The influence of secondary gain on surgical outcome: a comparison between cervical and lumbar discectomy

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Although the expectation of monetary compensation has been associated with failures in lumbar discectomy, the issue has not been investigated in patients undergoing cervical disc surgery. The authors analyzed the relationship between economic forms of secondary gain and surgical outcome in a group of patients with a common pay scale, retirement plan, and disability program.

All procedures were performed at the Portsmouth Naval Medical Center between 1993 and 1995; active-duty military servicepersons treated for cervical radiculopathy were prospectively included. Clinical, demographic, and financial factors were analyzed to determine which were predictive of outcome. Financial data were used to create a compensation incentive, which is proportional to the patient's rank, years of service, potential disability, retirement eligibility, and base pay and reflects the monetary incentive of disability. The results of cervical surgery were compared to a previously reported companion population of patients treated for lumbar disc disease. A good outcome was defined as a return to active duty, whereas a referral for disability was considered a poor surgical result. A 100% follow-up rate was obtained for 269 patients who underwent 307 cervical operations. Only 16% (43 of 269) of patients who underwent cervical operation received disability, whereas 24.7% (86 of 348) of patients who underwent lumbar discectomy obtained a poor result (p = 0.0082). Although economic forms of secondary gain were not associated with a poor outcome in cervical disease, both the rank (p = 0.002) and duration (p = 0.03) of an individual's military career were significant factors (p = 0.02). Of the medical variables tested, multilevel surgery (p = 0.03) and revision operations at the same level (p = 0.03) were associated with referral for medical discharge.

Secondary gain in the form of economic compensation influences outcome in lumbar but not cervical disc surgery patients; the increased rate of disability referral in patients who underwent lumbar discectomy may reflect an expectation of economic compensation. Social factors that are independent of the anticipation of economic compensation seem to influence the outcome in cervical disc surgery patients.
The clinical manifestations of cervical disc herniation were recognized by Mixter and Ayer[22] in the first part of the 20th century. Symptomatic relief following cervical discectomy has been achieved in 63 to 100% of patients.[2,3,6,15,20,21,23,27,28,31] As increasing numbers of individuals have been treated, demographic[6,10,11,31] and clinical factors[3,7,8,10,13,14,16,18,20,30,31] have been recognized to influence results of surgery. Williams, et al.,[31] and Eriksen, et al.,[10] noted gender differences in outcome, whereas DePalma, et al.[6] and Espersen, et al.[11] reported that older patients were less likely to benefit from discectomy. Clinical determinants have also been analyzed and include the pattern and duration of symptoms prior to treatment. Radiculopathy resulting from spondylosis is more amenable to decompressive laminectomy than spondylosis resulting in either axial neck pain or myelopathy.[7,8,13,30,31] Anatomical and pathological factors have also been implicated; treatment of a single-level disc herniation is more likely to result in symptomatic relief than treatment of multilevel disease.[10,18,27] Additionally, discectomy of soft-disc herniations results in superior clinical results in comparison to decompression of spondylotic spurs.[3,14,20]

Although secondary gain in the form of economic compensation has been associated with poor outcome in patients with lumbar disc disease,[1,4,9,19,25,26,29,32] the relative contribution of this factor in cervical disc disease has been studied only sparingly. In 1972, DePalma and coworkers[5] reported a series of patients treated both surgically and nonsurgically for disc herniation resulting in radiculopathy. Involvement in litigation predicted a poor outcome only in the nonsurgically treated group. The authors of two other studies addressing this issue found no correlation between economic incentive and treatment outcome.[13,15]

Assessment of the role of secondary gain is difficult in a civilian population because of differences in disability pay, legal action confounding work injuries, and regional variations in Workers' Compensation law. This issue was recently addressed in a report by Young and colleagues[32] who analyzed predictors of outcome in a population of military servicepersons who were prospectively treated for lumbar disc herniation. In the military, salary, disability pay, and retirement eligibility are determined by an individual's rank and duration of service. The incentive to obtain disability, therefore, can be quantified, facilitating a comparison between individuals. Young, et al., found that patients with a greater economic incentive to obtain medical discharge were more likely to report disabling symptoms after lumbar disc surgery.

