NATIONAL INSTITUTE FOR HEALTH AND CARE EXCELLENCE

INTERVENTIONAL PROCEDURES PROGRAMME

Interventional procedure overview of percutaneous transforaminal endoscopic lumbar discectomy for sciatica

The tough covering of a spinal disc (annulus) can sometimes break, allowing the soft centre to bulge through. This is called herniation, also known as 'slipped disc'. It may cause pain in the back, pain in the leg (sciatica), and numbness and weakness in the leg. In this procedure the bulging part of the disc is removed through the foramen (a natural opening for the nerve in the spinal bones, or vertebrae) using an endoscope (a thin tube with a camera on the end) through a small cut in the back. The aim is to remove the pressure on the nerve to relieve symptoms.

Introduction

The National Institute for Health and Care Excellence (NICE) has prepared this interventional procedure (IP) overview to help members of the Interventional Procedures Advisory Committee (IPAC) make recommendations about the safety and efficacy of an interventional procedure. It is based on a rapid review of the medical literature and specialist opinion. It should not be regarded as a definitive assessment of the procedure.

Date prepared

This IP overview was prepared in April 2015.

Procedure name

- Percutaneous transforaminal endoscopic lumbar discectomy for sciatica

Specialist societies

- British Association of Spinal Surgeons
- UK Spine Societies Board Ltd
- Society of British Neurological Surgeons.

Description

Indications and current treatment

Lumbar disc herniation occurs when the nucleus pulposus of an intervertebral disc protrudes through a tear in the surrounding annulus fibrosus. Symptoms include pain in the back or leg, and numbness or weakness in the leg. Serious neurological sequelae including painful foot drop, bladder dysfunction, or cauda equina syndrome, may sometimes occur.

Conservative treatments include analgesics, non-steroidal anti-inflammatory medication, manual therapy and acupuncture. Epidural corticosteroid injections can also be used to reduce nerve pain in the short term. Lumbar discectomy is considered if there is severe nerve compression or persistent symptoms that are unresponsive to conservative treatment. Surgical techniques include open discectomy, microdiscectomy or minimally invasive alternatives using percutaneous endoscopic approaches. The choice of operative technique may be influenced by several factors, including the presenting symptoms and signs and the location and size of the prolapsed disc.

What the procedure involves

Percutaneous endoscopic lumbar discectomy procedures aim to preserve bony structures and cause less damage to paravertebral muscles and ligaments than open lumbar discectomy, allowing a shorter hospital stay and faster recovery. Percutaneous transforaminal endoscopic lumbar discectomy is done with the patient in the prone or lateral position using local or general anaesthesia. Under fluoroscopic guidance, a needle is inserted through the skin and the appropriate intervertebral foramen into the disc. A small guidewire is placed through the needle and the needle is exchanged for a series of dilators to create a working channel through the muscles, to the ruptured disc. An endoscope and special rongeurs are used for piecemeal removal of the herniated disc fragments. A laser may also be used to aid removal of the disc. The patient can usually mobilise within a few hours of the procedure.

Literature review

Rapid review of literature

The medical literature was searched to identify studies and reviews relevant to percutaneous transforaminal endoscopic lumbar discectomy for sciatica. The following databases were searched, covering the period from their start to 28 April 2015: MEDLINE, PREMEDLINE, EMBASE, Cochrane Library and other databases. Trial registries and the Internet were also searched. No language restriction was applied to the searches (see appendix C for details of search

strategy). Relevant published studies identified during consultation or resolution that are published after this date may also be considered for inclusion.

The following selection criteria (table 1) were applied to the abstracts identified by the literature search. Where selection criteria could not be determined from the abstracts the full paper was retrieved.

Table 1 Inclusion criteria for identification of relevant studies

Characteristic	Criteria
Publication type	Clinical studies were included. Emphasis was placed on identifying good quality studies. Abstracts were excluded where no clinical outcomes were reported, or where the paper was a review, editorial, or a laboratory or animal study. Conference abstracts were also excluded because of the difficulty of appraising study methodology, unless they reported specific adverse events that were not available in the published literature.
Patient	Patients with symptomatic lumbar disc degeneration or herniated/prolapsed lumbar intervertebral disc.
Intervention/test	Percutaneous transforaminal endoscopic lumbar discectomy.
Outcome	Articles were retrieved if the abstract contained information relevant to the safety and/or efficacy.
Language	Non-English-language articles were excluded unless they were thought to add substantively to the English-language evidence base.

List of studies included in the IP overview

This IP overview is based on 10,256 patients from 1 systematic review, 1 comparative case series and 7 case series (mainly retrospective).

Other studies that were considered to be relevant to the procedure but were not included in the main extraction table (table 2) have been listed in appendix A.

Table 2 Summary of key efficacy and safety findings on percutaneous transforaminal endoscopic lumbar discectomy for sciatica

Study 1 Nellensteijn J (2010)

Details

Study type	Systematic review
Country	The Netherlands
Recruitment period	Search date: 1973 to 2008; databases: MEDLINE, EMBASE; limited to English, German, Dutch studies.
Study population and number	**n=8396 adult patients with symptomatic lumbar disc herniation (39 studies reported in 45 papers)** ***6 prospective controlled studies*** (n=920 [412 percutaneous transforaminal endoscopic lumbar discectomy versus 508 controls]), ***2 retrospective controlled studies*** (n=962 [325 percutaneous transforaminal endoscopic lumbar discectomy versus 637 controls]), and ***31 prospective cohort studies*** (n=6514)
Age and sex	Age range 12–92 years, 58% male (4490/7759)
Patient selection criteria	Inclusion and exclusion criteria varied between the studies (often not clearly described). 36 studies specified radiculopathy in the inclusion criteria. In most studies patients received some type of preoperative conservative treatment for few months, duration of symptoms varied, some included all types of herniation and some specific types only.
Technique	Transforaminal endoscopic surgery: A range of techniques (including intradiscal and intracanal) and instruments were used, including the Yeung Endoscopic Spine System (YESS), the Thomas Hoogland Endoscopic Spine System (THES-SYS), Richard Wolf, Hijikata, Surgical dynamics, Kambin, Sofamor-Danek and Karl Storz instrumentation. In 3 studies operations were performed under general anaesthesia.
Follow-up	**Ranged from 6 weeks to 108 months. 16 studies had a mean follow-up of more than 2 years.**
Conflict of interest/source of funding	The authors received a grant from the Health Care Insurance Board, Diemen, The Netherlands.

Analysis

Follow-up issues: The proportion of patients lost to follow-up ranged from 0% to 29%.

Study design issues: guidelines for systematic reviews by the Cochrane back review group were used. Review included observational studies and controlled trials with more than 15 patients and a follow-up period of more than 6 weeks. 2 reviewers independently extracted data and assessed the methodological quality of studies and any disagreements were resolved by consensus (trials were assessed using a criteria list recommended by the Cochrane back review group and observational studies assessed using a modified 5-point score). Most studies had major design weaknesses and were considered as having a high risk of bias. The authors noted only 1 RCT in 6 prospective controlled studies that reported adequate randomisation (n=60); it had a low risk of bias but poor generalisability because it only included patients with a specific type of herniated disc.

The included studies in this review were heterogeneous with regard to patient selection, indications, operation techniques, follow-up period and outcome measures and the authors noted that the methodological quality of the studies was poor. Studies used different instruments (both validated and non-validated) to measure outcomes. Pain was measured by visual analogue scale (VAS) or numerical rating scale. Functional status was measured by the Oswestry Disability Index (ODI) or Roland Morris Disability Scale. ODI measures degrees of disability in a person with low back pain. The index is scored from 0 to 100, 0 indicating no disability and 100 maximum disability. Global perceived effect is measured using the MacNab score or percentage of patients improved. Patient satisfaction is usually reported using a Likert scale.

Statistical pooling of data was not performed because of the heterogeneity of studies. The longest follow-up point was used.

Study population issues: 2 case series on 'endoscopic laser foraminoplasty' (n=250) and 4 studies with adjunctive procedures were included.

Other issues: none of the studies included were designed to assess adverse events, therefore the authors suggested that results should be interpreted cautiously.

Key efficacy and safety findings

Efficacy

Number of patients analysed: **8396**

Effectiveness of transforaminal endoscopic surgery (n=31 observational, non-controlled studies)

Outcome measure (Instrument)	Studies (patients, n)	Outcome median (min-max)
Pain leg (VAS)	7 (n=1558)	88% (65-89%) improvement
Pain back (VAS)	5 (n=1401)	74% (13-84%) improvement
Pain (region not specified) (VAS)	3 (n=144)	70% (63-85%) improvement
Global perceived effect (MacNab**)	15 (n=2544)	85% (72-94%) satisfactory* 6% (0.3-27%) poor
Functional status (ODI)	3 (n=624)	83% (74-90%) improvement
Patient satisfaction	3 (n=181)	78% (75-92%) satisfactory
Return to work	5 (n=757)	90% (67-95%)
Recurrence^	13 (n=2612)	1.7% (0-12%)
Re-operation*	28 (n=4135)	7% (0-27%)

**MacNab score is a 4-point scale ranging from 1 (excellent) to 4 (poor). The sum of excellent and good are reported as satisfactory.

Effectiveness of intradiscal and intracanal techniques (n=30 non-controlled studies)

Outcome measure (Instrument)	Studies (patients, n)	Outcome median (min-max)
Intradiscal techniques, 14 studies (n=1267)		
Pain leg (VAS)	2 (n=66)	83% (78-88%) improvement
Pain back (VAS)	1 (n=25)	75% improvement
Pain (region not specified) (VAS)	1 (n=66)	85% improvement
Global perceived effect (MacNab)	3 (n=279)	85% (78-89%) satisfactory* 6.5% (3.7-11%) poor
Recurrence^	3 (n=217)	0.7% (0.5-1%)
Re-operation*	14 (n=1267)	7.5% (1.3-30%)
Intracanal techniques, 16 studies (n=4985)		
Pain leg (VAS)	5 (n=1524)	88% (65-89%) improvement
Pain back (VAS)	4 (n=1408)	70% (13-84%) improvement
Pain (region not specified) (VAS)	2 (n=78)	67% (63-70%) improvement
Global perceived effect (MacNab)	12 (n=2292)	86% (72-93%) satisfactory* 6% (0.3-9.3%) poor
Recurrence^	10 (n=2395)	3.2% (0-12%)
Re-operation*	15 (n=3098)	74.6% (0-27%)

Effectiveness of transforaminal endoscopic surgery for different types of herniation

Outcome measure (Instrument)	Studies (patients, n)	Outcome median (min-max)
Far lateral LDH 6 studies (n=214)		
Pain (region not specified) (VAS)	4 (n=167)	82% (63-88%) improvement

Safety

Effectiveness of transforaminal endoscopic surgery (n=31 observational, non-controlled studies)

Outcome measure (Instrument)	Studies (patients, n)	Outcome median (min-max)
Complication**	28 (n=6336)	2.8% (0-40%)

Effectiveness of intradiscal and intracanal techniques (n=30 non-controlled studies)

Outcome measure (Instrument)	Studies (patients, n)	Outcome median (min-max)
Intradiscal techniques, 14 studies (n=1267)		
Complication**	12 (n=1206)	5.3% (0-40%)
Intracanal techniques, 16 studies (n=4,985)		
Complication**	17 (n=5362)	2.1% (0-17%)

Effectiveness of transforaminal endoscopic surgery for different types of herniation

Outcome measure (Instrument)	Studies (patients, n)	Outcome median (min-max)
Far lateral LDH 6 studies (n=214)		
Complication**	5 (n=214)	5.1% (0-17%)
Central LDH, 1 study (n=71)		
Complication**	1 (n=71)	2.7%
all LDH, 15 studies (n=3067)		
Complication**	15 (n=2934)	4.9% (0-45%)

Effectiveness of transforaminal endoscopic surgery versus open lumbar microdiscectomy (6 controlled studies, n=720)

Outcome measure (Instrument)	Studies (patients, n)	Outcome of improvement median (min-max) %	
		Endoscopic discectomy	**open discectomy**
Complication**	15 (n=1302)	1.5% (0-6.7%)	1.0% (0-12%)

**Most reported complications were transient dysaesthesia or hypaesthesia.

Patients operated on at the beginning of the learning curve had worse outcomes.

