

## Diagnostic Approach in Instability and Irritative State of a “Lumbar Motion Segment”\* Following Disc Surgery—Failed Back Surgery Syndrome

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### Summary

A diagnostic protocol for patients with suspected instability and irritative state of a “lumbar motion segment”\* following lumbar disc surgery is presented and the results of internal fixation are analyzed.

In this group of patients the clinical picture and physical signs may be quite distinct and suggestive of instability and irritation of a “lumbar motion segment”, however, in isolation, they do not allow to decide upon surgery. Radiological studies favour a decision for surgery only in cases with an obvious instability of a “motion segment”. Anaesthetizing the articular nerves permits localization of the irritable segment and non-surgical therapeutic decisions (thermocoagulation) can only be taken in cases of an isolated facet-syndrome when instability has been ruled out. The trial plaster jacket holds the most important position with respect to the indication for internal fixation as demonstrated by the conformity of the results of the plaster jacket and the results of surgery.

After internal stabilization excellent, good, satisfactory and moderate results were obtained in 20, 3, 1 and 1 patients, respectively.

*Keywords:* Lumbar disc surgery; failed back surgery syndrome; spinal instability; spinal fusion.

Results concerning pain relief remain unsatisfactory in 7 to 15% of all patients following lumbar discectomy. A stenosis of the lateral recess, a missed disc fragment, an unrecognized extraforaminal disc herniation, early recurrence, intervertebral discitis or scar formation may each be responsible for persisting or early recurring low back pain and sciatica and can be accurately diagnosed using modern neuroradiological techniques<sup>4, 8</sup>. In addition, instability and an irritative state of a

“lumbar motion segment” may be a further cause of persisting low back pain and sciatica after lumbar disc surgery, especially in patients operated upon repeatedly or at multiple levels<sup>3, 6–8, 17</sup>.

In these cases the diagnostic approach is much more difficult and requires a battery of tests. Diagnosis of instability is obvious when radiologically demonstrable and problematic in cases of an irritative state of a “motion segment” when functional x-rays fail to demonstrate such mechanical imbalance.

The aim of this paper is to elaborate correlations between the clinical presentation, results of our testing procedures and surgical results.

### Clinical Material and Methods

25 patients with persistent or early recurrent low back pain and pain in the lower limbs after lumbar disc surgery were investigated and treated according to the protocol described below. In all patients, the above mentioned other aetiologies were excluded previously by a myelogram and/or CT-study, combined with i.v. and/or intrathecal administration of contrast medium. 15 patients were male and 10 patients female; the mean age was 48.3 years.

Our present diagnostic work-up includes the clinical examination, radiological studies, a test-injection with a local anaesthetic drug along the course of the articular branches of the lumbar nerve roots and the confirmatory plaster jacket (Table 1).

### Clinical Features

The patients usually complain of low back pain which may be restricted locally or may be diffuse and include the paravertebral region and sacrum, sometimes associated with burning sensations. Low back

\* The German term “Bewegungssegment” comprises all parts which are involved in the movements of one vertebral segment, i.g. disc, facet joints, ligaments and related muscles.

pain is mostly accompanied by radiating leg pain. In contrast to monoradicular pain which typically radiates along the respective dermatome, pseudoradicular pain is more difficult to describe and corresponds rather to the sclerotomes and myotomes of the respective nerve roots. The cutaneous distribution is less segmentally confined and often changes its character (heat- and burning sensations, feeling of cold). Patients describe a dull painful sensation deep in the region of the greater trochanter, the gluteal region, around the knee and the perimalleolar area<sup>16</sup>. Another type of pain is characterized by diffuse, causalgic discomfort in one or both legs, often accompanied by pain in the inguinal folds. Typically, these complaints are enhanced by physical activity. The patients often describe a sensation of weakness and insecurity in the lumbar spine, sometimes accompanied by episodes of sudden loss of strength of the pelvico-femoral muscle groups on one side (giving-way-syndrome). Motor weakness and reflex abnormalities frequently are absent in the pseudoradicular syndrome.

Clinical examination often shows paravertebral muscular hypertension and hypertrophied muscle bands at the level of segmental instability, probably representing the patient's attempt to stabilize a hypermobile segment<sup>14</sup>. Palpation and compression of the intervertebral joints and spinous processes of the affected segment may provoke a "slide-pain-sensation" and sometimes a slip in inclination<sup>14</sup>. The gait is often characterized by slight flexion at the hip and knee joints.

