Spine

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Long-Lasting Cervical Radicular Pain Managed With Surgery, Physiotherapy, or a Cervical Collar: A Prospective, Randomized Study

[Cervical Spine]

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Abstract

Study Design. This prospective, randomized study compares the efficacy of surgical and conservative treatments in patients with long-lasting cervical radicular pain.

Objectives. To compare the effects of surgery, physiotherapy, and a cervical collar.

Summary of Background Data. There are no previous controlled outcome studies that have compared surgical treatment with nonsurgical treatment of patients with cervical radicular pain.

Methods. The study group comprised 81 patients with cervicobrachial pain of at least 3 months' duration, in whom the distribution of the arm pain corresponded to a nerve root that was significantly compressed by spondylotic encroachment with or without an additional bulging disc, as verified by magnetic resonance imaging or computed tomographic myelography. The patients were randomly allocated to surgery (Cloward technique), individually adapted physiotherapy, or a cervical collar. The therapeutic effects were evaluated with respect to pain intensity by the visual analogue scale, function by the Sickness Impact Profile, and mood by the Mood Adjective Check List. The measurements were performed before treatment (control 1), shortly after treatment (control 2), and after a further 12 months (control 3).

Results. At control 1, the groups were uniform. At control 2, the surgery group reported less pain (visual analogue scale) and, like the physiotherapy group, better function (Sickness Impact Profile) than the collar group. At control 3, there was no difference in visual analogue scale, Sickness Impact Profile, and Mood Adjective Check List measurements among the groups.

Conclusions. In the treatment of patients with long-lasting cervical radicular pain, it appears that a cervical collar, physiotherapy, or surgery are equally effective in the long term.

Acute neck pain is a relatively common experience that usually declines and disappears within a couple of weeks. Some patients do not recover and with time develop a chronic cervical pain condition that also may involve pain in the shoulder and arm, being most pronounced on one side. The pain is sometimes associated with numbness, tingling, muscle weakness, and loss of reflexes. A radiculopathy resulting from nerve root compression is then most likely. Some of these patients may demand surgery, but the indications are unclear, and whether surgical or conservative treatment is appropriate continues to challenge the judgment of neurosurgeons and orthopedic surgeons.[11] The possibility of diagnostic error is greatly enhanced by the fact that degenerative changes with osteophytes in middle age and beyond are almost universal.[14,16,28]

It is argued that patients with clear signs of radiculopathy and corresponding nerve root compression verified by computed tomography (CT), magnetic resonance imaging (MRI), or myelography are good candidates for successful surgery.[10,15] We know from experience, however, that some of these patients recover completely with no surgery, although we cannot predict which patients will do so. Moreover, it is known that many anterior discectomies with fusion have been carried out with immediate success, but long-term problems related to the ongoing degeneration of adjacent discs, graft failure, and misdiagnosis occur.[20]

Most patients are referred for conservative therapy, which mainly is synonymous with physiotherapy. There are many different techniques available, but the clinical efficacy of most of the physiotherapeutic methods has not been evaluated in controlled clinical trials.[27] Thus, we do not even know at present if cervicobrachial pain is best managed with immobilization or mobilization techniques.

The evident difficulties in finding the appropriate therapy initiated the current study, the aim of which was to compare the efficacy of the three different therapies-surgery, physiotherapy, or immobilization in a cervical collar-in patients with long-lasting cervicobrachial pain, in whom the pain had a distribution that corresponded to a specific nerve root compression revealed by MRI or CT-myelography.

Methods

Study Population. The study included 116 consecutive patients of both sexes between 18 years and 65 years of age (mean age, 48.3 years; median, 50 years; SD, 7.9 years; range, 28-64 years) with cervicobrachial pain of more than 3 months' duration. They had been referred to the outpatient clinic at the Neurosurgical Department, University Hospital of Lund between 1991 and 1992, because of neck-shoulder-arm pain, for consideration for surgical treatment. Patients with whiplash, other traumatic injuries, and serious somatic or psychiatric diseases were excluded, as were patients not able to speak and read Swedish well.

