The prevalence of depressive symptoms before and after surgery and its association with disability in patients undergoing lumbar spinal fusion

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Received: 13 June 2012 / Revised: 20 June 2013 / Accepted: 7 July 2013 / Published online: 24 July 2013
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Abstract

Purpose The aim of this study was to evaluate the prevalence of depressive symptoms and disability pre-operatively, at 3 months and at 1 year after lumbar spine fusion surgery.

Methods Data was extracted from a dedicated lumbar spine fusion register, giving 232 patients (mean age 62 years, 158 females) who had undergone instrumented lumbar spine fusion. The frequency of depressive symptoms and disability was evaluated using the Depression Scale (DEPS) and Oswestry Disability Index (ODI).

Results Depressive symptoms were found in 34, 13, and 15 % of the patients pre-operatively, at 3 months and at 1 year after surgery, respectively. The mean DEPS score decreased from 16.2 to 8.6 ($p < 0.001$) in patients who had depressive symptoms pre-operatively, and from 6.1 to 3.8 ($p < 0.001$) in those patients without pre-operative depressive symptoms. The mean ODI values pre-operatively, at 3 months and at 1 year after surgery were 53, 30,

and 23, respectively, in patients with pre-operative depressive symptoms and 41, 23, and 20 in those patients without pre-operative depressive symptoms. The differences between the groups were statistically significant at all time points ($p < 0.001$).

Conclusions One-third of our patients with chronic back pain undergoing spinal fusion had depressive symptoms pre-operatively. The prevalence of depressive symptoms decreased after surgery. Although disability remained higher in those patients who had reported depressive symptoms pre-operatively, disability did decrease significantly in both groups post-operatively. Thus, there is no need to exclude depressive patients from operation, but screening measures and appropriate treatment practises throughout both pre-operative and post-operative periods are encouraged.

Keywords Depressive symptoms · Depression scale DEPS · Disability · Lumbar spine fusion · Surgery

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Introduction

It has been reported that patients with chronic pain, especially chronic low back pain (CLBP), often have an abnormal psychological profile [1, 2]. According to Hägg et al. [3], there is a stepwise increase in the presence of depressive symptoms from lowest in general population free of back pain to highest in patients with CLBP. The processes underlying the association found between CLBP and depressive symptoms are not clear. Some authors have suggested that depressive symptoms may predispose to CLBP, while others have suggested that emotional problems are reactions to CLBP [4]. In the study by Polatin et al. [5], 59 % of the patients with CLBP had concurrent

depressive disorder, 55 % of them had depression before the onset of the pain and 45 % became depressed after the onset of the chronic pain.

Lumbar spine fusion may be performed in several disorders causing CLBP if patients remain severely symptomatic despite conservative treatment. However, the indications for spinal fusion surgery are still controversial. In certain diagnostic disorders such as spondylolisthesis, the spondylolisthesis surgery has been shown to be effective and also cost-effective [6]. Instead, in patients with chronic discogenic low back pain, the results of fusion surgery may not be better than those achieved with structured cognitive-behavioral therapy [7].

Depression, anxiety, thought patterns, and personality style have been reported to predict the outcome of spinal surgery [3, 8, 9, 17]. In the study by Katz et al. [10], depressive patients who underwent decompression surgery for spinal stenosis reported more pain, poorer satisfaction with treatment, poorer walking capacity and poorer life satisfaction after surgery than the group with no depressive symptoms. However, number of earlier studies on the influence of spinal fusion surgery on the prevalence of depressive symptoms is sparse.

The aim of this prospective study was to evaluate the prevalence of depressive symptoms in patients before, 3 months and 1 year after spinal fusion surgery. Factors associated with depressive symptoms and the relationship between depression and functional disability were also investigated.

Materials and methods

Patients

The present prospective follow-up study is based on spine register data collected in Tampere University Hospital and Jyväskylä Central Hospital. Data were collected prospectively as part of surgeons' standard clinical practice and consisted of pre-operative and 3-month and 1-year post-operative follow-up data. The database included 285 consecutive patients who underwent non-urgent instrumented lumbar spine fusion. After excluding a diagnostic group of tumours, fractures, neuromuscular and idiopathic scoliosis, 232 patients (81 %), 158 females (68 %), 74 males (32 %), mean age 62 years (range from 29 to 87) were included in the study. Of these patients 226 and 221, respectively, had completed 3- and 12-month post-operative data for all outcome measures.

