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Neurolysis outcome for Failed back surgery syndrome _ systemic research review after 2010

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Abstract

Failed back surgery syndrome (FBSS) defined as back pain not resolving to a satisfying level or a new back pain after spinal surgery. The scarring and adhesion in epidural space was considered lead to inflammation then this persisted inflammatory process may rise to more adhesion around nerve roots. So this vicious cycle is hard to break even after another surgery. Epidural injection or another surgery may be considered for those who suffered from persisted pain after conservative treatments. Except the above treatments, percutaneous epidural adhesiolysis (PEA) is one of the well-known options nowadays. By using Racz catheter to mechanically lysis adhesion and/or injecting medications such as steroids, saline, local anesthetics or hyaluronidase into epidural space to reduce inflammatory process, PEA can be an effective procedure to relief low back pain with low complication rate. Three randomized controlled trials and 1 observational study were included in this systemic review of PEA in treating low back pain due to FBSS. All of them showed positive results for pain relief and life quality improvement to 6 months after PEA. Besides, the complication rate was low and those complications were mostly self-limited. This review provides good evidence on effectiveness and safety of PEA in dealing with chronic low back pain due to FBSS.

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Key Words:
percutaneous epidural adhesiolysis, failed back surgery syndrome, low back pain, outcome

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Introduction

In this aging era, more and more people suffered from chronic low back (CLB) pain accompanied with radiculopathy and lead to compromised life quality. Data showed that about 20% of people aged between 20 and 59 had this medical problem. (1). Furthermore, 50%-80% of adults had at least experience low back pain once in their life. (2, 3). As a problem that affects both elder people and working age adults, it is a huge burden for individuals, health care system and society. The most common three causes of CLB were lumbar disc herniation, lumbar spinal stenosis, and failed back surgery syndrome (FBSS). For disc herniation, the intervertebral discs may lose fluid thus becoming flat and/or bulged because of aging, weight-bearing or other reasons. But this disc does not cause back or leg pain until nerve roots are pinched and/or the inflammatory materials irritate nerves. More than 90% of symptomatic lumbar disc herniation occur at the L4/L5 or L5/S1 levels. (4) For stenosis, a study showed that over 27% of the population had spinal stenosis, especially people order than 65 years old [5-7]. It is an abnormal narrowing of spinal canal mostly found in the lumbar spine and then cervical spine. Major symptoms for lumbar spinal stenosis are radicular pain, leg weakness and neurogenic claudication. Spinal stenosis may be related to aging process itself: osteoarthritis, herniated discs, thickened ligamentum flavum, and facet hypertrophy. But some studies also hypothesized a neurovascular mechanism that there might be intermittent insignificant bleeding and reduced arterial flow in cauda equina which leads to scarring, presentation of inflammatory materials and increased epidural pressure. [8, 9] For FBSS, 10%-40% patients may develop after spinal surgery. [10, 11] It is defined as persistent or recurrent low back pain and leg pain even after previous successful spine surgery. Other possible causes for FBSS are residual or recurrent disc herniation, persistent high pressure in spinal canal, segmental joint instability, or epidural fibrosis. Epidural fibrosis was also commonly found in post-laminectomy patients and was considered a normal result of wound healing process. The scarring itself does not cause pain. However, radicular pain developed when fibrosis entrapped the nerve roots. Circulation of the nerve might be impaired by scar tissues and caused ischemia pain. Although conservative treatments are preferred, they may fail sometimes. Repeat surgery may also suffer both the patients and doctors since the further scarring tissue makes surgery more difficult. So, less invasive techniques were developed to treat FBSS, such as epidural injection (EI), percutaneous epidural adhesiolysis (PEA), and epiduroscopic adhesiolysis. Many studies suggested that PEA is more effective than EI and less invasive than epiduroscopic adhesiolysis, being a good choice for patients who failed conservative treatments but do not want or suit further surgery. [12-14] percutaneous epidural adhesiolysis was also known as epidural lysis of adhesions or the Racz procedure, which was first developed by Professor Racz in 1989. It was originally designed to relief the pain from scarring and/or inflammation in epidural space for patients with FBSS. [15] Using Racz catheter for mechanical adhesiolysis, epidural scarring could be solved in some degree. For the injection of medications like dexamethasome, hypertonic saline, normal saline, local anesthetic agent or hyaluronidase into epidural space, some studies suggest that those procedures may be effective in treating lumbar stenosis and radicular pain caused by a herniated disc which is lack of scarring. [16] In this review, we focus on the effectiveness of percutaneous adhesiolysis in CLB pain caused by FBSS. Literatures after 2010 were reassessed and randomized controlled trials (RCTs), observational studies, retrospective

studies and complications reports about percutaneous adhesiolysis were included.

