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Efficacy of lumbar discectomy and percutaneous treatments for lumbar disc herniation

Summary

The changing health care environment necessitates careful re-evaluation of all costly elective procedures. Low back surgery is a typical example. This article reviews the current literature addressing the efficacy of surgery and invasive percutaneous treatments for discogenic sciatica. It also discusses the prospects for the continuation of reimbursement for these procedures under a system of managed health care. Relevant articles were identified using the MEDLINE and Current Contents databases, from bibliographies of articles identified from these databases, from recommendations of experts in the field, and from the Canadian Cochrane Collaboration. The review includes randomized clinical trials, meta-analyses, published practice guidelines and large case series. The literature is classified and discussed in these quality strata. The review includes 9 randomized trials, 6 meta-analyses or review articles, one evidence-based practice guideline, 38 surgical case series and 35 additional references. Though incomplete, the existing evidence indicates that open discectomy shortens the duration of discogenic sciatica in selected patients. Neurologic outcomes are similar in operated and unoperated patients. Predominant leg pain, evidence of nerve root tension and concordant symptoms and imaging findings, are associated with favorable surgical results. Chemonucleolysis is also associated with more rapid pain relief than conservative treatment, but provides less certain benefit than standard discectomy. Available data on other percutaneous disc treatments do not currently support a statement on efficacy. Various percutaneous techniques are available but there is no solid scientific evidence of efficacy. The benefits of open discectomy, principally reduced duration of pain, appear to justify its use in carefully selected patients when discogenic sciatica fails to improve with conservative measures. Though elective, the procedure will probably continue to be available under managed care, but with increasing scrutiny of operative indications.

Like most matters relating to low back disorders, lumbar spine surgery remains one of the most thoroughly reviewed but least well studied areas in clinical medicine. A recent MEDLINE search identified more than 100 review articles on low back surgery published between 1980 and 1996, but found only 14 randomized trials. Despite the abundance of past reviews, several recent developments lend new urgency to a critical re-appraisal of the risks and benefits of these procedures.

The first of these is that, in an increasingly cost-conscious health care system, the low back disorders compel attention by virtue of their magnitude alone. Annual direct cost estimates for treating acute low back disorders range from $8 billion to $13 billion in the US[1]. In 1988, 556'000 non-surgical back-related hospital admissions occurred, accounting for nearly three million in-patient days[2]. Surgeons in the United States currently perform approximately 200'000 lumbar disc procedures annually, and the overall rate of lumbar spine surgery rose by 53% between 1980 and 1985, despite a narrowing spectrum of generally accepted indications[3]. A recent study from Canada identified musculoskeletal disorders as the

leading cause of chronic health problems, long-term disability and physician visits, with back and neck disorders accounting for a large fraction of this disease burden[4]. Thus, the scope of low back disorders as a public health problem demands careful ongoing assessment of their treatment.

A second factor arguing for a careful re-appraisal of low back surgery is the rapid movement toward managed health care in several countries, and the changing role of costly elective procedures. Lumbar spine surgery represents a prototypic elective procedure. First, the vast majority of surgical operations are performed for conditions that are not life-threatening. Second, for most low back conditions, surgery is only one of a broad spectrum of treatment options, and is only rarely the unequivocal treatment of choice[3]. Indeed, the existing evidence suggests that long-term outcomes of operative and non-operative management differ little for most low back disorders, including those involving mechanical compression of neural elements[5–8]. In managed care settings, costly elective procedures like back surgery have come under intense scrutiny, initially by third-party payers, but increasingly also by provider groups who share the risk under capitated reimbursement arrangements. Under managed care, elective procedures may need to satisfy the criterion of *proven* benefit rather than that of *potential* benefit which served to justify reimbursement in the past[9].

Moreover, the membership of managed care plans has increased rapidly over the past several years. In certain regions of the US, more than 50% of patients are cared for by health maintenance organizations (HMOs). It is therefore a matter of concern that the existing literature may not present proof of the benefit for many types of back surgery. Data demonstrating marked geographic variation in low back surgery rates, especially the strikingly higher incidence in the United States than in other industrialized countries, cast doubt on the medical necessity of some of these procedures[10,11] (see Figure 1). The extraordinary failure of clinical researchers to evaluate even routine procedures like lumbar fusion with formal controlled trials may increasingly compromise access to these procedures in the managed care environment[12]. A re-appraisal of the literature may help to clarify these issues and to define the place of low back surgery under managed care.

