	1.00–4.00
D11: Self-blame (3 items)	2.57	0.59	2.66	1.00–3.66
D7: Seeking social support (4 items)	2.68	0.58	2.75	1.33–4.00
Escape Coping	1.82	0.41	1.82	1.10–2.78
D13: Seeking professional help (2 items)	2.01	0.89	2.00	1.00–4.00
D9: Religion (3 items)	1.42	0.67	1.00	1.00–3.33
D12: Drinking (2 items)	1.30	0.54	1.00	1.00–3.00
D3: Wishful thinking (5 items)	2.54	0.53	2.60	1.40–3.80
Passive Acceptance	2.78	0.55	2.88	1.36–3.62
D6: Resignation/acceptance (4 items)	2.50	0.65	2.50	1.00–3.75
D8: Social comparison (4 items)	3.97	0.73	3.25	1.00–4.00
Total	2.42	0.31	2.46	1.57–3.34

Table 5 ‘Active coping’, ‘escape coping’ and ‘passive acceptance’ before treatment (Control 1), in the different treatment groups. Mean, (Median) and SD are given

	Surgery (*n* = 27)			*Physiotherapy* (*n* = 27)			*Collar* (*n* = 27)		
Active coping	2.65	(2.66)	0.25	2.65	(2.67)	0.33	2.64	(2.64)	0.44
Escape coping	1.78	(1.88)	0.30	1.88	(1.88)	0.45	1.80	(1.62)	0.47
Passive	2.72	(2.75)	0.55	2.79	(2.87)	0.62	2.84	(2.88)	0.48
Total	2.39	(2.44)	0.26	2.44	(2.47)	0.31	2.42	(2.43)	0.37

COPING

Both active coping strategies, with problem-solving, catharsis and cognitive reappraisal and passive acceptance with social comparison, were the most frequently used strategies by the total sample of patients (n = 81) with cervical radiculopathy before treatment (table 5). The coping strategies between groups did not differ at the baseline, nor after the different treatments at Control 2 and 3 (table 5).

In the total study group with radicular neck pain (n = 81), significant correlations were seen between high ‘worst pain last week’, and the coping dimensions ‘cognitive reappraisal’ (r = 0.22) and ‘problem-solving’ (r = 0.28) before treatment.

At Control 2, no correlation was seen between pain intensity and coping strategies in the total group. However, in the patients treated with physiotherapy, the dimension ‘wishful thinking’ correlated with ‘current pain’ (r = −0.39) and ‘worst pain’ (r = −0.39) and the dimension ‘drinking’ correlated negatively with high ‘worst pain last week’ (r = −0.49).

At Control 3, in all patients, the factor ‘escape’ coping strategy correlated high ‘current (r = 0.26) and worst pain last week’, (r = 0.27), and the dimension ‘seeking social support’ negatively ‘current pain’ (r = −0.33) ‘worst pain last week’ (r = −0.30). High ‘worst pain last week’ correlated also to ‘seeking with professional help’ (r = 0.40) and negatively to ‘catharsis’ (r = −0.27).

In the surgery group ‘seeking social support’ correlated negatively with ‘current pain’ (r = −0.44) and ‘worst pain last week’ (r = −0.52), and ‘catharsis’ negatively with ‘current pain’ (r = −0.48) and ‘worst pain last week’ (r = −0.55). In the collar group, the dimension ‘seeking professional help’ correlated with high ‘current pain’ (r = 0.44) and high ‘worst pain last week’ (r = 0.41) and the dimension ‘social comparison’ correlated with high ‘worst pain last week’ (r = 0.41).

Long pain duration at Control 1, correlated with the factor ‘passive acceptance’ (r = 0.26), the dimensions ‘resignation/acceptance’ (r = 0.33), ‘seeking professional help’ (r = 0.25), and negatively to ‘drinking’ (r = −0.27).