Material and Method

1.1 Percutaneous adhesiolysis procedure

Originally, Percutaneous adhesiolysis was a three-day procedure with medications injected on separate day of mechanical adhesiolysis. One-day procedure was first introduced in 1999 by Manchikanti et al. [17] and then replaced three-day procedure. This one-day procedure was done under fluoroscopic guidance. Patient lied down in prone position. After sterilization and local anesthesia, an introducer needle was then placed through sacral hiatus into the caudal epidural space. Some contrast solution was injected to confirm the position of the needle and make sure no intravenous or subarachnoid space penetration. A Racz catheter was then inserted through introducer needle to scarring sites in epidural space. Some contrast solution was injected to confirm the filling defects. In other condition, the catheter may directly advance to pathological sites as seen in MRI or found by physical examination. After catheter position was confirmed, mechanical adhesiolysis was performed and medications like dexamethasome, hypertonic saline, normal saline, local anesthetic agent, or hyaluronidase were chosen for injection. An epidurogram was also done after adhesiolysis to see if filling defect persists which is also an important predictive factor for this procedure. [18]

1.2 Criteria for Including and Excluding Studies in the Systematic Review

Inclusion criteria was those older than 18 years old and suffering from CLB pain for at least 6 months who failed to response to conservative treatments such as oral medication, physical therapy, exercise therapy, chiropractic manipulation or other drug therapy. All studies included should provide proper study design and outcome measurements. Their follow up duration should be at least 6 months or 24 weeks. Only percutaneous adhesiolysis procedures were evaluated. Exclusion criteria was studies with low quality and do not provide enough information. RTCs scoring less than 6 in Cochrane review criteria were considered low quality and excluded [19]. Cohort studies scoring less than 7 in Newcastle-Ottawa Scales were considered low quality and excluded [20]

1.3 Outcome measurement

The primary outcome was the degree of pain relief such as decreased VAS score or NRS score. Secondary outcomes included functional improvement, life quality improvement, change in work status and reduction in opioid use or intervention. Significant improvement is defined as a 50% improvement or 3 points reduction in pain score or a 40% improvement in functional status. Significant improvement in at least 40% of the patients are considered as positive result. Complications during PEA were also being recorded.

1.4 key questions

This systemic review is aimed to answer the two questions:

Is percutaneous adhesiolysis effective in the treatment of chronic low back in failed back surgery syndrome?

What is the severity of the risks and adverse events associated with percutaneous adhesiolysis?

1.5 Search strategy

The search strategy focused on CLB pain with FBSS treated with percutaneous adhesiolysis. The search terminology included: chronic low back pain, radicular pain, failed back surgery syndrome, post lumbar surgery syndrome, spinal stenosis, disc herniation, sciatica, epidural fibrosis, epidural neurolysis, adhesiolysis, neuroplasty, percutaneous neurolysis, Racz procedure, or lysis of adhesions.

1.6 Study selection process

Randomized trials were assessed by the Cochrane review criteria and Cohort studies was assessed by the Newcastle-Ottawa Scales. Non-randomized observational studies were included only if at least 50 subjects were enrolled.

1.7 Analysis of evidence

The analysis of evidence was done using the U.S. Preventative Services Task Force (USPSTF) (Table 1) which graded evidence in 3 levels: good, fair, and limited or poor.

Results

2.1 Study selection

Figure 1 showed a flow diagram of the study selection process. Based on search criteria, 3 RCTs and 1 observational study were included in the systematic review. Table 2 showed assessment of randomized trials and observational studies for inclusion criteria.

2.2 Methodological Quality Assessment

Methodological Quality Assessment of RCTs were carried out using the Cochrane review criteria as shown in Table 3. Studies achieving Cochrane scores of 9 or higher were considered high quality, 6 to 8 were considered moderate quality, and studies scoring less than 6 were excluded. All the 3 randomized controlled trials evaluated were high quality.[21-23] Of the 3 randomized controlled trials, 2 were studies about failed back surgery syndrome and 1 was about LBP including both FBSS and herniated lumbar disc.