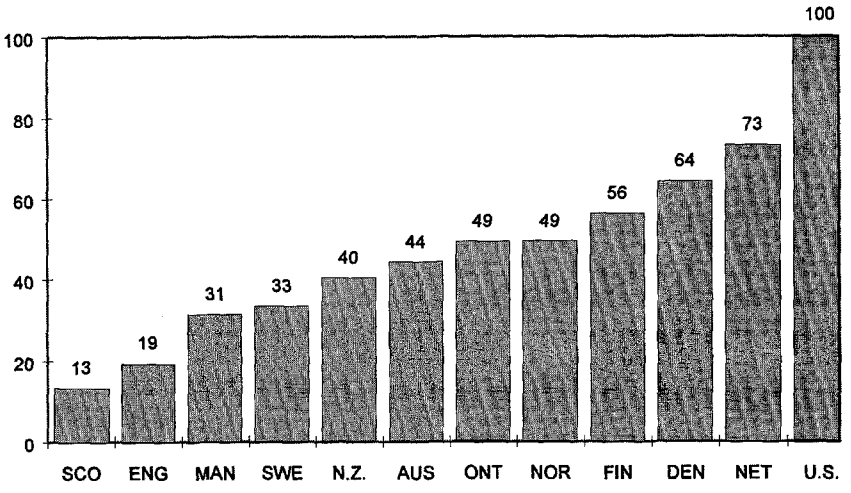

Figure 1. *Ratios of Lumbar spine surgery rates in international comparison. AUS = Australia, DEN = Denmark, ENG = England, FIN = Finland, MAN = Manitoba, NET = Netherland, N.Z. = New Zealand, NOR = Norway, ONT = Ontario, SCO = Scotland, SWE = Sweden, U.S. = United States. Reprinted with permission from: Cherkin DC, Deyo RA, Loeser JD, Bush T, Waddell G. An international comparison of back surgery rates. Spine 1994; 19: 1201–1206, © 1997 Lippincott-Raven Publishers, Philadelphia.*

A final reason for taking a fresh look at the back surgery literature is the powerful conceptual and methodological framework that has recently emerged for evaluating the published evidence[10,13]. Although high quality primary studies of spine surgery remain rare, our capacity to analyze the existing evidence has taken a quantum leap forward as health services researchers and national guideline panels have focused their attention on low back disorders. As a result, we now have formal meta-analyses of the three principal lumbar spine procedures (discectomy, fusion, and surgery for spinal stenosis)[3,14,15] and an evidence-based guideline for the treatment of acute low back pain from a multidisciplinary national consensus panel[16]. Meta-analysis allows a quantitative and objective synthesis of the clinical research addressing specific questions, such as the risks and benefits of surgical procedures. Although the conclusions drawn from recently published meta-analyses were sharply limited by the quality of the primary literature, even if based on studies with controlled trial design[17], they comprise a far more systematic assessment of the back surgery literature than has appeared previously. In this review, we have summarized the results of these recently published studies but have not undertaken further meta-analyses for two reasons. First, the spine surgery literature has changed little since these analyses appeared, and additional meta-analyses covering the same literature would be likely to yield similar

conclusions. Second, in offering a broad-based overview of the current status and future prospects of low back surgery, the review discusses both clinical and health policy issues not directly addressed by the quantitative literature syntheses.
Below we review the current literature on the benefits and risks of lumbar discectomy and invasive percutaneous treatments for lumbar disc herniation. The review begins with an overview followed by a discussion of the quality of the existing evidence. We then present results of controlled trials, followed by a discussion of published meta-analyses. Next, we present a focused, rather than an exhaustive review of the case series literature, concentrating on factors that receive little attention in the meta-analyses, like patient selection criteria. The review closes with a discussion of compliations and a summary statement on the current status of the procedures, including a discussion of how they are likely to fare under managed care.