At Control 2, the duration of pain still correlated negatively to ‘drinking’ (r = −0.28) in all patients (n = 81). In patients treated with surgery, a relation between long duration and less ‘active coping’ was seen (r = −0.40). In the physiotherapy group, a relation between

Table 6 The Disability Rating Index (DRI) at Control 1 (before treatment), in the different treatment groups. Mean (Median), Standard Deviation and Range are given. * = p< 0.05

	Surgery (*n* = 27)				*Physiotherapy* (*n* = 27)				*Collar* (*n* = 27)			
	Mean	(*Median*)	*SD*	*Range*	*Mean*	(*Median*)	*SD*	*Range*	*Mean*	(*Median*)	*SD*	*Range*
Dressing	18	(0)	25	0–78	11	(0)	17	0–50	9	(0)	11	0–25
Outdoor walk	10	(0)	20	0–75	5	(0)	9	0–25	7	(0)	13	0–51
Climbing stairs	10	(0)	17	0–75	7	(0)	13	0–51	9	(0)	17	0–50
Sitting for a long time	29	(23)	25	0–75	28	(16)	34	0–100	32	(24)	27	0–75
Standing bent over a sink	40	(48)	26	0–81	28	(23)	29	0–100	34	(34)	28	0–100
Carrying a bag	43	(48)	28	0–100	33	(24)	31	0–100	38	(34)	28	0–85
Making a bed	37	(32)	28	0–100	27	(20)	28	0–80	27	(22)	25	0–82
Running	56	(65)	32	0–100	31	(20)	35	0–100*	63	(76)	39	0–100
Light work	34	(22)	29	0–100	20	(20)	23	0–80	34	(24)	32	0–100
Heavy Work	77	(75)	18	45–100	65	(74)	33	0–100	71	(80)	32	0–100
Lifting heavy objects	79	(80)	21	16–100	74	(84)	32	0–100	75	(80)	27	18–100
Participating in sports	63	(70)	32	10–100	48	(44)	42	0–100	63	(80)	35	0–100

long pain duration and ‘social comparison’ was seen (r = 0.40).

At Control 3, after a further 12 months, the pain duration in all patients correlated with the dimension less ‘self-confidence/humour’ (r = −0.24). This relation was specially seen in patients in the surgery group (r = −0.44). In the physiotherapy group pain duration correlated negatively with drinking (r = −0.40).

The patients age did not show any correlation in coping strategies at Control 1. After treatment in the surgery group, age correlated with the factor ‘passive acceptance’ strategy in the surgery treated group (r = 0.46) and age with ‘seeking professional help’ the collar group (r = 0.44).

At Control 3, after a further 12 months, the dimensions ‘resignation/acceptance’ (r = 0.25), ‘self-blame’ (r = 0.23) and age correlated in all patients, The correlation between age and the dimension ‘resignation/acceptance’ was still seen in the patients treated with surgery (r = −0.41).

THE DISABILITY RATING INDEX (DRI)

Before treatment, was a significant difference between the physiotherapy group and the two other treatment groups in the dimension running (table 6). The same difference was seen at Control 2 and 3.

After treatment, the surgery group was significantly better (p< 0.05) in dressing and ‘heavy work’, and the physiotherapy group better in walking, sitting for a long time and ‘heavy work’ compared to the collar group. No significant differences were seen between the surgery and physiotherapy groups.

After further 12 months the variable ‘heavy work’ was significantly (p< 0.05) better in the surgery group compared to the other treatment groups.

Within groups, the surgery patients improved between Control 1 and Control 2, in the variables dressing, standing bent over a sink, light and heavy work. No improvement was seen between Control 2 and Control 3. At Control 3 compared to before surgery (Control 1), all variables except walking, climbing stairs, sitting for a long time, carrying a bag and making a bed were improved.

In the physiotherapy group, sitting for a long time had improved after three months (Control 2) and at the follow-up control, Control 3.

Patients treated with a collar improved their walking after three months (Control 2) and participating in sports after a further 12 months (Control 3).

Before treatment, the items: dressing, carrying a bag, making a bed and light work correlated significantly with high ‘current pain intensity’. ‘Worst pain last week’ correlated with the items: dressing, outdoor walk, climbing stairs and making a bed. After treatments, Control 2 and 3, all the variables in the DRI, correlated significantly with ‘current pain’ and ‘worst pain last week’ in (r = 0.29 – 0.47).

