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Five years' experience of retroperitoneal lumbar and thoracolumbar surgery

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Abstract Retroperitoneal video-scopie spine surgery has been developed in our department since 1994. It has been used not only at the lumbar, but also at the thoracolumbar and lumbosacral level. Thirty-eight patients have been operated on. We have performed 12 thoracolumbar approaches, 23 lumbar approaches, and 3 retroperitoneal lumbosacral approaches. In every case, a video-assisted technique has been employed. These techniques have been used for anterior grafting in 18 cases of fracture, for corporectomy and grafting with or without anterior osteosynthesis in 6 cases of malunion, for cage implantation or isolated grafting in 10 cases of degenerative disc disease, and for the treatment of 4 cases

of spondylodiscitis. Results were satisfactory for every type of pathology. The complications related to the approach were the same as those seen with open surgery; however, the video-scopie approach seems to be less invasive, with cosmetic benefit, less blood loss, and more rapid recovery. A video-assisted technique appears to be a good compromise between video-scopie technique and open surgery. With the development of these techniques, few indications remain for open anterior surgery on the lumbar spine in our opinion.

Key words Videoscopy · Retroperitoneoscopy · Endoscopic surgery · Lumbar spine · Lumbar approach · Arthrodesis

Introduction

Videosurgery is widely used in gynecology, abdominal and general surgery. The main success with this technique has been obtained in surgery of the gall bladder, where it provides better results than the classic procedure [14]. In addition to laparoscopy, the technique of retroperitoneoscopy has been developed and has been used in several diagnostic and therapeutic procedures. In vascular surgery retroperitoneoscopy has been employed for lumbar sympathectomy [3], allowing dissection close to the lumbar spine. In orthopedic surgery, video-scopie procedures have been used mainly in arthroscopy, but video-scopie techniques have also been successfully applied to surgery of the spine, first via laparoscopy at the lumbosacral level [9, 12], then via thoracoscopy at the thoracic level [7, 12, 13]. With the development of lumbar

retroperitoneal, thoracolumbar retroperitoneal, and retropleural approaches, all segments of the thoracic and lumbar spine can now be reached by the video-scopie method. Retroperitoneal surgery on lumbosacral segments has also been developed on lumbosacral segments and has several advantages [10]. Various techniques are used, but the aim is always to diminish the parietal lesion and increase the tolerability of the anterior surgery. In this paper we present techniques for lumbar and thoracolumbar retroperitoneal approaches and report on our 5 years' clinical experience.

Materials and patients

Lumbar approach

We use a left-side video-assisted retroperitoneal approach. The patient is placed in a right lateral position. This technique is used to

reach the anterior lumbar spine between the L2-L3 and L4-L5 discs. The approach is limited cranially by the costal arch and caudally by the iliac crest. For the approach to the L4-L5 disc, the patient is turned slightly backward, and the skin incision is more anterior because of the mass of the psoas muscle, which can be a hindrance in a straight lateral approach. Radioscopic control is necessary, and somatosensory evoked potentials are also monitored during the operation. The skin incision is made exactly in the direction of the disc or the vertebra targeted. A 4-cm incision is sufficient. After sectioning of the superficial tissues, the muscle fibers are carefully dissected away without transsection, as for a standard open appendectomy. The parietal nerves which can be seen during this approach are dissected and marked to avoid injury during closure. The retroperitoneal space is located and explored by blunt dissection. A balloon can be used at this stage but is not always necessary. The anterior part of the psoas muscle is progressively reached. A 3-cm-diameter straight anterior retractor is used to keep soft tissues in front of the psoas. A compress can be introduced anteriorly on the repaired thread and the retractor can then retain soft tissues more efficiently. The camera is introduced by a 1.5-cm incision 3 cm away from the incision. The surgeon uses the camera as a light source, although the operation can also be viewed directly or on the monitor. The assistant follows the operation on the screen. The anterior part of the psoas is dissected. The most difficult moment of the operation is the retraction of the psoas, because the dissection of the anterior part of the psoas must be performed at a sharp angle. The lateral prominence of the lumbar disc can be felt by palpation, and the fascia of the psoas muscle is incised at this level. A Low retractor can be used to retract the psoas fibers. This retraction is continued by a Cobb elevator. It is important to be careful not to hurt segmental arteries lying more deeply, in contact with the vertebral body. For a single-level arthrodesis, exposure of the lateral part of the disc is sufficient, and this way the segmental arteries can be preserved. The psoas muscle is fixed posteriorly by 2 Kirschner wires which are bent and fixed at the skin level (Fig. 1). This exposure is sufficient for lumbar arthrodesis, but using automatic retractors can be more satisfactory. Closure is performed on a retroperitoneal drain after complete hemostasis.

