Literature References Supporting the Technique of Epiduroscopy

Br J Anaesth. 2004 Aug;93(2):181-7. Epub 2004 Jun 11. Comment in: Br J Anaesth. 2004 Aug;93(2):173-4. Lysis of adhesions and epidural injection of steroid/local anaesthetic during epiduroscopy potentially alleviate low back and leg pain in elderly patients with lumbar spinal stenosis. Igarashi T, Hirabayashi Y, Seo N, Saitoh K, Fukuda H, Suzuki H. Department of Anaesthesiology and Critical Care Medicine, Jichi Medical School, Kawachi, Tochigi, Japan. igat@jichi.ac.jp BACKGROUND: Lumbar spinal stenosis causes various forms of back or leg pain, and is recognized with increasing frequency in elderly patients whose physical status is not always suitable for surgery. Epiduroscopy, a new, minimally invasive diagnostic and therapeutic technique, may be useful for pain relief in such patients. We investigated the epiduroscopic findings and immediate and long-term changes in back and leg pain after epiduroscopy in elderly patients with spinal stenosis. METHODS: Patients with degenerative lumbar spinal stenosis (n=58, median age 71 yr) were divided into two groups based on presenting symptoms: a monosegmental group (n=34) and a multisegmental group (n=24). Each patient underwent epiduroscopy, and the findings were evaluated using visual analogue scales for low back and leg symptoms. Epiduroscopy included breaking down adhesions in the epidural space by injections of saline, and injection of steroids/local anaesthetic. RESULTS: Epiduroscopy showed that the amount of fatty tissue and the degree of vascularity were greater in the monosegmental group than in the multisegmental group. Relief of low back pain was observed up to 12 months after epiduroscopy in both groups. Relief of leg pain was evident up to 12 months after epiduroscopy in the monosegmental group, and up to 3 months after epiduroscopy in the multisegmental group. None of the patients showed deterioration of motor or sensory deficits during follow-up. One patient was excluded from analysis because of accidental dural puncture during the procedure. CONCLUSIONS: The findings of epiduroscopy corresponded to the symptoms. Epiduroscopy may reduce low back and leg pain in elderly patients with degenerative lumbar spinal stenosis, particularly those with radiculopathy.

Curr Pain Headache Rep. 2002 Dec;6(6):427-35. Epidural lysis of adhesions and myeloscopy. Manchikanti L, Singh V. Pain Management Center of Paducah, 2831 Lone Oak Road, Paducah, KY 42003, USA. drm@asipp.org Chronic low back pain is one of the most common ailments in modern medicine, with as many as 79% of patients with acute pain continuing to suffer with chronic or recurrent low back pain 1 year after its onset. Lumbar epidural fibrosis and post-lumbar laminectomy syndrome are increasingly recognized as being responsible for persistent low back pain. Estimations show that approximately 5% to 40% of lumbar surgeries result in failed back surgery syndrome. Epidural adhesiolysis with myeloscopy is an interventional technique based on the premise that the three-dimensional visualization of the contents of the epidural space provides the physician with the ability to directly visualize the structures, perform appropriate adhesiolysis, and administer drugs specifically to the target. This review describes pathophysiologic aspects, purposes and goals, rationale and indications, complications, and effectiveness of epidural lysis of adhesions with myeloscopy

Reg Anesth Pain Med. 2002 Jul-Aug;27(4):343-52. Comment in: Reg Anesth Pain Med. 2002 Nov-Dec;27(6):621; author reply 621-2. Targeted methylprednisolone acetate/hyaluronidase/clonidine injection after diagnostic epiduroscopy for chronic sciatica: a prospective, 1-year follow-up study. Geurts JW, Kallewaard JW, Richardson J, Groen GJ. Department of Anesthesiology, Rijnstate Hospital, Arnhem, The Netherlands. anesthesiologen.arnhem@planet.nl BACKGROUND AND OBJECTIVES: It has been claimed that epiduroscopy offers an ideal combination of diagnostic and therapeutic interventions in one session. We prospectively evaluated whether abnormalities at the lumbar level as diagnosed by magnetic resonance imaging (MRI) are confirmed by epiduroscopy, and assessed if targeted epidural injection of medication alleviates sciatic pain. METHODS: A flexible, 0.9-mm fiberoptic endoscope was introduced through a disposable steering shaft into the caudal epidural space and advanced until the targeted spinal nerve was identified. Adhesions were mechanically mobilized under direct vision, and a mixture of 120 mg methylprednisolone acetate, 600 IU hyaluronidase, and 150 microg clonidine was applied locally. Pain scores were measured by visual analog scale (VAS) and global subjective efficacy rating. RESULTS: Nineteen of 20 patients studied