The criteria for surgery were severe, persistent back and/or radicular leg pain and radiologically (X-ray and magnetic resonance imaging or computed tomography) defined spinal disorder. Degenerative spondylolisthesis,

spondylolysis, spinal stenosis, instability or pain after previous surgery, disc herniation or degeneration and degenerative scoliosis were the main indications for fusion surgery in 122 (53 %), 40 (17 %), 22 (9 %), 20 (9 %), 15 (6 %) and 13 (6 %) of the patients, respectively. Spinal fusion was performed using instrumented posterolateral fusion with or without posterior lumbar interbody fusion or transforaminal lumbar interbody fusion. All patients had a history of unsatisfactory response to conservative treatment. The study was approved by the Ethics Committees of both hospitals and all patients signed a consent form prior to the operation.

Depressive symptoms

Depressive symptoms were screened for using the Finnish version of the DEPS [11]. The sensitivity of DEPS for clinical depression has been reported to be 74 % (for severe depression 84 %), and specificity for non-depression 85 % (for symptom-free patients 93 %) [12]. It has ten items (range 0–3 points), and the total score ranges from 0 to 30. DEPS identifies two groups of patients; those with no depressive symptoms and those with depressive symptoms. The reported cut-off point for clinical depression is 12 points (sensitivity 75 %, specificity 70 %), which was used in the analysis of the present results [13].

Disability, pain and associated factors

Disability was measured pre- and post-operatively using the Finnish validated version 2.0 of the Oswestry Disability Index (ODI) [14]. ODI is the most widely used back-specific disability questionnaire, both in clinical work and research. ODI contains ten items, each with six statements graded from zero to five. Scores range from 0 to 100, where according to the original publication 0–20 means minimal, 20–40 moderate, and 40–60 severe disability. Scores over 60 indicate that a patient is crippled and when the score is over 80 patients are either bedridden or are exaggerating their symptoms [15].

Back and leg pain was assessed with the visual analogue scale (VAS back and VAS leg: range 0–100 mm) [16]. Demographic data including patient's gender, age, marital status, years of education and employment status (working, unemployed, retired or on sick leave), leisure time physical activity (h/week) and data on previous lumbar spine surgery were also elicited by a questionnaire.

Statistics

The results are given as means, standard deviation (SD) or 98 % confidence level. Statistical comparison between the groups was performed using *t* test and χ^2 test as

appropriate. Repeated measures were analyzed using correlation structure in generalized estimating equation models. Generalized estimating equations were developed as an extension of the general linear model to analyze longitudinal and other correlated data. The comparisons between the groups were adjusted for age and sex. Correlations were estimated using Pearson's correlation coefficient.

Results

Pre-operatively 78/232 (34 %) of patients, who scored ≥ 12 points on DEPS, were classified to have depressive symptoms. The corresponding numbers 3 months and 1 year after surgery were 29/226 (13 %) and 33/221 (15 %), respectively. Before surgery, the prevalence of depressive symptoms was significantly higher in females (37 %) than in males (27 %), but at 1 year after surgery the difference between males (17 %) and females (14 %) disappeared.

In the whole group of participants, the mean pre-operative DEPS score (SD) was 9.4 (5.9) and decreased to 5.4 (5.2) ($p < 0.001$) at 3 months and remained 5.9 (5.6) ($p < 0.001$) at 1 year after surgery. In patients with depressive symptoms at baseline DEPS score decreased from 16.2 (3.7) to 8.6 (6.4) ($p < 0.001$) and in patients without depressive symptoms from 6.1 (3.4) to 3.8 (3.7) ($p < 0.001$), respectively. The decrease in DEPS score was statistically significant in both groups between pre-operative and 3-month follow-up and thereafter the changes were minor. Figure 1 shows the age and sex adjusted changes in DEPS in both groups.

Patients with depressive symptoms reported more back pain ($p = 0.016$) than patients without depressive symptoms at baseline, but there was no significant difference between the groups as regards leg pain ($p = 0.089$). After surgery, the mean (95 % CI) decrease in back pain in patients without depressive symptoms was -36 (-42 to -30) mm and in patients with depressive symptoms -34 (-42 to -26) mm (both $p < 0.001$). The respective changes in leg pain were -34 (-41 to -28) mm and -34 (-42 to -25) mm (both $p < 0.001$). The difference between groups in the changes in low back and leg pain was not significant. The change in back pain from baseline to 1-year follow-up correlated significantly with the change of DEPS ($r = 0.43$, $p < 0.001$).