Global perceived effect (MacNab)	2 (n=52)	86% (85-86%) satisfactory* 9.8% (8.6-11%) poor
Recurrence^	2 (n=76)	2.6% (0-5.1%)
Re-operation*	5 (n=214)	8.0% (7.6-11%)
Central LDH, 1 study (n=71)		
Global perceived effect (MacNab)	1 (n=71)	91% satisfactory* 12% poor
Re-operation*	1 (n=71)	4.6%
all LDH, 15 studies (n=3067)		
Pain leg (VAS)	4 (n=1374)	88% (69-89%) improvement
Pain back (VAS)	4 (n=1374)	70% (13-84%) improvement
Pain (region not specified) (VAS)	1 (n=43)	70% improvement
Global perceived effect (MacNab)	9 (n=1810)	83% (79-94%) satisfactory* 4.6% (0.3-9.3%) poor
Recurrence^	9 (n=2201)	3.6% (0-12%)
Re-operation*	15 (n=2934)	5.6% (2.3-27%)

Effectiveness of transforaminal endoscopic surgery versus open lumbar microdiscectomy (6 controlled studies, n=720)

Outcome measure (Instrument)	**Studies (patients, n)**	**Outcome of improvement median (min-max) %**	
		Endoscopic discectomy	**open discectomy**
Pain leg (VAS)	1 (n=200)	89% improvement	87% improvement
Pain back (VAS)	1 (n=200)	42% improvement	-8.3% improvement
Pain (region not specified) (VAS)	1 (n=60)	71% improvement	82% improvement
Global perceived effect (MacNab)	5 (n=1102)	84% (70-97%) satisfactory* 1.7% (0-5.4%) poor	78% (65-93%) satisfactory 3.3% (0-15%) poor
Recurrence^	4 (n=1182)	5.7% (5-6.6%)	2.9% (0-6.8%)
Re-operation*	15 (n=2934)	6.8% (3.3-15%)	4.7% (0-11.5%)

^defined as a reappearance of a symptomatic LDH at the same level after a pain-free interval of longer than a month.

*The most common cause of reoperation was persistent complaints because of missed lateral bony stenosis and remnant fragments.

Abbreviations used: LDH, lumbar disc herniation; ODI, Oswestry disability index; VAS, visual analogue scale.

Study 2 Choi G (2013)

Details

Study type	Case series (prospective)
Country	South Korea
Recruitment period	not reported
Study population and number	n=**89** Mean duration for back and leg pain was 156.8 and 18 weeks 8, 19, 49 and 13 patients had disc herniation at the L2-3, L3-4, L4-5 and L5-S1 levels.
Age and sex	Average 46.6 years (59/89) male
Patient selection criteria	Inclusion criteria: lower limb radiculopathy, presence of root tension signs (sciatic or femoral nerve), failure of conservative treatments, corroborative clinical and radiological findings. Exclusion criteria: patients with cauda equina syndrome, severe central canal stenosis, and associated segmental instability.
Technique	Image-guided transforaminal PELD using a specially designed fluoroscope and an MRI-equipped operating suite (XMR): The patient first had an MRI scan and was then placed in a prone position on the sliding table with labelling of the skin entry points. The patient was then moved from the MRI to the fluoroscopic suite. PELD using the Yeung endoscopic spine system was performed with the same surgical steps by a transforaminal approach under local anaesthesia. The patient then had an intraoperative MRI scan to check the adequacy of decompression. If any remnant fragments were found, the patient was moved to the fluoroscopy suite for removal of fragments. Standard postoperative regimens are prescribed.
Follow-up	**2 years**
Conflict of interest/source of funding	None

Analysis

Follow-up issues: complete follow-up (by telephone interview, mailed questionnaire or hospital follow-up).

Study design issues: patients were evaluated pre- and postoperatively (at 12 weeks) by clinical history, physical examination, visual analogue scale (VAS) for back and leg pain (score range from 0 to 10, 0 indicating best and 10 worst scores), Oswestry disability index (ODI) and radiological imaging. The MacNab criteria are excellent (without pain and normal function), good, fair and poor (no progress).

Study population issues: There were 22.7% of patients with high-grade migration and 21.3% with high-grade canal compromise.

Key efficacy and safety findings

<table>
<tr><th>Efficacy</th><th>Safety</th></tr>
<tr><td>
Number of patients analysed: 89
Mean operative time: 60 minutes.
Symptom improvement
<table>
<tr><th></th><th>Preoperative</th><th>Postoperative</th></tr>
<tr><td>Mean ODI %</td><td>67.4</td><td>5.61</td></tr>
<tr><td>Mean VAS score for back pain</td><td>4.0</td><td>2.3</td></tr>
<tr><td>Mean VAS score for leg pain</td><td>7.99</td><td>1.04</td></tr>
</table>
Global perceived effect (MacNab score) %
<table>
<tr><td>Excellent</td><td>85.4 (76/89)</td></tr>
<tr><td>Good</td><td>8.89 (8/89)</td></tr>
<tr><td>Fair</td><td>3.37 (3/89)</td></tr>
<tr><td>Poor</td><td>2.25 (2/89)</td></tr>
</table>
Remnant fragments after first stage PELD: MRI showed remnant fragments after first stage TF-PELD: 4.5% (4/89). All these patients had either highly migrated or sequestrated disc fragments preoperatively. Second stage TF-PELD was done and fragments removed.
Recurrence: Recurrent disc herniation within 2 weeks after operation was reported in 2.2% (2/89).Open surgery was performed in these patients.
</td><td>
Symptomatic postoperative haematoma was reported in 2.2% (2/89) patients. Open surgery was performed in both patients.
</td></tr>
<tr><td colspan="2">Abbreviations used: TF-PELD, transforaminal percutaneous endoscopic lumbar discectomy; ODI, Oswestry disability index; VAS, visual analogue scale.</td></tr>
</table>

Study 3 Choi K-C (2013)

Details

Study type	**Retrospective comparative study**
Country	South Korea (2 centres)
Recruitment period	2010
Study population and number	n=**60 (30 transforaminal PELD versus 30 interlaminar PELD)** consecutive patients with L5-S1 disc herniation.
Age and sex	Mean 35 years; 48% (29/60) male
Patient selection criteria	Inclusion criteria: unilateral radicular pain, single level intracanal disc herniation and failure of conservative treatment for more than 6 weeks. Exclusion criteria: definite congenital anomalies, including lumbarisation, spondylolysis, instability, foraminal or extraforaminal disc herniation and lateral recess stenosis.
Technique	• Transforaminal PELD: The procedure was performed under local anaesthesia. An epidurography and a discography were performed. If the spinal needle was on the medial pedicular line on anteroposterior view and not on the posterior vertebral line on lateral view, foraminoplasty was performed. An endoscope supplied by YESS system was used. Endoscopic forceps and a side-firing holmium: yttrium-aluminum-garnet (Ho: YAG) laser were used to remover the herniated disc and fibrotic scar tissues. • Interlaminar PELD: Provocative discography was performed before induction of general anaesthesia. An endoscope supplied by Wolf was used. Disc forceps were used to remove the protruded or sequestered disc pieces.
Follow-up	**Minimum 2 years**
Conflict of interest/source of funding	This study was supported by a grant from the Wooridul Spine Foundation. The authors reported no conflict of interest.

Analysis

Follow-up issues: Not reported.

Study design issues: Pre- and postoperative data were obtained from a chart review and a radiologic examination. An independent observer performed the radiological assessments before the procedures. High-grade herniation was defined as migration larger than the measured height of the posterior marginal disc space and low-grade migration was defined as migration less than the measured height of the posterior marginal disc space.

Study population issues: Significant differences between the interlaminar and the transforaminal groups were observed for disc location, disc type and degree of migration. Prevalence of axillary disc herniation (67% [20/30]) was higher than that of shoulder disc herniation (33% [10/30]) in the interlaminar group. However, in the transforaminal group, shoulder disc herniation (67% [20/30]) was more prevalent than axillary disc herniation (33% [10/30]; p=0.01). The prevalence of central disc herniation was significantly lower in the interlaminar group (7% [2/30]) than in the transforaminal group (33% [10/30]; p=0.01).

37% (11/30) of patients with high-grade migration were treated by interlaminar PELD and 1 patient (1/30) was treated by transforaminal PELD (p=0.01). The discs were migrated upward or downward by up to 8 mm.

Additional techniques: foraminoplasty was needed in 40% (12/30) patients in the transforaminal group and medial facetectomy was needed in 17% (5/30) patients in the interlaminar group.

Key efficacy and safety findings

Efficacy

Number of patients analysed: **60 (30 transforaminal PELD versus 30 interlaminar PELD)**

	Transforaminal (n=30)	**Interlaminar (n=30)**	**p value**
Follow-up	**mean 2.3 years**	**mean 2.2 years**	**NS**
Pain (VAS, mean ± SD)			
VAS back			
Preoperative	5.2 ± 2.0	5.5 ± 1.5	NS
Final follow-up	2.4 ± 0.8	2.4 ± 1.0	NS
VAS leg			
Preoperative	7.4 ± 1.5	7.6 ± 1.4	NS
Final follow-up	1.6 ± 1.0	1.7 ± 1.5	NS
Disability (ODI, %)			
Preoperative	52 ± 16	51 ± 18	NS
Final follow-up	12 ± 8	15 ± 9	NS
Time to return to work (week)	4.9 ± 2.6	4.4 ± 1.7	NS
Operative failure-incomplete removal of the disc fragment (converted to open surgery)	3 (1/30)	7 (2/30)	NR
Recurrence of disc herniation (open surgery performed)	3 (1/30)	7 (2/30)	NS

Safety

Complications % (n)

	Interlaminar % (n=30)	**Transforaminal % (n=30)**
Dysaesthesia	7 (2/30)	0

Abbreviations used: NS, not significant; ODI, Oswestry disability index; NR, not reported; PELD: percutaneous endoscopic lumbar discectomy; VAS, visual analogue scale.

Study 4 Iprenburg M (2008)

Details

Study type	**Retrospective case series**
Country	Netherlands (2 centres)
Recruitment period	2004-08
Study population and number	n=**255** patients with lumbar disc herniation
Age and sex	not reported
Patient selection criteria	not reported
Technique	Single level transforaminal endoscopic lumbar discectomy. Most of the surgeries were performed at L4-5 and L5-S1 levels.
Follow-up	**12-42 months (in transforaminal endoscopic group)**
Conflict of interest/source of funding	not reported

Analysis

Study design issues: results were compared retrospectively with a 1-year report of the Swedish National Spine Register of microscopic discectomies.

Other issues: Authors state that the learning curve is steep.

Key efficacy and safety findings

Efficacy

Number of patients analysed: **255**

Functional and symptomatic outcomes

Oswestry disability score (%)	13±16.7
Roland disability score (%)	22±2.8
VAS for back pain (mean ± SD)	14.2±6.8
VAS for leg pain (mean ± SD)	13.7±20.1
Eurocol score	0.87±0.17

A comparison of the transforaminal endoscopic lumbar discectomies with the microscopic discectomies in the Swedish Spine Register showed a significantly better result for the transforaminal group with regard to VAS scores for back and leg pain, walking distance and patient satisfaction (p=0.031, p=0.021, p<0.001, and p<0.001 respectively).

Recurrence: overall 6.6% (17/255)

During the first 80 operations the recurrence was 11%.

Reoperations: 5 were treated microscopically, and 12 endoscopically. One was converted to a microscopic operation due to pain.

Safety

Adverse events

	n
Dural tears (causing headaches)	2
Transitory foot drop	1
Transitory sensibility disturbance of the foot	3

Abbreviations used: SD, standard deviation; VAS, visual analogue scale.

Study 5 Peng CWB (2010)

Details

Study type	**Case series (prospective)**
Country	Singapore
Recruitment period	2002-6
Study population and number	n=**55 patients with herniated intervertebral disc**
Age and sex	Mean 35.6 years 58% (32/51) male
Patient selection criteria	Patients who had radicular symptoms due to discogenic lumbar nerve root compression and failed conservative therapy, diagnosed with lumbar disc herniation on MRI.
Technique	Percutaneous transforaminal endoscopic discectomy performed by 2 surgeons. 66% (36/51) were done under local anaesthesia and 34% (19/51) under general anaesthesia. A transforaminal epidural injection was injected to reduce pain and discomfort. Discectomy was performed through a posteriolateral approach using a Yeung endoscope spine system. 39 patients had L4-5 discectomy, 12 had L5-S1, 2 had L3-4, 2 had L4-5 and L5-S1. There were 44 disc protrusions, 10 extrusions, 1 sequestrated disc.
Follow-up	**Mean 3.4 years (range 2-6.5 years)**
Conflict of interest/source of funding	None

Analysis

Study design issues: single-centre study with small sample size.

Quality of life is measured by 36-item Short Form (SF-36).

Key efficacy and safety findings

Efficacy

Number of patients analysed: **55**

Mean operative time: 55.8 minutes

Mean length of hospital stay: 17.3 hours

Quality of life (SF-36 scores)

	Preoperative	6 months	2 years
Physical function	56.2	65.8	80.9
Role physical	20.9	56.8	73.5
Bodily pain	35.5	57.9	74.4
General health	66.4	67.1	68.5
Vitality	47.3	58.3	71.5
Social function	56.1	75.4	94.1
Role emotional	50.9	85.9	94.1
Mental health	66	74.8	84.5

There was significant improvement in all aspects of quality-of-life scores (all $p<0.05$) except for general health at 6 months and 2 years.

NASS and VAS scores

There was significant improvement in the NASS scores for back disability and neurogenic symptoms and the VAS scores for back pain and lower limb pain at 6 months and 2 years postoperatively compared with preoperative scores (all $p<0.05$).

