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Evaluation of the kinesthetic sense and function of the hand in early period in operated cervical disc hernia

Received: 18 October 2004
Revised: 1 December 2004
Accepted: 17 January 2005
Published online: 26 April 2005
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Abstract A prospective study made into cervical disc hernias. To determine the kinesthetic sense and hand functions, which are important for the patients with cervical disc hernia to return to work life and daily activities that need skill. Neurosurgical department. Data Symptoms in cervical disc hernias and hand functions are affected depending on long-term pain. The evaluation of the hand is essential in assessing the patients' overall recovery and ability to return to daily activities and work life. Thirty-four patients with cervical disc hernia, who were operated on, were included in the study. Eight different test positions in the assessment of the hand's kinesthetic sense and hand function sort (HFS) in the evaluation of the hand function were applied. The disability levels of the patients were determined with The Neck Pain and Disability Scale, on the preoperative and postoperative

discharge day and in the postoperative second month. Patients were divided into groups according to the side involved. In the evaluation of the kinesthetic test of the hand, only in the postoperative second month was a significant difference observed between the 1, 2, 3, and 4 test positions of the right side of the groups. On the other hand, no significant difference was found between the groups in the assessment of the hand function. In the measurement of hand functions and disability levels, strong and important correlations were determined. An early assessment of the hand's kinesthetic sense and function is instrumental in the patients' evaluation of recovery and resumption of work.

Keywords Cervical hernia operation · Kinesthetic sense · Task performance · Hand

Introduction

The clinical symptoms of the cervical disc hernia show themselves as pain, reflex loss and motor deficits depending upon the location and severity of the protrusion, and thus they affect hand functions [5, 6, 19, 32].

It was reported by Bucciero et al. [8] that complete or almost complete relief of preoperative symptomatology was found in 96% of patients with radiculopathy and 83% of those with myelopathy as a result of an anterior

discectomy in cervical disc hernia. The long follow-up period did not indicate a relation between the preoperative symptoms and postoperative symptoms [8]. In consequence, it is necessary to make a detailed evaluation of the symptoms both in preoperative and particularly postoperative periods [12, 20]. Functional scales measure the effect of a disease on the performance of daily activities rather than focus on diagnosis. Therefore, self-report measures of such performances are very useful in the assessment of the outcome of the treatment [10, 33]. The hand function sort (HFS) is a new instru-

ment developed for this purpose and it focuses on upper extremity work task performance [28, 29].

Kinesthesia has also been found to play a crucial role in the acquisition and performance of skilled hand movements, including handwriting [17, 25]. Kinesthetic awareness in the hand is important for fine motor skills and hand function. Impairment of kinesthetic sense has an impact on especially functional use of the hand [3, 30].

The purpose of our study was to determine such effects on the kinesthetic sense and hand functions needing skill when the patients with cervical disc hernia returned to daily activities and work after the operation.

Methods

Thirty four patients with cervical disc hernia, whose mean age was 47.14 ± 6.63 and who were operated on, were included in the study. The age, sex, BMI, occupation range, education of the patients were recorded.

Inclusion criteria

Patients included in the study were required to have magnetic resonance imaging of clinical signs and symptoms of cervical disc herniations.

Exclusion criteria

- Having succeeded in the practice position of the kinesthetic test of the hand.
- Being over 60, with proprioceptive defects occurring with problems such as diabetes mellitus, sensory deficits, etc.
- Having narrow spinal canal.
- Having traumatic disc herniation with severe motor and sensory deficits.
- Having had decompensated depression, vascular encephalopathy, dementia, hemiparesis, aphasia).
- Having osteoporosis with pain-induced proprioceptive sense failure.
- Being unable to engage actively in postoperative rehabilitation.
- Having additional diseases such as motor neuron disease, multiple sclerosis, progressive polyarthritis [15].

Surgical treatment Anterior discektomy and anterior fusion by taking graft from iliac crista were applied to all the patients. Surgical operation was performed by the same surgeon [7].

Procedure

After the operation the patients were asked to perform exercises intended for the strengthening and coordination

of the hand with handball and posture exercises three times a day for 2 months (as the intense exercise program assigned had a positive effect on the kinesthetic sense and function of the hand). The exercises were shown and applied by a physiotherapist and also a brochure defining the exercises was given to them. The patients used cervical collar until the postoperative second month. The measurements were assessed on the preoperative day; postoperative discharge day and in the postoperative second month.