The patients underwent a full neurologic examination by a senior neurosurgeon (C-AC). In this study, emphasis was laid on the patients' pain and quality of life. Reflex disturbances and motor and sensory deficits were used, together with the distribution of pain, to determine the clinical

level of radiculopathy. Muscle strength in shoulders, arms, and hands as well as sensory deficits and reflex disturbances will be described in a forthcoming study. Plain radiographs and MRI of the cervical column or cervical CT-myelography were performed. The patients were given written information about the study, which had been accepted by the Ethics Committee of Lund University. Six patients did not want to participate in the study. The remaining 110 patients were divided into three groups depending on the clinical and radiologic findings:

Group 1: Clinical and radiologic findings indicating spinal cord compression with or without root compression (n = 10).
Group 2: Clinical and radiologic findings indicating root compression corresponding to the distribution of pain, but without spinal cord compression. The nerve root compression was caused by spondylotic spurs with or without an additional bulging disc (n = 81).
Group 3: Clinical findings indicating root compression or unspecified cervicobrachial pain, but with no or insignificant radiologic findings indicating root compression (n = 19).

Group 2 constituted the current study group. Groups 1 and 3 will not be further commented on in this study. The study group had a mean age of 47.5 ± 7.9 years (range, 28-64 years) and comprised 46% women. Further social and demographic data were recorded by comprehensive history and questionnaire (Table 1).

	Surgery (n = 27)	Physiotherapy (n = 27)	Cervical Collar (n = 27)
Male (%)	16 (59)	11 (41)	17 (63)
Female (%)	11 (41)	16 (59)	10 (37)
Age (yr) at examination			
Mean (median)	45 (47)	48 (48)	49 (50)
SEM	1.6	1.6	1.2
Range	28–56	31–61	36–64
Pain onset (age, yr)			
Mean (median)	42 (43)	44 (45)	47 (49)
SEM	1.6	1.4	1.3
Range	20–56	28–58	36–63
Pain duration (mo)			
Mean (median)	34 (15)	40 (31)	28 (21)
SEM	6.6	6.3	4.7
Range	5–120	6–120	8–120
Months of sick leave	(n = 22)	(n = 19)	(n = 19)
Mean (median)	15 (11)	16 (13)	13 (9)
SEM	2.0	2.5	3.0
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)
Living arrangements (%)			
Living with others	18 (66)	22 (81)	23 (85)
Living alone	9 (33)	5 (19)	4 (15)
Living environment (%)			
Town	15 (56)	17 (63)	16 (59)
Suburb/country	12 (44)	10 (37)	11 (41)
Own house	17 (63)	20 (74)	17 (63)
Apartment	10 (37)	7 (26)	10 (37)
Education and work (%)			
Unskilled and semiskilled workers	9 (33)	12 (44)	9 (33)
Skilled workers	6 (22)	4 (15)	8 (30)
Assistant nonmanual employees	3 (11)	4 (15)	4 (15)
Intermediate nonmanual employees	5 (19)	5 (19)	1 (4)
Employed and self-employed professionals, higher civil	3 (11)	0 (0)	2 (7)

Table 1. Selected Demographic, Social, and Pain Data of the 81 Patients Divided Into the Different Treatment Groups

The 81 patients were randomized by the use of sealed envelopes into three treatment groups: surgery, physiotherapy, and cervical collar.

Study Design. There was one baseline measurement (control 1) before the treatment, one outcome measurement (control 2) 14-16 weeks after the treatment had begun, and a third measurement (control 3) after a further 12 months. This means the total follow-up time from the start of treatment was 15-16 months. Control 3 always took place at the predetermined time, even if the patients underwent a second surgery between control 2 and 3.

During the pretreatment period, each patient was clinically examined by a physiotherapist (LP) according to a fixed protocol, with emphasis on the neurologic and musculoskeletal examination. The same physiotherapist (LP), who did not take part in the treatment, also administered the post-treatment measurements. The patients received written and verbal information about how to use the self-assessment inventories. The questionnaires could be filled in at the hospital under supervision or filled in at home and sent back in a coded envelope within a day.