The present study was performed to evaluate the influence of clinical, pathological, demographic, and economic variables on the success of cervical discectomy and to compare these predictors of outcome to those found in a companion population of patients who underwent lumbar disc procedures.[32]

CLINICAL MATERIAL AND METHODS

Patient Population

Active-duty military servicepersons who were treated surgically for cervical and lumbar disc herniations between 1993 and 1995 were prospectively included in this study; the results of lumbar discectomy have been previously reported.[32] All operations were performed at Portsmouth Naval Medical Center in Portsmouth, Virginia, by four board-certified or board-eligible neurosurgeons. We excluded patients who
presented with myelopathy, previous cervical disc surgery, or pathology affecting more than two cervical levels. In the population of patients who underwent lumbar disc surgery, those patients treated for lumbar stenosis, far-lateral disc herniation, or those who underwent lumbar fusion were not included.

**Cervical Spine Surgical Technique**

Centrally herniated discs were treated by both Cloward and Smith-Robinson techniques, whereas lateral herniations were treated either by an anterior approach as previously cited or through a posterior laminotomy. In the latter operation, only decompression without fusion was performed. The indications for reoperation were recurrent disc herniation, painful pseudarthrosis, bone graft complications, and herniation at a different level. Paracentral lumbar disc herniations were treated through partial hemilaminotomy; in cases of central disc herniation a total laminectomy was performed. All operations were facilitated by the use of either loupe or microscopic magnification.

**Data Collection**

Data were collected prospectively on various demographic, anatomical, surgical, and financial factors that had potential to influence the results of surgery. Anatomical and surgical variables included level of disc herniation, presence of one- or two-level disease, whether an anterior or posterior approach was used, and if the patient underwent reoperation at same level or a second operation at a different level. Demographic variables included gender, age, rank, class (officer, warrant officer, or enlisted), and years of military service.

**Financial Variables**

Monthly salary and potential retirement benefits, based on 1995 wage calculations, are dependent on rank and duration of military service. The potential monthly stipend from disability was calculated using a formula that factors in rank, base pay, length of military service, and an assumption of a 30% disability rating. To obtain full benefits the "medical disability board" (description following) must confer at least a 30% rating; full benefits include monthly payments, vocational rehabilitation, and lifetime medical service. A higher rating earns a proportionally greater monthly salary whereas a less than 30% rating entitles a person to a one-time severance payment. Because patients receive counseling as an initial step of the medical-board referral, they are aware of the importance of this rating and frequently contest lesser judgments. The monthly disability payments, which are calculated assuming 30% disability, provide the most conservative estimate of the incentive to obtain compensation but may obscure the influence of disability payments because a higher disability rating would translate into greater compensation.

Base pay, disability pay, and retirement pay were used to create a ratio called the compensation incentive (Fig. 1). In this equation, values are expressed in the amount of money received monthly, and monthly disability pay is a proportion of base pay that is always greater than retirement pay. The compensation incentive, therefore, is greater for those with shorter service records who are not eligible for retirement.[32] The actual values of compensation incentive range from 0.01 to 0.5; the greater value is reflective of a greater economic incentive to obtain disability.

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\text{compensation incentive} = \frac{\text{disability pay} - \text{retirement pay}}{\text{base pay}}
\]

Fig. 1. Equation used to calculate the compensation incentive of servicepersons in the military.
Follow-Up Review and Outcome Analysis

Attending medical appointments is mandatory in the military; thus, 100% of the follow-up data were obtained. Patients were followed from 10 to 48 months after surgery. The ultimate condition of a patient must be determined no later than 18 months after initiation of "limited duty," which is determined at the time of the first office visit. Resolution of a medical condition results in a reinstatement to "full duty." To maintain a full-duty rating all servicepersons must obtain sufficient symptomatic relief to pass a biannual physical fitness test and return to their previous military post. In this study such an outcome is defined as a good result. If full-duty status is not possible, the operating surgeon initiates the process of medical discharge by referring the patient to the "medical disability board" or "physical evaluation board." This national panel consists of attorneys, physicians, and administrators who determine whether an individual is "fit for duty." A disability rating is proposed for patients deemed "medically unfit for duty"; this rating is based on national standards outlined by the Veterans Administration system. For neck pain, low-back pain, or radiculopathy, these referrals are initiated if pain or weakness is exacerbated by work-related activities and usually results in a medical discharge with full benefits. In this study, a referral for medical disability is defined as a poor result.

Statistical Analysis

Statistical analysis was performed using STATISTICA for Windows 5.1 (StatSoft Inc., Tulsa, OK). The Student t-test was used to compare group means. Fisher's exact test was used to analyze the 2 X 2 contingency table in the univariate analysis. Logistic regression was used to assess variables in both the univariate and multivariate analyses as they relate to a poor outcome or referral for medical disability. The odds ratio was calculated for significant outcome predictors. The level used to determine statistical significance was p < 0.05.

