

## TECHNIQUE AND RESULTS OF DIAGNOSTIC DISC PUNCTURE AND INJECTION (DISCOGRAPHY) IN THE LUMBAR REGION

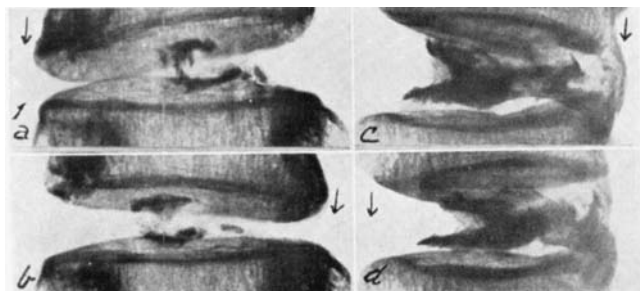
*By*

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### ANATOMICAL ORIENTATION

Anatomical specimens in which dye has been injected into the centre of the disc demonstrate that it is possible to fill up most of the disc spaces. In spite of the irregularity two main spaces can be outlined, an upper and a lower, which communicate with one another. These spaces appear to be necessary for the displacement of the nucleus during movements of the spine (Fig. 1).

In the normal disc the spaces are limited to the region of the nucleus. In the ruptured disc one or both spaces project into, and on occasions, through the annulus, often following one or both vertebral surfaces. This indicates that a loosening of the annulus from its bony attachment has occurred (Fig. 2). The normal annulus is formed by layers of crossing bundles of firm connective tissue with possible interlamellar movements. In the region of a rupture the structure is changed



*Fig. 1 a-d.*

Discograms of normal (a-b) and ruptured (c-d) disc, demonstrating displacement of nucleus by movements of spine. Arrows mark concave side.



*Fig. 2.*

Photograph of autopsy specimen in sagittal section through radial rupture. Rupture runs adjacent to vertebral surface.



*Fig. 3.*

Photograph of disc with nuclear cavities filled with barium; no communication between these cavities and rupture cavity in anterior part of annulus.

into a more or less homogeneous mass of firm connective tissue with decreased interlamellar mobility. This is thought to be essential for the loosening of the annulus from its bony attachment.

The outermost layer of the disc is vascular and in this region reaction occurs in the form of granulation tissue which obviously digests the protruding disc mass.

In exceptional cases pathological spaces appear in the annulus without definite communication with the central spaces (Fig. 3).

#### DISC PUNCTURE IN LIVING SUBJECTS

Disc puncture and injection in living subjects not only demonstrates the normal spaces and ruptures of the discs but also reproduces pain which may be identical with that originally complained of by the patient.

The purpose of this paper is to report the present technique of disc puncture in the lumbar region and experiences with this procedure in 150 cases.

## TECHNIQUE

On a lateral film the distance from the skin to the disc centre is measured with the aid of a centimeter-scale attached along the line of the spinous processes. A double needle of a corresponding length is inserted, the outer needle into the spinal canal and the inner needle (0.5 mm in diameter) into the centre of the disc. A mixture of 2 cc 35 % perabrodil (diodrast) and 0.5 cc 5 % novocain is injected.

During the procedure the patient is placed in the prone position on a fluoroscopic table. Pads are placed under the abdomen to straighten the lordosis. The position should not be absolutely flat, but slightly oblique, as it is easier to adjust the needle when it is inserted through the muscles at the side of the interspinous ligaments and, in addition, the spinous processes will not interfere with the needle.

The point of insertion is marked on the skin under fluoroscopy and sterilized. The skin and the underlying muscles are infiltrated with novocain. Local anaesthesia is necessary for proper adjustments of the needle. These are made under fluoroscopic control by pulling the skin in such a direction that the needle points toward the centre of the disc; the needle is then pushed in a little deeper. If the adjustments cannot be made by pulling the skin, the needle must be withdrawn and re-inserted. The adjustments should be made before piercing the ligamentum flavum.

The needle is not forced into the spinal canal until its direction is perfect. The puncture is then completed by pushing the inner needle into the disc. Small adjustments in direction are still possible in the spinal canal, and these are sometimes necessary, towards one side or the other, to avoid puncturing a nerve root. If the needle passes the dural sac near to the mid-line, pain from touching roots is unusual.

When the needle reaches the posterior longitudinal ligament and the posterior surfaces of the disc the patient will experience pain in his back at the level of the puncture. If the disc is normal this pain is slight, but in pathological cases it may be severe; "often described as if the needle was touching an abscess". This pain may radiate for a short distance along the adjacent part of the spine. A painful longitudinal ligament or disc surface indicates that the offending disc is being entered.