In the surgery group, three patients refused surgical treatment because of subjective improvement at the time of operation, but the allocation to the surgical group was retained in accordance with the "intention to treat" principle.[1] In the physiotherapy and cervical collar groups, all patients carried out the allocated treatment. No other treatments were given between control 1 and 2. Between control 2 and 3, some patients received other treatments than that determined by the randomization. In the surgery group, eight patients underwent a second surgery: six on cervical levels adjacent to the originally operated level, one because of an infection of the bone graft, and one had an exploration of the brachial plexus. The indication for the surgery on adjacent levels was the persistence of symptoms or the appearance of new symptoms. The plexus exploration was performed because of persistent, severe pain, but no pathologic changes were found. One patient in the physiotherapy group and five patients in the collar group underwent surgery because the result of the conservative therapies was unsatisfactory. Eleven patients in the surgery group and 12 patients in the collar group received physiotherapy in a further attempt to reduce their pain.

Dropouts. At control 3, one patient in the surgery group had moved, and one patient in the collar group did not keep the appointment because she was completely recovered.

Measurements. The pain intensity was assessed by means of a visual analogue scale (VAS).[8] Present pain and the worst pain the previous week had to be filled in on two different scales. Together with notice of the appointment with the physiotherapist, the authors mailed to the patients a form for pain drawing, including an intensity assessment. Patients were asked to fill in the form and to bring it to the appointment. Pain intensity assessment was repeated at the appointment 8-12 days after the patients had received the forms by mail. The mean of the current pain intensity and the mean of the worst pain last week on the two occasions were used for statistical analysis.

The Sickness Impact Profile (SIP) is a standardized questionnaire with 136 statements developed and refined for measurements of health status.[3,4,19] The 136 statements are grouped into 12 categories. Three of the categories-ambulation, body care and movement, and mobility-are aggregated into a physical dimension. Emotional behavior, social interaction, alertness behavior, and communication are aggregated into a psychosocial dimension. The five remaining categories-eating, work, sleep and rest, home management, and recreation and pastimes-are free-standing. All 12 categories form an overall SIP dimension. Predetermined weights based on estimates of the relative severity of each dysfunction were used.[4] Scores for each of the 12 categories are calculated by adding the scale values (weights) for each statement and expressing the sum as a percentage of the maximum possible dysfunction score for that category. Scores for physical and psychosocial dimensions and overall SIP are calculated in the same manner. The potential score goes from 0 to 100, with higher numbers representing greater "sickness impact" and thus poorer health. The SIP has been modified for Swedish conditions.[25] An age-matched sample from a previous population study of women in Göteborg (1980-81) was used as a reference group.[21]

The Mood Adjective Check List (MACL) offers a quantitative composite measure of mental well-being.[22] In the current version, the MACL consists of 71 adjectives describing mood and related feelings. The patients indicate their current emotional states by marking a series of scales from 1 to 4, with higher scores indicating more positive states. The adjectives are clustered in six bipolar dimensions: pleasantness/unpleasantness, activation/deactivation, calmness/tension, extroversion/introversion, positive/negative social orientation, and confidence/lack of confidence. The same reference group as for the SIP measurements was used for comparison. Because age correlates positively with the SIP and MACL dimension scores, adjustment for age with Mantel's technique of pooling was used.[18]

Overall Estimation. At control 3, the patients were asked how they felt generally with respect to their cervicobrachial symptoms, compared to control 1: restored, improved, unchanged, or worse.

Treatments. The surgery was performed by different surgeons at a single level, using the anterior cervical decompression and fusion technique described by Cloward.[11] The fragment of the protruded disc and the osteophytes were removed and a dowel of purified bone (Unilab Surgibone, Mississauga, Ontario, Canada) was used for fusion. One patient underwent nerve root decompression by laminectomy with the posterior approach.[17] The patients were mobilized on the first postoperative day. A cervical collar sometimes was used after surgery for 1 or 2 days. No physiotherapy was given between control 1 and 2.

Physiotherapy was provided by 25 different physiotherapists working in the patients' geographic neighborhood. They all had documented experience of treating patients with neck, shoulder, and arm pain. Information about clinical, radiographic, and MRI findings was given to the physiotherapists by phone or letter. The type of therapy was decided by the physiotherapist according to preferences and symptoms. The treatment extended over 3 months and was divided into 15 sessions. There were one to two 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 in Lund. 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 were the most frequent treatments, combined with heat therapy or relaxation exercises. Active exercises were used, including neck and shoulder stretching and flexibility exercises, isometric neck strengthening exercises to increase the strength and endurance, and aerobic exercises to increase oxygen consumption. The patients were encouraged to reduce the load on the neck muscles by resting and relaxation exercises. Ergonomic instruction and postural corrections aimed to reduce strenuous positions during work and leisure. Chiropractic manipulation or acupuncture were not used.