Literature search methods

Relevant articles were identified by searching the MEDLINE database for the period from 1966 through July, 1996. The principal search strategies used the medical subject headings *lumbar vertebrae*, *lumbosacral region* and *intervertebral disc* cross-references by a number of terms including *surgery*, *laminectomy*, *discectomy* and *outcome*. Additional searches were carried out for certain subtopics including *percutaneous discectomy*, *chemonucleolysis* and *discography*. In choosing articles to retrieve and include in the review, we gave preference to prospective clinical trials, observational studies comparing results of surgery to other treatment, and formal meta-analyses and literature syntheses. We also retrieved clinical case series reporting results of surgery in more than 100 patients, and some smaller studies that addressed specific clinical variables, such as phyical findings, that might affect the outcomes of low back surgery. We have also searched the *Current Contents* database monthly since 1989 using the search terms *low back pain, sciatica, lumbar* or *neurogenic claudication, disc, discectomy, laminectomy*, and *spinal fusion.* From this database we retrieved all articles describing surgical and nonoperative treatments for herniated lumbar disc, spinal stenosis, spinal instability and low back pain, excluding case reports. Aware that MEDLINE searching cannot collect all relevant studies[18], we identified additional articles from the reference lists of papers located using MEDLINE and *Current Contents*, from the bibliographies of textbook chapters and from the recommendations of clinicians with expertise in spinal disorders. We complemented our search with information received from the Back Disorders Group of the Canadian Cochrane Collaboration Center, and also included articles encountered in non-indexed journals. Using the selection criteria outlined above, we selected nine randomized trials, six meta-analyses or review articles, one evidence-based practice guideline, thirty-eight surgical case series and thirty-five additional articles for inclusion in the current review.

Lumbar discectomy

Overview

Procedures to relieve compression of lumbar nerve roots by herniated lumbar disc material represent by far the most common type of back surgery, with nearly 200'000 cases annually in the United States[3]. An analysis of national hospital discharge data found that herniated discs accounted for 73% of low back surgical operations performed in the United States during 1988–1990[19]. This contrasts with outpatient care, where lumbar disc herniation accounted for only 11% of visits, for low back problems, with the remainder of visits being for non-specific back problems, stenosis and suspected instability[20]. Since inpatient care generated more than a third of the total medical costs associated with spinal disorders in 1990[21], lumbar disc herniation accounts for a disproportionate share of overall spending on low back pain. We found no detailed data partitioning the total direct costs of caring for lower back disorders into discrete syndromal categories (e.g., radiculopathy, stenosis, mechanical back pain).
Although the terms laminectomy, laminotomy and disectomy are routinely used to identify these procedures, the surgery in fact targets neither the lamina nor the intervertebral disc itself, but rather the extruded fragments of nucleus pulposus which produce symptoms through radicular compression and inflammation[1]. With the advent of the operating microscope, the trend has been toward removing herniated disc fragments through smaller exposures, involving minimal disruption of vertebral and soft tissue elements. This trend toward minimally invasive surgery has now led to the development of a variety of percutaneous and endoscopic disc treatments (discussed below).
Despite advances in surgical technique and preoperative imaging, neither the indications nor the reported success rates for lumbar disc surgery have changed appreciably in the past two decades (Table 1). Although patients who undergo discectomy frequently manifest radicular neurologic deficits[22], intractable sciatic pain remains the principal indication for surgery[3]. The likelihood of resolution of radicular neurologic deficits is similar regardless of whether the patient is treated surgically or with nonoperative measures[5,23].

Author	Sample size	Type	Outcome % Good	Fair	Poor	Factors associated with good outcome
Spangfort[22] 1972	2504	retrospective	77	18	5	degree of disc herniation (intraoperative)
Finneson[39] 1979	280	retrospective	79	8	13	predictive score card with positive factors: single root syndrome with corroborating radiology positive straight leg raising crossed straight leg raising sciatica more severe than LBP psychology
Strefling[40] 1984	228	prospective	78	17	15	non workers' compensation
Herron[41] 1985	106	prospective	75	13	12	positive straight leg raising crossed straight leg raising sensory defect non workers' compensation psychology
Lewis[42] 1987	100	prospective	62	24	14	positive straight leg raising
Spengler[43] 1990	84	prospective	77	7	16	imaging psychology
Abramovitz[44] 1991	450	prospective	79	16	5	leg pain absent back pain positive straight leg raising free fragment on imaging non workers' compensation
Pappas[45] 1992	654	retrospective	78	18	4	non workers' compensation
Davis[46] 1994	984	retrospective	89	8	3	non workers' compensation psychology

Table 1. *Lumbar discectomy: Surgical results and factors from nine uncontrolled case series reported over the past two decades.*