### Radiologic Investigations

Apart from the conventional x-rays of the lumbar spine functional x-ray studies are performed with maximal forward flexion and backward extension as well as lateral inclination to both sides. These functional studies sometimes allow radiographic demonstration of lumbar instability, either as an increased translation and rotation displacement along the z-axis, or less frequently along the x- and y-axes of the three-dimensional coordinate system proposed by White and Panjabi<sup>18</sup> (Fig. 1). Failure to demonstrate an unstable mobile segment however does not exclude a so-called irritative state of a "motion segment" or a facet arthropathy. In such cases even a radiographically hypomobile segment may be found. Important are tomographic (a.p. projection, Fig. 2) and CT-studies which disclose the extent of the previous operative reduction of the facet joints and interarticular portions as well

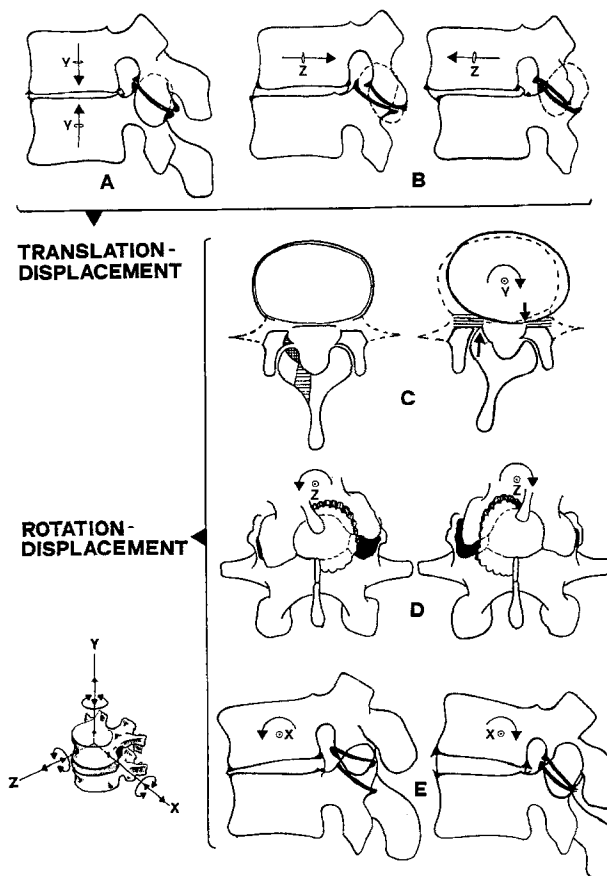


Fig. 1. Most frequent types of vertebral displacement in cases of instability of a lumbar "motion segment" after discectomy and operative reduction of the posterior column(-s). Translation-displacement mostly occurs along the y- (A) and z-axes (B), rotation-displacement along the y- (C), z- (D) and x-axes (E). Lower left: Three-dimensional coordinate system proposed by White and Panjabi<sup>18</sup>

as the extension of a fenestration, hemilaminectomy or laminectomy.

### Test-Injection of the Articular Nerves

The third diagnostic step is the test-anesthesia of the rami articulares of the affected facet joints. Under a.p. fluoroscopy 1–2 cc of Scandicain 1% is injected on the paramedian superior rim of the transverse processes of the adjacent vertebrae on both sides as described by Bogduk and Long<sup>1, 2</sup>. This test is used as an additional aid either to confirm the radiologically affected unstable segment or to localize it in case of radiographically negative results. Usually, the test-anesthesia is performed first at the level of the previous operation, but sometimes has to be extended to the level above or below due to the overlapping innervation of the facet joints<sup>1, 2</sup>.

