Pain Physician 2007; 10:129-146 • ISSN 1533-3159

Review

Systematic Review of Effectiveness and Complications of Adhesiolysis in the Management of Chronic Spinal Pain: An Update

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Funding: None
Conflict of Interest: None.

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Background: Percutaneous epidural adhesiolysis and spinal endoscopic adhesiolysis are interventional pain management techniques used to treat patients with refractory low back pain due to epidural scarring. Standard epidural steroid injections are often ineffective, especially in patients with prior back surgery. Adhesions in the epidural space can prevent the flow of medicine to the target area; lysis of these adhesions can improve the delivery of medication to the affected areas, potentially improving the therapeutic efficacy of the injected medications.

Study Design: A systematic review utilizing the methodologic quality criteria of the Cochrane Musculoskeletal Review Group for randomized trials and the criteria established by the Agency for Healthcare Research and Quality (AHRQ) for evaluation of randomized and non-randomized trials.

Objective: To evaluate and update the effectiveness of percutaneous adhesiolysis and spinal endoscopic adhesiolysis in managing chronic low back and lower extremity pain due to radiculopathy, with or without prior lumbar surgery, since the 2005 systematic review.

Methods: Basic search identified the relevant literature, in the MEDLINE, EMBASE, and BioMed databases (November 2004 to September 2006). Manual searches of bibliographies of known primary and review articles, and abstracts from scientific meetings within the last 2 years were reviewed. Randomized and non-randomized studies are included in the review based on criteria established. Percutaneous adhesiolysis and endoscopic adhesiolysis are analyzed separately.

Outcome Measures: The primary outcome measure was significant pain relief (50% or greater). Other outcome measures were functional improvement, improvement of psychological status, and return to work. Short-term relief was defined as less than 3 months, and long-term relief was defined as 3 months or longer.

Results: Studies regarding the treatment of epidural adhesions for the treatment of low back and lower extremity pain were sought and reviewed. The evidence from the previous systematic review was combined with new studies since November 2004. There is strong evidence for short term and moderate evidence for long term effectiveness of percutaneous adhesiolysis and spinal endoscopy.

Conclusion: Percutaneous adhesiolysis and spinal endoscopy may be effective interventions to treat low back and lower extremity pain caused by epidural adhesions.

Key Words: Spinal pain, chronic low back pain, percutaneous adhesiolysis, spinal endoscopic adhesiolysis, spinal stenosis, post lumbar laminectomy syndrome, epidural fibrosis, epidural adhesions, caudal neuroplasty.

Pain Physician 2007; 10:129-146

Chronic low back pain has a prevalence ranging from 35% to 75% at 12 months after the initial attack of pain (1,2). It is widely held that 90% of low back pain is short-lived and that most patients get better on their own. However, this myth has been dispelled in multiple studies (3-6). Croft et al (3) followed 490 patients, aged 18 – 75 years, for 12 months. 463 patients consulted the authors regarding low back pain over the 1-year study period; of those, 59% had only the single consultation, suggesting resolution of their pain. However, 25% still complained of low back pain one year later. Elliott et al (4) followed more than 2000 individuals over 4 years and concluded that chronic pain is a common, persistent problem with a relatively high incidence and low recovery rate. More specifically, Enthoven et al (5) prospectively followed 314 primary care patients with neck and back pain over a 5-year period; 52% still had pain at the end of the five years, confirming that the pain didn't "just go away."

Kuslich et al (6), by operating on patients under local anesthetic, were able to identify different tissues such as intervertebral discs, nerve roots, dura, facet joints, ligaments, and muscles that were potentially pain generators. But it was only stimulation of the swollen, inflamed, or adhered nerve root, though, which caused "sciatica" or pain down the leg.

It is commonly assumed that abnormalities found on MRIs reflect the etiology of low back pain, but Jensen et al (7) dispelled that idea by reviewing MRIs of asymptomatic patients, showing that up to 52% had significant and what would have been considered potentially surgical pathologies. It is concerning that the rate of back surgery in the US is at least 40% higher than in any other country and more than 5 times that of England and Scotland (8). In 2002, more than 1 million spinal surgeries were performed in the US (9), and in 2003, US spine surgery represented $2.5 billion of the $3 billion spent on back surgery worldwide (10,11). The prevalence of pain following surgery for the lumbar spine, also known as post lumbar laminectomy syndrome, is estimated to occur in 5% to 40% of patients after surgical intervention (11-22), which may be related to epidural scarring.

A retrospective review (12) of 182 surgical revisions of failed back surgery patients revealed that most failures were due to epidural fibrosis, which did not respond well to repeat surgery. Ross et al (23) looked at peridural scar after lumbar discectomy and found that there was a significant relationship between extensive peridural scarring and recurrent radicular pain. They felt that epidural fibrosis caused pain in failed back surgeries and found that for every 25% increase in scarring, the risk of recurrent radicular pain increased 2.0 times, and subjects with extensive peridural scarring were 3.2 times more likely to have recurrent radicular pain.

Harrington et al (24) showed that glutamate from intervertebral disc material could cause an inflammatory and hyperalgesic response in rats when infused epidurally. This inflammatory reaction can be expected to create nerve root swelling creating entrapment, as well as adhesions that would be expected to remain even after the inflammation resolves. Thus, epidural adhesions can occur from leaking discs, without prior spinal surgery.

Hematoma formation in the epidural space during the post operative period is invaded by dense fibrous tissue from the periosteum and the deep surface of the paravertebral musculature (25,26). Fibrous tissue in the epidural space may adhere to the dura mater and nerve roots; this causes a mechanical tethering of the nerve roots or the dura. Mechanical tethering may contribute to chronic low back pain and lower extremity pain following lumbar laminectomy in a significant subset of patients. LaRocca and McNab (25) have demonstrated the presence of fibrous connective tissue causing epidural fibrosis into a postoperative hematoma. Fibrosis in the spinal canal may also develop without any surgical intervention as in infection, hematoma, annular tear, or intrathecal contrast media (26-28). McCarron et al (26) reported an inflammatory reaction in spinal cord sections taken from dogs sacrificed after an initial injection of homogenized nucleus pulposus. Cooper et al (27) were able to identify periradicular fibrosis and vascular abnormalities occurring with herniated intervertebral discs. Parke and Watanabe (28) demonstrated epidural adhesions in 40% of cadavers with lumbar disc herniation at L4-L5, 36% at L5-S1, and in 16% at the L3-L4 level. Perineural fibrosis can interfere with cerebrospinal fluid mediated nutrition, which can render the nerve roots hyperesthetic and hypersensitive to compression (29-31).

Epidurography was introduced in 1921 by Sicard and Forestier (32), and identification of "filling defects" is felt to be consistent with epidural fibrosis. Fluoroscopically directed lumbar epidural corticosteroid injections have been used in interventional pain management to treat chronic low back pain and lumbar radiculopathy, but epidural adhesions can prevent

the flow of medication to the affected areas. Once the filling defects have been identified, adhesiolysis (either percutaneous or endoscopic) can be used to eliminate the deleterious effects of scar, allowing the direct application of drugs to nerves or other tissues to treat chronic back and extremity pain (33,34).