Quality of published evidence

Evaluation of a treatment's efficacy requires data that support an accurate comparison of its benefits and risks in the clinical situations where it is generally used. Although clinical case series can provide information on a procedure's risks, generally only randomized controlled trials (RCTs) can "demonstrate specific benefit incurred by the therapeutic intervention over and above the natural course of illness, random fluctuations and the non-specific benefits of the treatment setting"[24]. For this reason, schemes for classifying the quality of published evidence typically place RCTs alone in the first rank, followed by cohort and case-control studies, then non-randomized studies with comparison groups and finally clinical case series[25]. Systematic reviews of the spine surgery literature, including that on lumbar disectomy, consistently find an abundance of clinical case series, but a striking shortage of controlled studies that allow direct estimates of the procedures' benefits[3,10,14,15,25,26]. Although more controlled studies of discectomy have appeared than for any other low back surgical procedure, evidence on efficacy remains exceedingly sparse. To date, only six randomized controlled trials of discectomy have appeared. Four of these compared surgery to chemonucleolysis using chymopapain[27–30]. A single study compared surgery to non-operative treatment[5] and another compared automated percutaneous lumbar discectomy to microdiscectomy[31]. A recent synthesis of the discectomy literature found the overall quality quite low: of 81 studies that met inclusion criteria for review, only 23% used any kind of comparison group, 17% had a prospective design, 27% employed statistical analysis, and only

6% used independent observers to collect outcomes data[3].

The surgical literature indicates that lumbar discectomy is performed for indications ranging from simple sciatica without neurologic deficit to acute cauda equina syndrome. Published case series generally include patients with a broad range of symptom severities and durations. Some reports have described an association between individual historical or physical findings and surgical outcomes[5,22] (Table 1). However, the literature does not support separate description of surgical outcomes for patients with and without objective evidence of radiculopathy. First, the clinical syndromes of radiculopathy and referred pain from other spinal structures overlap significantly[32]. Second, neurologic findings (including motor, sensory and reflex deficits) have no greater than 50% sensitivity and 70% specificity in identifying a disc herniation in patients with sciatica[33]. Finally, although electrodiagnostic studies aid diagnosis in selected cases[34], a minority of discectomy series have reported clinical outcomes in relation to preoperative electrodiagnostic results. Thus, while recent practice guidelines recommend confirmation of root injury by either physical examination or electrodiagnostic studies prior to surgery[16], the evidence supporting this approach is not conclusive. In summary, published evidence does not support separate reporting of discectomy results for patients with and without objective preoperative evidence of nerve root injury.

Results of randomized controlled trials

Weber's classic study comparing discectomy to physical therapy in patients with discogenic sciatica remains the only randomized trial comparing lower back surgery to any non-invasive treatment[5]. This study, carried out more than two decades ago in Oslo, was of 126 patients with myelographically proven disc herniations, strong clinical evidence of radiculopathy and failure to improve after two weeks of bed rest and physical therapy. They were randomly selected to receive either standard discectomy or continued conservative care. The results showed a clear advantage for surgery at one year follow-up; approximately two thirds of surgically treated patients were restored to baseline function as compared to one third in the conservatively treated group. However, the differences between groups were no longer statistically significant at four year follow-up, and at ten years results of surgery and non-operative treatment were essentially equal. Interestingly, neurologic outcomes including motor and sensory deficits were equivalent in the two groups (though patients who presented initially with major motor deficits received early surgery and were not randomized). Weber's data[5], along with descriptive reports comparing long-term outcomes in operated and non-operated patients with sciatica[23] underlie the current thinking that the principal benefit of discectomy is a reduction in the duration of sciatic pain from lumbar disc herniation. A recent review of Weber's article points out several critical flaws in the study including a large number of crossovers, the small sample size and insensitive outcome measurements[35]. However this is still the only RCT comparing surgical versus conservative treatment.The four randomized trials comparing open surgery to chemonucleolysis[27–30] support the surgical approach: each found superior symptomatic and functional recovery in the group undergoing surgical discectomy compared to patients who received chymopapain injections. However, none included untreated controls.

Results of meta-analyses and reviews

Hoffman and colleagues recently conducted a formal literature synthesis on surgery for herniated lumbar discs[3]. Despite the poor overall quality of the literature, the authors concluded that in selected patients discectomy does in fact offer superior short-term relief from sciatica compared with conservative treatment. Surgery appears to have little effect on long-term results. However, their conclusions were based principally on the small number of controlled studies mentioned above and thus re-state rather than create new evidence. The authors also stress the importance of balancing faster pain relief against the risks and expense of surgery when choosing among therapeutic options.

Three less formal approaches were also recently published. The first is a state-of-the-art article which points to the need for randomized, controlled and double-blind studies[36]. The second compares the results of surgery with conservative treatment: the indication for surgery is always relative except in very rare cases (caudal equine syndrome, intractable pain, severe motor deficits) and the only advantage of microdiscectomy is during the first months[37]. The third is a recent review of literature assessing the effectiveness of current medical care, focusing on type and timing of conservative treatment, usefulness of imaging and other investigate procedures and type of intervention[38]. It concludes that minimally invasive surgery should be preferred to laminectomy, but that percutaneous discectomy is only suitable for patients with contained prolapsed disc.