Finally the inner needle is forced into the disc centre; this does not produce any pain. The diodrast-novocain solution is injected. This is easy if the tip of the needle is in the nucleus, but difficult or impossible if the tip is in the annulus. The cavities in a normal disc are

entirely filled by half a cc, while a ruptured disc can take more. If the rupture perforates the surface of the disc large quantities can be injected, as dye escapes through the rupture and is distributed outside the disc.

Distension of the disc produces pain. In a normal disc and in one which is ruptured but not manifesting symptoms, this pain is similar to mild low back pain at the puncture level. On the contrary, distension of the offending disc reproduces the patient's usual low back and sciatic pain. In many cases the pain becomes so sharp that only a fraction of a cc can be injected. In exceptional cases the dye leaks out through the ruptures so quickly that little distension of the disc occurs and so no pain is produced.

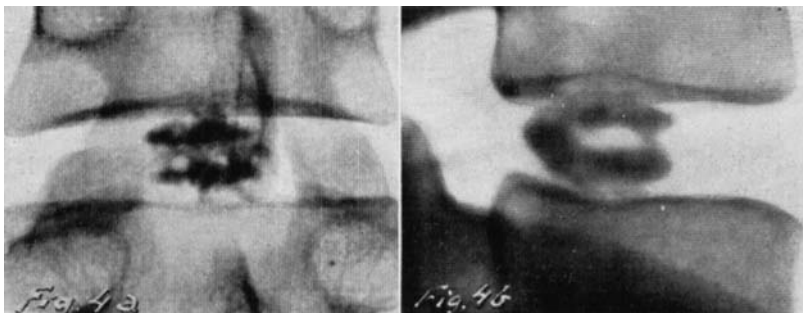
It is important to tell the patient about the procedure during the puncture and ask him to signify when pain is felt and also its nature. In many cases it is necessary to prepare the patient for puncture with sedatives, but the dosage of the drug must be moderate in order that perception to pain is not killed.

Usually the two or three lower lumbar discs have to be punctured in low back and sciatic cases. Only if the patient has pure sciatic pain and this pain is entirely reproduced by distension of that disc which is punctured first, does it become unnecessary to puncture more discs.

In the first and second lumbar discs the puncture is not made transdurally. Instead the needle is inserted 45-60 degrees laterally, passing anteriorly to the intervertebral foramina.

#### THE NORMAL DISCOGRAM

As illustrated in Fig. 4 the normal discogram has two dye-filled spaces, one along the upper and the other along the lower vertebral margin. These layers outline the nucleus and do not project into the



*Fig. 4 a-b.*

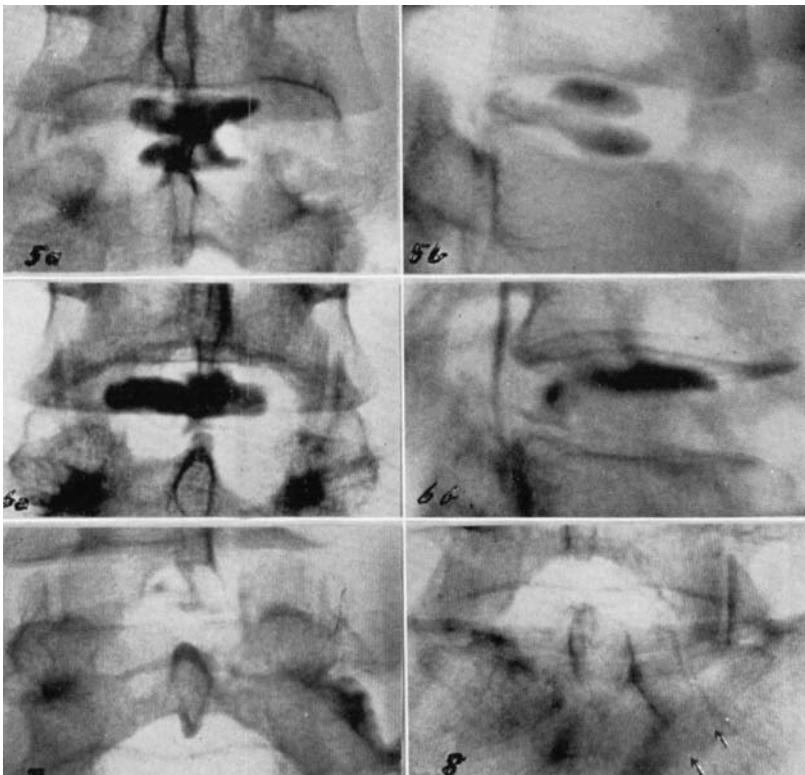
Normal discograms in living subject.

annulus. The two layers are joined by an irregular streak of dye through the centre of the disc. The appearance of the normal discogram is like a "collar button".