showed adhesions via epiduroscopy. In 8 patients, 6 of whom had never undergone surgery, these were not detected with earlier magnetic resonance imaging. Six patients showed concomitant signs of active root inflammation. Of 20 patients treated with a targeted epidural injection, 11 patients (55%) experienced significant pain relief at 3 months. This was maintained at 6, 9, and 12 months for 8 (40%), 7 (35%), and 7 (35%) patients, respectively. Mean VAS at 3 months was significantly reduced (n = 20; DeltaVAS = 3.55; P <.0001), and this persisted at 12 months (DeltaVAS = 1.99, P =.0073). CONCLUSIONS: Epiduroscopy is of value in the diagnosis of spinal root pathology. In sciatica, adhesions unreported by MRI can be identified. Targeted epidural medication, administered near the compromised spinal nerve, results in substantial and prolonged pain relief.

Minim Invasive Neurosurg. 2003 Feb;46(1):1-4. Endoscopic surgery of the lumbar epidural space (epiduroscopy): results of therapeutic intervention in 93 patients. Ruetten S, Meyer O, Godolias G. Ressort Spine Surgery and Pain Therapy, Orthopaedic Clinic at the Faculty of Radiology and Microtherapy, University of Witten/Herdecke, St. Anna-Hospital, Herne, Germany. s-ruetten@t-online.de Determination and therapy of the underlying pathology in chronic pain syndrome in the lumbar spine is frequently difficult. Minimally invasive and microsurgical techniques may offer advantages. Epiduroscopy is available for visualization of the lumbar epidural space. 93 patients with chronic back-leg pain syndrome were epiduroscopically operated. When findings were appropriate, mechanical instruments and the holmium:YAG laser were applied therapeutically. 45.9 % of these patients presented with positive results in postoperative examination. Pathomorphological processes corresponding to the multifactorial pain processes, which escape detection in modern imaging procedures, can be diagnosed in the epidural space using epiduroscopy Therapeutic intervention is basically possible. However, use is limited due to technical difficulties. Navigation of the endoscope is especially limited in access via the hiatus sacralis.
J Clin Laser Med Surg. 2002 Aug;20(4):203-6. Application of holmium:YAG laser in epiduroscopy: extended practicabilities in the treatment of chronic back pain syndrome. Ruetten S, Meyer O, Godolias G. Department of Minimally Invasive Spine Surgery, Orthopaedic Clinic, Faculty of Radiology and Microtherapy, University of Witten/Herdecke, St. Anna Hospital, Herne, Germany. ruetten@orthopain.de OBJECTIVE: Minimally invasive and endoscopic techniques offer advantages in the treatment of chronic back pain syndrome and may provide for expanded indications and visualization. Epiduroscopy for the visualization of the epidural space still is burdened with technical problems. The mechanical instruments now available, coupled with the narrow working canal, result in marked limitations. The aim of this study was to assess the possibilities and technical requisites for the use of the holmium:YAG laser in lumbar epiduroscopy. BACKGROUND DATA: Epiduroscopy has been used for visualization of the lumbar epidural space since the 1930s. Studies have been performed to evaluate the effects and possibilities of epiduroscopy in chronic back pain. Most of them only describe the anatomical aspects. MATERIALS AND METHODS: Forty-seven patients were epiduroscopied and treated, for findings of corresponding epidural adhesions, with the holmium:YAG laser. The examinations concentrated on the general applicability of the holmium:YAG laser in epiduroscopy and the technical parameters necessary for this procedure. The clinical evaluation of therapy was made prospectively in comparison with the preoperative status and compared to already recorded groups in previous studies. RESULTS: Bending behavior without negative impact of the epiduroscope was only attained with laser fibers less than 300 microm, so a fiber with a diameter of 265 microm was used as the standard. The minimum energy output of the laser required for an adequate ablative effect was 0.8 J at a frequency of 8 Hz. The total energy output was 0.256-1.4 kJ. Complications did not occur intraoperatively nor following the procedure. The follow-up examinations showed no deterioration of the complaints in any patient. There was no occurrence of relevant laser-related edemas or adhesions. The proportion of painful conditions that could be positively influenced corresponded to that in a control group treated only by mechanical means. CONCLUSION: The results show that the holmium:YAG laser considerably expands therapeutic possibilities and aids in solving the technical problems of epiduroscopy. No negative effects occurred when the laser is used.