Percutaneous and endoscopic adhesiolysis have been employed in interventional pain management in the management of chronic, refractory low back and lower extremity pain. The purpose of percutaneous epidural lysis of adhesions is to eliminate scar and assure delivery of high concentrations of injected drugs to target areas (33-38). Epidural lysis of adhesions and direct deposition of corticosteroids in the spinal canal are also achieved with a 3-dimensional view provided by epiduroscopy or spinal endoscopy (35,36,38-41).

This systemic review was undertaken to update evidence for the effectiveness and complications since the last review (38). We sought to answer the following questions:

1. Are percutaneous adhesiolysis and endoscopic adhesiolysis effective treatments?
2. Are percutaneous adhesiolysis and spinal endoscopy superior to epidural steroids?
3. Does the addition of various medications improve the efficacy of percutaneous adhesiolysis and spinal endoscopy?
4. Are percutaneous adhesiolysis and spinal endoscopy safe treatments?
5. Are these techniques superior to standard noninvasive therapy?
6. Is one procedure superior to the other?

Methods

Literature Search

An Internet review of the English literature from December 2004 (the date of the most recent systemic review) (38) to December 2006 was performed. Databases searched included EMBASE, PubMed, and Web of Science, as well as Google and MD Consult. Terms searched included: adhesiolysis, epidural neuroplasty, epidural neurolysis, lysis of adhesions, percutaneous adhesiolysis, endoscopic adhesiolysis, spinal endoscopy, epiduroscopy, Racz catheter, and epidural adhesions. All reviews, published trials, and case reports were examined.

Selection Criteria

Randomized and non-randomized studies, and observational studies published in the last 2 years evaluating the efficacy or complications of adhesiolysis (percutaneous and endoscopic) to treat chronic low back and leg pain were considered for inclusion.

Outcome Measurements

Pain relief of short term (≤ 3 months) and long term (≥ 3 months) was the primary outcome measured. Secondary outcomes included functional or psychological improvement, improvement in work status, and complications.

Review Methods

The quality of individual articles was evaluated using the criteria from the Agency for Healthcare Research and Quality (AHRQ) publication (42). Important domains and elements for randomized and non-randomized trials are shown in Tables 1 and 2. For evaluation of randomized trials, criteria described by the Cochrane Review Group for musculoskeletal disorders (43) were also utilized (Table 3).

A study was regarded as relevant if at least 1 of the questions was addressed, and at least one of the outcome measures concerned pain intensity, overall improvement, or functional status. A study was considered for inclusion only if the methodological score was 50% or more, with the exception that randomized trials not meeting the 50% criteria were considered for inclusion as observational studies.

Inclusion and Exclusion Criteria

Only studies that met the inclusion criteria (Table 4 and Fig. 1) were included.

Prior Treatment Criteria

Patients must have undergone non-interventional treatment (physical therapy, oral medications) or prior fluoroscopically guided epidural steroid injections. If not specifically addressed, patients with pain for long periods of time (greater than 12 months) were assumed to have been treated conservatively.

Data Extraction

Each study was scored using data sheets modified from the Agency for Healthcare Research and Quality (AHRQ) (42). Methodologic quality assessment was performed as described in the "Review Methods" section (see Table 3).

Table 1. *Domains and elements for randomized controlled trials.*

Domain#	Elements*
Study Question	• **Clearly focused and appropriate question**
Study Population	• **Description of study population** • **Specific inclusion and exclusion criteria** • Sample size justification
Randomization	• *Adequate approach to sequence generation* • ***Adequate concealment method used*** • *Similarity of groups at baseline*
Blinding	• ***Double-blinding (e.g., of investigators, caregivers, subjects, assessors, and other key study personnel as appropriate) to treatment allocation***
Interventions	• **Intervention(s) clearly detailed for all study groups (e.g., dose, route, timing for drugs, and details sufficient for assessment and reproducibility for other types of interventions)** • Compliance with intervention • Equal treatment of groups except for intervention
Outcomes	• **Primary and secondary outcome measures specified** • Assessment method standard, valid, and reliable
Statistical Analysis	• ***Appropriate analytic techniques that address study withdrawals, loss to follow-up, missing data, and intention to treat*** • Power calculation • Assessment of confounding • Assessment of heterogeneity, if applicable
Results	• **Measure of effect for outcomes and appropriate measure of precision** • Proportion of eligible subjects recruited into study and followed up at each assessment
Discussion	• **Conclusions supported by results with possible biases and limitations taken into consideration**
Funding or Sponsorship	• ***Type and sources of support for study***

 # Key domains are in italics
**Elements appearing in italics are those with an empirical basis. Elements appearing in bold are those considered essential to give a system a Yes rating for the domain.*
Adapted from ref 42

Analysis of Evidence

The methodological quality criteria of the Cochrane Musculoskeletal Review Group for randomized trials and the criteria established by the AHRQ for evaluation of randomized and non-randomized trials were used to evaluate the strength of the data. A qualitative analysis was conducted using 5 levels of evidence for effectiveness of adhesiolysis as illustrated in Table 5. Duration of pain relief was considered for both short-term (less than 3 months) and long-term (3 months or longer). A study was judged to be positive if the authors concluded that adhesiolysis (percutaneous or endoscopic) was more effective than the reference treatment in randomized trials or simply concluded that it was effective in the other studies. All other conclusions were considered negative. If, in the opinion of reviewers, there was conflict with a conclusion, the conclusion was modified with appropriate explanation.

Results

Percutaneous Adhesiolysis

Our search strategy yielded a total of 8 new articles on percutaneous adhesiolysis (44-51), and one on cost effectiveness (52). Of the reports evaluated for lumbar percutaneous adhesiolysis (44-46), there was 1 randomized controlled trial (44) and 2 prospective evaluations (45,46). Studies considered for inclusion in the previous systematic review by Chopra et al (38) were 4 randomized controlled trials (53-58) and 7 retrospective evaluations (37,57-62).