#### THE PATHOLOGIC DISCOGRAM, EARLY STAGES

From one layer or both there is a projection of dye into the annulus or through the annulus to the outside of the disc (Fig. 5). In cases of complete perforation of the disc the dye spreads outside the disc, posteriorly or postero-laterally; rarely anteriorly in the lower lumbar discs. Epidurally the dye may outline the disc prolapse or spread along the nerve roots forming characteristic contours (Figs. 6-8). Postero-laterally the dye may outline the nerves and the ganglia.

In the direction of the rupture the two layers have a tendency to join. This confluence usually runs adjacent to one vertebral surface.

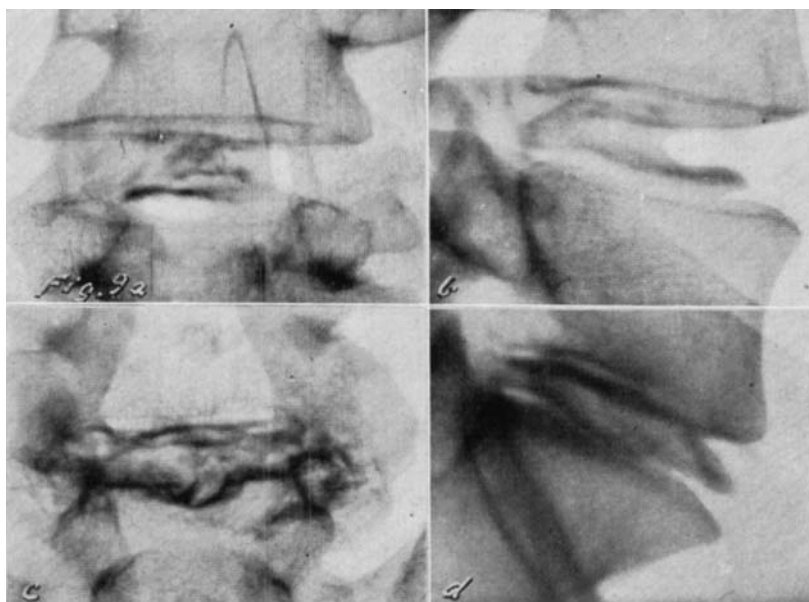


Figs. 5-8.

Discograms in living subjects illustrating:—dorsal radial rupture (5); dorsal rupture with epidural leakage (6); rupture with perineural leakage (7-8).

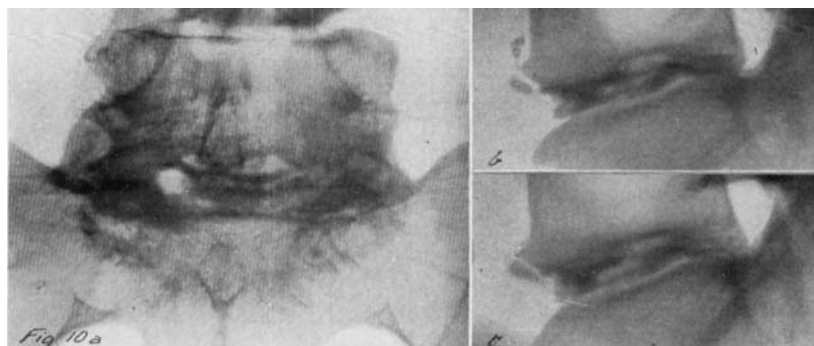
## THE PATHOLOGIC DISCOGRAM, LATE STAGES

The two layers of dye spread along the entire vertebral surface of the disc. The disc tissue between the two layers is more or less reduced and has almost the appearance of a loose body (Fig. 9). At the vertebral edges projections of dye are seen reaching the surface of the bulging disc or continuing into the adjacent tissue. Where marginal osteophytes are present, a contrast-filled rupture is usually seen following the vertebral surface to the very edge of the osteophyte (Fig. 10).



*Fig. 9 a-d.*

Discograms demonstrating more advanced ruptures.