The mean NASS score for satisfaction with treatment (score range from 1 [extremely dissatisfied] to 6 [extremely satisfied]) was 3.9 at 6 months and 4.7 at 2 years.

Return to work: all patients working preoperatively returned to work. The mean time to return to work was 24.3 days (range 10–60 days).

Recurrence

Recurrent disc prolapse was reported in 5% (3/55) patients. 2 patients were treated by open discectomy and 1 patient had conservative treatment. All patients subsequently had lumbar fusion for persistent back pain.

Safety

Adverse events

	% (n)
Sequestered disc post-procedure (treated with open discectomy)	2 (1/51)
Discitis (after 4 days, treated with endoscopic washout of the disc space and antibiotics)	2 (1/51)

Abbreviations used: NASS, North American Spine Score; SF-36, Short From 36; VAS, visual analogue scale.

Study 6 Kang SH (2011)

Details

Study type	**Case series**
Country	South Korea
Recruitment period	2003-2008
Study population and number	n=**1406 patients (1503 operations [298 IL, 1205 TF])** with protruded or extruded disc materials compressing the lumbar root(s)
Age and sex	Mean 22.6 years; 100% (1503/1503) male
Patient selection criteria	Consecutive patients with protruded or extruded disc materials compressing the lumbar root(s).
Technique	The endoscopic discectomies were performed using the Vertebris® system (Richard Wolf). Interlaminar endoscopic discectomy was performed in L5/S1 level. Transforaminal endoscopic discectomy was performed in all other patients and in some L5/S1 patients. Most patients received intraoperative epidural steroids at the end of their surgery.
Follow-up	**Mean 25 months**
Conflict of interest/source of funding	Not reported

Analysis

Follow-up issues: All patients had postoperative MRI scans within 7 days after surgery. When new symptoms occurred, follow-up MRIs were checked.

Study design issues:

- A 23-member board of neurosurgeons performed the 1503 procedures.
- Radiologically, cystic lesions of T2W high- and T1W low-signal intensity at discectomy site were regarded as post-discectomy pseudocyst (PP).
- PP patients were divided into 2 groups according to the treatment modality after PP detection, surgically treated and conservatively treated.

Study population issues:

- All patients were soldiers at the time of their procedures.

Other issues:

- No distinctions were made between the IL and TF groups for the clinical outcomes.

Key efficacy and safety findings

Safety
Number of patients analysed: n=**1406 patients (1503 operations [298 IL, 1205 TF])** **Symptomatic post-discectomy pseudocysts:** • IL: 3% (9/298) • TF: 1% (6/1205) The mean interval from surgery to detection was 53.7 days. Significant difference between groups (p=0.001). 5 pseudocysts were treated surgically and 10 were treated conservatively but the paper did not mention the original procedure for these. There was no difference in treatment outcome between conservative and surgical management at a mean follow-up of 25 months. No distinctions were made between the IL and TF groups for the clinical outcomes so the results were not reported.
Abbreviations used: FE, full-endoscopic; IL, interlaminar; MRI, magnetic resonance imaging; PP, post-discectomy pseudocyst; TF, transforaminal.

Study 7 Ahn Y (2012)

Details

Study type	**Case series (retrospective)**
Country	South Korea
Recruitment period	2001-9
Study population and number	n=**9821**
Age and sex	not reported
Patient selection criteria	Patients with soft lumbar disc herniation manifesting as radicular leg pain and/or back pain.
Technique	Standard transforaminal endoscopic lumbar discectomy (TF-PELD) was performed under local anaesthesia (fluoroscopic guided posteriolateral transforaminal approach through the foraminal window).
Follow-up	**Mean 31.7 months (range 20-48 months)**
Conflict of interest/source of funding	None

Analysis

Study design issues: medical records were retrospectively reviewed. Cases of infection were identified and clinical course and treatment details extracted, clinical outcomes were assessed using VAS, ODI and modified MacNab criteria. Postoperative infection was confirmed by MRI and biopsy procedures. Laboratory markers were determined, bacterial cultures and biopsy were performed.

There might be some overlap with the other studies by Ahn in table 2.

Key efficacy and safety findings

Safety

Number of patients analysed: **12**

Postoperative spondylodiscitis (with or without soft tissue infection): 0.12% (12/9281)

Mean age: 41.4 years (range 21-65 years; 9/12 male).

Treated level L4-5 in 10 patients and L5-S1 in 2 patients.

Average time for MRI diagnosis: 14.6 days.

10 cases of bacteriologically positive septic types and 2 negative septic types.

Treatment: 4 patients were treated with only antibiotic therapy; 2 with surgical debridement, the remaining 6 did not respond to initial therapies or surgical drainage and finally had anterior lumbar interbody fusion with posterior instrumentation surgery.

Clinical outcomes

	Baseline	**Last follow-up (mean 31.7 months)**
VAS for leg pain (mean±SD)	7.92±1.00	2.25±0.62
VAS for back pain (mean±SD)	4.58±1.88	3.00±1.19
ODI (mean±SD)	60.4%±19.4%	29.3%±15.4%
Modified MacNab criteria	NR	58.3% (7/12) had excellent or good outcome.

Abbreviations used: ODI, Oswestry disability index; NR, not reported; SD, standard deviation; VAS, visual analogue scale.

Study 8 Ahn Y (2011)

Details

Study type	**Case series (retrospective)**
Country	South Korea
Recruitment period	2003-7
Study population and number	n=**816**
Age and sex	not reported
Patient selection criteria	Patients with soft lumbar disc herniation manifesting as radicular leg pain and/or back pain confirmed on CT and MRI. Exclusion criteria: patients with segmental instability, bony stenosis, calcified disc herniation or painless weakness.
Technique	Standard transforaminal endoscopic lumbar discectomy (PELD) was performed under local anaesthesia (fluoroscopic guided posteriolateral transforaminal approach through the foraminal window).
Follow-up	**Mean 30.8 months (range 18-44 months)**
Conflict of interest/source of funding	None

Analysis

Study design issues: medical records were retrospectively reviewed and cases of infection identified and clinical course and treatment details extracted. Clinical outcomes were assessed using VAS (for pain intensity), ODI (for functional status) and modified MacNab criteria (classified as excellent, good, fair or poor). Postoperative infection was confirmed by MRI and biopsy procedures. Laboratory markers were determined, bacterial cultures and biopsies were performed.

There might be some overlap with the other studies by Ahn in table 2.

Key efficacy and safety findings

Safety

Number of patients analysed: **9**

symptomatic dural tears (confirmed by secondary open surgeries): 1.1% (9/816)

Mean age: 47.3 years (range 18-70 years; 4/9 male).

In 3 patients dural tears were detected intraoperatively, patients complained of headache with back pain as the cerebrospinal fluid leak happened. Patients had subsequent open surgery for repair without any neurological sequelae.

6 had delayed diagnosis after a symptom-free interval (average time for clinical manifestation was 2.5 days, unresponsive to conservative management).

2/6 had nerve root herniation causing profound leg pain and neurological deficits (detected on MRI).

4/6 had nerve root irritation causing leg pain (diagnosed by clinical findings).

All patients had secondary open repair surgery (with a standard microscope-assisted interlaminar approach). One had subsequent fusion surgery at same level.

Clinical outcomes

	Baseline	**Last follow-up**
VAS for leg pain (mean±SD)	8.3±0.9	2.6±1.3
VAS for back pain (mean±SD)	4.1±1.4	2.6±0.9
ODI (mean±SD)	69.6%±11.9%	29.2%±17.2%
Modified MacNab criteria		67% (6/9) had excellent or good outcome.

The final outcome was poor in 2 patients with unrecognised dural tear with nerve root herniation.

Abbreviations used: ODI, Oswestry disability index; SD, standard deviation; VAS, visual analogue scale.

Study 9 Ahn Y (2009)

Details

Study type	**Case series (retrospective)**
Country	South Korea
Recruitment period	2005-7
Study population and number	n=**412**
Age and sex	not reported
Patient selection criteria	Patients with soft lumbar disc herniation manifesting as unilateral radicular leg pain and/or back pain confirmed on CT and MRI, failure of conservative management for >6 weeks. Exclusion criteria: patients with segmental instability, central osseous stenosis, infection, calcified disc herniation, painless weakness and spinal fracture.
Technique	Standard transforaminal endoscopic lumbar discectomy (PELD) was performed under local anaesthesia (fluoroscopic guided posteriolateral transforaminal approach through the foraminal window).
Follow-up	**Mean 21.3 months (range 13-29 months)**
Conflict of interest/source of funding	None reported. The study was supported by a grant from Wooridul Spine Foundation.

Analysis

Study design issues: medical records were retrospectively reviewed and clinical outcomes assessed using VAS (for pain intensity) and ODI (for functional status).

There might be some overlap with the other studies by Ahn in table 2.

Key efficacy and safety findings

Safety

Number of patients analysed: **4**

Symptomatic retroperitoneal haematoma: 0.97% (4/412)

Mean age: 42.5 years (range 31-64 years; 2/4 male).

Mean time to clinical detection: 2.9 hours (range 0.5-4 hours) after PELD.

All had inguinal pain. The mean haematoma volume was 527.9 ml. Two patients with massive diffuse type RPHs compressing their intra-abdominal structures needed open haematoma evacuation and the other 2 patients with small localised RPHs of <100 ml had conservative treatment.

Symptoms improved without any neurological sequelae in 3 and 1 had transient hip flexion weakness and mild dysaesthesia on the lateral thigh which improved in 6 months.

Clinical outcomes

	Baseline	**Last follow-up**
VAS for leg pain (mean±SD)	7.6±0.5	1.8±0.5
VAS for back pain (mean±SD)	4.3±0.9	2±0.8
ODI (mean±SD)	58.8%±7.8%	9.1%±4.8%

Abbreviations used: ODI, Oswestry disability index; PELD, percutaneous endoscopic lumbar discectomy; RPH, retroperitoneal haematoma; SD, standard deviation; VAS, visual analogue scale.

Efficacy

Symptom improvement (back and leg pain)

A systematic review of transforaminal endoscopic surgery for symptomatic lumbar disc herniation reported that the median percentage improvement (measured using a visual analogue scale [VAS] for pain) in non-controlled studies for leg pain was 88% (7 studies, n=1558) and for back pain was 74% (5 studies, n=1401). There was no significant difference in improvement between intradiscal and intracanal techniques (leg pain 83% versus 88%; back pain 75% versus 70%). The controlled studies found no significant difference in leg pain and back pain reduction between transforaminal endoscopic surgery and open lumbar microdiscectomy (leg pain 89% versus 87%; back pain 42% versus -8.3% [1 study, n=200])[1].

A retrospective comparative study of 60 patients comparing transforaminal endoscopic lumbar discectomy (n=30) against interlaminar endoscopic lumbar discectomy (n=30) reported a decrease in mean VAS scores (ranging from 0 to 10, 0 indicating best and 10 worst scores) for leg and back pain at mean 2.2-year follow-up. For transforaminal discectomy, back pain reduced from 5.2 to 2.4 and leg pain reduced from 7.4 to 1.6, whereas for interlaminar discectomy, back pain reduced from 5.5 to 2.4; and leg pain reduced from 7.6 to 1.7 (no significant differences between the groups)[3].

A prospective case series of 89 patients who had transforaminal endoscopic lumbar discectomy using a specially designed fluoroscope and an MRI-equipped operating suite (XMR protocol) reported that postoperative mean VAS scores for back and leg pain improved significantly from 4.0 to 2.3 and from 7.99 to 1.04 respectively[2].

A prospective case series of 55 patients who had transforaminal endoscopic discectomy reported significant improvement in VAS scores for back pain and leg pain at 6 months and 2-year follow-up (all $p<0.05$)[5].

Functional outcomes

Improvement in daily activity (disability score)

The systematic review reported that the median improvement in functional status (assessed using the Oswestry disability index [ODI] questionnaire for low back pain-specific functional disability) for non-controlled studies was 83% [3 studies, n=624][1].

The retrospective comparative study of 60 patients reported improvements in mean ODI scores (ranging from 0 to 100, 0 indicating no disability and 100 maximum disability) from 51% to 15% in the interlaminar group and from 52% to

12% in the transforaminal group at mean 2.2-year follow-up (no significant difference between the groups)[3].

The prospective case series of 89 patients who had transforaminal endoscopic lumbar discectomy using a specially designed fluoroscope and an MRI-equipped operating suite (XMR protocol) reported that postoperative mean ODI decreased from 67.4 to 5.61%[2].

The case series of 55 patients reported significant improvement in North American Spine Score (NASS) for back disability and neurogenic symptoms at 6 months and 2-year follow-up (all $p<0.05$). The mean NASS score for satisfaction with treatment (scores ranging from 1, extremely dissatisfied, to 6, extremely satisfied) was 3.9 at 6 months and 4.7 at 2-year follow-up[5].

