ORIGINAL ARTICLE

Natural history of lumbar disc hernias: Does gadolinium enhancement have any prognostic value?☆

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Received 13 October 2010; accepted 30 October 2011

KEYWORDS
Herniated disc;
Sciatica;
Magnetic resonance imaging;
Contrast enhancement

Abstract

Objectives: To evaluate the percentage of disc hernias that have disappeared after one year of follow-up and the time to disappearance. To determine whether gadolinium enhancement is useful for predicting whether the hernia will disappear. To analyze whether the pattern of enhancement can help predict whether the fragment will disappear.

Materials and methods: This prospective study included 118 patients with acute symptoms of lumbosciatica and a herniated disc diagnosed by CT. In 72 patients, we performed gadolinium-enhanced MRI every 6 months for one year or until the herniation disappeared; we related the findings of protrusion, extrusion, and the enhancement pattern with the disappearance or persistence of herniated disc material. We analyzed the results with univariate and multivariate statistics.

Results: The 59% of the hernias disappeared within 1 year of follow-up and 66% disappeared within the first 8 months of follow-up. The 83% of the extruded hernias disappeared, and this was significant in the multivariate analysis (p < .005). The absence of enhancement was significantly associated with the persistence of the hernia in the univariate analysis. The enhancement pattern was not useful for predicting whether the hernia would disappear. Five hernias disappeared within the first two months.

Conclusions: A high percentage of disc hernias disappear. We found a significant association between extrusion and disappearance but no correlation between the pattern of gadolinium uptake and the disappearance of the hernia.

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Introduction

Among the different causes of severe lumbosciatica lumbar disc hernia is one of the most important of all. Most patients do well with conservative therapy. However some authors claim surgery is the best therapy in the short term. Some studies claim that one of the most important causes of improvement is to shrink size of hernia. Other authors think that the change of size and shape of hernias do not explain their clinical evolution. As a matter of fact there are several immunological, vascular and biochemical factors that can produce the patients’ painful presentation with no mass effect or root compression. This is why it is not clear if the ideal therapy is conservative or surgical therapy. Nevertheless conventional wisdom on surgical therapy is based on the roots’ mechanical compression by the disc hernia and this is why if hernia disappears spontaneously surgical therapy can only be considered in cases where there is a serious deterioration of the patients’ quality of life.

One of the important factors speaking against surgery is risk of back surgery syndrome unforeseen by clinical or morphological data.

One important aspect of disc hernia evolution is its relation to gadolinium enhancement. Some descriptions say this enhancement is associated to a good evolution and even disappearance of hernia. These are retrospective or prospective studies with few patients. In a prospective study with a great number of patients they only did MR monitoring at 6 months. Purpose of this prospective study is analyze the following issues:

Assessment after one year of follow-up the percentage of hernias that finally go away and how fast they do so.

Assessment if presence of gadolinium enhancement at the disc hernia is a factor predisposing to disappearance of hernia.

Conclusion: Un alto porcentaje de hernias de disco desaparecen, se ha encontrado la asociación estadísticamente significativa entre extrusión y desaparición, y falta de correlación entre el patrón de captación de gadolinio y la desaparición de la hernia.

Materials and methods

We are talking about a prospective study of 118 consecutive patients with lumbosciatica and disc hernia diagnosed through CT at 26 months. Study was approved by Hospital Research Committee (600-bed-2nd degree academic hospital) and obtained informed consent from all patients. Our study is basically an anamoradiological study to analyze natural history of hernia. Because of the difficult anatomic-clinical correlation known to these types of hernia, presentation was not taken into consideration—just as an initial way of selection. Our series is therefore made up of patients with lower back pain or lumbosciatica 3 weeks after medical therapy—when disc hernia was found through CT. In our work we did not assess the type of conservative therapy and its possible relation to the evolution of anatomical or enhancement findings.
These were inclusion criteria:

Lower back pain and lumbosciatalgia of over 3 months duration.
CT showing major disc hernia > 3 mm.
Informed consent to do a gadolinium-enhanced MR.

These were the exclusion criteria:

Disc hernia < 3 mm.
Moderate or severe stenosis at the lower back rachial channel.
Spondylolisthesis > stage 2.
Cases of a difficult differential diagnosis between hernia and disc bulging.
Claustrophobia or other MR complications.