Findings from case series

In contrast to the paucity of controlled studies, a vast number of uncontrolled case series on lumbar

disc surgery have appeared in the literature during the six decades of the procedure's existence[22,39–50]. Eddy[9] points out that uncontrolled clinical series supply useful information on a treatment's efficacy only when three conditions hold: "the outcomes are obvious, the outcomes are immediate, and the treatment causes dramatic changes in the outcomes, so dramatic that the changes cannot be explained by any other factors". Despite the dramatic relief some patients experience immediately following discectomy, recovery from discogenic sciatic is highly variable regardless of the treatment modality used[6,22,23]. Thus none of Eddy's conditions truly holds for low back surgery, and uncontrolled case series probably contribute little to our understanding of efficacy. Given the striking uniformity of reported success rates from series carried out at different times, in different populations and using markedly differing imaging technologies (see Table 1), the contribution to the knowledge base of the additional uncontrolled surgical series which continue to appear[46,49] seems likely to be marginal.

Despite this limitation, the surgical case series do provide useful insights unavailable in the small number of published controlled trials. Most importantly, among the patient populations who undergo surgery these studies help to identify specific clinical factors predictive of a favorable result. These factors include predominance of unilateral lower extremity pain over low back pain[44,49,51], signs of nerve root tension as evidenced by sciatic pain on straight leg raising[41,44,52–54], of monoradiculopathy evidenced by sensory, reflex and in some cases motor deficits[22,44], the absence of psychological characteristics that inhibit recovery[41,43,55], and the duration of preoperative working disability[56–58]. The clinical case series also shed useful light on the role of pre-operative imaging studies. Despite a growing literature documenting a high prevalence of lumbar disc abnormalities in asymptomatic subjects[59–63], surgical case series generally report an important correlation between the demonstration of a true disc herniation concordant in location with the patient's symptoms on pre-operative imaging, and favorable post-operative results[41,43,44]. In other words, patients with imaging findings that do not correlate with the clinical history and examination generally fare poorly with surgery[64,65].

A final issue not conclusively addressed in the literature is the comparative effectiveness of disc surgery for acute and chronic sciatica. The practice guideline recently released by the US Agency for Health Care Policy and Research[16] defines acute low back problems as those which produce three months or less of activity limitation. Problems lasting more than three months are defined as chronic. The published literature describing discectomy does not clearly identify different surgical outcomes in the actute and chronic groups.

Hurme and Alaranta[48, 54] reported that the results of discectomy were best in patients with two months or less of sciatica at the time of surgery. This result, along with Weber's finding of a less favorable outcome of surgery in patients with more than three months of sciatica, has raised the question of a "surgical window" that is, an optimal time interval for performing disc surgery, after an adequate trial of conservative management has failed but before irreversible nerve root injury has occurred. Most of the published surgical series include patients who have had radicular symptoms for periods varying from a few weeks to several months at the time of discectomy, and most fail to describe the effect, if any, of preoperative symptom duration on outcome. However there is some evidence to suggest that if such a window exists, it may extend significantly beyond the two or three months indicated by Weber and Hurmes' results[5,54]. In the study by Saal and Saal[6] most of the 64 patients with radiculopathy due to herniated lumbar discs achieved good or excellent clinical outcomes with nonoperative management, but several went on to have surgery after 16 weeks or more of conservative care. All of these patients achieved a good or excellent clinical result. The authors point out that many of the patients who did well without surgery in their series required twelve weeks of conservative treatment to achieve their maximal functional outcome.

In Lewis'[42] series, patients underwent surgery after having had sciatica for an average of 16 months, and 73% achieved complete relief of leg pain at one year follow-up. Patients with more than 17 months of preoperative sciatica did only slightly worse, with 63% reporting complete relief at one year, and long term outcomes were the same as for patients with shorter preoperative symptom duration. Spangfort's[22] patients had a mean duration of sciatica of more than three years at the time of surgery, and 60% achieved complete relief of pain postoperatively.

In summary, the literature fails to demonstrate conclusively a difference in surgical outcomes between patients with acute sciatic and those with more prolonged symptoms. A trial of nonoperative treatment lasting several months is not clearly associated with less favorable surgical results.