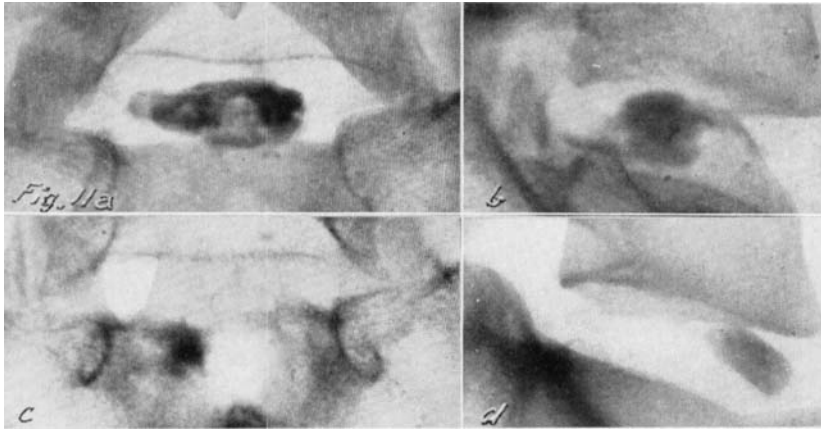


*Fig. 10 a-c.*

Discograms in final stage of disc rupture.

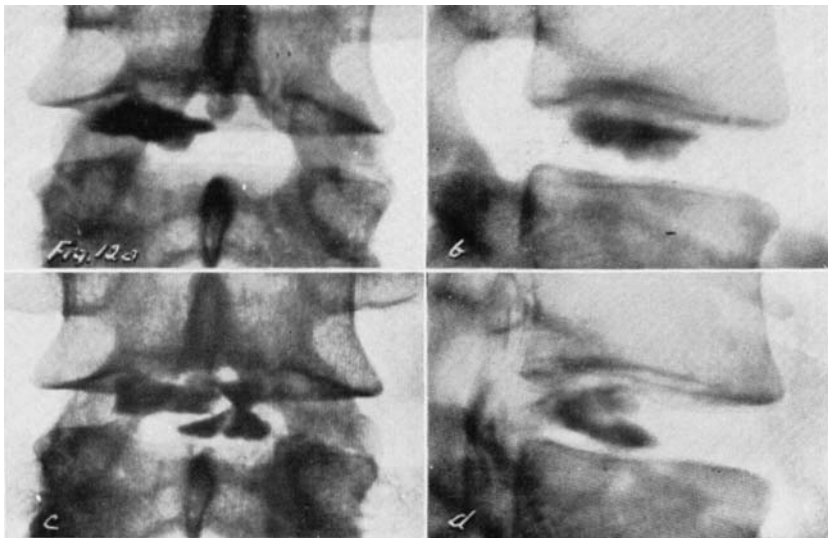
## TECHNICAL ERRORS

It is of the utmost importance that the point of the needle be in the centre of the disc when the injection is made. It is impossible to inject dye into the normal annulus or the thin cartilage plates which cover the disc surfaces of the vertebrae. However, there are cases



*Fig. 11 a-d.*

Discograms in posterior rupture (a-b); sciatica was reproduced. At first puncture and injection, dye was injected into anterior part of annulus (c-d); no pains experienced at this injection.



*Fig. 12 a-d.*

Discograms in posterior rupture (c-d); sciatic pain reproduced. At first puncture dye was injected lateral to nucleus (a-b); no pain.

with degenerated cavities within the annulus which do not communicate with the spaces in the nucleus (Fig. 3). Such cavities explain why in two cases injection could be made into the annulus. In one case the cavity lay anteriorly and in the other, laterally (Figs. 11-12). Distension of the discs by these injections caused only a slight low back pain. Following a new puncture the disc centre was pierced, and in both cases the patient's pain was reproduced by the central injection, which demonstrated posterior ruptures and protrusions of the discs in both cases.

These experiences indicate that *radiographic control of the disc puncture and of the dye injection is absolutely necessary*. It is not satisfactory to rely only on the reproduction of pains without radiographic proof that the injection has been made into the disc centre.

If a disc operation has been performed by the posterior approach between a first and a second puncture, it is necessary to check the puncture depth again. In one case a secondary disc puncture was performed two weeks after an operation and the measurement from the primary puncture was used. The post-operative swelling equalled 2 cm and the injection was made in the subarachnoidal space. The dye resulted in spasms about two hours later. Recovery was complete after morphin-scopolamin was administered.