Z Orthop Ihre Grenzgeb. 2002 Mar-Apr;140(2):171-5. [Epiduroscopic diagnosis and treatment of epidural adhesions in chronic back pain syndrome of patients with previous surgical treatment: first

results of 31 interventions] [Article in German] Ruetten S, Meyer O, Godolias G. Klinik fur Orthopadie am Lehrstuhl fur Radiologie und Mikrotherapie, Universitat Witten/Herdecke, St. Anna-Hospital, Herne, Germany. ruetten@orthopain.de AIM: Scars in the epidural space play an important role in the chronic lumbar pain syndrome of patients with previous surgical treatment. The results of surgical resection are frequently unsatisfactory. Discrepancies to imaging diagnostics are conspicuous. These are known from experience with endoscopic operations. Minimal adhesions may promote pain. Epiduroscopy is available for visualization of the epidural space. The objective of this study was to examine its possibilities in patients with previous surgical treatment. METHOD: 31 patients with chronic lumbar pain syndrome who had previously received surgical treatment were operated epiduroscopically. Mechanical instruments and the holmium:YAG laser were used for epidural adhesion. RESULTS: All patients showed adhesions. 24 patients also presented with adhesions on the contralateral side. There were marked discrepancies between imaging and intraoperative findings. The use of mechanical instruments was limited. The use of laser fibers resulted in greater possibilities. Back pain could be better influenced than leg pain. The procedure was limited by still-existing technical problems. CONCLUSION: Epiduroscopy offers a novel view of this compartment. Minimal adhesions which are not visible in imaging ean promote pain. They can be partially diagnosed and treated by epiduroscopy. There are still marked limitations to epiduroscopy due to technical problems. These must be minimized.

Masui. 2001 Nov;50(11):1257-9. [Epiduroscopy in patients with chronic low back pain without remarkable findings on magnetic resonance imaging] [Article in Japanese] Saitoh K, Igarashi T, Hirabayashi Y, Horikawa Y, Seo N, Motegi R, Miyashita K. Department of Anesthesiology, Jichi Medical School, Tochigi 329-0498. Two patients with chronic low back pain and sciatica failed to respond to conservative treatments. In these patients, magnetic resonance imaging (MRI) showed no remarkable findings corresponding to their symptoms. We treated these patients using epiduroscopy. Epiduroscopic visualization of the spinal canal permits efficient adhesiolysis and irrigation. One patient got better after two epiduroscopic procedures, and the other did not. Epiduroscopy may be an effective, minimally invasive treatment as well as examination for patients with chronic low back pain without remarkable findings on MRI.

Anaesthesia. 2001 May;56(5):454-60. Spinal endoscopy in chronic low back pain with radiculopathy. A prospective case series. Richardson J, McGurgan P, Cheema S, Prasad R, Gupta S. Microendoscopy, Endoscopy, Research, Innovation and Training Centre, Bradford Royal Infirmary, Bradford BD9 6RJ, UK. docjohnnyr@hotmail.com All 38 patients listed for day-case spinal endoscopy over a 12-month period (April 1998 - April 1999), who had chronic severe low back pain with a radiculopathic element, were studied prospectively. The mean [range] pain duration before treatment was 10.9 [2-26] years and 50% had failed back surgery syndrome. In all patients in whom treatment was completed (n = 34), the pain-generating nerve roots were located through symptom interaction with the patient. All had epidural scar tissue, 14 (41%) having dense adhesions. Mobilisation of adhesions around the nerve root (neuroplasty) was performed so that a pocket was formed for the subsequent placement of bupivacaine, Depomedrone and clonidine. No intra-operative complications occurred and side-effects were minimal. Follow-up over a 12-month period showed statistically significant reductions in pain scores and disability. Spinal endoscopy may be the diagnostic method of choice for epidural fibrosis. It has substantial therapeutic and research potential. Prospective randomised studies are required.