Methodological Quality Assessment of cohort studies were carried out using the Newcastle-Ottawa Scales as shown in Table 4. Studies achieving scores of 10 or higher were considered high quality; 7 to 9 were moderate quality; studies scoring less than 7 were considered low quality and were excluded. Quality of the only cohort studies evaluated [24] was moderate.

2.3 Study characteristic

Table 5 shows the study characteristics of 3 RCTs and 1 observational study.

2.4 Analysis of evidence

Table 6 shows the results of Analysis of evidence whether percutaneous adhesiolysis is effective in dealing with chronic low back pain due to failed back surgery syndrome.

2.5 Effectiveness of adhesiolysis

The primary outcome was degree of pain relief, and significant improvement means a 50% improvement or 3 points reduction in pain score. In Chun-Jing et al., 2012 (21) showed 3.40 and 3.24 mean decrease in VAS at 1 month and 6 months in PEA group. Manchikanti et al., 2012 (22) found 70% of PEA group had >50% relief at 12 months. Gerdesmeyer et al., 2013 (23) described 5.3 and 5.1 mean decrease in VAS at 6 month and 12 months in PEA group. As for Akbas et al., 2018 (24), the mean decrease in VAS score in three groups were between 4.35 and 6 across 1 month, 3 months and 6 months.

Secondary outcomes included functional improvement, life quality improvement, change in work status and reduction in opioid use or intervention. Significant improvement indicated 40% improvement in functional status. In Chun-Jing et al., 2012 [21], no measurement of function was collected. Manchikanti et al., 2012 [22] found significant improvement in functional status in 70% of the patients in PEA group at the end of 1 year and 82% at the end of 2 years. In Gerdesmeyer et al., 2013 [23], 90% of the patients in PEA group were found to have > 50% improvement on the ODI. Akbas et al., 2018 [24] showed a mean decreased in OWS between 40.2% and 53.5% in three groups across all time intervals.

Of the 4 studies about failed back surgery syndrome, 3 are high quality RCTs with positive results and 1 is moderate quality observational study with positive result. Using the USPSTF criteria, the evidence of effectiveness

in dealing with chronic low back pain due to failed back surgery syndrome is good.

2.6 Complications

The complications of PEA are very similar with EI, including dural puncture, spinal cord compression, catheter shearing, infection, post-procedure pain, headache, pain during injection, paresthesia, and chemical arachnoiditis. The complication rate of PEA was low, and the complications are often self-limited [12, 25-27].

Discussion

Since FBSS may be not only caused by epidural fibrosis but also others such like residual or recurrent disc herniation, impaired circulation by scar tissues, or aging process itself, it is not reasonable to resolve pain by only single procedure. Repetition of this procedure seems inevitable. But the procedure itself may also causes problems even rare. According to this review, percutaneous epidural adhesiolysis (PEA) is safe and simple enough to carried out in OPD and provides significant effect for longer pain-relieving duration for patients suffering from FBSS. One study [22] showed that average pain relief per procedure was approximately 12 weeks. Over a two-year observation period, adhesiolysis provide 78 weeks of relief, which means significant pain relief (50% or more) and reduction of ODI scores to 50% or more.

Despite epidural injections (EI) have been introduced since 1960s to treat lumbar radicular pain [28], controversial results make us concern about the effectiveness [29-31]. The EI managed chronic low back pain by injecting mixture of local anesthetic, corticosteroids and saline [32]. In addition to their anti-inflammatory effects, local anesthetic and corticosteroids can also suppress ectopic discharges from injured neurons [33]. Moreover, the injected solutions may help washout inflammatory cytokines. There is widespread consensus that EI might provide short-term benefit in patients with FBSS (level II). The effect in long-term relief and prevention of surgery remained controversial [34, 35].

Major complications associated with EI were rare. In a 2011 retrospective study [36], 1857 patients were followed over 7 years, with 4265 times EI being performed. An overall complication rate per injection was 2.4%, including increased pain (1.1%), pain at the injection site (0.33%), persistent numbness (0.14%), and other (0.80%). Only 1 post dural puncture headache was reported. The low incidence may be due to the older patient population or the use of fluoroscopic guidance. Arachnoiditis due to unintentional intrathecal injection of corticosteroid were also found in some individuals. Major complications like neurotoxicity, neurologic injury, pharmacological effects of corticosteroids, and dural puncture were less frequently reported.