In the cervical collar group, the patients tried out the most comfortable, shoulder-resting rigid collar, intended to be used during the daytime (Lundakrage, LIC, University Hospital Lund, Sweden; Miami J Collar, Jerome Medical, Mount Laurel, NJ; Necky [rigid], Rehband Anatomiska Ab, Sollentuna, Sweden; Ortho-collar, W.J. Teufel, Stuttgard, Germany; Philadelphia Collar, Camp Scandinavia AB, Helsingborg, Sweden). A soft collar to be used during the night was supplied if the patient wanted one (Adam, Professional Products Ltd. Orthopedics, Burkshire, England; Camp, Camp Scandinavia AB, Helsingborg, Sweden; Necky [soft], Rehband Anatomiska AB, Sollentuna, Sweden). 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.

Statistical Methods. Nonparametric tests were chosen. For comparison between patients and controls, Fisher's nonparametric permutation test was used.[7] Mantel's technique of pooling was used for age adjustments.[18] For intergroup comparison before and after treatment, Kruskal-Wallis one-way analysis of variance was used, and if this yielded significant results, a post hoc pairwise comparison with the Mann-Whitney U-test was performed. For comparison of values obtained before and after treatment within treatment groups, the Wilcoxon matchedpairs signed-ranks test was used. Correlations between variables were analyzed with Spearman rank correlation coefficients. A difference of $P < 0.05$ was considered statistically significant.

Results

As may be seen from Table 1, comparability for social and demographic variables is good between the three groups. Similarly, the values for pain intensity (VAS), function (SIP), and mood (MACL) were evenly distributed in the three groups. In the statistical description, the material was considered homogeneous and uniform.

Pain Intensity

Between-Group Comparisons. Before treatment, the groups did not differ with respect to pain intensity, registered as present pain (Table 2) and worst pain last week (Table 3). The registration at control 2 showed that the surgery group reported less pain than the collar group, with respect to present pain ($P < 0.01$) and to worst pain last week ($P < 0.01$). There was no significant difference between the physiotherapy group and the collar group. At control 3, 12 months later, there was no difference between any of the groups.

	Surgery [mean (median), SEM]	p Level	Physiotherapy [mean (median), SEM]	p Level	Cervical Collar [mean (median), SEM]
Control 1					
Mean present pain	47 (54) 4.90	NS	50 (50) 3.98	NS	49 (51) 3.83
p level	$p < 0.001$		NS		NS
Control 2					
Mean present pain	27 (28) 4.43	NS	41 (42) 5.50	NS	48 (54) 4.46
			$p < 0.01$		
Difference control 2 − 1	−20 (−17) 5.56	NS	−9 (−5) 4.91	$p < 0.05$	−1 (−5) 5.22
			$p < 0.01$		
p level	NS		NS		$p < 0.01$
Control 3					
Mean present pain	30 (25) 5.98	NS	39 (37) 4.96	NS	35 (37) 4.83
Difference control 3 − 2	3 (4) 5.62	NS	−2 (−2) 4.52	NS	−13 (−8) 4.70
			$p < 0.05$		
Difference control 1 − 3	−17 (−8) 6.22	NS	−12 (−6) 5.34	NS	−14 (−21) 6.72

NS = not significant.

Table 2. Mean Present Pain Intensity (VAS) Between and Within the Different Treatment Groups at Control 1, Control 2, and Control 3: Mean (Median), SEM, and p Level for Between- and Within-Group Comparisons

	Surgery [mean (median), SEM]	p Level	Physiotherapy [mean (median), SEM]	p Level	Cervical Collar [mean (median), SEM]
Control 1					
Mean worst pain	72 (74) 4.10	NS	70 (68) 3.53	NS	68 (51) 3.18
p level	$p < 0.001$		$p < 0.001$		NS
Control 2					
Mean worst pain	43 (37) 6.94	NS	51 (61) 5.62	NS	64 (65) 4.18
			$p < 0.01$		
Difference control 2 − 1	−29 (−33) 7.60	NS	−19 (−21) 4.79	NS	−4 (2) 4.48
			$p < 0.001$		
p level	NS		NS		$p < 0.01$
Control 3					
Mean worst pain	42 (48) 6.07	NS	53 (51) 5.50	NS	52 (62) 5.43
Difference control 3 − 2	1 (8) 8.24	NS	2 (−1) 5.31	$p < 0.05$	−12 (−18) 4.54
			$p < 0.05$		
Difference control 1 − 3	30 (22) 6.87	NS	−17 (−9) 5.30	NS	−16 (−16) 6.75

NS = not significant.