Thoracolumbar approach

Our technique is very similar to that reported by Marnay et al. [8]. Retroperitoneal retropleural approaches are used. They are indicated for the surgery of L1 or L2 vertebrae, and for the L1-L2 disc; the T12-L1 disc can also be reached by thoracoscopy. The patient is placed in the straight right lateral position. A 6-cm skin incision is made 5 cm posteriorly from the point of the 11th or 12th rib on its superior margin. After the sectioning of superficial tissues, the lateral part of the 11th or 12th rib is explored, then the rib is dissected carefully by a subperiosteal approach to avoid opening the pleural space. The choice of rib depends on the level to be operated on. The rib is sectioned in the middle part. The anterior part is held by a forceps and retracted posteriorly; at the same time retraction of the anterior part of the incision allows the junction between the rib and its cartilage to be reached and sectioned. Posteriorly, the dissection of the rib is continued as far as possible, generally for a distance of 3 or 4 cm from the spine. The rib is sectioned at this level, and any sharp points are cut by gouge forceps. The segmental subcostal nerve is dissected and marked to avoid being sutured during closure. Blunt dissection allows progression posteriorly and caudally in the retropleural space until the inferior limit of the pleura is reached. The blunt dissection is continued caudally by posterior detachment of the diaphragm insertion at the level of the lateral arcuate ligament, and the retroperitoneal space is reached. Mobilization is easier posteriorly, and it is important to not try to separate the pleura from the diaphragm, because this way it can be easily torn. The detachment of the posterior part of the dia-

Fig. 1 Cross sectional view of the retroperitoneal, retropleural approach to the thoracolumbar spine

Fig. 2 Three-dimensional view of the lumbar retroperitoneal graft technique

phragm stops at the insertion of the medial and lateral arcuate ligament on the L1 transverse process. A dissector is introduced, and the insertion is sectioned between ligatures to allow reinsertion at closure. Progressively the lateral part of the spine is reached by mobilization of the diaphragm. During this exploration the dia-

Table 1 Indications for surgery and procedures carried out in 38 patients

Level	Diagnosis	Operation	No. of patients
Thoraco-lumbar spine	Recent fracture	1 Disc graft	4
		2 Disc graft	2
	Malunion/pseudoarthrosis	Corpectomy + graft + osteosynthesis	3
		Corpectomy + isolated graft	2
	Degenerative disc disease	Cage + posterior osteosynthesis	1
Lumbar spine	Recent fracture	1 Disc graft	6
		2 Disc grafts	5
		Corpectomy + graft + decompression	1
	Malunion/pseudoarthrosis	Corpectomy + graft + osteosynthesis	1
	Degenerative disc disease	Cage + posterior osteosynthesis	6
	Spondylodiscitis	Curettage + Biopsy	1
		Curettage + Biopsy + graft	2
		Curettage + Biopsy + graft + posterior osteosynthesis	1
Lumbosacral spine	Degenerative disc disease	Cage + posterior osteosynthesis	2
		Isolated graft + posterior osteosynthesis	1

phragm and the pleura are retracted slightly anteriorly by a straight anterior retractor. As the incision is longer (approximately 6 cm), a separate incision for the camera is not necessary, and it is introduced in the same incision (Fig. 2). Arriving to the lateral part of the spine, the superior attachment of the psoas muscle is detached, retracted posteriorly, and fixed by Kirschner wires. The section of segmental arteries is necessary only for corpectomies. Automatic retractors can be very useful. Closure is carried out progressively. The graft area is covered by a surgical hemostatic tissue, and a drain is placed in contact with the spine. The insertions of the segmental arteries are sutured. The intercostal muscles are sutured with interior placement of the knots.

Isolated dissection of the T12-L1 disc is possible without detachment of the diaphragm, and a retropleural supradiaphragmatic approach is sufficient. It is also possible to operate on this disc by thoracoscopy. For isolated exploration of the L1-L2 disc, detachment of the diaphragm close to the spine is not necessary, and the dissection can remain infradiaphragmatic.

Graft technique

In the treatment of recent traumatic cases the first operation has been always posterior. A solid posterior fixation using pedicular screws and hooks at the extremities of the construct allows reduction and stabilization. Second-stage anterior surgery is performed if anterior decompression is necessary, or if, after posterior instrumentation and reduction of the fracture, only discal reduction is obtained with a significant anterior bone defect. In these cases, complete discectomy is carried out. Specific instrumentation is used for the graft technique, manufactured by Practicum LTD and by Sofamor Danek [11]. An operating tube is fixed on the lateral part of the disc straightly in its plan. Across this tube, a reamer allows completion of the discectomy, then the limiting vertebra end-plate is decorticated. The bone graft is taken from the iliac crest, or from the internal condyle of the opposite knee. This autologous cancellous graft is compacted in the tube, then introduced into the discal space. Two or more short plugs is used, and the discal space is filled progressively to avoid bone migration.

In the lumbosacral spine, we have performed three retroperitoneal procedures following the method of Onimus et al. [10] for anterior cage or tricortical graft placement by a median approach.

Patients

Thirty-eight patients have been operated on (15 female, 23 male). The mean age was 42 years (range 17–73 years). Table 1 shows the indications for surgery.

Eighteen recent fractures were operated on by secondary anterior graft technique. The mean time interval between the posterior and anterior interventions was 20.5 days (range 5–115 days).