Specific complication related to percutaneous epidural adhesiolysis is catheter shearing and its retention in the epidural space [37]. A retrospective evaluation in 2003 [38] including 250 patients classified complications as immediate complications, such as bleeding in the epidural space (15.6%), hypotension (4.8%), catheters misplaced transdurally (4.4%), tearing of catheter (1.2%) and sheared catheter remnant remained in the epidural space (0.4%), or late complications such as numbness (8.8%), infection at entrance site (3.2%), bowel-bladder dysfunction (1.2%), epidural abscess (1.2%), and meningitis (0.4%). A systemic review published in 2007 [39] found that the most reported complications of percutaneous adhesiolysis were dural puncture, catheter shearing, and infection. In another systemic review published in 2005 [40], including 6 studies with total 340 patients, showed complication rate per procedure

as below: subarachnoid puncture (2.24%), infection (1.78%), post dural puncture headache (14%) with minor complications such as rash, itching, increased discomfort, and neck pain. Some case reports [41-43] also revealed rare complications such as transient cardiac arrhythmias, myelopathy, paralysis, and loss of sphincter control due to hypertonic saline injection.

In this review, we found that percutaneous epidural adhesiolysis (PEA) showed better outcomes compared to EI in patients with FBSS. All the studies above revealed significant improvement in pain after PEA. As for secondary outcome, three studies [22-24] showed significant improvement in functional status after PEA. There are good evidences that PEA is effective in relieving back or leg pain caused by FBSS.

Different from simply injected some medications during EI, PEA is designed to lyse epidural adhesion by both chemical and mechanical methods. Epidural adhesion can be due to several situations, including surgery, disc herniation, aging, infection or microtrauma. Since adhesion may lead to tethering of nerve roots, decreasing blood flow to the roots, and continuous inflammation process, resolving those adhesions is vital for reliving persistent low back pain. Specially designed Racz catheter can eliminate adhesion to some extent, and medications that injected have anti-inflammatory, analgesic, or chemical lysing function.

Usually, the PEA procedure was done by caudal approach. However, Akbas et al. [24] found no difference in both pain relief outcomes and complication rate among caudal approach, S1 foraminal approach, and L5-S1 transforaminal approach during 1, 3, and 6 months follow-up. There were also significant decreases in VAS and OWS, and functional assessment across all time intervals in all 3 groups.

In conclusion, our review concluded that there are good evidences that PEA is effective in relieving back or leg pain caused by FBSS. Complication rate was low, and complications are often self-limited. PEA should be an option for patients with FBSS after conservative treatment failed and before another surgical treatment performed.

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Figure 1. Flow diagram of study selection

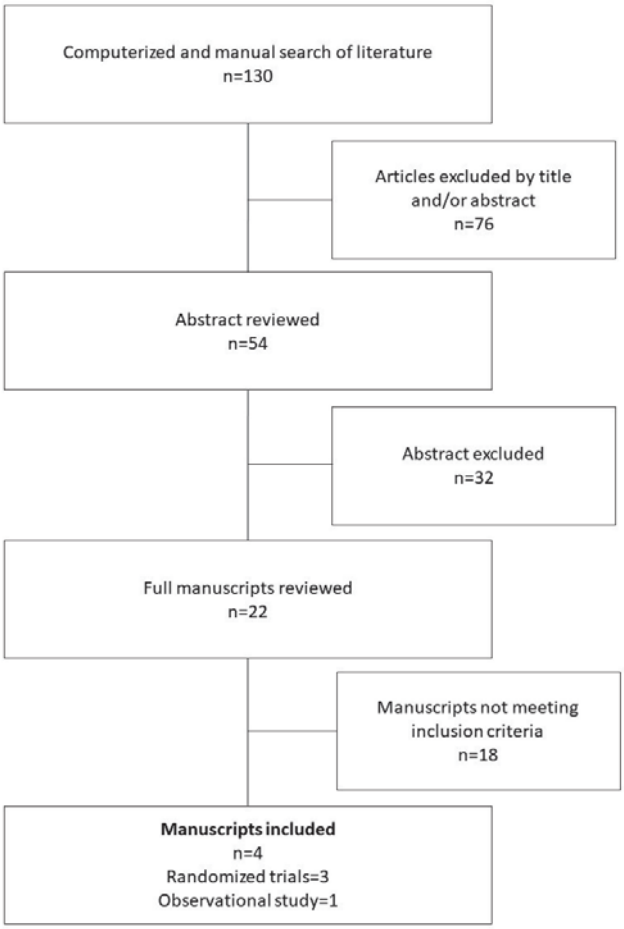

Table 1. Method for grading the over strength of the evidence for an intervention