Discussion

To our knowledge this is the first randomized trial comparing surgery and conservative treatments in patients with cervical radiculopathy concerning coping strategies and well-being. Our results showed that the chronic neck-shoulder-arm pain influenced both function

and mental well-being such as emotional state, level of anxiety, depression, sleep and coping behaviour. Before treatment, such disturbances were not related to only the pain per se.

Pain was reported to be the primary stressor by the patients and reduction of pain is the most important goal of treatment. Even if reduced pain occurs after treatment, the success cannot be attributed solely to the treatment but might be a consequence of the natural history. Several outcome studies in acute or subacute patients, with different conservative treatments have reported significant improvements irrespective of treatment. Highland *et al.*[24] found significant pain reduction after 8 weeks of dynamic exercise of the cervical spine in patients with cervical herniated disk. Using a 'variety of different treatments', the radiculopathy usually improves without the need for surgery.[25] An 'aggressive physical rehabilitation programme' had a good or excellent effect on function and pain in 83% in one group of patients with cervical radiculopathy.[26] Injection with corticosteriods periradicular/epidural, has been shown to reduce radiculopathy.[27]

Many successful outcomes in surgically treated patients have been reported.[28,29] We found in our study that the patients treated with surgery reduced their pain compared to the conservative groups after a short follow up, but there was no difference after a further 12 months. In the literature, the clinical outcome after surgery has been reported to be good or excellent in 72–94%. It is difficult to compare outcome measurements of surgically treated patients. Most articles are retrospective and the follow up times differ widely, as does the selection of patients. The post-operative treatment is not always described and not usually performed by a blinded observer.

The re-operation rate in our surgery group was high (29%). Recurrent pain and new symptoms from adjacent levels after cervical decompression and fusion may be one explanation.[30,31] The high proportion of smokers may be another explanation. It is notable that non-smokers in the surgery group had less pain after surgery than smokers. There are several studies in the literature showing a strong association between smoking and spinal pain.[32,33] The negative effects of smoking on the cervical disk disease and for the surgical outcome should be explained to the patients.

Patients with chronic cervical radiculopathy have a low emotional state compared to an age-matched control group representing the general population.[34] The low positive mood state (MACL-score) seen before treatment, did not improve over time. This could be due to the long duration of pain, probably inducing feelings of hopelessness/helplessness i.e. features inherent in a depressive mood state. This is supported by the results in the coping inventory, where the patients who had pain for a long time were in a state of passive resignation and dejection bringing them to seek further professional help. It was also shown that the patients who still had pain after treatment were socially withdrawn and ceased to express their emotions, which are other features in a depressive mood state. At baseline, no correlations were seen between variables pertaining to pain and anxiety and depression scales as measured with HAD. These findings may be connected to the low positive mood state found in the MACL. The HAD anxiety score was especially high in the patients both before and after treatment. About 40% of the patients had anxiety, seemingly only partially connected to pain and 30% were depressed before treatment and about 20% were still depressed after 12 months. In the patients with high pain intensity after treatments, low function, high depression and anxiety was seen. The group treated with surgery showed significantly more anxiety and depression if pain continued. Thus the patient's expectations on treatment may have been higher in this group, bringing about more disappointment if the treatment failed.

The strongest correlation between a depressed mood state and pain was found in the group treated with a collar after 12 months. This group of patients was not actively treated and hence did not receive the same amount of care and attention as the other groups. A double blind study design is impossible with this type of treatments.

Behavioural consequences with anxiety and depression have been reported.[35] Pain may be aggravated by conditioning reflexes and personality traits and 'dysfunctional pain' may gradually develop[36] and the pattern of pain in some patients may not be caused by the visualized root compression. Chronic pain and sleeping problems may deepen into depression[37] and such patients may gradually develop a neurotic reaction similar to psychogenic pain behaviour.[38]

Generally, as concerns coping with pain, strategies were significantly changed at follow-up. Active coping (i.e. cognitive reappraisal and problem-solving), frequently used before treatment, disappeared after treatment, especially in the group treated with surgery. This group probably viewed the surgical procedure the ultimate treatment. Because of this they may have, more so than the other treatments groups, changed their former, presumably 'internal locus of control' (active coping) into the ultimate 'external locus of control' namely surgical intervention, a situation in which the patient is completely passive.[39] At both follow-ups, in

general, coping with pain was changed into a more passive/escape focused strategy. The patients also used less alcohol and avoided seeking social support and expressing their emotions (catharsis).