Table 2. *Domains and elements for observational studies*

Domain#	Elements*
Study Question	• **Question clearly specified and appropriate**
Search Strategy	• ***Sufficiently comprehensive and rigorous with attention to possible publication biases*** • *Search restrictions justified (e.g., language or country of origin)* • Documentation of search terms and databases used • Sufficiently detailed to reproduce study
Inclusion and Exclusion Criteria	• **Selection methods specified and appropriate, with a priori criteria specified if possible**
Interventions	• **Intervention(s) clearly detailed for all study groups**
Outcomes	• **All potentially important harms and benefits considered**
Data Extraction†	• Rigor and consistency of process • Number and types of reviews • Blinding of reviewers • Measure of agreement or reproducibility • Extraction of clearly defined interventions/exposures and outcomes for all relevant subjects and subgroups
Study Quality and Validity	• ***Assessment method specified and appropriate*** • Method of incorporation specified and appropriate
Data Synthesis and Analysis	• ***Appropriate use of qualitative and/or quantitative synthesis, with consideration of the robustness of results and heterogeneity issues*** • Presentation of key primary study elements sufficient for critical appraisal and replication
Results	• **Narrative summary and/or quantitative summary statistic and measure of precision, as appropriate**
Discussion	• **Conclusions supported by results with possible biases and limitations taken into consideration**
Funding or Sponsorship	• ***Type and sources of support for study***

 # Key domains are in italics
**Elements appearing in italics are those with an empirical basis. Elements appearing in bold are those considered essential to give a system a Yes rating for the domain. †Domain for which a Yes rating required that a majority of elements be considered.*
Adapted from ref 42

Table 3. *Methodologic quality criteria list (key items of internal validity) of Cochrane Musculoskeletal Review Group*

Patient selection			
1. *Treatment allocation*			
Was the method of randomization described and adequate?	Yes	No	Don't know
Was the treatment allocation concealed?	Yes	No	Don't know
2. *Were the groups similar at baseline regarding the most important prognostic indicators?*	Yes	No	Don't know
Intervention			
3. *Was the care provider blinded?*	Yes	No	Don't know
4. *Was controlled for co-interventions which could explain the results?*	Yes	No	Don't know
5. *Was the compliance rate (in each group) unlikely to cause bias?*	Yes	No	Don't know
6. *Was the patient blinded?*	Yes	No	Don't know
Outcome measurement			
7. *Was the outcome assessor blinded?*	Yes	No	Don't know
8. *Was at least one of the primary outcome measures applied?*	Yes	No	Don't know
9. *Was the withdrawal/drop-out rate unlikely to cause bias?*	Yes	No	Don't know
Statistics			
10. *Did the analysis include an intention-to-treat analysis?*	Yes	No	Don't know

Adapted from ref 43

Table 4. *Inclusion/exclusion criteria*

1. Are the patients described in sufficient detail to allow you to decide whether they are comparable to those that are seen in clinical practices of interventional pain management?
A) Setting – office, hospital, outpatient, inpatient
B) Physician – interventional pain physician, general physician, anesthesiologist, physiatrist, neurologist, rheumatologist, orthopedic surgeon, neurosurgeon, etc.
C) Patient characteristics - duration of pain
D) Non-interventional techniques or surgical intervention in the past
E) Exclusion criteria
F) Inclusion criteria
2. Is the intervention described well enough to enable you to provide the same for patients in interventional pain management settings?
A) Nature of intervention
B) Frequency of intervention
C) Duration of intervention
3. Were clinically relevant outcomes measured?
A) Proportion of pain relief
B) Disorder/specific disability
C) Functional improvement
D) Allocation of eligible and non-eligible patients to return to work
E) Ability to work
F) Psychological assessment or improvement

Adapted and modified from ref 38

Methodological Quality

Of the 3 new studies, 1 randomized trial (44) and 2 prospective evaluations (45,46) met the criteria for inclusion. From the previous systematic review by Chopra et al (38), 3 randomized studies were included (53,55,56). Of the 7 observational reports, 2 retrospective evaluations were included in the evidence synthesis (57,58).

Methodological quality criteria are shown in Table 6.

Descriptive Characteristics

All the studies included in the evidence synthesis described patient baseline characteristics (44-46,53-58). Of the 4 randomized trials, 3 studies (53,55,56) had similar patient characteristics. Manchikanti et al (55,56) also reported the proportion of patients included with history of previous surgery, which ranged from 64% to 72% in all intervention groups. Patients in all 3 studies failed multiple conservative modalities of treatments including fluoroscopically directed epidural steroid injections. The study by Veihelmann et al (44), which is new since the previous review evaluated patients with a history of chronic low back pain and sciatica. Inclusion criteria were radicular pain with a corresponding nerve root compressing substrate found on magnetic resonance imaging or computed tomography scans. All patients prior to randomization received physiotherapy, local injections, and analgesics. Local injections were not defined. All patients were evaluated for radicular pain by an independent neurologist. Exclusion factors were paralysis, spinal canal stenosis, rheumatologic disease, and malignancy. They have not identified of these, how many patients had post laminectomy syndrome. However, post laminectomy syndrome or epidural fibrosis was not exclusion criteria, thus, it is believed that some of the patients probably included post laminectomy syndrome or epidural fibrosis.

Among the 2 prospective evaluations (45,46), both were new since the publication of previous systematic review by Chopra et al (38). Gerdesmeyer et al (45) in a prospective pilot study evaluated 25 patients with mono segmental radiculopathy of the lumbar spine. All the patients suffered from chronic disc herniations

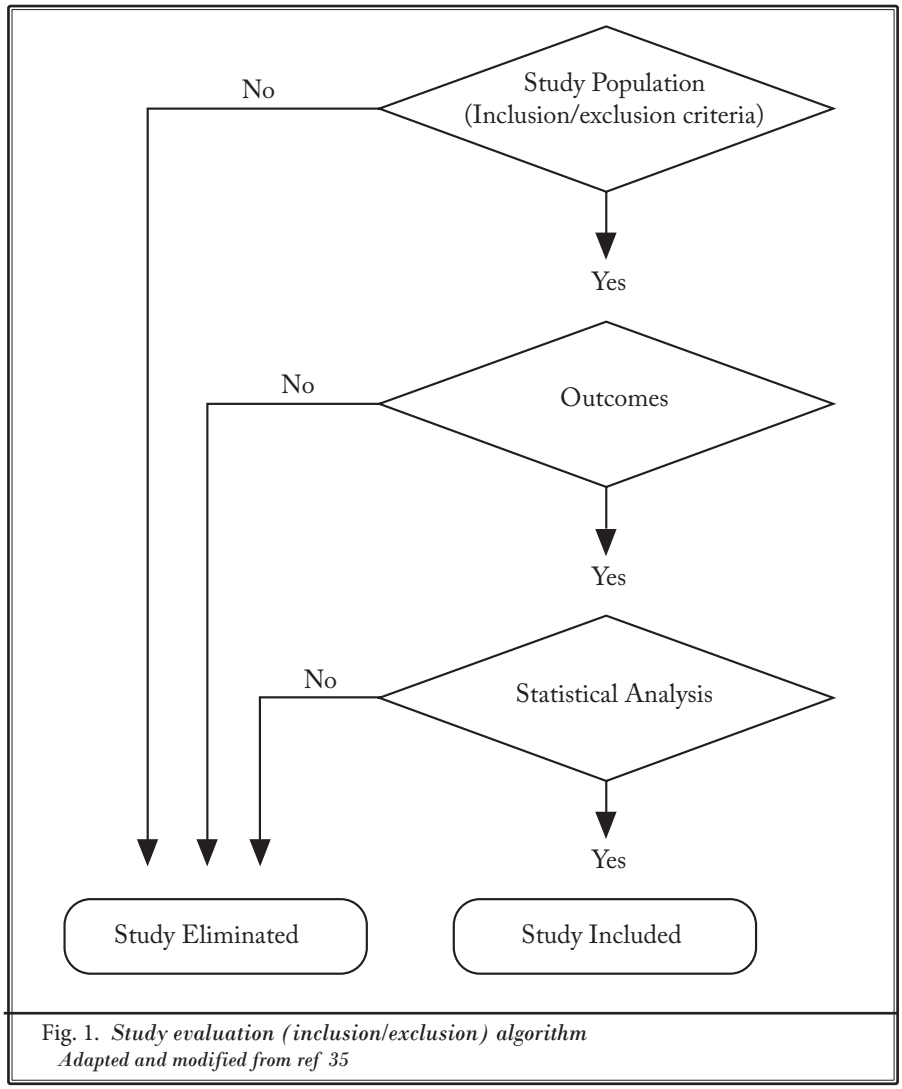

Fig. 1. ***Study evaluation (inclusion/exclusion) algorithm***
Adapted and modified from ref 35