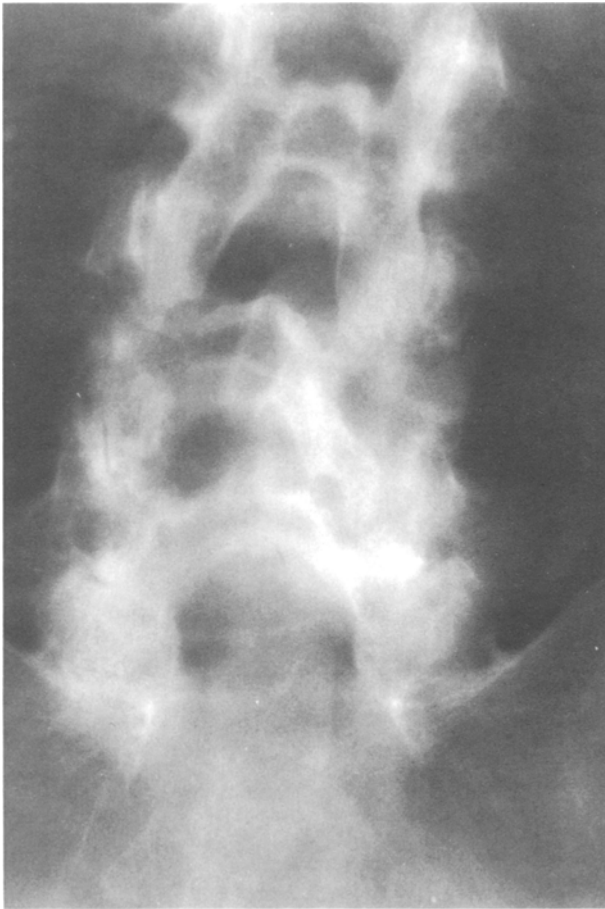


Fig. 2. Impairment of the left posterior pillar after fenestration L4/L5 with operative reduction of the isthmus and facet joint and extraforaminal approach to an intra- and extraforaminal disc prolapse on the left side (a.p. tomography)

In case of complete disappearance of the low back pain and pain in the lower extremity(-ies) the question arises whether we are confronted with an isolated facet-syndrome which will respond well to a facet rhizotomy. When functional x-rays fail to demonstrate a manifest instability or tomographic investigations do not show an extensive reduction of the facet joints a facet rhizotomy by thermocoagulation may at first be carried out.

#### *Confirmatory Plaster Jacket*

The last diagnostic step consists in placing the patient into a plaster jacket. The goal is to immobilize the lumbar or lumbosacral spine within a molded plaster body jacket which extends cranially to the xyphoid in the front and to the level of the 12th thoracic vertebra in the back and includes caudally the symphysis and the anterior and posterior iliac crests. In cases of lum-

bosacral instability and in obese patients, the plaster jacket has to include the thigh on one side. The jacket has to remain in place for approximately two weeks. In general, the low back pain as well as the pain in the lower limb(-s) start to subside only after three to four days and the patients have to be encouraged to endure this period. It was our impression that patients who are seriously suffering are willing to endure this period while patients with predominantly psychogenic complaints demand the withdrawal of the plaster jacket after a few days. The result of this test is considered positive if the patient has complete relief of his low back pain and pseudoradicular symptoms.

#### *Indication for Operative Stabilization*

According to our protocol the operation was indicated when the plaster jacket test led to complete resolution of the lumbar and pseudoradicular symptoms in the presence of physical and radiological signs suggestive of instability. Positive results for the test-anaesthesia of the articular nerves were not mandatory for the indication of internal stabilization.

#### *Applied Technique of Operative Stabilization*

In cases of monosegmental instability the method of translaminar screw fixation, as described by Magerl<sup>12</sup>, was used. In case of previous hemilaminectomy we combine this method with a technical variation which consists in the reconstruction of the resected hemilamina and inferior articular process. In cases of bisegmental instability the lumbar and lumbosacral plate fixation methods according to Louis<sup>9,10</sup> and internal fixator systems<sup>15</sup> were used.

#### **Results**

Table 1 depicts the results of the clinical presentation, the radiologic investigations, the test-anaesthesia and the "trial" plaster jacket as well as the final outcome in our series. Patients 1-6, 9, 10, 12-22 and 25 (Group I) are more suitable for analysis of the results because there were no concomitant radicular symptoms as was the case in patients 7, 8, 11, 23 and 24 (Group II). These 5 patients, besides their pseudoradicular symptoms, showed definite signs of involvement of the previously affected nerve root. CT-examination demonstrated severe epidural scar formation, a small disc recurrence or root compression due to hypertrophic pseud-arthrotic facet joints.