Table 3. Mean Worst Pain Intensity Last Week (VAS) Between and Within the Different Treatment Groups at Control 1, Control 2, Control 3: Mean (Median), SEM, and p Values for Both Between- and Within-Group Comparisons

Within-Group Comparisons. The differences in pain intensity within groups are depicted in Tables 3 and 4. It can be seen that all three treatment groups improved compared with the pretreatment measurements. The surgery group and the physiotherapy group manifested reduced pain at control 2, and the improvement remained at control 3, 12 months later. The collar group showed no improvement at control 2, but had improved at control 3 (Table 3).

	Study Group (n = 81) Control 1				Reference Group (n = 87)				Study Group (n = 78) Control 3		
Variables	Mean	Median	SEM	p	Mean	Median	SEM	p	Mean	Median	SEM
SIP											
Physical dimension	4.91	2.22	0.75	*	2.91	0.00	0.71	†	4.36	1.54	0.70
Ambulation	4.08	0.00	0.73	NS	3.84	0.00	0.91	NS	4.14	0.00	0.79
Body care and movement	4.97	1.50	0.70	*	2.43	0.00	0.59	†	4.67	3.20	0.67
Mobility	5.66	0.00	1.21	*	2.47	0.00	0.83	NS	4.27	0.00	0.98
Psychosocial dimension	9.58	6.11	1.22	†	5.22	2.91	0.88	†	8.96	4.79	1.25
Emotional behavior	13.82	9.79	1.66	‡	8.39	0.00	1.51	‡	12.55	9.79	1.67
Social interaction	8.46	4.62	1.25	‡	6.36	3.52	1.07	NS	7.76	0.00	1.29
Alertness behavior	11.96	8.62	2.11	‡	5.09	0.00	1.09	NS	10.82	0.00	1.96
Communication	4.07	0.00	0.83	†	1.06	0.00	0.44	‡	4.72	0.00	1.07
Independent categories											
Eating	1.06	0.00	0.24	NS	1.38	0.00	0.38	NS	0.79	0.00	0.26
Work	38.24	34.57	3.31	*	3.28	0.00	0.84	*	35.17	27.18	3.54
Sleep and rest	19.11	12.22	1.88	*	9.37	0.00	1.53	‡	15.37	12.22	1.83
Home management	20.62	10.33	2.48	*	3.86	0.00	1.25	*	15.63	6.59	2.16
Recreation and pastime	17.44	10.19	1.88	‡	14.44	0.00	1.89	NS	17.72	10.19	2.07
Overall SIP	12.46	9.79	0.97	*	5.12	2.99	0.73	*	9.97	7.76	1.00
MACL											
Pleasantness/unpleasantness	2.85	2.83	0.07	*	3.37	3.42	0.05	*	2.93	3.00	0.08
Activation/deactivation	2.80	2.84	0.07	*	3.43	3.50	0.05	*	2.96	3.00	1.08
Calmness/tension	2.65	2.67	0.08	*	3.17	3.21	0.07	*	2.76	2.71	0.09
Extroversion/introversion	2.82	2.85	0.06	†	3.07	3.10	0.05	†	2.85	2.93	0.07
Positive/negative social orientation	3.26	3.40	0.05	*	3.63	3.67	0.03	NS	3.29	3.41	0.05
Confidence/lack of confidence	2.93	2.99	0.06	NS	3.06	3.06	0.06	NS	2.96	2.95	0.06
Overall MACL	2.89	2.98	0.06	*	3.29	3.27	0.04	*	2.95	2.93	0.06

* $p < 0.001$.
† $p < 0.01$.
‡ $p < 0.05$.
SIP = sickness impact profile; MACL = mood adjective check list; NS = not significant.