Table 5. ***Designation of levels of evidence***

Level I	Conclusive: Research-based evidence with multiple relevant and high-quality scientific studies or consistent reviews of meta-analyses
Level II	Strong: Research-based evidence from at least one properly designed randomized, controlled trial; or research-based evidence from multiple properly designed studies of smaller size; or multiple low quality trials.
Level III	Moderate: a) Evidence obtained from well-designed pseudorandomized controlled trials (alternate allocation or some other method); b) evidence obtained from comparative studies with concurrent controls and allocation not randomized (cohort studies, case-controlled studies, or interrupted time series with a control group); c) evidence obtained from comparative studies with historical control, two or more single-arm studies, or interrupted time series without a parallel control group.
Level IV	Limited: Evidence from well-designed nonexperimental studies from more than one center or research group; or conflicting evidence with inconsistent findings in multiple trials
Level V	Indeterminate: Opinions of respected authorities, based on clinical evidence, descriptive studies, or reports of expert committees.

Adapted and modified from ref 35

Table 6. *Results of randomized trials and observational studies of percutaneous adhesiolysis and hypertonic saline neurolysis.*

Study/ Methods	Participants	Intervention(s)	Outcome(s)	Result(s)	Conclusion(s)	Complications
Veihelmann et al (44) A prospective, randomized, double blind trial	99 patients with chronic low back pain and sciatica (13 with prior back surgery). Nerve root compromise confirmed by MRI and CT. 52 patients treated with physiotherapy (control) • 5 prior surgery 47 underwent epidural neuroplasty (percutaneous adhesiolysis) •8 prior surgery PT patients could cross over after 3 months (12 patients crossed over)	Group I underwent physical therapy (no description of specific exercises) Group II underwent percutaneous adhesiolysis - Catheter placed through sacral hiatus to level of pathology after epidurogram to confirm position. - 9cc ropivacaine and 40mg triamcinolone catheter secured • 30 minutes later, 10cc of 10% saline instilled • Unclear whether this was a 1 day or 3 day protocol.	Timing: 3 months, 6 months, 12 months Outcome measures: VAS back, VAS leg, Oswestry disability score, Gerbershagen score, analgesic score.	Intention to treat analysis was performed. Among the adhesiolysis patients, there was a significant decrease in VAS and Oswestry scores at 1, 3, 6, and 12 months. 28 patients adhesiolysis patients were able to decrease I` Gerbershagen grade compared to 2 PT patients.	Positive short-term (< 6 months) and long-term relief (> 6 months)	No major complications noted. 15 patients had transient sensory deficit. Contrast showed intrathecal placement in 2 patients. One catheter ruptured on removal but was easily removed under local anesthetic.
Manchikanti et al (55) A randomized, double-blind trial	75 patients were evaluated 25 patients in Group I served as controls and were treated with catheterization but no adhesiolysis. 25 patients in Group II were treated with catheterization, adhesiolysis, followed by injection of local anesthetic, normal saline, and steroid. 25 patients in Group III. treatment consisted of adhesiolysis followed by injection of local anesthetic, hypertonic saline, and steroid.	Experimental groups: Adhesiolysis, hypertonic saline neurolysis, steroid and local anesthetic and adhesiolysis, normal saline, steroid. Control group: Catheterization and no adhesiolysis.	Tming: 3 months, 6 months, and 12 months. Outcome measures: VAS pain scale, Oswestry Disability Index 2.0, work status, opioid intake, range of motion measurements and psychological evaluation by P-3.	72% of patients in Group III (adhesiolysis and hypertonic neurolysis), 60% of patients in Group II (adhesiolysis only), compared to 0% in Group I (control) showed significant improvement at 12-month follow-up.	Positive short-term and long-term relief	None noted.
Heavner et al (53) A randomized, double-blind trial	59 patients with chronic intractable low back pain. All the patients failed conservative management, along with fluoroscopically directed epidural steroid injections.	Group I: hypertonic saline plus hyaluronidase Group II: hypertonic saline Group III: isotonic saline (0.9% NaCl) Group IV: isotonic saline plus hyaluronidase	Timing: 4 weeks, 3 months, 6 months, and 12 months . Outcome measures: Pain relief.	Initially 83% of the patients showed significant improvement compared to 49% of the patients at 3 months, 43% of the patients at 6 months, and 49% of the patients at 12 months.	Positive short-term and long-term relief	None noted.

Table 6 Continued. *Results of randomized trials of percutaneous adhesiolysis and hypertonic saline neurolysis*