The patient's function was significantly related to pain intensity. This relation was specially seen after treatments in patients where the treatment failed and pain intensity was still high. The surgery and physiotherapy patients had better function than the collar group. The patients in the physiotherapy group may have got a more active attention towards work and function, compared to the collar treated group with a more passive (rest and immobilization) treatment.

Similar results of function outcome, measured with Sickness Impact Profile have been seen earlier.[34]

In summary our results showed that the patients with chronic radicular neck pain had a low mood state, anxiety, depression and sleep disturbances. Before treatment, such disturbances were not related to only the pain per se. The patient's low positive mood state also did not improve over time. The level of anxiety was especially high in all the patients both before and after treatment. About 40% of the patients had anxiety, seemingly only partially connected to pain. Thirty percent of the total group of patients were depressed before treatment and about 20% were depressed after 12 months. As the patients enter medical care, they also ceased to cope actively. We feel that it is of utmost importance to make careful follow-ups concerning psychiatric and psychological sequele after long-lasting cervico-brachial pain. A recently published, large epidemiological study of patients with long-lasting chronic pain in the neck and shoulders, shows that well over one third of the patients have symptoms of stress and depression, and to an extent that could be classified as psychiatric morbidity.[40] The authors conclude that these patients cannot be optimally treated, without the inclusion of psychological-behavioural therapy programmes. This study also shows that the patients who use active coping with pain consume less sick leave days.[40]

The paper concludes that it is important to give adequate information as concerns the expectations that the patient may have on the various treatments. For instance, the patients who will undergo surgery should be objectively informed that the operation will remove the mechanical cause of pain but other components such as nociceptive pain with muscular tension[41,42] and pain memory[43] may remain. We would suggest that the treatment for these patients should be to include them in a multidisciplinary rehabilitation programme with cognitive behavioural therapy groups, working with improving coping with remaining pain and limitations and to alter negative attitudes towards work, social circumstances and disability to maintain a positive self-image.[44–47] As mentioned our patients did actually have the ability to cope actively before treatment, probably why a cognitive behavioural therapy programme may have been particularly successful in the present patients. In our opinion, such a programme should start before treatments (surgery, physiotherapy etc.) and continue for some weeks after treatment. In this study, many patients in the surgery group continued with physiotherapy on their own initiative, one year after the operation, indicating that many patients have the need for an extended rehabilitation after surgery. Anti-depressive medication in those patients where it's clinically relevant could also be used, the older patients especially may benefit from such treatment. Both psychological/ behavioural and psychopharmacological interventions may be necessary and should be attended to, in order to optimize the effects of the conventional treatment regimens.

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References

1 Matsumoto M, Fujimura Y, Sukuki N, Toyama Y, Shiga H. MRI of cervical intervertebral discs in asymptomatic subjects. *Journal of Bone and Joint Surgery* 1998; **80**: 19–24.
2 Schellhas K, Smith M, Gundry C, Pollei S. Cervical discogenic pain. Prospective correlation of magnetic resonance imaging and discography in asymptomatic subjects and pain suffers. *Spine* 1996; **21**: 300–312.
3 Ahlgren BD, Garfin SR. Cervical radiculopathy. *Orthopedic Clinics of North America* 1996; **27**: 253–263.
4 Rydevik B, Brown MD, Lundborg G. Pathoanatomy and pathophysiology of the nerve root compression. *Spine* 1984; **9**: 7–15.
5 Hagberg M. *Arbetsmiljöns betydelse för besvär i skuldra och halsrygg. Arbetsmiljöfondens rapporter*. Stockholm, 1989 (In Swedish).
6 van der Donk J, Schouten J, Passchier J, Rosmunde L, Valkenburg H. The association of neck pain with radiological abnormalities of the cervical spine and personality traits in a general population. *Journal of Rheumatology* 1991; **18**: 1884–1889.
7 Curci P, Gozzi M, Mari M. Cervicobrachial neuralgia and low-back pain: psychological problems. *Psychotherapy and Psychosomatica*1986; **45**: 91–96.
8 Katz J. Ritvo P, Irvine MJ, Jackson M. Coping with chronic pain. In: Zeidner M, Norman S, Endler S (Eds). *Handbook of Coping*. New York: John Wiley Sons, 1996.
9 Lasarus RS. *Psychological Stress and the Coping Process*. New York: McGraw-Hill, 1966.
10 Hallberg LR-M, Erlandsson SI, Carlsson SG. Coping strategies used by middle-aged males with noise-induced hearing loss, with and without tinnitus. *Psychology and Health* 1992; **7**: 273–288.