Grade	Definition
Good	Evidence includes consistent results from well-designed, well-conducted studies in representative populations that directly assess effects on health outcomes (at least 2 consistent, higher-quality RCTs or studies of diagnostic test accuracy).
Fair	Evidence is sufficient to determine effects on health outcomes, but the strength of the evidence is limited by the number, quality, size, or consistency of included studies; generalizability to routine practice; or indirect nature of the evidence on health outcomes (at least one higher-quality trial or study of diagnostic test accuracy of sufficient sample size; 2 or more higher-quality trials or studies of diagnostic test accuracy with some inconsistency; at least 2 consistent, lower-quality trials or studies of diagnostic test accuracy, or multiple consistent observational studies with no significant methodological flaws).
Limited or Poor	Evidence is insufficient to assess effects on health outcomes because of limited number or power of studies, large and unexplained inconsistency between higher-quality trials, important flaws in trial design or conduct, gaps in the chain of evidence, or lack of information on important health outcomes.

Adapted and modified from methods developed by U.S. Preventive Services Task Force(44)

Table 2. Assessment of randomized trials and observational studies for inclusion criteria.

Manuscript Authors	Number of patients	Treatment vs. Comparator	Length of Follow up	Outcome Parameters	Comments
RCT					
Chun-Jing et al., 2012(21) RCT	76 FBSS	38 patients received PEA 38 patients received EI	7 d, 1 m, 6 m	VAS, Opioid use; MacNab criteria	3.40 and 3.24 mean decrease in VAS at 1 month and 6 months in PEA group, compare to 1.03 and 0.82 mean decrease in VAS at 1 month and 6 months in EI group.
Manchikanti et al., 2012(22) RCT	120 FBSS	60 patients receiving PEA 60 patients with EI Repeat PEA were provided after at least 3 months based on the response to the prior injection.	3, 6, 12, 18, and 24 m Of EI group, 43 were unblinded at 1 year and 52 at 2 years; of the PEA group, 2 were unblinded at 1 year and 4 at 2 years.	NRS ODI 2.0 employment status opioid intake	Significant pain relief and improvement in functional status in 70% of the patients in PEA group at the end of 1 year and 82% and the end of 2 years High Drop-out rate, 72% patients dropped out at 1 year in EI group and 3 % patients dropped out at 1 year in PEA group
Gerdesmeyer et al., 2013 (23) RCT	90 FBSS+HLD	46 patients in the Neurolysis group with a 3-day drug injection regimen. 44 patients in the control group	3, 6, and 12m	VAS, ODI	Including patients with disc protrusion and failed disc surgery. Ninety percent of the patients were found to have > 50% improvement on the ODI and more than 93% have > 50% improvement on the VAS at 6 months.
Observational study					

Akbas *et al.*, 2018 (24) retrospective	60 FBSS	20 Caudal Approach 20 Transforaminal L5 Approach 20 S1 Approach patients were randomly assigned to each of the 3 groups by computer generated random allocation sequence.	1, 3, and 6m	OWS VAS Patient satisfaction	A retrospective study compared the effectiveness of 3 approaches to PEA. There were significant decreases in pain relief scores and functional assessment across all time intervals and in all 3 groups. Analysis revealed that VAS, OSW, and patient satisfaction scores were comparable across the 3 groups.