Minim Invasive Neurosurg. 1999 Sep;42(3):146-51. Endoscopy of the spinal cord: cadaveric study and clinical experience. Eguchi T, Tamaki N, Kurata H. Department of Neurosurgery, Kobe University School of Medicine, Japan. Recent improvements in instruments permit endoscopic examination of previously inaccessible sites. We report on the clinical use of a small-diameter endoscope to examine the spinal subarachnoid space, cord surface and syrinx cavities. Prior to clinical application, three types of endoscopes with external diameters of 0.5, 1.4 or 2.2 mm were inserted percutaneously in the lumbar region of five cadavers for preclinical evaluation of the procedure and the three endoscopes. The observations permitted us to perform spinal endoscopy preoperatively or intraoperatively using the 0.5-mm instrument in seven patients with spinal cord lesions between 1995 and 1997. The patients included two with spinal cord herniation through a dural defect, two with syringomyelia, one with

spinal arachnoid cyst, one with spinal epidural cyst and one undergoing lumboperitoneal shunt for hydrocephalus. In patients in whom an endoscope was used preoperatively, the endoscope provided morphological information useful in preoperative diagnosis and planning surgical strategy. When the endoscope was used intraoperatively, areas outside the field of vision of a microscope could be examined, and physiological evaluation could include visualizing improved cord perfusion from the spinal subarachnoid space after surgery. Endoscopes could be safely inserted and approached to the lesions under direct vision while avoiding blood vessels and nerve roots on the spinal cord surface. No changes in symptoms or complications occurred in association with endoscopy. Using a small-diameter endoscope, the contents of the spinal subarachnoid space could be examined. Further improvements to increase possible endoscopic manipulation and enhance safety may extend the possibilities for endoscopic examination and permit endoscopic treatment.

Masui. 1999 Jan;48(1):9-17. [Dorsal root identification using spinal endoscopy and electro-physiology] [Article in Japanese] Chinzei M, Chinzei T, Yonezawa T, Lee CS, Tagami M, Hanaoka K, Imachi K. Surgical Center, University of Tokyo Faculty of Medicine. We aimed to develop a method of accurately identifying the dorsal root for the corresponding peripheral afferent nerve under endoscopic observation. We developed an endoscope with an external diameter of 1.8 mm. After small laminectomy on the lower thoracic vertebrae, we inserted this endoscope carefully into the epidural and then subarachnoid spaces. We observed structures in these spaces with the endoscope. We tried to determine the spatial relationship between these electrodes and dorsal root. After identifying each space, we inserted two electrodes into the visualized space to record evoked potentials; a bipolar electrode (protocol 1) and a catheter-type eight polar electrode (protocol 2). Each pole could be distinguished by marks. To stimulate peripheral nerves, we inserted needle-type electrodes into Th 10, 11 and 12 intercostal nerves. We attempted to record potentials from dorsal surface of the cord generated by intercostal nerve stimulus. Protocol 1: We moved the position of the bipolar recording electrodes between Th 9 and L 1 by 1 cm increment, and obtained evoked potentials correspondingly. Protocol 2: We chose the neighboring pairs of poles sequentially from the tip of the catheter for bipolar recording. At the end of each experiment, we dissected the animal and checked the intercostal nerve originating from the root. With the endoscope, we could clearly observe structures in the epidural and subarachnoid spaces. We could record evoked potentials from the dorsal spinal cord with the electrodes located either in epidural or in subarachnoid spaces. Shapes of evoked potentials changed characteristically according to the relative position between the root and the electrode. The largest potentials were obtained when the electrode was nearest to the dorsal root, of which the peripheral nerve was being stimulated. By combining endoscopy with the electrophysiological technique, we could accurately identify the dorsal roots for the corresponding peripheral afferent nerves. This method may be used for the selective dorsal root blockade under the visual field.

Anesteziol Reanimatol. 1996 Jul-Aug;(4):62-4. [Endoscopic method for the diagnosis and treatment of spinal pain syndromes] [Article in Russian] Shutse G, Kurtse G, Grol O, Enns E. The endoscopy of the epidural space-"Epiduroscopy"-is a new imaging technique in the diagnosis and therapy of spinal pain syndrome. For investigation of the epidural space either a steerable or controllable flexible endoscope with an outer diameter of 2.5 mm and a working channel or a flexible catheter-secured epiduroscope unit can be used. Epidural anatomic structures, such as the dura mater spinalis, connective tissues, blood vessels, nerve fibers, and adipose tissues could be identified easily. Further it was possible to find pathological structures such as epidural adhesions, fibrosis, and scars. Due to epiduroscopy an epidural catheter could be placed safely in patients with chronic pain syndromes for a continuous intrathecal application of opioids or a precise epidural adhesiolysis. Percutaneous epiduroscopy, a new invasive micro-endoscopic technology, enables the extension of therapeutic potentials in chronic pain syndromes in addition to the diagnosis.