Study/ Methods	Participants	Intervention(s)	Outcome(s)	Result(s)	Conclusion(s)	Complications
Manchikanti et al (56) A randomized, controlled trial	45 patients were evaluated. 15 patients in group I were treated conservatively. 30 patients in group II were treated with percutaneous epidural adhesiolysis and hypertonic saline neurolysis.	Experimental group: Adhesiolysis, hypertonic saline neurolysis and epidural steroid injection, one or more occasions. Control group: Physical therapy exercise program and medication.	Timing: 1 month, 3 months, 6 months, 1 year. Outcome measures: Pain relief, functional status, psychological status, employment status.	Experimental group showed improvement with pain relief in 97% at 3 months, 93% at 6 months, and 47% of the patients at 1 year. Generalized anxiety disorder, somatization disorder, average pain, and functional status improved significantly in Group II.	Positive short-term and long-term relief	None noted.
Gerdesmeyer et al (45) Prospective controlled pilot	25 patients with monosegmental radiculopathy due to disc herniations or failed back surgery. Ave. duration of symptoms 28 months.	All patients underwent percutaneous adhesiolysis "according to Racz's technique"; unclear whether 1 day or 3 day protocol.	Evaluation at 12 weeks. Outcome measures: Oswestry score. subjective pain scores (McNab score).	All patients apparently improved in Oswestry score. None of the patients got worse.	Positive short-term relief (< 6 months).	None noted.
Gerdesmeyer et al (46) Observational	61 patients with lumbar radiculopathy treated with percutaneous adhesiolysis.	All patients underwent percutaneous adhesiolysis "according to Racz's technique"; unclear whether 1 day or 3 day protocol.	Evaluation at 3 and 6 months. Outcome measures: subjective pain scores (McNab score).	"Subjective pain perception clearly improved after 3 as well as 6 months."	Positive short-term relief (< 3 months) as well as long-term (6 months)	2 partial catheter shearing, 1 infection.
Manchikanti et al (57) A retrospective randomized evaluation	A retrospective randomized evaluation of the effectiveness of 1-day adhesiolysis and hypertonic saline neurolysis in 129 patients.	Adhesiolysis, hypertonic saline neurolysis, and injection of steroid.	Timing: 4 weeks, 3 months, 6 months, 12 months. Outcome measures: Pain relief.	Initial relief was reported in 79% of the patients with 68% of the patients reporting relief at 3 months, 36% at 6 months, and 13% at 12 months with 1 injection.	Positive short-term and negative long-term relief	None noted.
Manchikanti et al (58) A retrospective evaluation of 60 post lumbar laminectomy patients with chronic low back pain	60 post lumbar laminectomy patients were included after failure of conservative management.	Adhesiolysis, hypertonic saline neurolysis, and injection of steroid	Timing: 3 months, 6 months, 12 months Outcome measures: Pain relief.	With multiple injections, initial relief was seen in 100% of the patients, however it declined to 90% at 3 months, 72% at 6 months, and 52% at 1 year.	Positive short-term and long-term relief	None noted.

or failed back syndromes after surgery, all of them with radiculopathy. In the second study by Gerdesmeyer et al (46), there were 98 patients initially and of these, 61 patients met inclusion criteria. Based on the review, even though specifically not mentioned, it appears that patients with disc herniation, as well as post lumbar laminectomy syndrome were included.

Among the 2 observational reports included (57,58), patient demographics were described in both studies. In one of the studies, the proportion of patients in Group II was 37% compared to 65% in Group I (57). In addition, work-related injury was lower in Group II (30%) than Group I (50%). Duration of pain was also longer in Group II compared to Group I. Patients in Group I received adhesiolysis and hypertonic saline neurolysis on two consecutive days with the catheter in place for the second day. In contrast, Group II patients received a single day procedure with percutaneous adhesiolysis, as well as hypertonic saline neurolysis. In another retrospective evaluation, only patients with post lumbar laminectomy were included (58).

Heavner et al (53) compared various types of solutions after mechanical adhesiolysis was performed. Group A received a combination of hyaluronidase and hypertonic saline; Group B, hypertonic sodium chloride solution; Group C, isotonic saline solution; and Group D, hyaluronidase and isotonic saline solution.

Manchikanti et al (55) divided 75 patients randomly into 3 groups, with Group I consisting of a control group without adhesiolysis, with injection of local anesthetic, steroid, and normal saline; Group II consisting of patients undergoing adhesiolysis, with injection of local anesthetic, steroid, and normal saline; and Group III consisting of patients undergoing adhesiolysis, as well as injection of 10% sodium chloride solution, in addition to local anesthetic and steroid.

Note that Heavner et al (53) evaluated a 3-day procedure where the catheter was inserted on the first day and the drugs were injected on the second and third day, whereas Manchikanti et al (55,56) evaluated one-day adhesiolysis. Veihelmann et al (44) and Gerdesmeyer et al (45,46) used a 3-day protocol in all 3 studies. They also used hyaluronidase as part of the treatment protocol.

The outcome parameters by Heavner et al (53) included short-form McGill Pain Questionnaire and Visual Analog Scale for back pain and leg pain. Manchikanti et al (55) utilized VAS pain scale, Oswestry Disability Index 2.0, work status, opioid intake, range of motion measurement, and psychological evaluation by Pain Patient Profile.

Outcome measures included in the third randomized clinical trial (57) were significant pain relief (>50%) cumulative pain relief, physical health, mental health, functional status, narcotic intake, psychological status, and return to employment. Veihelmann et al (44) used Visual Analogue Scale scores for back pain and leg pain, Oswestry Disability Score, Gerbershagen Score, and a quantified score for the use of analgesics. They also used a blinded observer. Gerdesmeyer et al (45) used subjective pain sensation according to the McNab Score and Oswestry Scores. Gerdesmeyer et al (46) used subjective pain sensation evaluated with the McNab Score and Oswestry Score.

Manchikanti et al (56) included 45 patients with 15 patients in the control group, who were treated with conservative modalities of treatments, and 30 patients in Group II, who were treated with percutaneous epidural adhesiolysis and hypertonic saline neurolysis. In the randomized trial by Veihelmann et al (44), a total of 99 patients with a history of chronic low back pain and sciatica were randomly assigned to 1 of the 2 groups: 1 group had conservative treatment with physiotherapy and the second underwent epidural neuroplasty. In the 2 prospective reports by Gerdesmeyer et al (45,46), there was no control group, all the patients were treated with 3-day adhesiolysis.

Randomization was adequate in all 4 studies. Blinding was adequate in 2 studies (53,55).

Statistical analysis included Fisher's Exact Test (2-by-2 tables) and the generalized Fisher's Exact Test (4-by-2 tables) by Heavner et al (53); chi-squared test, Fisher's Exact Test, student's "t" test, paired "t" test, and intent-to-treat analysis were utilized by Manchikanti et al (55); students paired "t" test within the groups, students unpaired "t" test for differences between the two groups, and P values were utilized by Veihelmann et al (44); "t" test, Wilcoxon test (ranking - summation), and P values were utilized by Gerdesmeyer et al (45,46); and chi-squared statistic, student's "t" test, and paired "t" test were utilized by Manchikanti et al (56).

Description of results of published studies of percutaneous adhesiolysis and hypertonic saline neurolysis are shown in Table 6.

Effectiveness

Effectiveness was evaluated based on the predefined questions.

1) Is percutaneous adhesiolysis an effective treatment?

All 4 randomized trials (44,53,55,56) evaluated the effectiveness of percutaneous adhesiolysis. Two prospective evaluations (45,46) also evaluated effectiveness of percutaneous adhesiolysis. Two randomized trials (44,53) utilized a 3-day protocol with repeat injections with the catheter left for 3 days, whereas the other 2 randomized trials (55,56) utilized 1-day protocol with adhesiolysis. Veihelmann et al (44) utilized a 3-day protocol. Subsequently 2 retrospective evaluations (57,58) also evaluated percutaneous adhesiolysis. Heavner et al (53) had no control group. However, they assessed effectiveness of adhesiolysis by means of patients being their own controls, as all the patients failed previously fluoroscopically directed epidural steroid injections, and other conservative modalities of treatments.