Table 3. Assessment of methodological quality of randomized trials: Cochrane review criteria

	Chun-Jing et al., 2012 (21)	Manchikanti et al., 2012 (22)	Gerdesmeyer et al., 2013 (23)
Randomization adequate	Y	Y	Y
Concealed treatment allocation	Y	Y	Y
Patient blinded	Y	N	Y
Care provider blinded	N	Y	Y
Outcome assessor blinded	Y	U	Y
Drop-out rate described	Y	Y	Y
All randomized participants analyzed in the group	Y	Y	Y
Reports of the study free of suggestion of selective outcome reporting	Y	Y	Y
Groups similar at baseline regarding most important prognostic indicators	Y	Y	Y
Co-interventions avoided or similar	Y	Y	U
Compliance acceptable in all groups	Y	Y	Y
Time of outcome assessment in all groups similar	Y	Y	Y
	11/12	10/12	11/12

Table 4. Assessment of Cohort study: Newcastle-Ottawa Scales

	Akbas *et al.*, 2018 (24)
Selection	
1) Representativeness of the exposed cohort	
a) truly representative of the average pt with discogenic pain in the community *	x
b) somewhat representative of the average pain patients in the community *	
c) selected group of users e.g. nurses, volunteers	
d) no description of the derivation of the cohort	
2) Selection of the non exposed cohort	
a) drawn from the same community as the exposed cohort *	x
b) drawn from a different source	
c) no description of the derivation of the non-exposed cohort	
3) Ascertainment of exposure	
a) secure record (eg surgical records) *	x
b) structured interview *	
c) written self report	
d) no description	
4) Demonstration that outcome of interest was not present at start of study	
a) yes *	x
b) no	
Comparability	
1) Comparability of cohorts on the basis of the design or analysis	
a) study controls for _____ (Select the most important factor.) *	
b) study controls for any additional factor *	
Outcome (Exposure)	
1) Assessment of outcome	
a) independent blind assessment *	x
b) record linkage *	
c) self-report	
d) no description	
2) Was follow-up long enough for outcomes to occur	
a) yes (select an adequate follow up period for outcome of interest) *	x
b) no	
3) Adequacy of follow up of cohorts	
a) complete follow up - all subjects accounted for *	x
b) subjects lost to follow up unlikely to introduce bias *	
c) follow up rate < ____% (select an adequate %) and no description of those lost	
d) no statement	
SCORE	7/13

Table 5. Study Characteristics

Reference, Year	Number of Patients/ Selection Criteria	Control/ Comparator	Outcome Measures	Time of Measurements	Results	Strengths/ Weakness	Quality Assessment
Failed back surgery syndrome							
Chun-Jing *et al.*, 2012 (21)	76 patients Inclusion: pain and radiculopathy after surgery for disc herniation; no evidence of facet joint pain; conservative management failed Exclusion: Facet joints pain; >400 mg/day morphine equivalent use	38 patients receiving PEA with saline and dexamethasone. 38 patients in control group received EI of dexamethasone.	VAS, Opioid use; MacNab criteria	1 w, 1m, 6m	The VAS scores were 6.00, 6.21 in EI group at 1 month, 6 months. The VAS scores were 3.55, 3.71 in PEA group at 1 month, 6 months. There was a statistical difference between two groups.	Strengths: high quality RCT. Weakness: no measure of functions; only f/u for 6 months.	11/12
Manchikanti *et al.*, 2012 (22)	120 patients Inclusion: pain and radiculopathy after surgery for HLD; conservative management failed Exclusion: pain of facet joint origin or sacroiliac joint origin; morphine equivalent use >400 mg/day	60 patients received EI 60 patients received PEA Repeat PEA procedures were provided after at least 3 months based on the response to the prior injection.	NRS ODI 2.0 employment status opioid intake	3, 6, 12, 18, and 24 m	Significant pain relief and improvement in functional status in 70% of the patients in PEA group at the end of 1 year and 82% and the end of 2 years. PEA may provide on average 78 weeks of relief over a period of 2 years.	Strengths: high quality RCT with long-term follow-up (2 years). Weakness: High proportion of unblinded and withdraw rate in control group.	10/12
Akbas *et al.*, 2018 (24)	60 patients Inclusion: pain and radiculopathy after surgery for L5-S1; conservative management failed Exclusion: age ≥ 60 years	20 Caudal Approach 20 Transforaminal L5 Approach 20 S1 Approach	OWS VAS Patient satisfaction Patient satisfaction was evaluated using a Likert-type scale.	1, 3, and 6 m	Relative to baseline, there were significant decreases in VAS and OWS, and functional assessment across all time intervals in all 3 groups VAS, OWS, and patient satisfaction scores were comparable across the 3 groups at all time intervals.	Strengths: comparing different anatomical approaches used in PEA Weakness: limited by the number of patients and the period of follow-up.	7/13
Failed back surgery syndrome+ Herniated lumbar disc (HLD)							
Gerdesmeyer *et al.*, 2013 (23)	90 patients Inclusion: Chronic lumbar radicular pain; age > 18 years; conservative management failed; VAS Score > 4;ODI score > 45; 6 weeks after EI Exclusion: patient with neurologic motor deficits; spinal stenosis; polysegmental disc disease; Previous epidural catheter interventions	46 patients in the PEA group with a 3-day drug injection regimen. 44 patients in the control group	VAS, ODI	3m, 6m, 12m	90% of the patients in PEA group were found to have > 50% improvement on the ODI and more than 93% have > 50% improvement on the VAS at 6 months	Strengths: high quality RCT showing positive results in 6 months and 12 months. Weakness: the effect of placebo intervention as performed in our trial reaches clinically relevant size and has shown improvement up to 12 months after intervention.	12/12