Return to work

The systematic review reported that the median percentage of patients in non-controlled studies who returned to work was 90% (5 studies, n=757)[1].

The retrospective comparative study of 60 patients comparing transforaminal endoscopic lumbar discectomy (n=30) against interlaminar endoscopic lumbar discectomy (n=30) reported that the mean time to return to work was 4.9 weeks for the transforaminal group and 4.4 weeks for interlaminar group (no significant difference between the groups)[3].

The case series of 55 patients reported that all patients working preoperatively returned to previous work at a mean time of 24.3 days (range 10–60 days)[5].

Global perceived effect (MacNab score)

The systematic review reported that the median score in global perceived effect for non-controlled studies was satisfactory in 85% and poor in 6% of patients (15 studies, n=2544). There was no significant difference in median scores between intradiscal and intracanal techniques (85% satisfactory [3 studies, n=279] versus 86% satisfactory [12 studies, n=2292]) or between far lateral herniation (86% satisfactory; 2 studies, n=52); central herniation (91% satisfactory; 1 study, n=71) and all types of herniation (83% satisfactory; 9 studies, n=1810). The controlled studies found no significant difference in median global perceived effect score between transforaminal endoscopic surgery and open lumbar microdiscectomy (84% versus 78% satisfactory; 5 studies, n=1102). The sum of ‘excellent’ and ‘good’ scores was reported as ‘satisfactory’[1].

The prospective case series of 89 patients who had transforaminal endoscopic lumbar discectomy using a specially designed fluoroscope and an MRI-equipped operating suite (XMR protocol) reported that as per MacNab criteria, 85% (76/89) patients showed excellent, 8.9% (8/89) good, 3.3% (3/89) fair and 2.2% (2/89) poor results[2].

Patient satisfaction

The systematic review reported that the median percentage of patients in non-controlled studies who were satisfied with treatment was 78% (3 studies, n=181)[1].

Quality of life

The case series of 55 patients who had transforaminal endoscopic lumbar discectomy reported that there was significant improvement in many aspects of quality-of-life scores. These were SF-36 scores for physical function, role physical, bodily pain, vitality, social function, role emotional and mental health (all $p<0.05$, except for general health scores at 6-month and 2-year follow-up, which were 66.4 at baseline, 67.1 at 6 months and 68.5 at 2 years). These improvements correlated with improvements in the NASS score[5].

Incomplete removal of fragments (operative failure)

The comparative study of 60 patients reported incomplete removal of the disc fragments in 3% (1/30) of patients in the transforaminal group and in 7% (2/30) of patients in the interlaminar group. Open surgery was needed in these patients[3].

The case series of 89 patients (who had either highly migrated or sequestered disc fragments preoperatively) reported that remnant disc fragments were seen on intraoperative MRI after first stage transforaminal endoscopic lumbar discectomy in 4.5% (4/89) patients. Reoperation (second stage transforaminal endoscopic discectomy) was needed in these patients[2].

Recurrence

The systematic review reported that the median rate of recurrence in non-controlled studies (13 studies, n=2612) was 1.7% (range 0–12%). Recurrence was defined as reappearance of a symptomatic lumbar disc herniation at the same level within a month or after a pain-free interval of more than a month. There was no significant difference in median recurrence rates between intradiscal (0.7%; 3 studies, n=217) and intracanal techniques (3.2%; 10 studies, n=2395) or between far lateral herniation (2.6%; 2 studies, n=76) and all types of herniation (3.6%; 9 studies, n=2201). The controlled studies found no significant difference in median recurrence rates between transforaminal endoscopic surgery (5.7%) and open lumbar microdiscectomy (2.9%; 4 studies, n=1182). The most common cause of reoperation was persistent symptoms because of missed lateral bony stenosis and remnant fragments[1].

The case series of 55 patients who had transforaminal endoscopic lumbar discectomy reported a recurrence rate of 5% (3/55) at 2-year follow-up. Two patients were treated by open discectomy and 1 patient had conservative treatment. All patients subsequently had lumbar fusion for persistent back pain[5].

Reoperation

The systematic review reported that the median reoperation rate in non-controlled studies was 7% (range 0–27%; 28 studies, n=4135). There was no significant difference in median reoperation rates between intradiscal (7.5%; 14 studies, n=1267) and intracanal techniques (74.6%; 15 studies, n=3098); or between far lateral herniation (8.0%; 5 studies, n=214); central herniation (4.6%; 1 study, n=71) and all types of herniation (5.6%; 15 studies, n=2934). The controlled studies found no significant difference in median reoperation rates between transforaminal endoscopic surgery (6.8%) and open lumbar microdiscectomy (4.7%; 15 studies, n=2934)[1].

Safety

Complications

The systematic review reported that the mean percentage of complications in non-controlled studies was 2.8% (28 studies, n=6336). There was no significant difference in median complication rates between intradiscal (5.3%; 12 studies, n=1206) and intracanal techniques (2.1%; 17 studies, n=5362); or between far lateral herniation (5.1%; 5 studies, n=214); central herniation (2.7%; 1 study, n=71) and all types of herniation (4.9%; 15 studies, n=2934). The controlled studies found no significant difference in median complication rates between transforaminal endoscopic surgery (1.5%) and open lumbar microdiscectomy (1.0%; 6 studies, n=1302). Most reported complications were transient dysaesthesia or hypaesthesia[1].

Post discectomy pseudocyst (cystic lesions of T2W high and T1W low at discectomy site, detected on postoperative MRI)

Post-discectomy pseudocysts were detected on postoperative MRI at 2 months in 1% (15/1503) of procedures in a case series of 1406 patients. The mean interval from surgery to detection was 53.7 days. The interlaminar approach significantly correlated with pseudocyst formation (3%; 9/298) compared with the transforaminal approach (1%; 6/1205) (p=0.001). Ten pseudocysts were treated conservatively and 5 were treated surgically. There was no difference in treatment outcome between conservative and surgical management at a mean follow-up of 25 months[6].

Retroperitoneal haematoma

Symptomatic retroperitoneal haematoma was reported in 1.0% (4/412) of patients in a retrospective case series of 412 patients treated by transforaminal endoscopic surgery. Two patients with massive diffuse type retroperitoneal haematomas compressing their intra-abdominal structures needed open haematoma evacuation. The other 2 patients had small localised retroperitoneal haematomas that were treated conservatively. Symptoms improved without any

neurological sequelae in 3 patients at a median follow-up of 21 months. One patient had transient hip flexion weakness and mild dysaesthesia on the lateral thigh which improved in 6 months[9].

Symptomatic retroperitoneal haematoma (within 2 weeks of surgery) was reported in 2 patients in the case series of 89 patients who had transforaminal endoscopic lumbar discectomy. These patients had open surgery[2].

Dural tears

Symptomatic dural tears were reported in 1.1% (9/816) of patients in a case series of 816 patients treated by transforaminal endoscopic lumbar discectomy. In 3 patients, dural tears were detected intraoperatively (patients complained of headache with back pain as the cerebrospinal fluid leak occurred). Six patients had delayed diagnosis (clinical findings or by MRI) after an average symptom-free interval of 2.5 days and their condition was unresponsive to conservative management. Two of the delayed diagnosis patients had nerve root herniation causing profound leg pain and neurological deficits; 4 had nerve root irritation causing leg pain. All patients had secondary open repair surgery (with standard microscope-assisted interlaminar approach) without any neurological sequelae. One had subsequent fusion surgery at the same level. At a mean follow-up of 30.8 months, the mean VAS of leg and back pain and mean Oswestry disability index [ODI] improved. The final outcome was poor in 2 patients with unrecognised dural tear with nerve root herniation[8].

Spondylodiscitis

Spondylodiscitis (with or without soft tissue infection) was reported in less than 1% (12/9821) of patients in a retrospective case series of 9821 patients treated by transforaminal endoscopic lumbar discectomy. The average time to diagnosis by MRI was 14.6 days. Four patients were treated with antibiotic therapy only; 2 with surgical debridement; the remaining 6 were unresponsive to initial therapies or surgical drainage, and finally had anterior lumbar interbody fusion with posterior instrumentation surgery. At a mean follow-up of 31.7 months, the mean ODI and VAS for leg and back pain improved. Based on the modified MacNab criteria 58% (7/12) of patients had an excellent or good outcome[7].

Discitis (after 4 days) was reported in 1 patient who had transforaminal endoscopic surgery in the case series of 55 patients. The patient was treated with endoscopic washout of the disc space and antibiotics[5].

Sequestered disc

A sequestered disc post-procedure was reported in 1 patient who had transforaminal endoscopic surgery in the case series of 55 patients. The patient was treated by open discectomy[5].

Motor deficit

'Transitory foot drop' was reported in 1 patient and 'transitory sensibility disturbance' of the foot was reported in 3 patients in a retrospective case series of 255 patients who had transforaminal endoscopic lumbar discectomy (no further details were reported)[4].

Validity and generalisability of the studies

- The systematic review of transforaminal endoscopic surgery for symptomatic lumbar disc herniation included only 1 randomised controlled trial. Studies included in the review were heterogeneous and the methodological quality was poor. The non-controlled studies comparing transforaminal endoscopic surgery with open microdiscectomy did not find any statistically significant differences in outcomes. In the review 36 studies specified radiculopathy in the inclusion criteria.
- One study comparing the transforaminal and interlaminar approach did not report any statistically significant differences in outcomes.
- One study evaluated quality of life and it reported that there was significant improvement in all aspects of quality-of-life scores except for general health.
- Most of the studies were from South Korea.
- Studies reported short- to medium-term follow-up.

Existing assessments of this procedure

There were no published assessments from other organisations identified at the time of the literature search.

Related NICE guidance

Below is a list of NICE guidance related to this procedure. Appendix B gives details of the recommendations made in each piece of guidance listed.

Interventional procedures

- Non rigid stabilisation techniques for the treatment of low back pain. NICE interventional procedure guidance 366 (2010). Available from http://guidance.nice.org.uk/IPG366

- Percutaneous intradiscal laser ablation in the lumbar spine. NICE interventional procedure guidance 357 (2010). Available from http://guidance.nice.org.uk/IPG357
- Lateral (including extreme, extra and direct lateral) interbody fusion in the lumbar spine. NICE interventional procedure guidance 321 (2009). Available from http://guidance.nice.org.uk/IPG321
- Percutaneous intradiscal electrothermal therapy for low back pain. NICE interventional procedure guidance 319 (2009). Available from http://guidance.nice.org.uk/IPG319
- Prosthetic intervertebral disc replacement in the lumbar spine. NICE interventional procedure guidance 306 (2009). Available from http://guidance.nice.org.uk/IPG306
- Percutaneous endoscopic laser lumbar discectomy. NICE interventional procedure guidance 300 (2009). Available from http://guidance.nice.org.uk/IPG300
- Percutaneous disc decompression using coblation for lower back pain. NICE interventional procedure guidance 173 (2006). Available from http://guidance.nice.org.uk/IPG173
- Automated percutaneous mechanical lumbar discectomy. NICE interventional procedure guidance 141 (2005). Available from http://guidance.nice.org.uk/IPG141
- Endoscopic laser foraminoplasty. NICE interventional procedure guidance 31 (2003). Available from http://guidance.nice.org.uk/IPG31

Clinical guidelines

- Low back pain: Early management of persistent non-specific low back pain. NICE clinical guideline 88 (2009). Available from http://guidance.nice.org.uk/CG88. This guideline is currently being updated. For more information, see the Low back pain (update) page.

Specialist advisers' opinions

Specialist advice was sought from consultants who have been nominated or ratified by their Specialist Society or Royal College. The advice received is their individual opinion and is not intended to represent the view of the society. The advice provided by Specialist Advisers, in the form of the completed questionnaires, is normally published in full on the NICE website during public consultation, except in circumstances but not limited to, where comments are considered voluminous, or publication would be unlawful or inappropriate. Four Specialist Advisor Questionnaires for percutaneous interlaminar endoscopic lumbar discectomy for sciatica were submitted and can be found on the NICE website [INSERT HYPER LINK TO MAIN IP PAGE].

Patient commentators' opinions

NICE's Public Involvement Programme sent xxx questionnaires to xxx NHS trusts for distribution to patients who had the procedure (or their carers). NICE received xxx completed questionnaires.

Section to be inserted if there is no patient commentary

NICE's Public Involvement Programme was unable to gather patient commentary for this procedure.

Section to be inserted if patient commentators raised no new issues

The patient commentators' views on the procedure were consistent with the published evidence and the opinions of the specialist advisers.

Section to be inserted if patient commentators raised new issues

The patient commentators raised the following issues about the safety/efficacy of the procedure which did not feature in the published evidence or the opinions of specialist advisers, and which the Committee considered to be particularly relevant:

- [insert additional efficacy and safety issues raised by patient commentators and highlighted by IPAC, add extra rows as necessary].
- [Last item in list].