Injection of too much dye may cause confusion in the pictures. This occurred in one case where more than 4 cc were injected. The dye leaked out through a posterior rupture into the epidural space and probably from there through the intervertebral foramen on the non-affected side (Fig. 13). A major leakage from the epidural space through those foramina not blocked by protruding discs and adhesions, was found in a series of 50 cases examined by diodrast and novocain injected epidurally from the hiatus sacralis<sup>1</sup>. The distribu-

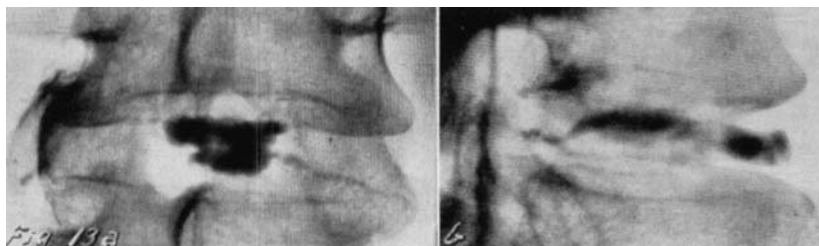


Fig. 13 a-b.

Discograms in posterior rupture with epidural leakage. Too much dye was injected and leaked out through intervertebral foramen (left) on non-affected side.

<sup>1</sup> Paper read before the Society of Swedish Radiology, June 1941.

tion of the dye was, however, too irregular to use the method for disc studies in clinical cases as well as in anatomical specimens.

#### DISCUSSION

Objections have been made to disc puncture because of supposed secondary destruction and rupture of discs (*Pease* and others). However, re-operated disc cases in which discs were punctured during the first operation did not show any rupture or protrusion at a secondary one. Because of these experiences it seemed to be possible to perform

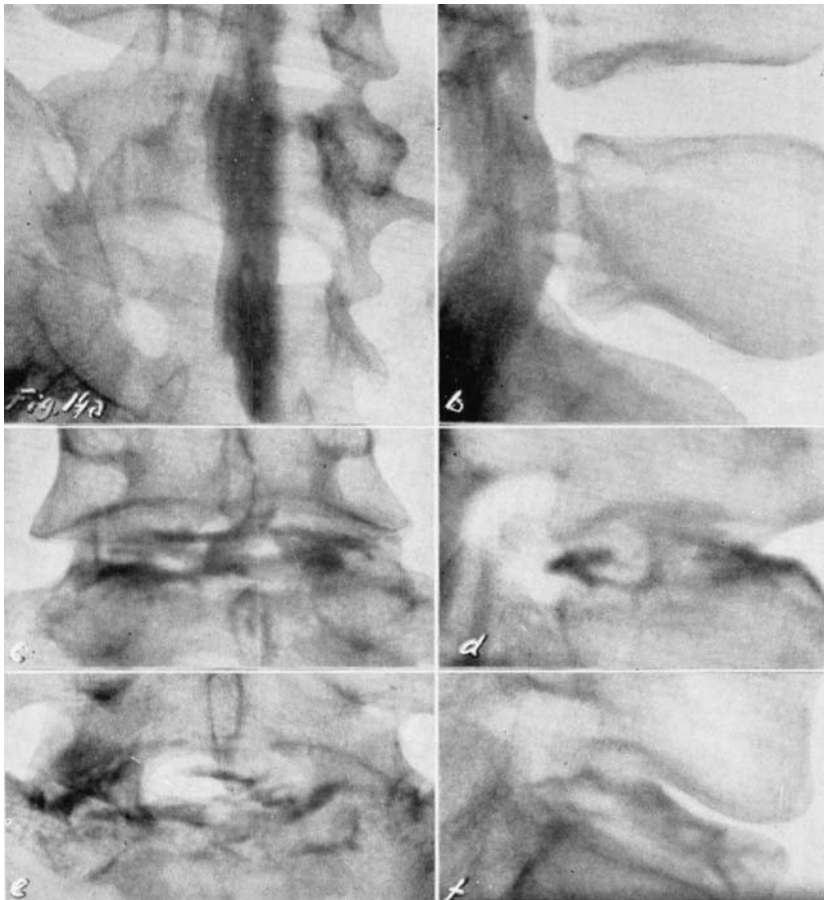
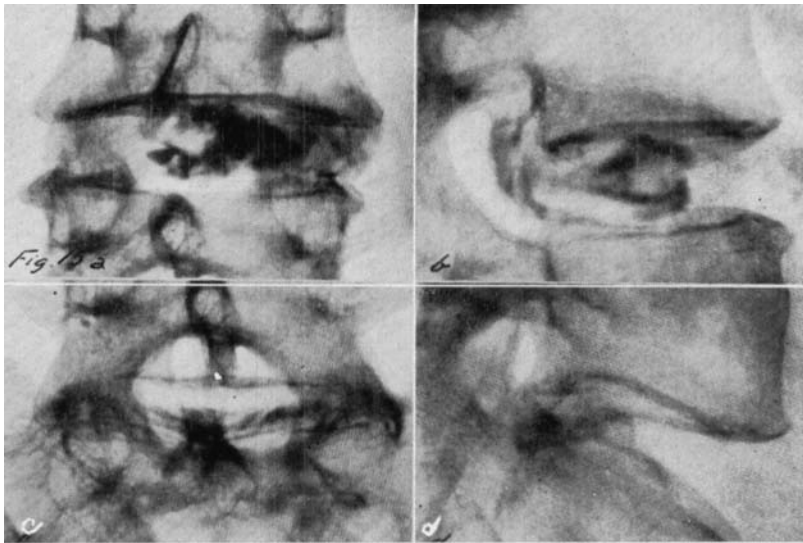