Measurement

Assessment of the kinesthetic sense

Eight different test positions devised by Lynch et al., and later adapted by Grant and Water were used in the assessment of the kinesthetic sense of the hand [25]. The test was explained to the patients before application and the positions were practiced (Fig. 1). Those who failed the practice test were excluded from the study with no other positions shown. The evaluation was done in a quiet room with a table at a suitable height. The subject's vision was occluded by a masking box on the table, whereas a full view of the subject's hand was allowed. An internal shelf in the box supported the forearms along predetermined lines at an angle of 20 degrees to the edge of the table, with the hands hanging freely over the edge of the shelf. Kinesthetic awareness level of the hands was measured by the subject's ability to copy hand positions. The test positions were assessed as

Fig. 1 Hand positions

- 0 = *failure to move the hand from the resting position,*
 1 = *no resemblance to the test position,*
 2 = *incomplete replication, which may include use*
 of the wrong fingers in the correct relationship,
 one finger out of place, inappropriate
 opposition, or a reversal of gesture,
 3 = *complete and accurate replication.*

Assessment of hand function

Hand function sort (HFS) is used in the evaluation of hand function. HFS consists of 62 questions and included seven items on physical demands with activities of daily living. Each item is composed of a drawing of the task accompanied by a simple description. The self-rating evaluation was done by judging the ability on a 5-point scale from able to unable. The questioning was done by taking the side involved into consideration. The items are categorized as follows:

1. Brief fingering,
2. Sustained fine coordination,
3. Hand, wrist, forearm stability,
4. Sustained or forceful handling,
5. Full body light,
6. Full body medium,
7. Full body heavy [29].

Disability The patients' disability levels were measured by using The Neck Pain and Disability Scale (NPDS). The Neck Pain and Disability Scale was developed as a comprehensive measure of neck pain. This scale consists of 20 items that measure problems with the neck, intensity of pain, its interference with functional aspects of living, and the presence and extent of associated emotional factors. Patients respond to each item by marking along a 10-cm scale. Item scores range from 0 to 5 in quarter-point increments. The scale will contain self-reported measures assessing the degree to which pain interferes with activities of daily living. Higher scores correlate with greater disability [14].

The study was approved by the Ethical Committee at local committee. All the necessary explanation was done to the patients and informed consent was obtained from them.

Statistical analysis

Descriptive statistics include frequency distribution for categorical variables and means and standard deviations for continuous variables. In the univariate analyses of demographic data the chi-square test for categorical

variables (gender) was used. Mann-Whitney *U* test, which is a non-parametric test, was used to determine the differences between group I and group II, in terms of age and BMI. In order to determine the differences between the assessments related to the hand's kinesthetic sense and function made on the preoperative day and postoperative discharge day and in the postoperative second month, one-way ANOVA was performed in both groups. Pearson correlation analysis was used in determining the correlations between neck disability index and the hand's kinesthetic sense and functions. The statistical analysis was performed using the statistical package for social sciences (SPSS), version 11.0.

Results

The patients included in the study were divided into groups according to the side involved: those with the right side involved were named group I (with 12 patients constituting 35.29% of all) and group II (with 22 patients constituting 64.71%). All of the patients were right dominant. There was no significant difference between the groups in terms of age, BMI, sex, occupation, education (Table 1). In the evaluation of the hand's kinesthetic sense, a significant difference in the 1, 2, 3, and 4 test positions of the right side were found between the groups only in the postoperative second month. However, no significant difference was seen in the assessment of the hand's function (Table 2). There was no difference in the disability measurements of either group, and whereas no correlation was found between the kinesthetic sense and disability measurements, strong and significant correlation appeared between hand functions and disability measurements.

Discussion

Neck pain or dysfunction, which is nearly as prevalent as low back pain, is a major causal factor leading to disability and loss of work days [22, 27, 38]. In postoperative patients pain is reduced and functional recoveries can be observed [11, 40]. It is widely recommended that patients should be encouraged to resume normal activities as soon as possible [9]. And the evaluation of the hand function is vital for this purpose. The impairment of the hand's kinesthetic sense affects its performance. [26, 37]. Studies conducted in the kinesthetic sense of the hands of children with spina bifida and myelomeningocele can be found in literature, yet there are no studies in literature on patients with cervical disc hernia [18, 41]. We aimed to investigate the hand's kinesthetic sense in this population.