Complications

Serious complications from lumbar disc surgery occur uncommonly. Spangfort found three postoperative deaths in his series of 2,504 patients (0.1%), and noted a mortality rate of 0.3% in more than 22,000 cases described in the literature[22]. The wound infection rate was 3.2%, and 4.4% required intra-

operative transfusion. Three patients developed cauda equina syndrome postoperatively.
A recent prospective study of 481 primary and repeat discectomies found no deaths[66]. Intraoperative complications including dural perforations and nerve root injuries occurred in 8% of patients who had microdiscectomies, 14% of those treated with standard discectomy and in 28% of patients having a repeat operation. Postoperative complications were less than 4% overall, and arose more frequently in older patients.
A population based study of more than 28,000 discectomies found a mortality rate of 0.06%, all deaths resulting from pulmonary embolism, myocardial infarction or septicemia[67]. The overall rate of pulmonary embolism was 0.1% and 0.3% of patients had infections requiring intravenous antibiotics; 0.3% of patients had a second operation during the index hospitalization, either for repeat discectomy or to treat a complication.
A more recent population based study from the State of Washington found that surgery for herniated disc was associated with fewer complications than other lumbar spine procedures[68]. There were three deaths among patients being operated on for herniated discs, all in patients older than 55. The overall in-hospital complication rate was 4.7% higher for patients who underwent laminectomy and discectomy compared to those who had discectomy alone. Hoffman's recent meta-analysis of 81 studies also found relatively low complication rates, with overall mortality less than 0.15% and other serious complications such as permanent nerve injury and deep wound infection in fewer than one percent of cases[3].
In summary, the rate of serious complications for patients undergoing lumbar disc excision appears to be low, especially in younger patients who have simple discectomies performed. The most frequent complication is failure of the surgery to relieve symptoms, which occurs in 10 to 20% of cases (see Table 1).

Percutaneous treatment for herniated lumbar disc

In the past several years, several techniques have been developed to excise or ablate portions of lumbar discs without performing an open surgical procedure. These include chemonucleolysis, automated percutaneous discectomy, laser discectomy and endoscopic techniques. Chemonucleolysis by injection of chymopapain into the nucleus pulposes was described more than three decades ago and remains in active use in Europe[69]. Its popularity in the United States has waned largely due to occasional severe complications including fatal anaphylaxis[70]. Mechanical percutaneous discectomy, first described in 1975, has increased greatly in popularity since the introduction of an automated nucleotome probe in 1985[71]. By 1992, more than 50'000 patients had undergone automated percutaneous discectomy worldwide[69]. Laser and endoscopic discectomy represent very recent innovations[72–76], as does laparoscopic lumbar discectomy with an anterior surgical approach[77,78]. In Table 2 the randomized trials concerning these percutaneous techniques and the results are summarized.
Percutaneous disc treatments all attempt to decrease the volume of a disc herniation by reducing the amount of material contained within the nucleus pulposus. While some authors have reported that the size of the residual disc defect on post-treatment imaging correlates with clinical response to intradiscal treatments[79], larger series have failed to confirm this relationship[80]. None of the percutaneous treatments directly removes nuclear material that has extruded through an annular defect as occurs in a frank disc herniation, the lesion most closely linked to lumbar radiculopthy[81]. Thus, the rationale for performing percutaneous disc procedures does not conform closely to current thinking on the pathophysiology of discogenic sciatica.

Chemonucleolysis

The literature on chemonucleolysis consists of a large number of clinical case series and a few controlled studies. Three randomized trials which compared intradiscal chymopapain to placebo injection reported significantly greater symptoms relief in the group that received the active drug[82–84]. In one trial, the advantage of chymopapain over placebo was sustained over a ten-year follow-up period[85]. Two articles claim that in selected patients the use of chymopapain and chemonucleolysis "is effective for the treatment of lumbar intervertebral disc herniation" even though the procedure is "somewhat less effective than open discectomy"[86,87]. Thus, chemonucleolysis does appear to offer symptom relief superior to placebo injection. However, studies which have directly compared chemonucleolysis to surgical discectomy have uniformly reported superior results with conventional open techniques[27–30]. Three randomized trials comparing chemonucleolysis to conventional disc surgery reported significantly superior short-term results with open discectomy, but no significant long-term differences in outcomes[27,29,30] A fourth study reported a sustained advantage for surgery over chemonucleolysis, and also found poor results among patients who underwent conventional discectomy after unsuccessful chymopapain injection[28]. Rates of failed chemonucleolysis leading to subsequent open surgery ranged from 20% to 56% in these studies, far higher than the re-operation rate following conventional disc surgery. To summarize, although chymopapain injection may speed