Issues for consideration by IPAC

- Ongoing trials
  - NCT01997086: Percutaneous Transforaminal Endoscopic Discectomy vs Microendoscopic Discectomy for Treatment of Lumbar Disc Herniation; China; RCT; estimated enrolment=345; estimated completion date=August 2023.
  - NCT01622413: Trial to Show Non-inferiority / Superiority of an Endoscopic Transforaminal Discectomy to Standard Microdiscectomy (TESCORT); Austria and Germany; RCT; estimated enrolment=200 (study not yet recruiting); estimated completion date=September 2018.

References

1. Nellensteijn J, Ostelo R et al (2010). Transforaminal endoscopic surgery for symptomatic lumbar disc herniations: a systematic review of the literature. European Spine Journal. 19:181-204.
2. Choi G, Modi HN et al (2013). Clinical results of XMR-assisted percutaneous transforaminal endoscopic lumbar discectomy. Journal of Orthopaedic Surgery and Research. 8(14) 1-8.
3. Choi K-C, Kim J-S et al (2013). Percutaneous endoscopic lumbar discectomy for L5-S1 disc herniation: transforaminal versus interlaminar approach. Pain Physician 16:547-556.
4. Iprenburg M, Goldschal A (2008). Transforaminal endoscopic surgery in lumbar disc herniation in an economic crisis-the TESSYS method. US Musculoskeletal Rev. 3 (2):47-9.
5. Peng CWB, Yeo W et al (2010). Percutaneous endoscopic discectomy: clinical results and how it affects the quality of life. Journal of spinal disorders and techniques. 23 (6) 425-30.
6. Kang SH, Park SW (2011). Symptomatic post-discectomy pseudocyst after endoscopic lumbar discectomy. Journal of Korean Neurological Society. 49:31-36.
7. Ahn Y & Lee SH (2012). Postoperative spondylodiscitis: following transforaminal percutaneous endoscopic lumbar discectomy: clinical characteristics and preventive strategies. British Journal of Neurosurgery 26(4) 482-86.
8. Ahn Y, Lee HY et al (2011). Dural tears in percutaneous endoscopic lumbar discectomy. Eur Spine J 20:58-64.
9. Ahn Y, Kim JU (2009). Postoperative retroperitoneal hematoma following transforaminal percutaneous endoscopic lumbar discectomy. American Association of Neurological Surgeons. 10 (6) 595-602.

Appendix A: Additional papers on percutaneous transforaminal endoscopic lumbar discectomy for sciatica

The following table outlines the studies that are considered potentially relevant to the IP overview but were not included in the main data extraction table (table 2). It is by no means an exhaustive list of potentially relevant studies.

Article	Number of patients/follow-up	Direction of conclusions	Reasons for non-inclusion in table 2
Ahn Y (2012). Transforaminal percutaneous endoscopic lumbar discectomy: technical tips to prevent complications. [Review]. Expert Review of Medical Devices 9 (4) 361-366.	Expert review Transforaminal percutaneous endoscopic lumbar discectomy	There are several guidelines to increase the effectiveness of endoscopic techniques and prevent complications. Initial landing should be as close to the target as possible. Complete herniotomy after release of annular anchorage is a key to success. The definitive end point of the procedure is free mobilization of neural tissues, not direct exposure of neural tissues.	Expert review
Ahn Y Lee, SH et al (2004). Percutaneous endoscopic lumbar discectomy for recurrent disc herniation: surgical technique, outcome, and prognostic factors of 43 consecutive cases. Spine 29 (16) E326-E332.	Case series n=42 with recurrent disk herniations Percutaneous endoscopic lumbar discectomy (posterolateral approach) Follow-up: mean 31 months	Based on the MacNab criteria, 81.4% showed excellent or good outcomes. The mean visual analog scale decreased from 8.72 +/- 1.20 to 2.58 +/- 1.55 (P <0.0001). In our series, better outcomes were obtained in patients younger than 40 years (P = 0.035), patients with duration of symptoms of less than 3 months (P = 0.028), and patients without concurrent lateral recess stenosis (P = 0.007).	Included in systematic review in Nellensteijn 2010.
Ahn Y Lee, SH et al (2009). Transforaminal percutaneous endoscopic lumbar discectomy for upper lumbar disc herniation: Clinical outcome, prognostic factors, and technical consideration. Acta Neurochirurgica.151 (3) 199-206.	Case series n=45 patients with upper lumbar disk herniation PELD for upper lumbar disc herniation Follow-up: 39 months	The outcome of the 45 patients was excellent in 21 (46.7%), good in 14 patients (31.1%), fair in six patients (13.3%), and poor in four patients (8.9%). Four patients with a poor outcome underwent further open surgery. Mean scores on a visual analog scale decreased from 8.38 to 2.36 (P<0.0001). Age less than 45 years and a lateral disc herniation were independently associated with an excellent outcome (P<0.05).	Included in systematic review by Liao 2014.
Birkenmaier C, Komp M et al (2013). The current state of endoscopic disc surgery: review of	Review of literature (PubMed and Embase	Endoscopic techniques had shorter operating times, less blood loss,	Comprehensive review of all endoscopic

controlled studies comparing full-endoscopic procedures for disc herniations to standard procedures. Pain Physician 16 (4) 335-344.	searched) Cervical or lumbar disc herniations. Full endoscopic disc surgery compared to microsurgical standard procedures. 4 RCTs (from 1 group) and 1 controlled study were included.	less operative site pain, and faster postoperative rehabilitation/shorter hospital stay/faster return to work than the microsurgical techniques. There were no significant differences in the main clinical outcome criteria between the endoscopic and the microsurgical techniques in any of the trials. All 5 studies had fewer complications with the endoscopic technique and this was statistically significant in 2 of the studies. One study showed a lower rate of revision surgeries requiring arthrodesis with the endoscopic technique	techniques (transforaminal, interlaminar, lumbar, anterior transdiscal cervical).
Cahichankul C et al (2012). The effect of learning curve on the results of percutaneous transforaminal endoscopic lumbar discectomy. J Med Assoc Thai. 95, S206-S212.	Retrospective case series n=50 PTELD in patients with symptomatic herniated discs Follow-up: 6 weeks	Statistical significant improvement at 6 week follow-up was reported for VAS leg pain. The amount of surgical volume has an influence in the improvement of the VAS of leg pain and the adequacy of disc compression.	Learning curve. Short follow-up.
Chae KH, Ju C et al (2009). Strategies for non-contained lumbar disc herniation by an endoscopic approach: transforaminal suprapendicular approach, semi-rigid flexible curved probe, and 3-dimensional reconstruction CT with discogram. J Korean Neurosurgery Soc. 46:312-316.	Case series n=153 patients with difficult non-contained lumbar disc herniations. Transforaminal suprapendicular approach, semi-rigid flexible curved probe, and 3-dimensional reconstruction CT with discogram. Mean follow-up:18 months.	The mean visual analogue scale (VAS) of the patients prior to surgery was 9.48, and the mean postoperative VAS was 1.63. According to MacNab criteria, 145 patients had excellent and good results and thus satisfactory results were obtained.	Preoperative 3D CT images with a discogram and a semi rigid flexible curved probe are used to the general PTELD. Minor variation.
Chiu JC (2004). Evolving transforaminal endoscopic micro decompression for herniated lumbar discs and spinal stenosis. Surgical technology international.13, 276-286.	Case series n=2000 with herniated lumbar discs. Transforaminal endoscopic micro-decompression.	No postoperative mortalities occurred, and the morbidity rate was less than 1%, in the 2000 patients. For a single level, 94% of the patients had good or excellent results; 6% had some residual symptoms although improved overall.	Included in systematic review in Nellensteijn 2010.
Cho JY et al (2011). Prevention of development of postoperative	Case series	Mean operative time was 36 minutes. Mean	Larger and longer follow-up studies

dysesthesia in transforaminal percutaneous endoscopic lumbar discectomy for intracanalicular lumbar disc herniation: floating retraction technique. Minim Invas Neurosurg 54:214-218.	n=154 LDH TFELD: floating retraction technique Follow-up: mean 3.4 years.	hospital stay was 1.8 days. No patient underwent repeat surgery. All patients experienced relief of symptoms, as determined by VAS and ODI. No patient developed POD, 1 had dural injury, 1 case of discitis. Recurrence rate was 1.95% (n=3).	were included in table 2.
Choi I, Anh J-O et al (2013) Exiting root injury in transforaminal endoscopic discectomy: preoperative image considerations for safety. Eur Spine . 22: 2481-87.	Retrospective cohort study n=233 Patients who had PELD for lumbar disc herniation. The distance from the exiting root injury to the facet at the lower disc level was measured using MRI.	Group A (n=20) those who had postoperative exiting root injury – exhibited a shorter distance from the root injury to the lower facet and longer operative time relative to group B (n=20, who did not have a root injury).	Study assessed radiological risk factors for exiting root injury during PELD. Root injury (motor weakness and POD) reported in studies in table 2.
Dalbayrak S, Yaman O et al (2014). Transforaminal approach in thoracal disc pathologies: transforaminal microdiscectomy technique. Minimally Invasive Surgery 2014 301945-	Case series n=42 with disc hernias in the medial of the pedicle Tansforaminal approach without an endoscope Follow-up: mean 30.2 months	The procedure took 65 minutes in the average, and the mean bleeding amount was about 100cc. They were mobilized within the same day postoperatively. No complications were seen.	No endoscope used.
Ditsworth DA (1998). Endoscopic transforaminal lumbar discectomy and reconfiguration: A posterolateral approach into the spinal canal. Surgical Neurology.49 (6) 588-598.	Case series n=110 LDH endoscopic transforaminal lumbar procedures Follow-up: 2 -4 years	Using MacNab's criteria, the success rate (excellent or good) was 95% in the 75 patients with disc presenting lateral to the dura - 'lateral presenting,' - and 83% in the 35 patients not presenting disc for direct removal - 'non-lateral presenting' (i.e., dura in the pathway) - making an overall success rate of 91%. One patient who developed discitis was the only complication.	Included in systematic review in Nellensteijn 2010.
Gibson JN, Cowie JG, and Iprenburg M (2012). Transforaminal endoscopic spinal surgery: the future 'gold standard' for discectomy? - A review. Surgeon Journal of the Royal Colleges of Surgeons of Edinburgh	Systematic Review +RCT (unpublished results) Transforaminal endoscopic spinal surgery (TESS)	Based on current evidence there are good arguments supporting a more wide-spread adoption of transforaminal endoscopic surgery for	Systematic review Studies reviewed were already included in Nellensteign 2010. Safety outcomes from unpublished

& Ireland 10 (5) 290-296.	using HD-video technology, comparing with microdiscectomy	the treatment of lumbar disc prolapse with or without foraminal stenosis. Outcomes following surgery are at least equivalent to those following microdiscectomy.	study already reported in table 2.
Gotfryd A, Avanzi O (2009). A systematic review of randomised clinical trials using posterior discectomy to treat lumbar disc herniations. Int Orthop 33 (1):11-7	Systematic review		Different discectomy techniques reviewed.
Hermantin FU et al (1999). A prospective. Randomised study comparing the results of open discectomy with those of video-assisted arthroscopic microdiscectomy. The Journal of Bone and Joint Surgery. 81: 958-965.	Randomised controlled trial n=60 intracanicular lumbar dis herniation. Group 1 (video assisted arthroscopic microdiscectomy) vs group 2 (open laminotomy and discectomy) Follow-up: mean 32 months.	93-97% patients in the 2 groups had a satisfactory outcome. Patients in group 1 used nacrotics for longer duration, returned to work later than group 2. No complications or infections were noted.	Included in systematic review in Nellensteijn 2010.
Hirano Y, Mizuno J etal (2012). Percutaneous endoscopic lumbar discectomy-early clinical experience. Neurologia medico-chirurgica. 52:625-630.	Case series n=37 (28 transforaminal, 5 interlaminar, 4 extraforaminal)	Surgery was discontinued due to intraoperative pain or anatomical inaccessibility in 1 interlaminar and 2 extraforaminal approach cases. Immediate symptom relief was achieved in all, hospital stay was 1-2 days.	Results not reported separately for transforaminal and interlaminar approach.
Hoogland T, Schubert M et al (2006). Transforaminal posterolateral endoscopic discectomy with or without the combination of a low-dose chymopapain: A prospective randomized study in 280 consecutive cases. Spine.31 (24) E890-E897.	RCT n=280 patients with a primary herniated, including sequestrated, lumbar disc with predominant leg pain. TFED vs TFED with low dose chymopapain injection. Follow-up: 2 years.	At 3-months only minor complications were registered. At 1-year, group 1 (endoscopy alone) had a recurrence rate of 6.9% compared to group 2 (the combination therapy), with a recurrence rate of 1.6%, which was a statistically significant difference in favor of the combination therapy (P = 0045). At the 2-year follow-up, group 1 reported that 85.4% had an excellent or good result, 6.9% a fair result, and 7.7% were not satisfied. At the 2-year follow-up, group 2 reported that 93.3% had an excellent or good	Included in systematic review in Nellensteijn 2010.

		result, 2.5% a fair result, and 4.2% were not satisfied. This outcome was statistically significant in favor of the group including chymopapain. There were no infections or patients with any form of permanent iatrogenic nerve damage, and no patients had a major complication.	
Hoogland T, Brekel-Dijkstra K et al (2008). Endoscopic transforaminal discectomy for recurrent lumbar disc herniation: A prospective, cohort evaluation of 262 consecutive cases. Spine.33 (9) 973-978.	Case series n=262 recurrent LDH TFED Follow-up: 24 months	At 2-year follow-up 85.71% of patients rated the result of the surgery as excellent or good. 9.66% reported a fair and 4.62% patients an unsatisfactory result. Average improvement of back pain of 5.71 points and 5.85 points of leg pain on the VAS scale (1-10). According to Mac Nab, 30.67% of the patients felt fully regenerated, 50% felt their functional capacity to be slightly restricted, 16.81% felt their functional capacity noticeably restricted, and 2.52% felt unimproved or worse. All patients participated in a 3-month follow-up to establish the perioperative complications. The overall complication rate was 10/262 (3.8%), including 3 nerve root irritations and 7 early recurrent herniations (<3 month). There was no case of infection or discitis. After 3 months and within 2 years, 4 patients have been treated for a recurrent herniated disc in our own center and 7 patients have been treated elsewhere, resulting in a recurrence rate 11/238 (4.62%).	Included in systematic review in Nellensteijn 2010.