Fig. 14 a-f.

Abrodil myelograms and discograms in a case with lumbago from disc L<sub>4</sub> and sciatica from disc L<sub>5</sub>.

disc punctures with a very tiny needle in living subjects without any greater risk of damage.

In addition 24 disc punctures with injection of diodrast in 4 dogs' tails did not show any macroscopical or microscopical changes after 7 days to 4 months. A remnant of a haemorrhage in one of the discs was explained by a puncture lesion of a bony surface.



*Fig. 15 a-d.*

Discograms in a case with sciatic pain in groin from disc L<sub>4</sub> and sciatic pain in calf from disc L<sub>5</sub>.

This does not mean that disc puncture is such an innocuous method that it should be performed in every case of low back and sciatic pain. It is mainly a method for pre-operative localization in disc cases. As such, it gives better information than does myelography. It tells in almost every case which disc is responsible for the symptoms. If several discs are ruptured it reveals which disc is responsible for which symptoms. Thus, in several cases the main part of the low back pain originated from one disc while the sciatic pain came from another disc (Fig. 14), while in other cases two discs were both responsible for the backache and the irradiating pain (Fig. 15).

The value of disc puncture is still greater when the disc is operated upon from a lateral approach, a decompression by fenestration of the disc. In those cases the surgeon has to rely entirely on information gained from the disc puncture, as the disc prolapse will not be visible during the operation.

Myelography is indicated in atypical cases and when symptoms cannot be sufficiently reproduced by disc puncture. It must be remembered that caudal tumors, for example, often produce symptoms very similar to those of protruding discs.

Transdural puncture in the mid-line can be made in the three lower lumbar discs. Above the third disc a puncture from the posterolateral side is possible. In two cases the first and second lumbar discs were punctured in this way. Cervical discs were punctured from the antero-lateral side. A report of these experiences with cervical disc puncture will be published at a later date.

In 1950 *Erlacher* claimed certain advantages for paradural disc puncture in the lumbar spine. Such a paradural puncture through the spinal canal can only be made when the dural sac is narrow and the space between the vertebral arches is broad. This only occurs in some cases between L 5 and the sacrum and never at the 4th and 3rd disc levels. In the paradural puncture the needle does not touch the region of the posterior longitudinal ligament; therefore this method does not provide any valuable information as to whether the ligament is tender or not.

#### S U M M A R Y

The technique of transdural diagnostic disc puncture and injection is described. The value of both reproduction of the pain during the procedure and visualization of the disc ruptures is emphasized.

#### R E S U M E

L'auteur décrit la technique de la ponction discale transdurale et de l'injection intradiscale de produit de contraste. Il insiste sur le fait, qu'on doit reproduire les douleurs, spontanément ressenties par le patient, en même temps qu'on visualise une rupture, pour pouvoir considérer la disque examinée comme étant la cause de troubles.

#### Z U S A M M E N F A S S U N G

Die Technik der transduralen Discuspunktion- und injektion wird beschrieben. Der Wert der Reproduktion von Schmerzen durch den Eingriff sowohl als des Sichtbarmachens von Discusrupturen wird hervorgehoben.

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