Author	Sample size	Type	Techniques involved	Result
Chatterjee[31] 1995	71	randomized, controlled	ALPD vs lumbar microdiscectomy	ALPD ineffective in the treatment of the contained lumbar disc herniation
Crawshaw[28] 1984	52	randomized, controlled	surgery vs chemonucleolysis	failure 48% for chemonucleolysis vs 39% for surgery. Poor results for surgery following unsuccessful chymopapain injection
Ejeskar[27] 1983	29	randomized	chemonucleolysis vs surgery	short-term results favorable to surgery. No difference at 5 months
Feldman[84] 1986	39	double-bind randomized	chymopapain vs placebo	55% effective in treatment group vs 26% in control group
Fraser[82] 1984	60	double-bind randomized	chymopapain vs placebo	two-years follow-up favored treatment group 77% vs 47%
Gogan[85] 1992	60	double-bind randomized	chymopapain nucleolysis vs placebo (discographie and H_2O injection)	therapeutic effect of chymopapain sustained at 10 years. 77% improvement vs 38% for placebo
Javid[83] 1983	108	double-bind randomized	chymopapain nucleolysis vs placebo (saline injection)	chymopapain more effective than placebo, 71% vs 45% at 6 weeks follow-up
Mayer[74] 1993	40	prospective, randomized	percutaneous endoscopic discectomy vs microdiscectomy	success rate 95% for endoscopic discectomy vs 72% for microdiscectomy
Muralikuttan[30] 1992	92	randomized	chemonucleolysis vs disc surgery	chemonucleolysis has inferior short-terms results using multiple outcomes
Revel[69] 1993	141	randomized	APLD vs chemonucleolysis	one-year success rate 66% for chemonucleolysis and 37% for ALPD
Van Alphen[29] 1989	151	randomized	chemonucleolysis vs discectomy	efficacy of discectomy appeared to be definitely superior

Table 2. *Randomized trials of percutaneous techniques for the treatment of compressive lumbar disc herniation. (ALPD = Automated percutaneous lumbar discectomy).*

the resolution of discogenic sciatica in some patients, open procedures appear to provide both more rapid and more certain relief.

Percutaneous discectomy

Despite its rapidly rising popularity, until recently the literature on percutaneous discectomy has consisted almost entirely of clinical case series, most describing small numbers of patients. The largest series have reported success rates ranging from 55% to 87% [71,88,89]. There are only two randomized controlled trials published comparing percutaneous procedures to open surgery. The first one compared automated percutaneous lumbar discectomy (ALPD) with microdiscectomy [31], concluding that ALPD is less effective. Because of the specificity of this procedure this result is not applicable to other percutaneous techniques. The second one compared automated percutaneous discectomy to chemonucleolysis and found substantially inferior results with the percutaneous procedure [69]. In this study, chemonucleolysis was considered successful in 61% of cases, compared to 44% in the percutaneous discectomy group. During the six months following initial treatment, seven percent of the chemonucleolysis group and 37% of the percutaneous discectomy group underwent open surgical discectomy. However, the largest series have reported success rates ranging from 55% to 87% [71,88,89].

Results of one uncontrolled study may provide some insight into the variable success rates reported to date with the percutaneous procedure [90]. The authors performed contrast discography on all patients prior to automated discectomy, and classified disc herniations as either broad-based or narrow-based from the pattern of the injected contrast medium. Percutaneous discectomy had a success rate of 80% in the group with broad-based herniations, compared with only 57% in those with narrow-based lesions. These data support the view that intradiscal procedures may be less effective in cases where nuclear material has extruded through a narrow annular defect. At present, the evidence suggests that, while some patients may benefit from percutaneous discectomy, this procedure is less effective than chemonucleolysis which in turn yields inferior results to those obtained with conventional disc surgery. In choosing among treatment options, patients should be aware that these less invasive procedures have a lower certainty of success.

Newer percutaneous techniques

Recently, reports have appeared in the literature describing percutaneous laser discectomy [72–74], athroscopic microdiscectomy [91] and endoscopic discectomy [74,92].