The pre-operative Oswestry score (SD) for patients with and without depressive symptoms was 52 (14) and 40 (14) respectively. The difference was statistically significant ($p < 0.005$). In both groups, ODI decreased significantly from baseline to 12 months, -23 with and -17 points without depressive symptoms ($p < 0.001$). However, the functional disability in patients with depressive symptoms

Fig. 1 Age and sex adjusted changes in depressive symptoms in patients with and without depressive symptoms. Dotted line shows cut-off point for DEPS score < 12

remained significantly more severe than in the other patients at both 3-month and 1-year follow-up ($p < 0.001$). The changes in ODI from baseline to 3-month and 1-year follow-up also correlated significantly with the changes in DEPS ($r = 0.48$ and $r = 0.49$; both $p < 0.001$), respectively. The changes in ODI score according to DEPS groups are presented in Fig. 2.

When grouped according to baseline DEPS, the patients with depressive symptoms (DEPS ≥ 12) had shorter education ($p = 0.001$) and were more likely to be out of work ($p = 0.004$) than the other patients (Table 1). Of all participants, 26 % had undergone previous lumbar spine surgery; 24 and 30 % in patients with and without pre-operative depressive symptoms, respectively.

Discussion

In the present study, the prevalence of depressive symptoms and the factors associated with them were evaluated from the register-based data on patients undergoing spinal fusion. Our results show that the prevalence of depressive symptoms in patients with chronic back pain was high and decreased at 1-year follow-up after surgery. Although the

Fig. 2 Changes in ODI in patients with (DEPS score < 12) and without (DEPS score > 12) depressive symptoms at 1-year follow-up

level of functional disability decreased in both groups, it remained higher in patients with depressive symptoms than in those without depressive symptoms at 1-year follow-up.

The prevalence of depressive symptoms in CLBP patients undergoing lumbar fusion surgery has previously been reported to be 20–30 % [17–19] compared to an average European population prevalence of 8.5 % [20]. Our result of 34 % prevalence of depressive symptoms is in accordance with the high prevalence of depressive symptoms reported in earlier studies. The prevalence of depressive symptoms assessed by the Beck depression inventory (BDI) in Finnish average women and men is 16–22 and 8–18 %, respectively [21]. Comparing DEPS to BDI in Finnish population, the mean BDI scores were borderline higher in females than in males, with no gender difference in DEPS scores [22]. In the present study evaluating the patients with CLBP, the prevalence of depressive symptoms was higher in females than in males. However, the prevalence of depressive symptoms in females decreased more after surgery than in males and, therefore, the difference between genders disappeared. In

Table 1 Baseline demographics and clinical data

	DEPS score		<i>p</i> value between the groups
	I (0–11) <i>N</i> = 154	III (≥12) <i>N</i> = 78	
Number of females, <i>n</i> (%)	100 (65)	58 (74)	0.15
Age, mean (SD)	61 (12.7)	63 (11.1)	0.15
Married/cohabiting, <i>n</i> (%)	104 (68)	49 (63)	0.31
Education, years, mean (SD)	11.1 (4.4)	9.1 (4.5)	0.001
Smoking, <i>n</i> (%)	23 (15)	11 (15)	0.80
Employment status, <i>n</i> (%)			
At work	48 (31)	8 (10)	0.004
Retired	86 (56)	58 (75)	
Sick leave	9 (6)	8 (10)	
Unemployed	5 (3)	3 (4)	
Not reported	6	1	
Leisure time physical activity, h/week, mean (SD)	3.7 (3.8)	3.8 (2.5)	0.58
Duration of symptoms, mo, median (IQR)	171 (153)	199 (206)	0.19
Pain, VAS ^a , mm 0–100, mean (SD)			
Back	61 (26)	70 (26)	0.016
Leg	60 (28)	64 (26)	
Indication for fusion, <i>n</i> (%)			
Degenerativeolisthesis	81 (53)	41 (52)	0.58
Spondylolysis	30 (20)	10 (13)	
Spinal stenosis	14 (9)	8 (10)	
Disc herniation or degeneration	11 (7)	4 (5)	
Post-operative instability/conditions	11 (7)	9 (11)	
Degenerative scoliosis	7 (4)	6 (8)	

^a VAS visual analogue scale

light of this result, the depression in females may, however, be more pain and/or disability dependent than in males.

Pre-operatively patients with depressive symptoms had statistically significantly more back pain than patients without depressive symptoms. However, the difference of 9 mm in mean pain is probably not clinically significant. Moreover, the differences in leg pain and post-operative back pain between groups were not significant. For patients with chronic low back pain, the minimum clinically important difference (MCID) has been reported to be around 20 mm [25] and the corresponding value in leg pain around 15 mm [26]. In the present study, the mean changes in both back and leg pain at 3 months and 1 year after surgery in patients with and without depressive symptoms were −34 and −36 mm, which indicates a clinically significant decrease in back and leg pain in both study groups. However, there was no significant difference between groups in the change in low back and leg pain, which

means that the decrease of pain in patients with and without depressive symptoms was similar.