Hsu HT, Chang SJ et al (2013). Learning curve of full-endoscopic lumbar discectomy. European Spine Journal 22 (4) 727-733.	Case series n= 57 Full endoscopic discectomy (34 transforaminal approach and 22 interlaminar approach) versus 66 open micro discectomy Follow-up: mean 20.4 months.	After full-endoscopic lumbar discectomy, the VAS and ODI results of the patients followed up were comparable with those of open microdiscectomy. A steep learning curve was observed for the transforaminal procedure, but not the interlaminar procedure.	Results not reported separately for transforaminal and interlaminar approach. Only comparison of complications between TF and IL approach was reported.
Jang J.-S, An S.-H, and Lee S.-H (2006). Transforaminal percutaneous endoscopic discectomy in the treatment of foraminal and extraforaminal lumbar disc herniations. Journal of Spinal Disorders and Techniques.19 (5) 338-343.	Case series n=35 foraminal and extraforaminal lumbar disc herniation posterolateral endoscopic discectomy Follow-up: median 18 months	The mean Visual Analog Score improved from 8.6 before the surgery to 3.2 after the surgery. Overall, excellent or good outcomes were obtained in 30 (85.7%) of the 35 patients at the last follow-up examination, with both these outcomes showing statistically significant improvement (P<0.01). There were no complications related to the surgery, nor was any spinal instability detected. Three patients (8.6%) experienced persistent radiculopathy and subsequently underwent open microdiscectomy at the same level.	Included in systematic review in Nellensteijn 2010.
Jasper GP, Francisco GM et al (2013). Endoscopic transforaminal discectomy for an extruded lumbar disc herniation. Pain Physician 16 (1) E31-E35.	Case report n=1 lumbar herniated disc fragment Transforaminal endoscopic discectomy Follow-up: 3 months	At 6 week and 3 month follow-up, the patient reported pain relief between 90-100%.	Larger and longer follow-up studies included in table 2.
Jasper GP, Francisco GM et al (2014). Outpatient, awake, ultra-minimally invasive endoscopic treatment of lumbar disc herniations. Rhode Island Medical Journal. June, 47-49.	Comparative case series n=41 patients with lower back and radicular pain and L5-S1 herniated disk Endoscopic procedure (24 transforaminal vs 17 interlaminar approach) Follow-up: 1 year	The average pain relief at1- year was 75.9% for TF group and 75.3 for IL group, both excellent results defined by MacNab. The average 1 year VAS scores reduced from 8.2 to 1.7 in TF group and from 8.4 to 2.1 in IL group (from severe and constant pain to Mild and intermittent pain). There were no complications.	Larger and longer follow-up studies included in table 2.

Kafadar A, Kahraman S, and Akboru M (2006). Percutaneous endoscopic transforaminal lumbar discectomy: a critical appraisal. Minimally Invasive Neurosurgery 49 (2) 74-79.	Case series n=42 Percutaneous endoscopic transforaminal lumbar discectomy Follow-up: 15 months	Excellent and good results were evaluated as successful and the overall success rate is 77 %. All six patients with foraminal disc herniations in whom a free fragment could be removed had excellent results	Included in systematic review in Nellensteijn 2010.
Kim MJ, Lee SH et al (2007). Targeted percutaneous transforaminal endoscopic diskectomy in 295 patients: comparison with results of microscopic diskectomy. Surgical Neurology 68 (6) 623-631.	Comparative case series n=915 patients with unilateral lumbar disk herniations. PTED 301 vs microscopic discectomy 614 Follow-up: 18 months	Good or excellent results were obtained in 84.7% and 85.0% of groups A and B (P = .92). The rates of recurrence were 6.44% and 6.75% in groups A and B (P > .05). Twenty-eight patients (14 cases of recurrence, 5 cases of incomplete removal, 5 cases of stenosis, 2 cases of diskogenic back pain, and 2 cases of diskitis) in group A and 38 patients (26 cases of recurrence, 6 cases of incomplete removal, 2 cases of stenosis, 2 cases of diskogenic back pain, 1 case of hematoma, and 1 case of diskitis) in group B underwent reoperation.	Included in systematic review in Nellensteijn 2010.
Kim JS, Choi G., and Lee SH (2011). Percutaneous endoscopic lumbar discectomy via contralateral approach: a technical case report. Spine 36 (17) E1173-E1178.	Case series n=5 Leg pain because of a soft disc herniation at L4-L5. Transforaminal PELD via a contralateral approach Follow-up: 48 hours	The symptom was relieved and the patient was discharged the next day.	Larger and longer follow-up studies included in table 2.
Kim CH, Chung CK et al (2014). The surgical outcome and the surgical strategy of percutaneous endoscopic discectomy for recurrent disk herniation. Journal of spinal disorders and techniques. 27: 415-422.	Case series (retrospective) n=26 recurrent intervertebral herniated disk herniations Transforaminal PELD11 vs Interlaminar 15) Follow-up: 19 months	In all recurrent disk material was removed successfully, postoperative MRI confirmed this, An excellent to good outcome (by MacNab's criteria) was achieved in 81% (n=21) patients.re-recurrence occurred in 2 patients at 6 and 12 months postoperatively.	Results not reported separately for transforaminal and interlaminar approach.
Kim HS, Chang Il Ju et al (2009). Endoscopic transforaminal suprapedicular approach in high grade inferior migrated lumbar disc	Case series n=53 high grade inferior migrated	The mean postoperative VAS for leg pain was 9.32 points where as the mean ODI was 79.82	Larger and longer follow-up studies included in table 2.

herniation. J Korean Neurosurgery Society. 45: 67-73.	lumbar disc herniations (L2-3 in 2 cases, L3-4 in 14, L4-5 in 39 cases). Single piece type in 34 cases and multiple piece type in 19 cases. Endoscopic transforaminal suprapedicular approach with a flexible semi-rigid curved probe. Follow-up: mean 9.8 months	points. At last follow-up, the mean postoperative VAS for leg pain was 1.78 points and the ODI improved to 15.27 points.	
Kleinpeter G, Markowitsch MM, and Bock F. Percutaneous endoscopic lumbar discectomy: minimally invasive, but perhaps only minimally useful? Surgical Neurology 43 (6) 534-539.540.	Comparative case series n=326 patients with lumbar disc herniations. (313 Open lumbar discectomy vs 13 PELD). Follow-up: 1 month	Only 4% (13/326) were suitable for PELD. Of these, 8 were operated on percutaneously. Within the first postoperative month, 62.5% (5 patients) of the PELD group required open surgery for definitive treatment, whereas only 14 (4%) of the 313 OLDS patients had to undergo additional surgery	Larger and longer follow-up studies included in table 2. (Not sure if PELD is transforaminal approach).
Kuonsongtum V, Paiboonsirijit S et al (2009). Result of full endoscopic uniportal lumbar discectomy: preliminary report. Journal of the Medical Association of Thailand 92 (6) 776-780.2009.	Case series n=46 (34 interlaminar, 12 transforaminal) Full endoscopic uniportal lumbar discectomy. Follow-up: postoperative	Excellent and good outcome was achieved in 87.4% of patients from Modified MacNab criteria. Forty-three patients (93.5%) had significant improvement of sciatic pain immediately after the operation. Eight postoperative complications were demonstrated and discussed.	Results not reported separately for transforaminal and interlaminar approach.
Lee SH, Chung SE et al (2006). Comparative radiologic evaluation of percutaneous endoscopic lumbar discectomy and open microdiscectomy: a matched cohort analysis. Mount Sinai Journal of Medicine 73 (5) 795-801.	Matched cohort study n=60 30 PELD vs 30 open microdiscectomy Follow-up: 3 years	The successful clinical outcomes were 96.7% in the PELD group and 93.3% in the OLM group. Among the various radiological parameters, changes of disc height (1.41 +/- 1.19 mm in the PELD group and 2.29 +/- 2.12 mm in the OLM group, p=0.024) and foraminal height (1.26 +/- 0.91 mm in the PELD group and 1.85 +/- 0.92 mm in the OLM group, p=0.017) were	Included in systematic review by Nellensteign 2010.

		significantly different between the two groups.	
Lee DY, Shim CS et al (2009). Comparison of percutaneous endoscopic lumbar discectomy and open lumbar microdiscectomy for recurrent disc herniation. Korean Neurosurgical society. 46 (6), 515-21.	Case series (retrospective) n=54 lumbar recurrent herniations. 25 TF endoscopic lumbar sequestrectomy and disc compression versus 29 open microsurgical sequestrectomy. Follow-up: average 34 months	The key findings were reduced operating time (46 vs 74 minutes) and a shorter average stay in hospital (0.9 vs 3.8 days) with the endoscopic technique. Clinical outcome and complication rates were not significantly different between the techniques.	Study included in Birkenmaier C 2013 review. Nellensteign 2010 reports similar results.
Lew SM, Mehalic TF et al (2001). Transforaminal percutaneous endoscopic discectomy in the treatment of far-lateral and foraminal lumbar disc herniations. Journal of Neurosurgery.94 (2) 216-220.	Case series n=47 far-lateral and foraminal LDH percutaneous transforaminal endoscopic approach Follow-up: median 18 months	Excellent or good outcome was obtained in 40 (85%) of 47 patients. Of the 38 patients working before the onset of symptoms, 34 (90%) returned to work. Five patients (11%) experienced poor outcomes and subsequently underwent open procedures at the same level. Of the 10 recipients of Workers' Compensation, MacNab criteria indicated a significantly worse outcome (70% excellent or good), but an excellent return-to-work status was maintained (90%). There were no complications.	Included in systematic review by Nellensteign 2010.
Liao Z, Chen W et al (2014). Transforaminal percutaneous endoscopic surgery for far lateral lumbar intervertebral disk herniation. Orthopedics 37 (8) e717-27	Case series+ systematic review n=15 patients with far lateral lumbar intervertebral disk herniation. Follow-up: median 6 months	Median operative time was 100 minutes. Median volume of blood loss was 20ml. MacNab's criteria rated surgical outcomes as excellent by 12, good 2, fair 1. The systematic review included 14 studies. Transforaminal endoscopic surgery appears to be a safe and effective minimally invasive procedure for treating FLLIDH.	Narrative synthesis of results. Some studies included in systematic review by Nellensteign 2010.
Mayer HM. and Brock M (1993). Percutaneous endoscopic lumbar discectomy (PELD).	Case series n=30 patients with non sequesterated	Results are excellent in 13 cases, good in 9 cases, fair in 6 cases,	Larger and longer follow-up studies included in table 2.