Published data on the laser procedure remain preliminary and do not support a comparison with the other techniques. Whereas some claim an advantage of this technique in terms of cost-effectiveness and efficiency [75] others conclude that its usefulness is minimal [76]. A small randomized study comparing endoscopic to conventional discectomy from a single center found superior results with the endoscopic procedure [74]. However, the reported success rate of 69% for open discectomy in this study fell far below that described in other recent series [44,45], calling into question the authors' conclusions. Laparoscopic lumbar discectomy has been assessed in several cases series. These do not provide any solid proof of its efficacy [77,78]. In summary, while rapid technologic innovation in this area continues, insufficient data exist to evaluate the efficacy of these newest procedures.

Conclusion

Methodologic limitations of the literature notwithstanding, the existing evidence suggests that lumbar discectomy decreases the duration of sciatica in carefully selected patients, providing superior short-term outcomes to nonoperative measures. Serious complications occur rarely. The potential benefits of surgery seem to exceed the risks sufficiently to justify offering the procedure to patients who fail to achieve adequate symptom relief with nonoperative measures and with the passage of time beyond the point where the natural course of the illness might lead to clinical improvement. Outcomes following open discectomy have been superior to those from invasive percutaneous procedures in published series. There is a trend from open discectomy to less invasive surgery using various endoscopic surgical techniques, but rigorous studies supporting the efficacy, effectiveness or efficiency of these techniques are lacking.

Nevertheless, lumbar discectomy remains an elective procedure without proven long-term advantage over conservative treatments. While proof of efficacy appears adequate to justify inclusion of lumbar disc surgery in a standard minimum benefit package, payers may well seek to restrict use of these procedures to patients who have unequivocal clinical and imaging findings of nerve root impingement and who fail a credible trial of nonoperative therapy and observation. Adoption of a standardized preoperative assessment database and routine documentation of outcomes with validated instruments might help to reduce the geographic variation in surgery rates, and help to ensure that these procedures remain available to the small subset of patients with herniated discs who actually require them. Tightly managed health care organizations may feel that surgical intervention in the more uncertain cases is not warranted [93,94].

Zusammenfassung

Wirksamkeit der lumbalen Discectomie und perkutaner Behandlungsmethoden von lumbalen Diskushernien

Die sich ändernden Bedingungen im Gesundheitswesen verlangen nach sorgfältiger Reevaluation von ausgewählten teuren Behandlungsmethoden wie die lumbale Diskushernieoperation. Dieser Artikel fasst die derzeit verfügbare Literatur zur Wirksamkeit der chirurgischen Behandlung und der invasiven percutanen Therapien der diskusbedingten Kreuzschmerzen zusammen. Die relevanten Arbeiten wurden aus den Datenbanken MEDLINE und Current Contents ausgewählt, später auch aus den Literaturangaben dieser Arbeiten, sowie gemäss den Empfehlungen von Experten in diesem Gebiet und den Angaben der Canadian Cochrane Collaboration. Berücksichtigt wurden 9 randomisierte Studien, 6 Metaanalysen und andere Übersichtsarbeiten, eine „evidence based" Behandlungsrichtlinie, 38 Fallserien und 35 weitere Referenzen. Die Auswirkungen der offenen Discectomie, es handelt sich vor allem um eine Verkürzung der Schmerzdauer, berechtigen diese Methode bei sorgfältig ausgewählten Patienten, wenn die konservativen Massnahmen keine Besserung gebracht haben. Dieser chirurgische Eingriff wird wahrscheinlich auch im Rahmen einer „managed care" verfügbar sein, wobei die Indikation enger gestellt werden wird.

Résumé

Efficacité de la discectomie lombaire et des traitements percutanes pour la hernie discale lombaire

Les changements qui interviennent dans les systèmes de soins nécessitent une réévaluation soigneuse des procédures électives coûteuses comme l'est la chirurgie lombaire. Cet article présente une revue de la littérature actuelle sur l'utilité de la chirurgie et des traitements percutanés invasifs dans le cas des sciatiques d'origine discale. Les articles concernés ont été identifiés par le biais des bases de données MEDLINE et Current Contents, des listes bibliographiques, des recommandations des experts et de la collaboration canadienne Cochrane. Elle comprend 9 essais randomisés, 6 méta-analyses ou articles de revue, 1 recommandation pour la pratique clinique basée sur les preuves, 38 grandes séries chirurgicales de cas et 35 références additionnelles. Les bénéfices de la discectomie par voie chirurgicale, principalement pour la réduction de la durée de la douleur, justifient son utilisation chez des patients soigneusement sélectionnés, souffrant de la sciatique d'origine discale, après échec d'un traitement conservateur. Bien qu'élective cette procédure continuera probablement à être disponible dans un système de soins type HMO mais avec une surveillance croissante des indications opératoires.

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