Table 4. The SIP and MACL Variables in the Study Group at Control 1 and 3 Compared With a Reference Group Representing the General Population

Function (SIP) and Mood (MACL) Outcomes

Between-Group Comparisons. At control 1, the study group showed more dysfunction (SIP) and a less positive mood state (MACL) than an age-matched reference group representing the general population (Table 4). There was no difference in SIP and MACL measurements between the three treatment groups before treatment. At control 2, the surgery and physiotherapy groups were better than the cervical collar group in "overall SIP" ($P < 0.05$), but at control 3 there was no difference between the groups.

There were no differences between the treatment groups in the MACL measurements at any control.

Within-Group Comparisons. The surgery group was significantly improved at control 2 with respect to "physical dimension" ($P < 0.05$) and "mobility" ($P < 0.01$), "psychosocial dimension" ($P < 0.05$) and "alertness behavior" ($P < 0.05$), and "overall SIP" ($P < 0.05$). Between control 2 and control 3, a deterioration in "alertness behavior" occurred ($P < 0.05$). Between control 1 and 3, improvement was seen in "overall SIP" and "work" ($P < 0.05$).

The physiotherapy group improved at control 2 in "physical dimension" ($P < 0.01$), and in "overall SIP" ($P < 0.05$), but showed deterioration in "physical dimension" ($P < 0.01$) and "ambulation" and "work" ($P < 0.05$) at control 3 compared with control 2. No significant improvement was seen between control 1 and 3.

The cervical collar group showed a marked improvement in "sleep and rest" ($P < 0.01$) at

control 2. No changes occurred between control 2 and control 3 or control 1 and 3.

At control 3, the SIP of the study group differed significantly from the SIP of the reference group in most of the variables that differed before treatment (control 1). Some variables ("mobility," "social interaction," "alertness behavior," "recreation and pastimes") had improved and no longer differed significantly from those of the reference group (Table 4).

The mood state (MACL) did not differ in any of the three groups at controls 2 and 3 compared with control 1.

Cross-Over

The patients who received new treatments or underwent additional surgery between control 2 and 3 did not differ at control 3 in pain intensity (VAS) or any SIP or MACL variable compared with those in the respective groups not receiving any new treatment. Regardless of whether the patients receiving new treatments or undergoing reoperation were included, it did not influence the between- and within-group comparisons.

Correlations

At control 1, the SIP measurements correlated significantly with intensity of pain in 3 of the 12 variables: "body care and movement" (r = 0.23), "home management" (r = 0.28), and "recreation and pastimes" (r = 0.22). There was no correlation between pain duration and any of the the SIP categories.

At control 2, the SIP measurement correlated significantly with pain intensity in all the variables (r = 0.23-0.45) except for "alertness behavior" and with four of the categories in the MACL: "pleasant/unpleasant" (r = 0.27), "activation/deactivation" (r = 0.23), "calmness/tension" (r = 0.28), "extroversion/introversion" (r = 0.22).

Overall Estimation

The patients' subjective estimation of disability at control 3, compared with control 1, is shown in Table 5. It can be seen that the groups are very uniform.

Estimation	Surgery Group (n = 26)	Physiotherapy Group (n = 27)	Cervical Collar Group (n = 26)
Restored	2	3	2
Unchanged	11	4	9
Improved	5	11	9
Worse	8	9	6

Table 5. The Subjective Estimation of Disability in the Different Treatment Groups at Control 3 Compared With the Disability at Control 1

Discussion

The most important finding of this prospective, randomized study is that in the 12-month outcome evaluation of patients treated with surgery, physiotherapy, or a cervical collar, there was no difference among the three groups. This was valid for pain (VAS), function (SIP), and mood (MACL) measurements. Because the groups were found equal at the 12-month evaluation (control 3) after a preference for surgery at the short-term post-treatment evaluation (control 2), the observation time was considered sufficient to be conclusive. This is also supported by a study by Espersen et al,[13] who found that the patient's statement with respect to functional outcome 1 year after Cloward's operation is almost final. It must also be considered that a prolonged observation time would have contaminated the study group by external and inherent influences. Not only would the patient have tried other treatments but, most important, the degenerative process of the patient's cervical spine would have proceeded, which would have reduced the symptoms or made them worse.