Manchikanti et al (55) evaluated the role of adhesiolysis, specifically with a control group receiving epidural steroid injection only where the catheter was inserted without adhesiolysis, followed by injection of epidural steroid and local anesthetic injection with sodium chloride solution injection with catheter in place in the sacral region (S2 or S3), and with Group II and Group III undergoing adhesiolysis. The third study (56) had no control group and intervention group consisted of adhesiolysis and hypertonic saline neurolysis. All 4 studies showed positive results for short-term and long-term improvement with adhesiolysis, either over the control group (44,55,56), or with patients as their own controls (53).

Among the prospective evaluations (45,46), both were positive for short-term relief and long-term relief.

Among the retrospective evaluations, both (57,58) were positive for short-term relief, whereas, only one (58) was positive for long-term relief.

2) Is percutaneous adhesiolysis superior to epidural steroid injections?

Heavner et al (53) and Manchikanti et al (55) demonstrated that percutaneous adhesiolysis was superior to epidural steroid injections and provided both short-term and long-term improvement in managing chronic low back and lower extremity pain. Manchikanti et al (55) evaluated the issue specifically due to epidural adhesions with a control group where patients only received epidural steroid injections in a random and blinded manner. These studies showed the clear superiority of adhesiolysis alone and with hypertonic saline neurolysis, over epidural steroid injections. Veihelmann et al (44) and Gerdesmeyer et al (45,46) also included only patients after failure of conservative management with epidural injections. Thus, they also considered epidural steroid injections to be a failure if the patients underwent adhesiolysis. Thus, these studies provide evidence of superiority of adhesiolysis over epidural steroid injections with a 3-day protocol. Other studies (56-58) also reveal evidence of successful pain relief with adhesiolysis with inclusion of patients after failure of fluoroscopically directed epidural steroid injections.

3) Does the addition of hypertonic sodium chloride solution improve outcomes?

Heavner et al (53) evaluated the effect of hypertonic sodium chloride solution and compared it with isotonic sodium chloride solution and hyaluronidase. They noted lack of significant differences among the groups. Manchikanti et al (55) evaluated the effectiveness of adhesiolysis alone or with hypertonic saline injection. In this study, authors demonstrated significant improvement with addition of hypertonic sodium chloride solution following adhesiolysis compared to adhesiolysis alone when they compared only the successful patients. When evaluating all patients, utilizing intent-to-treat analysis, the differences were not significant.

Veihelmann et al (44) and Gerdesmeyer et al (45,46) also utilized hypertonic saline neurolysis. However, they had no control group, so the specific value of hypertonic saline is unclear.

4) Does the addition of hyaluronidase improve outcomes?

Heavner et al (53) evaluated the effectiveness of hyaluronidase comopared to isotonic sodium chloride solution or mixed with hypertonic sodium chloride solution. However, they noted no significant differences among the groups.

Veihelmann et al (44) and Gerdesmeyer et al (45,46) used hyaluronidase in their protocol. However, there was no control group to compare the effectiveness of hyaluronidase since all patients received the same protocol. Thus, there is no demonstrated evidence thus far that hyaluronidase improves outcomes.

5) Is percutaneous adhesiolysis a safe procedure?

Heavner et al (53) reported no adverse effects. Manchikanti et al (55-58) reported one subarachnoid block, with 75 patients in their study (55), suspicion of infection in one case (56), subarachnoid blockade in 2% or 5 patients, serious infection in 1 patient with development of an abscess, suspicion of infection in 2% of patients or 4 cases in a retrospective evaluation (57); subarachnoid puncture in 4 out of 178 procedures,

Table 7. *Description of randomized and observational studies of spinal endoscopy*

Study/Methods	Participants	Intervention(s)	Outcome(s)	Result(s)	Conclusion(s)
Manchikanti et al (66) A prospective, randomized, double-blind trial AHRQ criteria 10/10 Cochrane review criteria 10/10	A total of 83 patients were evaluated, with 33 patients in Group I and 50 patients in Group II. Group I served as the control with endoscopy into the sacral canal without adhesiolysis, followed by injection of local anesthetic and steroid. Group II consisted of spinal endoscopic adhesiolysis, followed by injection of local anesthetic and steroid. 73% of the patients in Group I and 84% of the patients in Group II were of post lumbar laminectomy syndrome and had MRI evidence of epidural fibrosis.	In Group I, guide wire and a 0.8 mm fiberoptic spinal endoscopic video guided system was introduced and advanced until the tip was positioned S3. Injections included 10 ml of 1% lidocaine and 6 mg to 12 mg of Celestone or 40 mg to 80 mg of methylprednisolone. In Group II, spinal endoscope was advanced to the level of suspected pathology. Adhesiolysis was carried out. Injections included 10 ml of lidocaine 1%, preservative free, mixed with 6 mg to 12 mg of betamethasone acetate or 40 mg to 80 mg of methylprednisolone.	Timing: 1 month, 3 months, 6 months, and 12 months Outcome measures: Pain relief by visual analog scale Significant pain relief 50% or greater. Oswestry Disability Index 2.0 Work status Opioid intake Range of motion measurement Psychological evaluation Return to work	Intention to treat analysis was performed. Among the 50 patients in the treatment group with spinal endoscopic adhesiolysis 80% at 3 months, 56% at 6 months, and 48% at 12 months showed significant improvement without adverse events. In control group improvement was noted only at one month. Group II patients showed improvement in Oswestry Disability Scores, psychological status, reduced opioid intake, and increased employment.	Positive short-term and long-term relief.
Igarashi et al (68) Observational AHRQ Score 6/8	58 patients with degenerative lumbar spinal stenosis divided into monosegmental (34) and multisegmental (24) groups.	Epiduroscopy including adhesiolysis by injection of saline, and injection of steroids/local anesthetics.	Timing: up to 12 months Outcome measures: Amount of fatty tissue, degree of vascularity, relief of lower back pain, relief of leg pain	Amount of fatty tissue and degree of vascularity where greater in the monosegmental group. Relief of low back pain was observed up to 12 months in both groups. Relief of leg pain was evident up to 12 months in monosegmental group, and up to 3months in multisegmental group.	Positive short-term and long-term relief
Geurts et al (67) A prospective observational study AHRQ Score 6/8	20 chronic low back pain patients, the majority of them with post lumbar laminectomy syndrome failing to respond to other modalities of treatments.	Epiduroscopy with adhesiolysis and target delivery of 120 mg of methylprednisolone acetate, 600 IU of hyaluronidase, and 150 mcg of Clonidine.	Timing: 3, 6, 9 and 12 months. Outcome measures: Adhesiolysis and pain relief	19 of 20 patients studied showed adhesions via epiduroscopy. 55% of the patents experienced significant pain relief at 3 months, 40% at 6 months, and 35% of the patients at 12 months. Mean VAS at 3 months was significantly reduced that persisted at 12 months.	Positive short-term and long-term relief
Richardson et al (69) A prospective case series AHRQ Score 4/8	34 patients suffering with chronic, severe low back pain with 50% of the patients having failed back surgery syndrome.	Epidural adhesiolysis and target delivery of steroid. Adhesiolysis followed by injection of bupivacaine, Depo-Medrol, and Clonidine.	Timing: 1, 2, 6, and 12 months Outcome measures: Pain relief	A significant number of patients showed pain relief at all levels. They also reported that epidural adhesions were present in 100% of the patients, with 41% having dense adhesions. Follow-up over a 12 month period showed statistically significant reductions in pain scores and disability.	Positive short-term and long-term relief