Anesth Analg. 1989 Feb;68(2):157-60. The lumbar epidural space in patients examined with epiduroscopy. Blomberg RG, Olsson SS. Department of Anesthesia, Central Hospital, Norrkoping, Sweden. Percutaneous epiduroscopy was performed in 10 patients with the aim of comparing the lumbar epidural space of the patients with the findings made earlier in autopsy subjects. The patients were

scheduled for partial laminectomy for a herniated lumbar disc. A complete examination was possible in eight subjects. The extent of view was very limited. The epidural space opened up only temporarily as air was injected. The dura mater lay very close to the dorsal aspect of the epidural space and was attached to the flaval ligaments by a dorsomedian connective tissue band. The band was identified in all eight subjects and was found to cause a dorsal fold in the dura mater. An epidural catheter was introduced 2-5 cm into the space by midline puncture in four patients and by the paramedian approach in the other four. The catheter was visualized in two patients only when the paramedian approach was used. None of the midline catheters could be seen in the space. In 2 of the 10 subjects a moderate bleeding impaired the view and made complete examination impossible. Smaller bleeding occurred in three other subjects. The partial laminectomy performed one to two interspaces caudad to the level of endoscopy did not reveal any evidence of epidural bleeding in any subject. The postoperative course of all patients was uneventful.

Spine. 1998 Nov 1;23(21):2358-62. Ultrafine flexible spinal endoscope (myeloscope) and discovery of an unreported subarachnoid lesion. Uchiyama S, Hasegawa K, Homma T, Takahashi HE, Shimoji K. Department of Orthopaedic Surgery, Niigata University School of Medicine, Japan. STUDY DESIGN: Introduction of a new diagnostic procedure and a report on its usefulness. OBJECTIVES: To introduce a new endoscope (myeloscope) developed for the examination of the spinal canal and to present a previously unreported subarachnoid condition as a cause of paraparesis revealed by it. SUMMARY OF BACKGROUND DATA: In spite of the availability of advanced imaging technology, there still exists a significant number of patients with spinal diseases in whom a diagnosis cannot be made. Direct visualization of the pathologic area is required in these patients. Recent advances in fiberoptics have made this possible. METHODS: The endoscope consisted of a fiberscope with an external diameter of 0.5, 0.9, or 1.4 mm. It was inserted into the subarachnoid space in the lumbar spine and carefully advanced cranially. Since 1987, this examination has been performed on 18 patients aged 7 to 69 years who had pain or other neurologic symptoms of unknown origin. RESULTS: The surface of the spinal cord, roots, properties of the arachnoid membrane, and small vessels could be observed clearly. The scope could be advanced as far as the upper cervical spine. Cotton-candy-like proliferation of fibrous tissue was identified by myeloscopy in four paraparetic patients who had clinical and radiologic features similar to those of a spinal cord herniation. The fibrous tissue beat on the spinal cord with the pulsation of the spinal fluid. Resection of the fibrous tissue with conventional surgery resulted in neurologic improvement. Complications included one case of meningitis in the early period and five cases of postspinal headache. No nerve injury was apparent. CONCLUSIONS: Myeloscopy provides detailed information about the subarachnoid space and even reveals dynamic conditions that cannot be identified during open surgery or at autopsy. It will bring new concepts to the diagnosis of spinal diseases.

Zh Nevropatol Psikhiatr Im S S Korsakova. 1984;84(1):23-6. [Spinal endoscopy in the diagnosis of diseases of the spinal cord] [Article in Russian] Neretin VIa, Kir'iakov VA, Frolov IuA, Lobov MA, Kotov SV. A total of 112 patients with various diseases of the spinal cord were examined using spinal endoscopy. It is concluded on the basis of the findings obtained that this method is fairly reliable in detecting the pathological process in the cerebrospinal canal including secondary changes in its membranes and cerebrospinal radicals with the vessels attached to the latter which can develop in some forms of spinal diseases. While admitting the diagnostic significance of radioisotopic, roentgenocontrast and other methods of studying the spinal cord the authors consider spinal endoscopy to be fairly promising in terms of the topic and differential diagnosis of various disorders of the spinal cord, membranes and radicals which is crucial for early surgical of therapeutic management of the disease.