In studies made so far, some proprioceptive losses such as inability to take or copy the desired position

Table 1 Demographic characteristics of the patients

	Involment of the right side (<i>n</i> = 12)		Involment of the left side (<i>n</i> = 22)		All patients (<i>n</i> = 34)	
	Number	%	Number	%	Number	%
Gender						
Female	7	58.3	9	40.9	16	47.1
Male	5	41.7	13	59.1	18	52.9
Occupation						
House wife	—	—	7	31.8	7	20.5
Unemployed/retired	5	41.6	4	18.1	9	26.4
House outside	7	58.3	11	50.0	18	52.9
Education						
Tertiary level	2	16.7	6	27.3	8	23.5
Secondary school	6	50.0	12	54.5	18	52.9
Highest education level	4	33.3	4	18.2	8	23.5
Age (years)	45.91 ± 6.25		47.81 ± 6.87		47.14 ± 6.63	
BMI (kg/m ²)	26.82 ± 4.28		26.72 ± 4.88		26.76 ± 4.61	

Table 2 Function sort measurements of the patients

		1	2	3	4	5	6	7
Involment of the Right side	Pre	29.75 ± 10.36	4.75 ± 3.81	10.00 ± 7.66	11.50 ± 9.28	11.66 ± 7.45	11.00 ± 13.89	2.91 ± 8.60
	Post	22.50 ± 8.89	5.16 ± 5.98	7.08 ± 6.78	9.25 ± 7.04	7.58 ± 7.11	6.66 ± 7.69	1.08 ± 2.74
	Post2	45.75 ± 6.85	10.25 ± 1.95	21.33 ± 6.42	25.83 ± 5.90	21.33 ± 7.24	28.75 ± 17.38	8.66 ± 11.12
Involment of the left side	Pre	29.86 ± 9.91	5.72 ± 3.20	10.63 ± 5.53	13.77 ± 7.74	13.36 ± 7.10	11.09 ± 9.15	1.27 ± 3.29
	Post	25.22 ± 10.26	4.63 ± 2.75	8.18 ± 4.26	10.31 ± 6.28	9.50 ± 6.23	7.95 ± 7.22	—
	Post2	45.77 ± 4.79	10.50 ± 1.50	19.81 ± 3.38	25.63 ± 3.14	21.18 ± 3.31	22.50 ± 10.78	6.09 ± 6.21

Pre Preoperative day, *Post* Postoperative discharge day, *Post 2* Postoperative second month, 1 Brief fingering, 2 Sustained fine coordination, 3 Hand, wrist, forearm stability, 4 Sustained or forceful handling, 5 Full body light, 6 Full body medium, 7 Full body heavy

have been mentioned in relation to pain [13, 21–24, 31, 34, 35, 4]. In our study, the hand's kinesthetic sense showed significant differences in the 1, 2, 3, and 4 test positions on the right side and postoperative second month measurements also indicated significant differences between the groups. These differences can be attributed to the overuse of the hand in patients with the right-hand dominance. The variations in the total scores of the HFS of subjects with impaired dominant upper extremities in comparison with those without are a sure indicator of the functional limitation of an impairment involving the dominant extremity. Fear of the repetition of the disease and pain affects the use of the hand in daily activities [39]. On the other hand, no significant differences were found in hand functions in spite of the reduction in disability scores in early period. Detection of the daily life activities alone does not provide detailed information on the disability, kinesthetic sense, and functioning of the hand. This result emphasizes that the kinesthetic sense and functioning should be measured together in the therapy program applied.

Psychological distress can often accompany long-standing neck pain and can be related to an avoidance

of usual activities, leading to a sense of helplessness, which is why evaluations of psychological factors and avoidance of using the hand are considered necessary [1, 33].

In our study group, only 27 subjects (79.41%) worked actively in certain jobs. Though it was found to be important to assess fine skills, speed and coordination in these jobs, we consider it as important to evaluate the kinesthetic sense and use of the hand in daily activities so that we can determine how much the hand is effected by cervical disc hernia. Assessment of hand functions and recoveries is especially important in terms of resumption of work and efficiency. Discomfort and pain that stem from the neck–shoulder region and lead to work-related musculoskeletal disorders are complaints frequently observed in workers performing low load, static or repetitive work [1, 2, 16, 36]. Though in literature we come across studies into the assessment of the strength and range of motion of the cervical region, no such studies on the hand have been mentioned up till now. In our study, we aimed at investigating the early period outcomes in 0–2 months of the patients who were allowed to return to work and daily activities in the

postoperative second month. We continue to evaluate more long-term follow-ups with a wider range of patients and assess their fear of activity as well as their efficiency in exercises.

Limitation of the study

No control group was included in our study in as much as no two patients were expected to be alike in terms of motor and sense deficits. Instead, they were assessed within themselves and only short-term outcomes were

taken into account since they were allowed to return to work in 2 months.

Conclusion

We find it necessary to evaluate the hand's functional use in operated cervical disc hernias for the patients' daily activities and resumption of work. It is instrumental for making an evaluation of the hand's kinesthetic sense and function in the periods of postoperative assessment of recovery and resumption of work.

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