Table 2 illustrates the clinical presentation. Local

Table 1. *Clinical Presentation, Diagnostic Investigations and Surgical Results in 25 Patients with Irritative State and Instability of a Lumbar Motion Segment After Disc Surgery\**

Case No.:	Discectomy Approach:																									
	Fenestration											Hemilaminectomy					Laminectomy									
	1 Level					2+ < Levels																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
<b>Clinical Presentation:</b>																										
- Back Pain	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
- Radicular							■	■			■												■	■		
- Pseudoradicular	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
<b>Functional X - Rays:</b>																										
- Unstable	■		■		■	■		■			■	■	■	■	■			■	■	■		■	■		■	■
- Normal		■		■			■		■	■						■	■				■			■		■
<b>Facet Joints:</b>																										
- Reduction none - 1/3	■	■	■		■	■	■	■		■	■	■		■	■					■			■		■	■
- Reduction 1/2 and more				■					■				■					■	■	■	■		■		■	■
- Hypertrophy	■	■						■				■						■	■	■	■		■		■	■
- Test-Anaesthesia 0																	■							■		
- Test-Anaesthesia +							■	■			■	-	-													
- Test-Anaesthesia ++	■	■	■	■	■	■			■	■				■	■			■	■	■	■	■	■	■	■	■
<b>Plaster Jacket +:</b>																										
	■	■	■	■	■	■		+	■		+	■	■	■	■	■	■	■	■	■	■	■	■	+	■	■
<b>Surgical Results:</b>																										
- Excellent		■	■	■		■	■	■	■	■	■	■	■		■	■	■	■	■	■	■	■	■	■	■	■
- Good	■																									
- Satisfactory					■																					■
- Moderate														■												

\* Criteria for the evaluation of the surgical results: Excellent = Normal working capacity in previous or comparable activity, no or only occasional residual pain; Good = Normal working capacity in previous or comparable activity, mild residual low-back pain or dysesthesia in lower limb(-s); Satisfactory = Reduced working capability, but working in less heavy activity, residual low-back pain and pain in lower limb(-s); Moderate = Incapable to work, low back pain and pain in lower limb(-s) slightly improved. + = Resolution of pseudoradicular component only. - = not done because of multilevel instability.

or diffuse pain in the low back as well as heat and burning sensations, enhanced by physical activity was present in the majority of cases. A feeling of weakness and insecurity, accompanied by sudden loss of strength on one side (the giving-way-syndrome) was found in 60% of Group I- and in 20% of Group II-patients. In Group I-patients as well as in Group II-patients non-segmentally confined leg pain, i.e. either diffuse dysesthesia or causalgic pain was present in about 50%, while a typical radicular pain, as well as motor weakness and segmental hypaesthesia/hypalgesia occurred almost exclusively in the 5 Group II-patients. The characteristic gait was present in 50% of the patients.

18 out of the 20 Group I-patients responded with complete resolution of their low back pain and their nonspecific lower limb complaints after the test-anaesthesia. In two instances the test-injection was not done because of apparent multilevel instability. The confirmatory plaster jacket led to complete resolution of complaints in all patients included in Group I. In these 20 patients the surgical result can be directly correlated with the results of preoperative external fixation.

Table 3 depicts the correlation between the surgical outcome and results of the test procedures in the 20 Group I-patients (no additional radicular symptoms

Table 2. *Clinical Presentation in 25 Patients with Instability After Lumbar Disc Surgery*

Clinical presentation		Group I (n=20) %	Group II (n=5) %
Low back	Lumbovertebral local or diffuse pain	100	100
	Heat and burning sensation	65	20
	enhanced by physical activity	100	100
	Sensation of weakness and insecurity	60	20
Lower limb(-s)	Segmentally confined pain	15	100
	Non-segmentally confined pain	85	100
	diffuse dysaesthesia	55	80
	causalgic pain	45	60
	pain inguinal folds	20	20
	Segmental motor weakness	10	80
	Segmental hypaesthesia/hypalgesia	10	80
Reflex abnormalities	80*	100	
Characteristic gait		60	40

\* Mostly due to previous radicular compression.