11 Altman DG. *Practical Statistics for Medical Research.* London: Chapman & Hall, 1991: 440–476.
12 Cloward RB. The anterior approach for removal of ruptured cervical disks. *Journal of Neurosurgery* 1958; **15**: 602–617.
13 Huskisson EC. Measurement of pain. *Lancet* 1974; **7889**: 1127–1131.
14 Carlsson AM. Assessment of chronic pain. I. Aspects of the reliability and validity of the visual analogue scale. *Pain* 1983; **16**: 87–101.
15 Persson L. Moritz U. Pain drawing a quantitative and qualitative model for cervico-brachial pain syndrome. *The Pain Clinic* 1994; **7**: 13–22.
16 Sjöberg L, Svensson E, Persson LO. The measurement of mood. *Scandinavian Journal of Psychology* 1979; **20**: 1–18.
17 Sullivan M, Karlsson J, Sjöström L. Swedish obese subjects (SOS)—an intervention study of obesity. Baseline evaluation of health and psychosocial functioning in the firstly 1743 subjects examined. *International Journal of Obesity* 1993; **17**: 503–512.
18 Zigmond A, Snait R. The hospital anxiety and depression scale. *Acta PsychiatricaScandinavica* 1983; **67**: 361–370.
19 Aylard PR, Gooding JH, McKenna PJ, Snait RP. A validation study of three anxiety and depression self-assessment scales. *Journal of Psychosomatic Research* 198; **31**: 261–268.
20 Engström C-P, Persson L-O, Larsson S, Ryden A, Sullivan M. Functional status and well-being in chronic obstructive pulmonary disease with regarding to clinical parameters and smoking: a descriptive and comparative study. *Thorax* 1996; **51**: 825–830.
21 Persson L-O. Strategier att bemöta stress: presentation av ett frågeformulär. (Strategies for handling stress: presentation of a questionnaire). Department of psychology, University of Gothenburg, Report No 5. (In Swedish)
22 Child D. *The Essentials of Factor Analysis.* Guildford and London: Billings & Sons Ltd, 1973.
23 Salén BA, Spangford EV, Nygren ÅL, Nordemar R. The Disability Rating Index: An instrument for the assessment of disability in clinical settings. *Journal of Clinical Epidemiology* 1994; **47**: 1423–1434.
24 Highland TR, Dreisinger TE, Vie LL, Russel GS. Changes in isometric strength and range of motion of the isolated cervical spine after eight weeks of clinical rehabilitation. *Spine* 1992; **17**: S77–S82.
25 Ellenberg MR, Hornet JC, Treanor WJ. Cervical Radiculopathy. *Archives of Physical Medicine and Rehabilitation* 1994; **15**: 342–352.
26 Saal JA, Saal J, Yurth EF. Nonoperative management of herniated cervical intervertebral disc with radiculopathy. *Spine* 1996; **21**: 1877–1883.
27 Bush K, Hillier S. Outcome of cervical radiculopathy treated with periradicular/epidural corticosteroid injectionsa: a prospective study with independent clinical review. *European Spine Journal* 1996; **5**: 319–325.
28 Davis RA. A long-term outcome study of 170 surgically treated patients with compressive cervical radiculopathy. *Surgical Neurology* 1996; **46**: 523–533.
29 Sampath P, Bendebba M, Davis JD, Ducker T. Outcome in patients with cervical radiculopathy. *Spine* 1999; **15**: 591–597.
30 Hilebrand A, Carlsson GD, Palumbo MA, Jones PK, Bohlman HH. Radiculopathy and myelopathy at segments adjacent to the site of a previous anterior cervical arthrodesis. *Journal of Bone and Joint Surgery* 1999; **81A**: 519–528.