In the six cases of malunion and pseudarthrosis, anterior corpectomy was performed with anterior graft. Anterior osteosynthesis was performed in four cases; in two of them this was the only fixation (Fig. 3). Posterior osteosynthesis was performed four times. The mean time interval for malunions after the original trauma was 54 months (range 4 months to 25 years).

Eight patients have been operated on by cage surgery. The Aesculape-JBS hollow screw was used six times, the Stryker peak cage in one case, and the Euros anterior cage in one. Cages were always inserted in patients who had already undergone fixation by a posterior approach, or who were fixed secondarily by posterior instrumentation.

Spondylodiscitis cases were operated on when no specific bacteriological diagnosis could be made or when medical treatment was inefficacious.

Results

For the anterior approach, operating time was 206 min (range 120–360 min). Blood loss was in every case less than 200 ml.

Mean follow-up was 17 months (range 12–39 months). In the fracture group the mean traumatic regional angulation was 20.5° (range 5°–47°). Mean postoperative gain was 21.3° (range 5°–39°). The gain at the last follow-up was 16.3° (range 4°–37°). For 17 patients complete anterior radiological fusion has been observed; for one patient it is still incomplete. The mean angular loss at the last follow-up was 5° (range 0°–20°). The 20° angular loss was observed in a case where two pedicular screws of the posterior instrumentation were in an incorrect, extrapedicular

Fig. 3A–D A 37-year-old man with the sequel of an L4 fracture sustained at the age of 17. Anterior surgery is performed because of disabling lumbar instability. **A** Preoperative coronal view, **B** preoperative lateral view, **C** preoperative MRI, **D** coronal and lateral view at 12-month follow-up with an excellent clinical result

position. At the latest review, mean hand–ground distance was 12 cm (range 0–40 cm); there was only minor or moderate pain, and 75% of the patients had returned to their previous work.

In the malunion group the mean original traumatic angulation was 23°, postoperative gain was 20°, and angular loss was 6°. Consolidation was observed in every malunion patient.

An improvement of clinical status was observed in every cage patient.

Every case of spondylodiscitis healed.

In the first patient an ureteral fistula was observed, probably due to a coagulation point, which had to be treated by secondary surgery. One patient had to be reoperated on on the first postoperative day because of retroperitoneal hematoma coming from the iliac bone harvesting area. One patient experienced postoperative relaxation of the abdominal wall due to suturing of the parietal nerves during wound closure. There were no neurological complications during the operation, no material failure and no infections.

Discussion

The videoscopic approach has several advantages. There are cosmetic advantages, minimal blood loss, smaller parietal lesions and shorter recovery. However, there is no reason to use a videoscopic approach if the treatment cannot be as efficacious as open procedure. Our experience shows that even decompression by anterior surgery and insertion of a graft combined with osteosynthesis can be performed by this method. A videoscopic approach can be more frequently indicated, especially in cases where open surgery is considered too aggressive.

Surgeons must remember that if complications arise, it may be necessary to convert the approach, and the instrumentation required must always be available.

The videoscopic approach does not seem to us to be a difficult technique for an experienced spine surgeon, but there is a significant learning curve. On the other hand, learning the open anterior approach become more difficult for young surgeons as the indication has become rare.

In fracture care it is widely accepted that anterior surgery is necessary for an anterior bony defect remaining after posterior surgery [1]. Classically, tricortical iliac or fibular graft is used. In our department we have developed a special posterior construct with screws and hooks at the extremities, which allow sufficient resistance for almost 1 year without any external brace support [2]. This is sufficient time for the incorporation of anterior autologous cancellous graft. Our experience showed that using cancellous graft in combination with this type of construct is sufficient for the treatment of these very unstable fractures, with very small angular loss at follow-up and similar result to those of open surgery [4].

Compared to partial corpectomy with solid graft, anterior cancellous bone graft inserted in the discal space

has the advantage of being easier to perform and causing less trauma. Our experience shows that the anterior videoscopic approach can suffice even in the treatment of anterior malunions and pseudarthroses.

Anterior cage insertion proved to be very useful in our experience in cases of persistent anterior instability after posterior fixation of degenerative spine, and in cases where posterior surgery did not allow the placement of interbody cages. In our opinion, isolated anterior cylindrical cages cannot confer sufficient stabilization without posterior osteosynthesis.

The complications show that the learning curve – control of hemostasis, protection of the parietal nerves, correct performance of posterior fixations – is very considerable in this type of surgery.

Although using smaller incisions is possible [6, 12], we consider that videoassisted surgery has several advantages compared to retroperitoneoscopy with CO₂ insufflation: it avoids hypercapnia [5], allows the surgeon a direct views, and allows the use of standard instrumentation in most cases.

Further development of anterior implants and instruments adapted for this kind of surgery is necessary to extend the indications.

Conclusion

Videoassisted retroperitoneal and retropleural approaches proved to be useful in the treatment of pathological conditions of the lumbar and thoracolumbar spine. Our experience shows that, except in scoliosis and revision surgery, videoassisted retroperitoneal and retropleural surgery can replace the open procedure.

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