Neurosurgical Review 16 (2) 115-120.	lumbar disc herniations PELD (via posterior-lateral approach)	and bad in 2 cases. The relief of symptoms as judged by the patients was between 70-100 percent in the majority of the cases. Three patients had to be reoperated at the same level and site, because of either persistent or recurrent sciatica.	
Molyneux S, Spens HJ et al (2012). Transforaminal endoscopic or micro-discectomy: early results of a randomised controlled trial. J Bone Surg Br Proc 94-B 085-85	Randomised controlled trial n=48 Transforaminal endoscopic lumbar discectomy 25 versus microdiscectomy 23	3 months following surgery leg pain scores had decreased by 55 and 65% in the 2 groups. Patient satisfaction ratings were equal. ODI had decreased 15 points in both groups by 1yr and this improvement was maintained to 2 years (final scores: 7±3 TES v.14±13 Micro - means ±SD; p<0.05). Similar changes were noted in SF36-P. Mean bed stay was lower in the TES group (16 v. 40 hours). There were no immediate complications. One revision was required at 12 months (TES) and one at 18 months (Micro). Two patients presented with a disc prolapse at a different level and side (both TES).	Conference abstract. Safety outcomes already reported in table 2.
Ramsbacher J et al (2000). Transforaminal endoscopic sequestrectomy: indications, operative technique, and first clinical experience. Neurosurgery Quarterly 10: 224-227.	Case series n=39 Transforaminal endoscopic sequestrectomy. Follow-up: 6 weeks	2 patients' required subsequent conventional microsurgery and 2 suffered a recurrence. Patient satisfaction 6 weeks after surgery was rated very high (54%), high (23%), moderate (15%), and low (8%).	Included in systematic review by Nellensteijn 2010.
Ruetten S, Komp M et al (2009). Recurrent lumbar disc herniation after conventional discectomy: a prospective, randomized study comparing full-endoscopic interlaminar and transforaminal versus microsurgical revision. Journal of Spinal Disorders & Techniques 22 (2) 122-129.	RCT n= 100 patients with recurrent lumbar disc herniations after conventional discectomy, Full-endoscopic (interlaminar and transforaminal technique) (n=50) versus microsurgical	Postoperatively, 79% of the patients no longer had leg pain, and 16% had occasional pain. The clinical results of the full-endoscopic technique are equal to those of the microsurgical technique. The re-recurrence rate was 5.7% with no difference between the groups. The full-endoscopic techniques brought significant	Results not differentiated between endoscopic transformainal and interlaminar approaches.

	discectomy (n=50). Follow-up: 2 years	advantages in the following areas: rehabilitation, complications, and traumatization.	
Ruetten S, Komp M et al (2007). Use of newly developed instruments and endoscopes: full-endoscopic resection of lumbar disc herniations via the interlaminar and lateral transforaminal approach. Journal of Neurosurgery Spine 6 (6) 521-530.	Case series (prospective) n=234 Full-endoscopic lateral transforaminal (n=153) and interlaminar (n=111) resection of herniated lumbar discs (with new instruments) Follow up: 2 years	Postoperatively 84% of the patients no longer had leg pain, and 12% had only occasional pain. The results of decompression were equivalent to those of conventional procedures. The incidence of traumatization was reduced. Epidural scarring was minimized. The recurrence rate was 6.0%. No serious surgical complications were observed. Resection of the herniated disc was technically possible in all cases in which the new instruments were used.	Results not differentiated between endoscopic transformainal and interlaminar approaches.
Ruetten S, Komp M et al (2008). Full-endoscopic interlaminar and transforaminal lumbar discectomy versus conventional microsurgical technique: a prospective, randomized, controlled study. Spine 33 (9) 931-939.	Randomised controlled trial n=200 Transforaminal 41 + interlaminar 59 vs microdiscectomy 100 Follow-up: 2 years	After surgery 82% of the patients no longer had leg pain, and 14% had occasional pain. The clinical results were the same in both groups. The recurrence rate was 6.2% with no difference between the groups. The full-endoscopic techniques brought significant advantages in the following areas: back pain, rehabilitation, complications, and traumatization.	Included in systematic review by Nellensteign 2010. Some results presented separately but not clinical outcomes.
Sairyo K, Egawa H et al (2014). State of the art: Transforaminal approach for percutaneous endoscopic lumbar discectomy under local Anesthesia. Journal of Medical Investigation.61 (3-4) 217-225.	Review and case report n=3 Percutaneous endoscopic discectomy (PED) with a transforaminal approach	Review explains the state-of-the-art PED transforaminal technique for minimally invasive disc surgery and presents three successful cases.	Review, larger and longer follow-up studies included in table 2.
Sencer A, Yorukoglu AG et al (2014). Fully endoscopic interlaminar and transforaminal lumbar discectomy: short-term clinical results of 163 surgically treated patients. World Neurosurgery 82 (5) 884-890.	Case series n=163 patients with lumbar disc disease Fully endoscopic lumbar discectomy (71 Transforaminal,	During the follow-up period, 114 (70%) patients had no complaints, 30 (18%) patients had occasional pain, and 19 (12%) patients had no improvement. During postoperative follow-up, 8 patients required	Results not differentiated between endoscopic transformainal and interlaminar approaches.

	104 interlaminar approach) Follow-up: not reported	repeat surgery for recurrence or residual fragments. Postoperatively, 4 patients experienced dysesthesia, which completely resolved in time. Neurologic deterioration occurred in 5 patients, 4 of whom recovered completely without any intervention. Dural tears occurred in 6 patients.	
Schubert M and Hoogland T (2005). Endoscopic transforaminal nucleotomy with foraminoplasty for lumbar disk herniation. Operative Orthopadie und Traumatologie 17 (6) 641-661.	Case series n=611 patients with sequestered lumbar disk endoscopic transforaminal nucleotomy with foraminoplasty Follow-up: 2 years	Excellent or good results were achieved in 95.3% of the patients. 74.7% were very satisfied, 20.6% satisfied. The result was judged unsatisfactory by 4.7% of patients (less satisfied 3.9%, unsatisfied 0.8%). The numbness of the leg, present in 448 patients preoperatively, was either no longer present (63.9%) or had improved (30.3%). There were no serious complications, in particular no infections. The recurrence rate was 3.6%.	Included in systematic review by Nellensteign 2010.
Sasani M, Ozer AF et al (2007). Percutaneous endoscopic discectomy for far lateral lumbar disc herniations: Prospective study and outcome of 66 patients. Minimally Invasive Neurosurgery.50 (2) 91-97.	Case series n=66 patients with far lateral LDH. Percutaneous endoscopic discectomy Follow-up: 12 months	3 patients were reoperated due to recurring disk problems, in 2 root nerves were partially damaged, and I 2 root nerves were impinged by the working channel. The 4 patients had dysesthesias to a mean of 45 days. Patients also had minimal muscle weakness and diminished sensation of L4 area. all patients improved and became normal.	Included in systematic review by Nellensteign 2010.
Sencer A, Yorukoglu AG, Akcakaya MO et al. (2014) Fully endoscopic interlaminar and transforaminal lumbar discectomy: short-term clinical results of 163 surgically treated patients. World Neurosurgery 82:884-890.	Case series n=163 fully endoscopic surgery (transforaminal and interlaminar approaches) Follow-up: 1 year	114 (70%) patients had no complaints, 30 (18%) patients had occasional pain, and 19 (12%) had no improvement. During postoperative follow-up, eight patients required repeat surgery due to recurrence or residual fragments. Postoperatively, four	Larger studies included in table 2. Adverse events reported in table 2.

		patients experienced dysesthesia, which completely resolved in time. Five patients deteriorated neurologically, four of whom recovered completely without any intervention. Dural tears occurred in six patients.	
Wang H, Huang B, et al (2013). Learning curve for percutaneous endoscopic lumbar discectomy depending on the surgeon's training level of minimally invasive spine surgery. Clinical Neurology & Neurosurgery 115 (10) 1987-1991.	Comparative case series n=120 (group A –surgeon with little PELD training 60 vs group B surgeon with 2 years PELD experience 60)	Significant differences were observed in the operation time (p=0.000), postoperative hospital stay (p=0.026) and reoperation rate (p=0.050) between the two groups. In the operation time, significant differences were observed between the 1-20 patients group and 41-60 patients group in Group B (p=0.041), but there were no significant differences among the 1-20 patients group, 21-40 patients group and 41-60 patients group in Group A. In the postoperative hospital stay, the significant differences were observed in the 1-20 patients group between Group A and Group B (p=0.011). Significant differences were observed between preoperative and postoperative VAS back score, VAS leg score and JOA score. Higher improvement in the VAS leg score was observed in Group B than Group A (p=0.031). In the rate of reoperation, the significant difference was observed between the 1-20 patients group and 41-60 patients group in Group A (p=0.028) but there were no significant differences among the 1-20 patients group, 21-40 patients group and 41-60 patients group in Group B.	Larger and longer follow-up studies included in table 2. Not clear if its transforaminal approach.
Rasouli MR et al (2014). Minimally invasive discectomy versus microdiscectomy/open discectomy	Systematic review comparing the benefits and	MID may be inferior in terms of relief of leg pain, LBP and re-	The review has assessed different minimally invasive

for symptomatic lumbar disc herniation. *Cochrane Database of Systematic Reviews* 2014, Issue 9. Art. No.:CD010328. DOI: 10.1002/14651858.CD010328.pub2.	harms of MID versus MD/OD for management of lumbar intervertebral discopathy.	hospitalisation; however, differences in pain relief appeared to be small and may not be clinically important. Potential advantages of MID are lower risk of surgical site and other infections. MID may be associated with shorter hospital stay but the evidence was inconsistent. Given these potential advantages, more research is needed to define appropriate indications for MID as an alternative to standard MD/OD.	procedures-percutaneous nucleotomy, automated percutaneous discectomy, percutaneous endoscopic lumbar discectomy and transmuscular tubular microdiscectomy.

Appendix B: Related NICE guidance for percutaneous transforaminal endoscopic lumbar discectomy for sciatica

Guidance	Recommendations
Interventional procedures	**Non rigid stabilisation techniques for the treatment of low back pain. NICE interventional procedure guidance 366 (2010).** 1.1 Current evidence on the efficacy of non-rigid stabilisation techniques for the treatment of low back pain shows that these procedures are efficacious for a proportion of patients with intractable back pain. There are no major safety concerns. Therefore these procedures may be used provided that normal arrangements are in place for clinical governance, consent and audit. 1.2 Patient selection should be carried out by specialist spinal surgeons who are able to offer patients a range of surgical treatment options. **Percutaneous intradiscal laser ablation in the lumbar spine. NICE interventional procedure guidance 357 (2010).** 1.1 Current evidence on the safety and efficacy of percutaneous intradiscal laser ablation in the lumbar spine is adequate to support the use of this procedure provided that normal arrangements are in place for clinical governance, consent and audit. 1.2 Patients selected for the procedure should be limited to those with severe pain refractory to conservative treatment, in whom imaging studies show bulging of an intact disc, and who do not have neurological deficit requiring surgical decompression. **Lateral (including extreme, extra and direct lateral) interbody fusion in the lumbar spine. NICE interventional procedure guidance 321 (2009).** 1.1 Current evidence on the safety and efficacy of lateral (including extreme, extra and direct lateral) interbody fusion in the lumbar spine is inadequate in quantity and quality. Therefore this procedure should only be used with special arrangements for clinical governance, consent and audit or research. 1.2 Clinicians wishing to undertake lateral interbody fusion in the lumbar spine should take the following actions. • Inform the clinical governance leads in their Trusts. • Ensure that patients and their carers understand the uncertainty about the procedure's safety and efficacy and provide them with clear written

	information. In addition, the use of NICE's information for patients ('Understanding NICE guidance') is recommended. • Audit and review clinical outcomes of all patients having lateral interbody fusion in the lumbar spine (see section 3.1). 1.3 This procedure should only be carried out by surgeons with specific training in the technique, who should perform their initial procedures with an experienced mentor. 1.4 NICE encourages further research into lateral interbody fusion in the lumbar spine. Research outcomes should include fusion rates, pain and functional scores, quality of life measures and the frequency of both early and late complications. NICE may review the procedure on publication of further evidence. **Percutaneous intradiscal electrothermal therapy for low back pain. NICE interventional procedure guidance 319 (2009).** 1.1 Current evidence on the safety and efficacy of percutaneous intradiscal electrothermal therapy for low back pain is inconsistent. Therefore this procedure should only be used with special arrangements for clinical governance, consent and audit or research. 1.2 Clinicians wishing to undertake percutaneous intradiscal electrothermal therapy for low back pain should take the following actions. • Inform the clinical governance leads in their Trusts. • Ensure that patients and their carers understand the uncertainty about the procedure's safety and efficacy and provide them with clear written information. In addition, the use of NICE's information for patients ('Understanding NICE guidance') is recommended. • Audit and review clinical outcomes of all patients having percutaneous intradiscal electrothermal therapy for low back pain (see section 3.1). 1.3 NICE encourages further research into percutaneous intradiscal electrothermal therapy for low back pain. Research should describe patient selection, use validated measures of long-term pain relief and quality of life, address the role of the procedure in avoiding major surgery, and measure long-term safety outcomes. **Prosthetic intervertebral disc replacement in the lumbar spine. NICE interventional procedure guidance 306 (2009).** 1.1 Current evidence on the safety and efficacy of prosthetic intervertebral disc replacement in the lumbar spine is adequate to support the use of this procedure provided that normal arrangements are in place for clinical governance, consent and audit.