Table 7 Continued. *Description of randomized and observational studies of spinal endoscopy*

Study/Methods	Participants	Intervention(s)	Outcome(s)	Result(s)	Conclusion(s)
Manchikanti et al (58) A retrospective evaluation in post lumbar laminectomy syndrome AHRQ Score 4/8	60 patients with post lumbar laminectomy syndrome	Spinal endoscopy with targeted delivery of steroid.	Timing: 1, 3, 6, and 12 months Outcome measures: Pain relief	100% of the patients reported relief initially, which declined to 75% at 3 months, 40% at 6 months and 22% at 12 months.	Positive short-term and long-term relief
Manchikanti et al (70) A retrospective evaluation of spinal endoscopy AHRQ Score 4/8	85 consecutive patients underwent 112 epidural endoscopic procedures.	Spinal endoscopy with targeted delivery of steroid.	Timing: 1, 3, 6, and 12 months Outcome measures: Pain relief	100% of the patients reported pain relief initially. The relief decreased to 94% at 1 to 2 months, to 77% at 2 to 3 months, to 52% at 3 to 6 months, to 21% at 6 to 12 months and 7% after 12 months.	Positive short-term and long-term relief

infection in one of 178 procedures and suspicion of infection in 8 of 178 procedures (58). Manchikanti et al (55-58) also reported minor complications such as rash, itching, etc. However, none of the studies have reported arachnoiditis, paralysis, weakness, bladder disturbances, or other serious complications. In the controlled study by Veihelmann et al (44) there were 15 cases of transient sensory deficit, 2 patients had recognized subarachnoid catheters, and there was one sheared catheter, which was easily removed. The prospective study (46) had 2 partially sheared catheters and one infection noted.

6) Is percutaneous adhesiolysis superior to standard therapy?

In patients with epidural scar percutaneous adhesiolysis was shown to be superior to epidural steroid injections by Manchikanti et al (55) and superior to physical therapy by Veihelmann et al (44).

Level of Evidence

All randomized trials (44,53,55,56) showed positive short-term and long-term relief. Two prospective evaluations (45,46) also showed positive short-term and long-term relief. Of the two retrospective evaluations, both (57,58) showed short-term improvement, whereas long-term improvement was seen only in one study (58).

The level of evidence is designated as shown in Table 5. There was research-based evidence from 4 properly designed randomized controlled trials. Strong or level 2 evidence consisted of research-based evidence from at least one properly designed randomized, controlled trial; or research-based evidence from multiple properly designed studies of smaller size; or multiple low quality trials. Therefore, the evidence for percutaneous adhesiolysis is strong for short-term and long-term relief with repeat interventions, in chronic refractory low back and lower extremity pain secondary to post lumbar laminectomy syndrome or lumbar epidural fibrosis.

Based on 1 randomized trial (44) and 2 prospective evaluations (45,46), the evidence in managing monoradiculopathy secondary to disc herniation is moderate for short-term and long-term improvement.

The evidence for percutaneous adhesiolysis as a better treatment than epidural steroid injections and physiotherapy is also strong for short-term and long-term improvement.

The evidence for addition of hypertonic sodium chloride solution is moderate for short-term and long-term improvement, whereas the evidence for addition of hyaluronidase is limited.

Spinal Endoscopy

Our search strategy yielded a total of 3 new articles regarding spinal endoscopy (63-65). Relevant reports available for review regarding spinal endoscopic adhesiolysis were 1 randomized, double blind evaluation (65), 1 letter to the editor (64), and 1 case report (63). In the previous systematic review (38), 1 double-blind randomized controlled trial (66), 3 prospective evaluations (67-69), and 2 retrospective evaluations (58,70), met inclusion criteria. Dashfield et al (65) evaluated the role of spinal and targeted delivery of steroid in patients without previous surgical intervention and no evidence of adhesions. This was similar to the report previously published by Devulder et al (62)

thus, the study failed to meet the inclusion criteria, as the procedures did not include adhesiolysis, the primary criterion of this systematic review.

Descriptive Characteristics

There were no significant differences in demographic characteristics noted in any of the studies among the demographic characteristics. Patients with previous surgery comprised 73% in Group I and 84% in Group II in the study by Manchikanti et al (66). Igarashi et al (68) evaluated patients with spinal stenosis. All other studies included post lumbar laminectomy patients, whereas, 1 retrospective evaluation (58) included only post lumbar laminectomy patients who also have failed percutaneous adhesiolysis.

Inclusion criteria were uniform across all reports with failure to respond to conservative modalities of treatment, including fluoroscopically directed epidural steroid injections. Manchikanti et al (58,66,70) included patients who failed percutaneous adhesiolysis prior to performing spinal endoscopic adhesiolysis. Manchikanti et al (66) also identified the proportion of patients with epidural fibrosis as 73% in Group I receiving epidural steroid injections and 84% in Group II undergoing spinal endoscopic adhesiolysis.

Interventions included spinal endoscopic adhesiolysis with administration of local anesthetic and steroids in all the studies. In the randomized, double-blind trial by Manchikanti et al (66), the control group had the scope advanced into thesacral region (S2 or S3) followed by injection of steroid and local anesthetic, whereas, the intervention group received spinal endoscopic adhesiolysis in the targeted area with delivery of local anesthetic and steroids.

Outcomes included pain relief by a Visual Analogue Scale, Oswestry Disability Index 2.0, range of motion evaluation, psychological evaluation by Pain Patient Profile, opioid intake, and return to work (66); whereas, pain relief was the major outcome measurement in all the other reports. Geurts et al (67) also measured changes in employment status. Further, they utilized an independent evaluator. Statistical methods included student's "t" test, chi-squared test, Fisher's Exact Test, paired "t" test, and Wilcoxon Signed-Rank Test (66); Man-Whitney-U tests (68); paired "t" tests, and an adapted last-observation-carried-forward (LOCF) analysis (64); and 2 x 2 chi-squared test and student "t" test (58).

Effectiveness

The randomized trial (66) showed significant improvement in pain relief, as well as other parameters including return to work at 3 months, 6 months, and 1 year. The prospective evaluations (67-69) also showed improvement. Both retrospective evaluations (58,70) included in the analysis showed positive short-term and long-term results. Details of the included studies are illustrated in Table 7.

Effectiveness was evaluated based on the questions noted above.

1) Is spinal endoscopy an effective treatment?

Manchikanti et al (66) showed 80% improvement at 3 months, 56% improvement at 6 months, and 48% improvement at 12 months. They also showed significant improvement in pain relief, as well as other parameters including return to work at 3 months, 6 months, and 1 year. The prospective evaluations (67-69) also showed improvement. Both the retrospective evaluations (58,70) included in the analysis showed positive short-term and long-term results.