The association between CLBP and depression is unclear. According to Hägg et al. [27], there is a stepwise increase in depressive symptoms from lowest in pain-free general population to highest in chronic low back pain patients. Chronic pain may cause depression; however, depression itself may actually increase pain [5]. Therefore, in patients with depressive symptoms the surgical decision-making may be demanding. In the present study, the average back and leg pain VAS before surgery were >60 mm and the duration of symptoms was many years, which indicates that patients presented with a long-term and painful disorder. The prevalence of depressive symptoms decreased by 19 % 1 year after surgery and at the same follow-up point both back and leg pain decreased significantly. The change in depressive symptoms correlated significantly with the change in back pain. This result demonstrates that in patients with depressive symptoms relief from pain also alleviates the presence of depressive symptoms, which leads to the conclusion that spinal fusion surgery with strict indications and certain diagnosis groups also relieves depressive symptoms by also alleviating pain.

In addition to pain, disability may cause depression. In the study by Trief et al. [17], depressive symptoms predicted poorer functioning ability after lumbar fusion surgery. Copay et al. [26] reported that MCID of ODI in patients with lumbar spine surgery was 12.8 points. In the present study, the changes in ODI scores at 3-month follow-up were −23 in patients with and −18 in patients without depressive symptoms and the corresponding ODI changes between pre-operative and 1-year follow-up measurements were −24 and −21, respectively. According to the study by Copay et al. these changes are clinically significant. The moderate correlation between the decrease in DEPS and ODI also supports the clinical significance of this phenomenon. The disability of patients with depressive symptoms at baseline was statistically significantly poorer than that of other patients before surgery and 3 months and 1 year after surgery i.e., ODI values at follow-ups were 53 vs. 41, 30 vs. 23, and 29 vs. 20. These results concur with the results of Trief et al. suggesting that depression may increase disability. However, in our study the disability of patients with depressive symptoms also decreased significantly after surgery and the decrease in disability correlated with a decrease in depressive symptoms, which supports our previous suggestion that relieving symptoms such as pain or disability through surgery may also serve to alleviate depressive symptoms.

Chronic low back pain is one of the most significant disease groups causing sick leaves and retirement in Western countries [23]. In the present study, most of the patients were retired at baseline. However, although the

age of the patients was similar in both groups, significantly fewer depressive patients were still at work than other patients. Furthermore, patients with depressive symptoms were less educated than other patients. Naturally shorter education may lead to doing heavier work and hence to earlier retirement. However, this may also reflect the psychosocial factors attached the depressive symptoms.

Limitations

There are some limitations in this study. The assessment of depressive symptoms is based on a self-rating instrument, which is only a rough indicator of clinical depression. However, the DEPS scale has been shown to be a reliable screening instrument to detect depressive symptoms. Moreover, the follow-up period of only 1 year can be criticized, although it has previously been shown that the results of lumbar fusion last for up to 5 years [24]. The improvement of patients' mental status cannot be explained solely by the variables used in this study, and more long-term examination is needed to study the association of disability and depressive symptoms among patients undergoing spinal fusion surgery. In the future it might be important to study effect of depressive symptoms on recovery in the different diagnostic groups. In the present study, some of the subgroups remained rather small and, thus, it was not rational to test the groups separately.

Conclusions

According to our results, depressive symptoms are very common in patients suffering from chronic and severe back pain and undergoing spinal fusion surgery. Although the results of surgery for patients with depressive symptoms may not be as good as for other patients, the surgery is also effective for them, at least at 1-year follow-up. It also seems that the decrease in pain and disability after surgery in certain strict diagnostic groups may also alleviate the depressive symptoms. Thus, there is no need to exclude depressive patients, but screening measures and appropriate treatment practises throughout both the pre-operative and post-operative periods are encouraged.

Acknowledgments The authors thank Tampere University Hospital and Jyväskylä Central Hospital spine register teams, especially Liisa Pekkanen, Kati Kyrölä, Kirsi Piitulainen and Seija Rautiainen for collecting the register data. We also thank Virginia Mattila and Honorary Professor Associate Ian McDermott for editing English language of this manuscript. The study was supported by Medical Research Funds from Tampere University Hospital and Jyväskylä Central Hospital, Finland.

Conflict of interest None.

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