A strong measure of improvement with significant pain relief of 50% or more and a reduced disability status with reduction of ODI scores of 50% or more

Table 6. Analysis of Evidence

Study	Study Characteristics	Methodological Quality Scoring	Participants	Pain Relief and Function	Results at 6-12 months	Comments
Failed back surgery syndrome						
Chun-Jing *et al.*, 2012 (21)	RA, AC	11/12	38 PEA 38 EI	3.40 and 3.24 mean decrease in VAS at 1 month and 6 months in PEA group, compare to 1.03 and 0.82 mean decrease in VAS at 1 month and 6 months in EI group.	P at 6 months	High quality study with positive results for 6 months.
Manchikanti *et al.*, 2012 (22)	RA, AC	10/12	60 PEA 60 EI	70% of PEA group had >50% relief at 12 months; Adhesiolysis provide 78 weeks of relief over a period of 2 years. 3 procedure/year	P at 3, 6, 12, 18, and 24 months	High quality study with positive result at 2 years.
Akbas *et al.*, 2018 (24)	RA, RE	7/13	60 PEA 20 Caudal Approach 20 Transforaminal L5 Approach 20 S1 Approach	Relative to baseline, there were significant decreases in VAS and OWS and functional assessment across all time intervals and in all 3 groups.	P at 6 months	Different anatomical approaches all showed positive results.
Failed back surgery syndrome + Herniated disc						
Gerdesmeyer *et al.*, 2013 (23)	RA, AC	12/12	46 patients PEA. 44 patients EI	5.3 and 5.1 mean decrease in VAS at 6 months and 12 months in PEA group. 43.3 and 45.7 mean decrease in ODI at 6 months and 12 months in PEA group	P at 6 months and 12 months	High quality study with positive result at 6 months.

RA = randomized; AC = active-control; RE = retrospective; P = positive

脊椎術後疼痛症候群以神經解離治療的結果 _2010 年以後的系統性研究回顧

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脊椎手術後疼痛症候群(Failed back surgery syndrome)指的是在脊椎手術後疼痛不如預期的緩解，或是再次出現疼痛的問題。手術後的疤痕及沾黏造成硬脊膜外腔的發炎，而發炎的過程中又會導致更多的沾黏形成，即使是再次進行手術也難以打破這個惡性循環。通常這群病人在接受保守治療後，可以進行硬脊膜外腔的注射或是再次手術，而近來發展出的經皮硬脊膜外腔沾黏解離術(Percutaneous epidural adhesiolysis)可以是另一種選擇。經皮硬脊膜外腔沾黏解離術使用特製的 Racz 導管來破壞沾黏的組織，並在硬脊膜外腔注射類固醇、局部麻醉劑、食鹽水、或透明質酸 以降低發炎的反應。這個方式能有效降低病人的下背痛，而且只有很低的併發症發生率。這篇系統性文獻回顧評估了三篇隨機分派臨床試驗及一篇觀察性研究，發現在實行經皮硬脊膜外腔沾黏解離術的六個月後，病人的疼痛指數降低、生活品質提升，跟實行硬脊膜外腔注射的病人比起來有顯著的差異。除此之外，併發症的發生率及嚴重度不高，且通常都有自限性。在脊椎手術後疼痛症候群的病人身上，經皮硬脊膜外腔沾黏解離術會是一個有效又安全的處置。

關鍵字：經皮硬脊膜外腔沾黏解離術、脊椎手術後疼痛症候群、下背痛、效果

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