	1.2 A multidisciplinary team with specialist expertise in the treatment of degenerative spine disease should be involved in patient selection for prosthetic intervertebral disc replacement in the lumbar spine. The procedure should only be carried out in patients for whom conservative treatment options have failed or are contraindicated. 1.3 The current evidence includes studies with a maximum follow-up of 13 years, but the majority of evidence is from studies with shorter durations of follow-up. NICE encourages clinicians to continue to collect and publish data on longer-term outcomes, which should include information about patient selection and the need for further surgery. **Percutaneous endoscopic laser lumbar discectomy. NICE interventional procedure guidance 300 (2009).** 1.1 Current evidence on the safety and efficacy of percutaneous endoscopic laser lumbar discectomy is inadequate in quantity and quality. Therefore this procedure should only be used with special arrangements for clinical governance, consent, and audit or research. 1.2 Clinicians wishing to undertake percutaneous endoscopic laser lumbar discectomy should take the following actions. • Inform the clinical governance leads in their Trusts. • Ensure that patients and their carers understand the uncertainty about the procedure's safety and efficacy and provide them with clear written information. In addition, the use of NICE's information for patients ('Understanding NICE guidance') is recommended. • Audit and review clinical outcomes of all patients having percutaneous endoscopic laser lumbar discectomy (see section 3.1). 1.3 Surgeons undertaking this procedure should have specific training in the use of lasers and in endoscopy of the spinal canal. 1.4 NICE encourages further research into percutaneous endoscopic laser lumbar discectomy and may review the procedure on publication of further evidence. Research studies should provide long-term outcome data. **Percutaneous disc decompression using coblation for lower back pain. NICE interventional procedure guidance 173 (2006).** 1.1 Current evidence suggests that there are no major safety concerns associated with the use of percutaneous disc decompression using coblation for lower back pain. There is some evidence of short-term efficacy; however, this is not sufficient to support the use of this procedure without special arrangements for consent and for audit or research.

	1.2 Clinicians wishing to undertake percutaneous disc decompression using coblation for lower back pain should take the following actions. • Inform the clinical governance leads in their Trusts. • Ensure that patients understand the uncertainty about the procedure's efficacy and provide them with clear written information. Use of the Institute's information for the public is recommended. • Audit and review clinical outcomes of all patients having percutaneous disc decompression using coblation for lower back pain. 1.3 Further research will be useful in reducing the current uncertainty, and clinicians are encouraged to collect long-term follow-up data. The Institute may review the procedure upon publication of further evidence. **Automated percutaneous mechanical lumbar discectomy. NICE interventional procedure guidance 141 (2005).** 1.1 Current evidence suggests that there are no major safety concerns associated with automated percutaneous mechanical lumbar discectomy. There is limited evidence of efficacy based on uncontrolled case series of heterogeneous groups of patients, but evidence from small randomised controlled trials shows conflicting results. In view of the uncertainties about the efficacy of the procedure, it should not be used without special arrangements for consent and for audit or research. 1.2 Clinicians wishing to undertake automated percutaneous mechanical lumbar discectomy should take the following actions. • Inform the clinical governance leads in their Trusts. • Ensure that patients understand the uncertainty about the procedure's efficacy and provide them with clear written information. In addition, use of the Institute's information for the public is recommended. • Audit and review clinical outcomes of all patients having automated mechanical percutaneous lumbar discectomy. The Institute may review the procedure upon publication of further evidence. **Endoscopic laser foraminoplasty. NICE interventional procedure guidance 31 (2003).** 1.1 Current evidence of the safety and efficacy of endoscopic laser foraminoplasty does not appear adequate to support the use of this procedure without special arrangements for consent and for audit or research. Clinicians wishing to undertake endoscopic laser foraminoplasty should inform the clinical governance leads in their Trusts. They should ensure that patients offered the procedure understand the uncertainty about its safety and efficacy and should provide them with clear written information. Use of the Institute's information for the public is recommended. Clinicians should ensure that appropriate arrangements are in place for audit or research. Further research into safety and efficacy outcomes will be useful in reducing the current uncertainty. NICE is not undertaking further investigation at

	present.
Clinical guidelines	**Low back pain: Early management of persistent non-specific low back pain. NICE clinical guideline 88 (2009). [this guideline is currently being updated]** **1.1 Assessment and imaging** 1.1.1 Keep diagnosis under review. 1.1.2 Do not offer X-ray of the lumbar spine for the management of non-specific low back pain. 1.1.3 Consider MRI (magnetic resonance imaging) when a diagnosis of spinal malignancy, infection, fracture, cauda equina syndrome or ankylosing spondylitis or another inflammatory disorder is suspected. 1.1.4 Only offer an MRI scan for non-specific low back pain within the context of a referral for an opinion on spinal fusion (see section 1.9). **1.2 Information, education and patient preferences** 1.2.1 Provide people with advice and information to promote self-management of their low back pain. 1.2.2 Offer educational advice that: • includes information on the nature of non-specific low back pain • encourages the person to be physically active and continue with normal activities as far as possible. 1.2.3 Include an educational component consistent with this guideline as part of other interventions, but do not offer stand-alone formal education programmes. 1.2.4 Take into account the person's expectations and preferences when considering recommended treatments, but do not use their expectations and preferences to predict their response to treatments. 1.2.5 Offer one of the following treatment options, taking into account patient preference: an exercise programme (see section 1.3.3), a course of manual therapy (see section 1.4.1) or a course of acupuncture (see section 1.6.1). Consider offering another of these options if the chosen treatment does not result in satisfactory improvement. **1.3 Physical activity and exercise** 1.3.1 Advise people with low back pain that staying physically active is likely to be beneficial. 1.3.2 Advise people with low back pain to exercise. 1.3.3 Consider offering a structured exercise programme tailored to the person: • This should comprise up to a maximum of eight sessions over a period of up to 12 weeks. • Offer a group supervised exercise programme, in a group of up to 10 people. • A one-to-one supervised exercise programme may be offered if a group

programme is not suitable for a particular person.

1.3.4 Exercise programmes may include the following elements:

- aerobic activity
- movement instruction
- muscle strengthening
- postural control
- stretching.

1.4 Manual therapy

The manual therapies reviewed were spinal manipulation (a low-amplitude, high-velocity movement at the limit of joint range that takes the joint beyond the passive range of movement), spinal mobilisation (joint movement within the normal range of motion) and massage (manual manipulation or mobilisation of soft tissues). Collectively these are all manual therapy. Mobilisation and massage are performed by a wide variety of practitioners. Manipulation can be performed by chiropractors and osteopaths, as well as by doctors and physiotherapists who have undergone specialist postgraduate training in manipulation.

1.4.1 Consider offering a course of manual therapy, including spinal manipulation, comprising up to a maximum of nine sessions over a period of up to 12 weeks.

1.5 Other non-pharmacological therapies

Electrotherapy modalities

1.5.1 Do not offer laser therapy.

1.5.2 Do not offer interferential therapy.

1.5.3 Do not offer therapeutic ultrasound.

Transcutaneous nerve stimulation

1.5.4 Do not offer transcutaneous electrical nerve simulation (TENS).

Lumbar supports

1.5.5 Do not offer lumbar supports.

Traction

1.5.6 Do not offer traction.

1.6 Invasive procedures

1.6.1 Consider offering a course of acupuncture needling comprising up to a maximum of 10 sessions over a period of up to 12 weeks.

1.6.2 Do not offer injections of therapeutic substances into the back for non-specific low back pain.

1.7 Combined physical and psychological treatment programme

1.7.1 Consider referral for a combined physical and psychological treatment programme, comprising around 100 hours over a maximum of 8 weeks, for people who:

• have received at least one less intensive treatment (see section 1.2.5) and

• have high disability and/or significant psychological distress.

1.7.2 Combined physical and psychological treatment programmes should include a cognitive behavioural approach and exercise.

1.8 Pharmacological therapies

Both weak opioids and strong opioids are discussed in the recommendations in this section. Examples of weak opioids are codeine and dihydrocodeine (these are sometimes combined with paracetamol as co-codamol or co-dydramol, respectively). Examples of strong opioids are buprenorphine, diamorphine, fentanyl and oxycodone. Some opioids, such as tramadol, are difficult to classify because they can act like a weak or strong opioid depending on the dose used and the circumstances.

No opioids, cyclooxygenase 2 (COX-2) inhibitors or tricyclic antidepressants and only some non-steroidal anti-inflammatory drugs (NSAIDs) have a UK marketing authorisation for treating low back pain. If a drug without a marketing authorisation for this indication is prescribed, informed consent should be obtained and documented.

1.8.1 Advise the person to take regular paracetamol as the first medication option.

1.8.2 When paracetamol alone provides insufficient pain relief, offer:

• non-steroidal anti-inflammatory drugs (NSAIDs) and/or

• weak opioids

Take into account the individual risk of side effects and patient preference.

1.8.3 Give due consideration to the risk of side effects from NSAIDs, especially in:

• older people

• other people at increased risk of experiencing side effects.

1.8.4 When offering treatment with an oral NSAID/COX-2 (cyclooxygenase 2) inhibitor, the first choice should be either a standard NSAID or a COX-2 inhibitor. In either case, for people over 45 these should be co-prescribed with a PPI (proton pump inhibitor), choosing the one with the lowest acquisition cost. [This recommendation is adapted from 'Osteoarthritis: the care and management of osteoarthritis in adults' (NICE clinical guideline 59).]

1.8.5 Consider offering tricyclic antidepressants if other medications

	provide insufficient pain relief. Start at a low dosage and increase up to the maximum antidepressant dosage until therapeutic effect is achieved or unacceptable side effects prevent further increase. 1.8.6 Consider offering strong opioids for short-term use to people in severe pain. 1.8.7 Consider referral for specialist assessment for people who may require prolonged use of strong opioids. 1.8.8 Give due consideration to the risk of opioid dependence and side effects for both strong and weak opioids. 1.8.9 Base decisions on continuation of medications on individual response. 1.8.10 Do not offer selective serotonin reuptake inhibitors (SSRIs) for treating pain. **1.9 Referral for surgery** 1.9.1 Consider referral for an opinion on spinal fusion for people who: • have completed an optimal package of care, including a combined physical and psychological treatment programme (see section 1.7) and • still have severe non-specific low back pain for which they would consider surgery. 1.9.2 Offer anyone with psychological distress appropriate treatment for this before referral for an opinion on spinal fusion. 1.9.3 Refer the patient to a specialist spinal surgical service if spinal fusion is being considered. Give due consideration to the possible risks for that patient. 1.9.4 Do not refer people for any of the following procedures: • intradiscal electrothermal therapy (IDET) • percutaneous intradiscal radiofrequency thermocoagulation (PIRFT) • radiofrequency facet joint denervation.

Appendix C: Literature search for percutaneous transforaminal endoscopic lumbar discectomy for sciatica

Databases	Date searched	Version/files
Cochrane Database of Systematic Reviews – CDSR (Cochrane Library)	28/04/2015	Issue 4 of 12, April 2015
HTA database (Cochrane Library)	28/04/2015	Issue 1 of 4, January 2015
Cochrane Central Database of Controlled Trials – CENTRAL (Cochrane Library)	28/04/2015	Issue 3 of 12, March 2015
MEDLINE (Ovid)	28/04/2015	1946 to April Week 3 2015
MEDLINE In-Process (Ovid)	28/04/2015	April 27, 2015
EMBASE (Ovid)	28/04/2015	1974 to 2015 Week 17
PubMed	29/04/2015	n/a
BLIC	28/04/2015	n/a

The following search strategy was used to identify papers in MEDLINE. A similar strategy was used to identify papers in other databases.

The MEDLINE search strategy was adapted for use in the other sources.

1	(Transforamin* or trans foramin*).tw.
2	PTED.tw.
3	PETD.tw.
4	(((percutan* or endoscop*) adj4 (spinal adj4 surger*)) or TESS).tw.
5	(TESSY or TESSYS).tw.
6	JOIMAX.tw.
7	or/1-6
8	(Endoscop$ adj4 (disk* or disc$)).tw.
9	(Scop$ adj4 (disk* or disc$)).tw.
10	(Percutan$ adj4 (disk* or disc$)).tw.
11	(microdiskectom* or microdiscectom* or diskectom* or discectom*).tw.

12	Diskectomy, Percutaneous/
13	Diskectomy/
14	or/8-13
15	((foramin* or lumbar or spin*) adj4 stenosis*).tw.
16	foraminotomy/
17	Low Back Pain/
18	(low* adj4 back pain*).tw.
19	(low* adj4 back ache*).tw.
20	(low* adj4 backache*).tw.
21	LBP.tw.
22	lumbago*.tw.
23	Sciatica/
24	sciatic*.tw.
25	(chronic* adj4 back pain*).tw.
26	Intervertebral Disc Displacement/
27	Intervertebral Disc Degeneration/
28	(Intervertebr* adj4 (Disk* or disc*) adj4 (Displace* or degenerat*)).tw.
29	((slip* or extrude* or hernia* or prolaps* or an?ulus) adj4 (disc* or disk*)).tw.
30	((discogenic* or diskogenic*) adj4 pain*).tw.
31	(radicular adj4 pain*).tw.
32	Radiculopathy/
33	(lumbar adj4 radiculopath*).tw.
34	or/15-33
35	7 and 14 and 34
36	animals/ not humans/
37	35 not 36