31 Matsunaga S, Kabayama S, Yamamoto T, Yone K, Sakou T, Nakanishi, K. Strain on intervertebral discs after anterior cervical decompression and fusion. *Spine* 1999; **24**: 6670–6675.
32 An HS, Silveri CP, Simpson JM, File P, Simmons C, Simeone FA, Balderstone RA. Comparison of smoking habits between patients with surgically confirmed herniated lumbar and cervical disc disease and controls. *Journal of Spinal Disorders* 1994; **7**: 369–373.
33 Scott SC, Goldberg MS, Mayo NE, Stock SR, Poitras B. The association between cigarette smoking and back pain in adults. *Spine* 1999; **24**: 1090–1098.
34 Persson CGL, Carlsson C-A. Carlsson JY. Long-lasting cervical radicular pain managed with surgery, physiotherapy or a cervical collar. A prospective randomized study. *Spine* 1997; **22**: 751–758.
35 Rosomoff HL, Fishbain D, Rosomoff RS. Chronic cervical pain: Radiculopathy or brachialgia. Non-intervention treatment. *Spine* 1992; **17**: 362–366.
36 Sjölund BH. Chronic pain in society—a case for chronic pain as a dysfunctional state. *Quality of Life Research* 1994; **3**: S5–S9.
37 Hays RD, Steward AL. Sleep measures. In: Steward AL, Ware JE Jr (eds). *Measuring Function and Well-Being.* Durham and London: Duke Univ. Press,1992.
38 Sternbach RA. Psychlogical factors of chronic pain. *Clinical Orthopedic* 1977; **129**: 150–155.
39 Jensen MP, Turner J, Romano J, Karoly P. Coping with chronic pain: a critical review of the literature. *Pain* 1991; **47**: 249–283.
40 Ektor-Andersson J, Isacsson A-o, Lindgren A, Ørbæk. The experience of pain from the shoulder-neck area related to the total body pain, self-experienced health and mental distress. *Pain* 1999; **82**: 289–295.
41 Johansson H, Sojka P. Pathophysiological mechanism in genesis and spread of muscular tension in occupational muscle in chronic musculoskeletal pain syndromes. A Hypothesis. *Medicine Hypotheses* 1991; **35**: 196–203.
42 Larsson R, Öberg Å, Larsson S-E. Changes of trapezius muscle blood flow and electromyography in chronic neck pain due to trapezius myalgia. *Pain* 1999; **79**: 45–50.
43 Lundeberg T. Pathophysiological mechanisms. *Scandinavian Journal of Rehabilitation Medicine* 1995; **32**: S13–S42.
44 Jensen I, Nygren Å, Gamberale F, Goldie I, Westerholm P, Jonsson E. The role of the psychologist in multidisciplinary treatment for chronic neck and shoulder pain. A controlled cost-effectiveness study. *Scandinavian Journal of Rehabilitation Medicine* 1995; **27**: 19–26.
45 Friedrich M, Gittler G, Halberstadt Y, Cermak T, Heiller I. Combined exercise and motivation program: effect on the compliance and level of disability of patients with chronic low back pain: A randomized controlled trial. *Archives of Physical Medicine and Rehabiltation* 1998; **79**: 475–485.
46 Arnstein P, Caudill M, Mandle CL, Norris A, Beasley R. Self efficacy as a mediator of the relationship between pain intensity, disability and depression in chronic pain patients. *Pain* 1999; **80**: 483–491.
47 Morley S, Eccleston C, Williams A. Systematic review and meta-analysis of randomized controlled trials of cognitive behaviour therapy and behaviour therapy for chronic pain in adults, excluding headache. *Pain* 1999; **80**: 1–13.