Table 3. *Correlation Between Results of Testing Procedures and Surgical Outcome in 25 Patients with Instability After Lumbar Disc Surgery*

Results of tests	Facet anaesthesia		Plaster jacket		Surgical outcome	Surgical outcome		
	Group I (n=20)	Group II (n=5)	Group I (n=20)	Group II (n=5)		Group I (n=20)	Group II (n=5)	
Complete relief of pain	13	0	16	1	Excellent	16	4	
Markedly improved	0	4	0	3				
No improvement	1	0	0	0				
Complete relief of pain	3	1	2	1	Good	2	1	
Markedly improved	0	0	0	0				
No improvement	0	0	0	0				
Complete relief of pain	2	0	2	0	Satisfactory	1	0	
Markedly improved	0	0	0	0				
No improvement	0	0	0	0				
						Moderate	1	0

\* Not done in 2 patients because of multilevel instability.

masking the effect of external immobilization) and the 5 Group II-patients.

Obviously the final surgical outcome can almost be predicted by the use of the trial plaster jacket. On re-evaluation of the two patients in whom only satisfactory results have been obtained (Patients 5 and 14), we came to the following conclusions: In Patient 5, a 42-year-old woman, we only obtained resolution of her femoralgic complaints, the lumbovertebral pain reappeared after withdrawal of the postoperative plaster

jacket. We think that this was due to insufficient correction of her scoliotic deformity of the lumbar spine. In patient 14 (with an unsatisfactory result) the plaster jacket obviously gave a false positive result. Retrospectively we assume that this patient had additional psychogenic complaints which were not correctly recognized.

One has to take into account that in the 5 Group II-patients radicular symptoms due to recurrent disc prolapse, pseud-arthritis, scar formation and other ae-

tiologies were present intermingled with pseudoradicular signs as well as the other symptoms of an irritative state and instability. The latter accounts for the fact that the test-anaesthesia of the articular branches and the confirmatory plaster jacket have not been followed by complete resolution of the complaints in all instances (Tables 1 and 3). However, in conclusion, resolution of two thirds of the low back and leg pain while wearing the plaster jacket was an essential prerequisite prior to internal fixation in the Group II-patients.

When evaluating the over-all surgical results we have to take into account that the periods of postoperative observation are rather short so far (mean = 19.3 months). Excellent, good, satisfactory and moderate results have been obtained in 20 (80%), 3 (12%), 1 (4%) and 1 (4%) patients, respectively (Grading see footnote in Table 1). There was no case of malunion.

## Discussion

Persisting low-back pain and pain in the lower limb(-s) after lumbar disc surgery is a very complex clinical and socio-economic problem and merits much clinical consideration and commitment. This task belongs to the Neurosurgeon, Orthopaedic Surgeon or other Physician dealing with low-back pathology, with the proviso that he is willing to cross the orthodox borders of his own specialty.

There is urgent need for a concept of the diagnostic work-up in patients in whom differentiation between radicular symptoms and signs due to instability and an irritative state of a "lumbar motion segment" is difficult: Radicular and pseudoradicular symptoms may be present concomitantly, may mimic each other and the patient's complaints and clinical findings are difficult to interpret. We have been working with our diagnostic and therapeutic protocol for 3 years and we think that this testing procedure allows us to detect instability and an irritative state of the discectomized segment in the majority of the cases.

Detailed analysis of the modes of clinical presentation, results of clinical examination and particularly the response concerning pain relief following test-anaesthesia and the wearing of a plaster jacket for a trial period, allows the characterization of a quite distinct clinical picture typical for instability of the lumbar and lumbosacral spine.

The indication for operative stabilization is obvious when functional x-rays of the lumbar spine demonstrate an unstable segment and the test-injection of the articular nerves and the confirmatory plaster jacket

lead to resolution of the symptomatology. In the case of inconspicuous functional x-ray studies or even demonstration of a hypomobile segment, the confirmation or exclusion of a mechanical origin is rather difficult. In these cases plain tomographic and/or CT-studies are of great value because they illustrate the patient's "operation history" by showing the extent of bony resection of the posterior structures and allows an estimation of ligamentous and capsular resection.

The test-anaesthesia of the articular nerves allows confirmation of a facet-syndrome or rules it out. The latter is a common finding in the unstable segment and we assume that, in the majority of our cases, an irritative state of the facet joints was at least partially responsible for the patients' complaints. It is conceivable that the removal of a lumbar disc, in combination with partial destruction of the functional unit of one facet joint, including its ligaments, muscles and articular capsule, creates an instability in only this facet joint (in contrast to instability of a whole segment).