RESULTS

Overall Outcome

Surgical treatment of cervical disc disease resulted in better outcome than surgical treatment of lumbar disc disease. Only 16% (43 of 269) of the patients with cervical disease, in contrast with 24.7% (86 of 348) of the patients with lumbar disease, were referred for disability and therefore were classified as having poor results (p = 0.0082).

Demographic Data and Analysis

Two-hundred sixty-nine patients were treated for cervical disc disease; 91% (245 of 269) were men and 9% (24 of 269) were women (Table 1). The average age of the entire population was 37.5 years. Neither of these two variables was predictive for a particular outcome (Figs. 2 and 3).
<table>
<thead>
<tr>
<th>demographic variables</th>
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<tr>
<td>average age (yrs)</td>
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<tr>
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<tr>
<td>sex (%)</td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>245 (91)</td>
</tr>
<tr>
<td>female</td>
<td>24 (9)</td>
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</tr>
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<td>201 (75)</td>
</tr>
<tr>
<td>warrant officer</td>
<td>14 (5)</td>
</tr>
<tr>
<td>officer</td>
<td>54 (20)</td>
</tr>
</tbody>
</table>

| financial variables           |          |
| average base pay ($)*         |          |
| enlisted                      | 1912     |
| warrant officer               | 3014     |
| officer                       | 4034     |
| average disability pay ($)†    |          |
| enlisted                      | 801      |
| warrant officer               | 1305     |
| officer                       | 1729     |
| no. eligible for retirement (%)|          |
| enlisted                      | 107 (53) |
| warrant officer               | 13 (93)  |
| officer                       | 32 (60)  |

*These values represent monthly payments.
Fig. 2. Pie chart and tabular illustrations of good- and poor-outcome patients who underwent surgical treatment for cervical disc disease. Univariate analysis demonstrated that patients with longer service records were less likely to obtain a referral for disability with an odds ratio of 0.938 per additional year.

The average duration of military service for the entire population was 15.1 years; those who were referred for medical disability were more likely to have been in military service for a shorter time (13.1 years) compared with those who were treated successfully with cervical discectomy (15.5 years, p = 0.02) (Fig. 2).
Fig. 3. Graph depicting the rate of disability based on variables in patients who underwent surgical treatment of cervical disc disease, demonstrating that class and extent of pathology were predictive of outcome and that reoperation at the same disc level was associated with referral for disability.

There were 201 enlisted personnel (75%), 14 warrant officers (5%), and 54 officers (20%) (Table 1). Enlisted personnel as a group were referred to the medical disability board more frequently than either of the other two groups (p = 0.002) (Figs. 3 and 4). Additionally, within each class, higher ranking individuals were more likely to obtain symptomatic relief after treatment (p = 0.03) (Figs. 3 and 4).
Fig. 4. Graph demonstrating that the rate of referral for disability is proportional to class (p = 0.002) as well as rank within each class (p = 0.03).

Medical Variables

Table 2 illustrates the medical variables in the patients who underwent cervical discectomy. Of the 307 operations for cervical disc herniation, there were 269 first-time procedures and 38 additional surgeries. Seventy-seven percent (236 of 307) of the operations involved a single level, whereas 23% (71 of 307) involved two levels. Ten percent (28 of 269) of the patient population underwent 38 additional operations; 19 patients underwent one, eight underwent two, and one underwent three reoperations. Of the 38 additional operations, 14 approached two levels and four treated disease at a different level. Only 13.7% (28 of 205) of patients who underwent one-level operations were referred for disability, whereas 23.4% (15 of 64) of patients treated for two-level disease achieved a poor outcome (p = 0.03).

Additionally, reoperation at the same level resulted in disability in 29.6% (8 of 27) of patients, which is significantly increased when compared with a disability rate of 14% (34 of 241) in patients who required only one operation (p = 0.03). Although 50% (two of four) of patients who underwent a second surgery at a different level were referred for disability, this finding was not significantly different from the other groups (Fig. 3).
The anterior approach was used in 15.7% (28 of 178) of the patients. A total of 378 cervical levels were treated in 307 operations. Neither the approach (Fig. 3) nor the level of disc herniation was predictive of outcome.