2) Is spinal endoscopy superior to epidural steroid injections?

Manchikanti et al (66) showed superiority of spinal endoscopy over caudal epidural injections.

3) Is spinal endoscopy a safe procedure?

Specific complications are described below.

4) Is spinal endoscopy superior to standard therapy?

Manchikanti et al study (66) showed a clear superiority. In the previous systemic review (38), spinal endoscopic adhesiolysis was superior to epidural steroid injections especially after failed percutaneous adhesiolysis, and in lumbar spinal stenosis.

Safety

Complications were minor and included back soreness, recognized dural puncture, but no infections.

Level of Evidence

One randomized trial (66), 3 prospective trials (67-69) and 2 retrospective evaluations (58,70) showed positive short-term and long-term results. The evidence synthesis for spinal endoscopy showed strong evidence for short-term relief and moderate evidence for long-term improvement. This is also true for spinal endoscopic adhesiolysis compared to epidural steroid injections. The evidence for spinal endoscopic adhesiolysis in patients who failed percutaneous adhesiolysis is strong. On the other hand, the evidence for spinal endoscopic adhesiolysis in lumbar spinal stenosis is moderate for short-term and limited for long-term improvement.

Complications

Our search strategy yielded a total of 4 articles dis-

cussing complications from percutaneous adhesiolysis or spinal endoscopy (47-50). Complications reported in the controlled studies are described in the results section.

As in the previous systemic review, the most commonly reported complications of percutaneous adhesiolysis and spinal endoscopy were dural puncture, catheter shearing, and infection (47-50). Other potential complications include intravascular injection, vascular injury, cerebral vascular or pulmonary embolus, reaction to the steroids, hypertonic saline, or hyaluronidase, and administration of high volumes of fluids potentially resulting in excessive epidural hydrostatic pressures, death, and brain damage (38).

Talu and Erdine (47) reviewed percutaneous adhesiolysis complications in 250 patients. 3 patients (1.2%) developed epidural abscesses, and 1 patient developed a severe headache.

Perkins et al (48) described the consequences of a retained, sheared adhesiolysis catheter in a patient who underwent percutaneous adhesiolysis to treat persistent back and leg pain after two previous lumbar surgeries. The catheter sheared as it was passed to the nerve root. 3 months after the adhesiolysis procedure, the patient presented to clinic with worsening pain and a new radiculopathy by EMG. The patient underwent an MRI without difficulty, but the nerve root was obscured by metal artifact, and a CT/myelogram was performed which showed a non-filling defect. The catheter was removed intact during the subsequent laminectomy, and the patient did well. Although published in 2003, this case report was not included in the 2005 systemic review.

Wagner et al (50) reported a case of severe meningitis after percutaneous adhesiolysis, and then described a variety of previously reported complications. Richter (49) retrospectively analyzed by questionnaire the complications of epidural neuroplasty noted by neurosurgery departments across Germany. Only 63 of 171 questionnaires were returned, and 25 of those departments did not perform the technique. Of the remaining 38 centers, most noted only "mild" complications, though there were 22 cases of spinal infection, 14 "neurologic deficits," 6 hematomas, and 2 CSF fistulas. There was no attempt to obtain an indication of the number of procedures performed in order to ascertain an actual frequency, and the retrospective nature of the questionnaire may encourage the reporting of more dramatic cases.

Unintended subarachnoid or subdural puncture with injection of local anesthetic or hypertonic saline is one of the major complications of the procedure with catheter adhesiolysis. Shah and Heavner (63) described the visual and fluoroscopic clues indicating subarachnoid and subdural placement of the spinal endoscopy camera. Because the location of the camera was recognized, the technique was modified and complications were averted.

Discussion

The technique of adhesiolysis overcomes the difficulty of delivering various medications to a lesion specific site by placing the tip of a soft spring catheter or the tip of the fiberoptic endoscope within the scar which opens the perineural space. Thus, the steroid and other solutions can reach the appropriate site and provide anti-inflammatory effect and neural blockade. This systematic evaluation identified 4 appropriately performed randomized trials (44,53,55,56) of percutaneous adhesiolysis, and one well performed, randomized, double-blind trial of spinal endoscopic adhesiolysis (66). Further, there were multiple prospective and retrospective evaluations. The majority of the studies met the stringent and methodological criteria and showed positive short-term (≤ 3 months) and long-term (≥3 months or longer) improvement in pain status and other parameters. The variations in results may be explained by several factors including technical expertise and the drugs injected.

It appears that current techniques are valuable in cases of epidural scarring. However, the results must be looked at somewhat cautiously because of the variability in physician technique and procedural ability. More extensive work is needed to determine the characteristics of patients who may have the best outcomes with these techniques.

This systematic review provides strong evidence for the role of percutaneous adhesiolysis, moderate evidence for injection of hypertonic sodium chloride solution, and negative evidence for injection of hyaluronidase in managing chronic, refractory, low back pain and radicular pain.

Due to epidural scar there is moderate to strong evidence to indicate the effectiveness of spinal endoscopic adhesiolysis in managing chronic, refractory, low back and lower extremity pain. There is limited to moderate evidence for managing lumbar spinal stenosis with spinal endoscopic adhesiolysis. However, this updated review showed no evidence for the effectiveness of hyaluronidase. Both percutaneous adhesiolysis and spinal endoscopic adhesiolysis are superior to fluo-

roscopically directed epidural steroid injections.

Gerdesmeyer's studies in 2003 and 2005 (45,46) were published in Germany. The 2003 prospective pilot study (45) treated 25 patients with mono-segmental lumbar radiculopathy using percutaneous neurolysis according to Racz's technique. They noted an improvement in Oswestry scores, and no worsening of symptoms. These results were used to design a clinical trial (46), which evaluated 61 patients prospectively treated with percutaneous adhesiolysis. "Distinct clinical improvement" in McNab scores was obtained at 3 and 6 months. Although not randomized, they concluded from this study that the Racz catheter technique was safe and effective.

Veihelmann et al (44) compared epidural neuroplasty to physiotherapy by evaluating 99 patients with a history of chronic low back pain and sciatica. Half (52 patients) were treated with physiotherapy (a standard treatment for low back pain) and the other half (47 patients) underwent epidural neuroplasty (the European term for percutaneous adhesiolysis). Thirteen of the 99 patients had undergone disc surgery prior to the study (5 in the PT group and 8 in the adhesiolysis group). Physical therapy patients had the opportunity to cross over to neuroplasty after 3 months of inadequate response to PT. At 3, 6, and 12 months, only the neuroplasty patients had significant decreases in pain scores and improvement in Oswestry scores.

Conclusion

Percutaneous and endoscopic lysis of adhesion techniques are valuable in cases of pain caused by epidural scarring. This systematic review identified strong evidence for percutaneous adhesiolysis and spinal endoscopic adhesiolysis in managing chronic, refractory low back and lower extremity pain.

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