In the presence of a positive result of the test-anaesthesia and absent radiological signs of instability, a facet rhizotomy by thermocoagulation may first be performed. It may be argued that in the unstable spine, facet rhizotomy may be contraindicated because it might increase instability by denervating the multifidus musculature involved in the stability of the facet joints<sup>14</sup>. A negative result of the test-anaesthesia only excludes a facet-syndrome but does not rule out for instance an irritative state of the recurrent sinuvertebral nerve (N. Luschka, Fig. 3) of the operated segment. This accounts for the patients who experience complete relief of pain

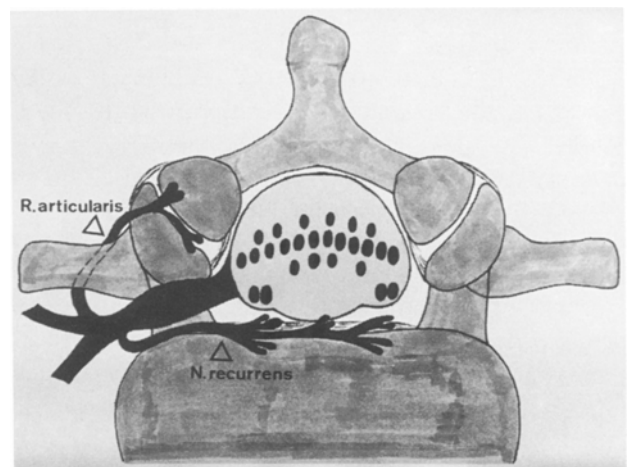


Fig. 3. Schematic drawing of articular branch and sinuvertebral nerve of Luschka

in the confirmatory plaster jacket despite a negative result of the test-injection (Case 12).

It is feasible that in these cases minute mechanical imbalance of the discectomized segment, together with scar formation, might lead to an irritation of Luschka's recurrent nerve innervating the dura and posterior longitudinal ligament. 19 out of 23 patients who were submitted to test-anaesthesia responded with complete pain relief in the low back and extremity(-ies) while in 4 patients (all Group II), only the pseudoradicular complaints subsided and no improvement was noticed in 1 patient (Group I). In 2 patients the test was not done because of multilevel instability (Cases 12 and 13, Table 1). The confirmatory plaster jacket holds the most important position with respect to the indication for internal fixation (Table 3). The patient himself can judge the result of external immobilization of the affected segment. Patients with psychogenic complaints are rapidly filtered out because they demand the withdrawal of the plaster jacket after a few days. The trial plaster jacket was followed by complete pain relief in 22 out of 25 patients; in 3 patients with concomitant recurrent nerve root involvement only the pseudoradicular symptoms vanished and in 1 patient (Table 1, Case 14), the result was a false positive. In the present series, after internal stabilization excellent, good, satisfactory and moderate results were obtained in 20, 3, 1 and 1 patients, respectively (Table 3, Results).

Among the techniques applied for internal fixation the method of translaminar screw fixation<sup>12</sup> is impressive because it allows a monosegmental stabilization with anatomic reconstruction of the spinal canal, intervertebral foramina (by distraction and arthrodesis of the facet joint and consecutive enlargement of the foramen) and preservation of the integrity of the posterior neural arch. The screws have the function of threaded bolts and after the operation the patients have to wear a plaster jacket for a period of two to three months. The screw plate fusion technique according to Louis allows satisfactory<sup>9,10</sup> fixation in the cases of bi- or multisegmental hypermobility and instability. This operation is always completed by a posterolateral fusion and postoperatively patients are also immobilized in a plaster jacket. When the instability exceeds translation displacement along the Z-axis (which is the most common type of displacement in the present series) other techniques<sup>15</sup> are selected for correction of the displacement and internal fixation. Details of the operative techniques will be presented separately.

Although the periods of postoperative observation are rather short (mean: 19.3 months), we think that

our results are encouraging. The presented diagnostic and therapeutic protocol allows us to detect a considerable number of patients with hypermobility and instability of the discectomized "motion segment" who will benefit from internal fixation.

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