**Financial Variables**

Both the compensation index (p = 0.0021) and base pay (p = 0.0005) were predictive of a referral for medical disability in the lumbar discectomy population.[32] Although there were differences in the average base pay and disability pay between classes (Table 1), financial factors were not predictive of outcome for the population of patients who underwent cervical discectomy. Fifty-seven percent (152 of 269) of servicepersons were eligible for retirement at the time of the study; 13% (20 of 152) of these individuals went on to obtain referral for disability. This was not significantly different from the 20% (23 of 117) who obtained a poor result and who were not eligible for retirement (Fig. 3). In contrast to the lumbar discectomy population, neither monthly salary, the amount of disability pay, nor compensation incentive were predictive of surgical outcome (Fig. 2).

**DISCUSSION**

Retrospective studies evaluating the results of cervical disc surgery traditionally define outcome by the extent of improvement of preoperative pain, weakness, or numbness. A useful grading system, however, should also address whether symptoms impede the ability to perform physical activities. The grading system proposed by Odom, et al.,[24] includes an assessment of the functional ramifications of pain from cervical disc disease. An excellent outcome is synonymous with complete resolution of symptoms. Patients with good results have "intermittent discomfort ... related to cervical disease but not significantly interfering with ... work." These two categories are distinguished from a satisfactory result, which is defined as improvement of symptoms but an inability to perform activities, and from a poor result, which is defined as worsening of symptoms after treatment. The grading system used in this study defines only two categories: 1) surgical success includes patients with excellent and good results; 2) surgical failure includes patients with satisfactory and poor outcomes. Patients in either outcome category may, therefore, report persistent symptoms, but only those with successful outcomes return to their previous occupation.

In this study, patients with cervical disc herniations were more effectively treated than patients who underwent lumbar discectomy (p = 0.0082). The increased rate of disability referral observed in the lumbar discectomy population may in part be related to the conception of back pain as a means to acquire economic reward. In 1995, the Virginia Workers’ Compensation Commission awarded 74 million dollars
to 4000 people with problems related to low-back injuries, whereas only 7 million dollars was distributed to the 350 reporting injuries resulting in cervical symptoms (Virginia Workers' Compensation Commission: statistical report for the calendar year of 1995). In studies on patients with lumbar disc disease, the expectation of secondary gain in the form of economic compensation has been shown to be associated with poor surgical outcome.[1,4,9,19,25,26,29,32] This finding was confirmed in the companion cohort of patients with lumbar disc herniations.[32] In that portion of this study, patients with higher compensation incentives (p = 0.0021) and lower base pay (p = 0.0005) were more likely to obtain referral for medical disability. We did not observe this relationship in the companion population of patients treated for cervical disc herniation (Fig. 2). This finding supports the observation of Henderson and colleagues[15] who reported equally satisfying results in both workers' compensation and noncompensation cases.

Demographic parameters, however, were predictive of surgical outcome in the cervical but not the lumbar discectomy population. Position in the military hierarchy was significantly associated with treatment efficacy independent of other variables (Figs. 3 and 4); the duration of military service was also predictive in the univariate analysis (Fig. 2). This discrepancy may be a function of the more rigorous and physically demanding tasks required of lower ranking individuals. The relationship between the nature of an occupation and surgical outcome has been noted in previous studies. In a series of patients who had undergone lumbar discectomy, Davis[4] found that manual laborers reported persistent or recurrent pain more often than individuals employed to perform more sedentary tasks.

Apart from differences in the type of labor, the increased rate of disability referral found in the lower military ranks may be related to differences in job satisfaction and career commitment. An individual with a longer service record generally holds a higher rank and commands greater responsibilities; this personal investment may override the discomfort caused by residual cervical radiculitis. Holmstrom, et al.[17] described a similar circumstance in a population of construction workers; neck and shoulder pain was more commonly reported by laborers who experienced more job-related stress and little job satisfaction.

Clinical factors that were identified to predict poor outcome include the presence of multilevel disease and revision operation at the same level and at a different level. The increased prevalence of poor outcome in the two-level discectomy group has been described previously and may relate to higher pseudarthrosis rates noted in multilevel surgery.[18,27] Cervical spondylosis presenting as multilevel foraminal osteophytosis may also be more difficult to treat than a single-level soft-disc herniation (Fig. 3).[3,14,20] This analysis also confirms a report by Espersen, et al.,[12] who noted that revision surgery is less likely to result in relief of symptoms.

CONCLUSIONS

Economic incentive to obtain disability is an independent predictor for outcome in lumbar but not cervical disc surgery. The increased likelihood of surgical failure in the lumbar discectomy population may in part relate to an expectation of economic compensation. Social factors relating to work ethic, work environment, and social class influence the efficacy of cervical discectomy.

References


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