The validity of the VAS has been documented.[8] The SIP has been shown to be a valid and reliable method, sensitive to clinical changes and covering a wide spectrum of dysfunction.[4,24-26] The MACL technique of measuring the emotional state in patients with chronic pain has been validated previously in patients with rheumatoid arthritis, chronic pain, and tension-type headache.[2,9,23] In the current study, the VAS correlated significantly with certain SIP variables, which mutually strengthens the validity of the methods. This correlation was most pronounced after the treatment, which indicates that the patients who did not improve with respect to pain also presented a lower quality of life.

The surgery and physiotherapy were given by different physiotherapists and surgeons. This is a realistic situation in a clinical setting. Some patients had changed the assigned treatment to another treatment or, concerning the surgery group, undergone reoperation during the 1-year period between the second and third post-treatment controls. These patients did not diverge with respect to outcome from the patients receiving no new treatment. Thus, the mean values of pain intensity and the overall SIP and MACL were not notably influenced if the patients receiving additional treatment were included or not included in the allocated groups.

In a way, this strengthens the presented results, which indicate that the treatment groups are not affected differently by the applied treatments. The remarkable uniformity of the results between the treatment groups could be interpreted as implying that the degenerative process of the cervical spine is too dominant and implacable to be affected by the treatment methods used. The degenerative process is probably most progressive in the studied age groups. Clinical experience indicates that the degenerative process slows down and becomes more asymptomatic with increasing age.[16]

There is some evidence that the presented results do not diverge from the natural course of this cervical disorder. Twenty-one patients with cervical radicular pain on waiting lists for at least 10 months at two neurosurgical clinics were asked by telephone about their conditions. Three

(14%) answered that they were quite well, five (24%) were significantly improved, and 13 (62%) considered themselves to be unchanged or impaired. The waiting list comparison, however, does not fulfill the criteria for a scientific comparison. First, these patients do not represent a randomized group; second, they were questioned by telephone and not according to a structured inventory; and third, and most important, they represented a waiting list group from which a number of patients had been picked out for treatment because of severe symptoms. Considering these biases, it is nevertheless striking how close this "natural course" comes to the outcome of the treated groups in this study.

The patients' compliance must be considered. All patients were admitted to the neurosurgery department, and it might be assumed that they expected to undergo surgery. Therefore, the surgery group was most favored by the patients' cooperation. Those receiving physiotherapy or a cervical collar were probably disappointed because many of them had already tried various forms of physiotherapy. In spite of that, they entered the study. It should be pointed out in this context that, under normal conditions, all 81 patients would have been recommended for surgery in accordance with the treatment principles of the department. Only five patients in the physiotherapy and collar groups underwent surgery during the 1-year follow-up period. This should indicate that many patients considered the treatment to be of some benefit, which is also confirmed by the measurements.

It is notable that eight (29%) patients underwent additional surgery in the surgery group between controls 2 and 3, which is a markedly higher reoperation rate than reported in previous studies. Bertalanffy and Eggert,[5] in a study of 251 patients who underwent discectomy without interbody fusion, reported that five patients (2%) underwent additional surgery at the same level, and 14 patients (5.6%) underwent surgery at adjacent levels between 5 months and 5 years after the first surgery because of recurrent symptoms.

The clinical implications of the study must be considered with appropriate caution. It appears that such simple treatment as a collar, or possibly even no treatment, is as effective in the long run as physiotherapy or surgery. However, the study concerns patients with cervical radicular pain of at least 3 months' duration. It is a general experience that patients with acute, intolerable pain and disc herniation at a corresponding cervical level usually benefit from surgery. There are, however, no controlled outcome studies that have compared surgical with nonsurgical treatment of cervical radiculopathy, either in the acute stage or in the chronic stage.[12] Similarly, the effect of physiotherapy in the treatment of patients with cervical radicular pain has not been scientifically evaluated.[12,27]

Some authors are of the opinion that surgery should be considered in patients who have persistent pain for 3 months in spite of careful nonsurgical treatments.[6,17] The current study cannot support that indication for surgery. Prospective studies evaluating the treatment options in the acute stage are evidently necessary to perform. This is a difficult task for several reasons, one being that a considerable number of patients recover spontaneously during the first weeks. On the other hand, it would be of exceptional value to find specific interventions that prevented the development of chronic symptoms.

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