All patients underwent an initial gadolinium-enhanced MR after obtaining informed consent. Average time between CT and MR was just 2 months.

In time 46 patients were excluded from the study for the following reasons:

15 underwent surgery.
31 were lost to follow-up due to patients’ denial to undergo an MR.

A total of 72 patients with 80 disc hernias entered the study. Of these only 5 underwent the initial MR showing disappearance of hernia. Sixty-seven patients were pending study through a gadolinium-enhanced follow-up every 6 months and for one year or until hernia was gone. In 26 cases we only did 2 MR studies due to disappearance of hernia during first control. In the remaining 45 cases we did 5 studies.

Disposition of patients in the study:

Initial: 118 with TC and presence of disc hernia.
Excluded: 46 patients.
Initial MR: 72 patients.
One MR: 5 patients.
Two MR: 26 patients.
Three MR: 41 patients.

A conventional L3-S1 transversal slices 5 mm thick every 5 mm-Somat® HQ (Siemens Medical Solutions, Erlangen, Germany) was used for CT scans; 512×512 matrix; 25 cm 120–140 kV-vision field.

All MR scans were done with a 1.5 Tesla (Magnetom-Vision, Siemens Medical Systems, Erlangen, Germany) with following sequences, all of them obtained with 3 mm thick (10% separation) and 3 acquisitions: sagittal T1-weighted spin-echo (TR/TE: 800 ms/12 ms; matrix: 512×256), axial T1-weighted spin-echo (TR/TE: 984 ms/12 ms; matrix: 256×256), and sagittal T2-weighted fast spin-echo (TR/TE: 5500/128 ms; matrix: 322×512). Both sagittal and axial sequences on T1 were obtained after IV administration of 0.1 mmol per kg of Gadoteridol (ProHance®, Bracco, Milan, Italy) with the same parameters that non contrast sequences. Interval between the administration of contrast and the beginning of the first sequence was 30 s.

Systematically all patients were assessed according to age, gender, level of hernia and presence and type of hernia enhancement.

Following criteria by the American Society of Spin Radiology and the American Society of Neuroradiology,12 disc hernia was defined as a disc material spreading beyond the interverbral disc it comes from in a focal way–different from disc bulging where the disc margin spreads not in a focal but in a diffuse way.

Protrusion was seen as the asymmetrical expansion of focal disc spreading beyond the disc it comes from with an axis in any inferior level to the disc seat. Finally extrusion was achieved when the asymmetrical expansion of focal disc had a base at the disc it comes from, inferior to the maximum extension diameter of such border. One loose fragment was considered extrusion.

Gadolinium enhancement was classified as peripheral, homogeneous or heterogeneous. In the peripheral one the contrast had the shape of a ring surrounding a non-enhanced center. Homogeneous enhancement enhanced most of the disc, and heterogeneous enhancement existed when there was a hernia enhancement associated to unenhanced areas.

Degree of hernia shrinkage was classified as:

Disappearance: when over 90% of disc material was gone. Shrinkage of over 50%. Shrinkage of less than 50%. Unchanged.

Hernia was gone in 5 patients when the first MR scan was done. Absolute size of hernia was not taken into account during the follow-up of our patients considering that most studies do not give meaning to these data.13,17–20

Assessment of MR scans in relation to location, evolution of size, type of hernia or contrast enhancement was carried out independently in a delayed way by 2 readers—the two first authors with huge experience in spine MR. When they disagreed a consensus reading was carried out. Size of hernia was measured at the axial image in a perpendicular point apart from the disc. Situation of hernia at the axial image or its signal features on T1 or T2 sequences were not assessed on the axial level–central, lateral, foraminal.

Statistical study was done with software SPSS 11.0 (SPSS Inc., Chicago, IL, USA).

Univariate analysis was done through Chi-Squared test or Fisher’s Exact Test. Demographic values, gender, age and enhancement patterns correlated to persistence or disappearance of hernia.

Multivariate logistic regression analysis assessing persistence or disappearance of hernia was carried out with independent variables associated with age, gender, location, and enhancement pattern. p < 0.05 was statistically significant.

Results

Table 1 shows univariate analysis of 75 MR-scanned disc hernias associated with hernia disappearance, age, gender, level and type of hernia and contrast enhancement. If we look at this table we can see that contrast enhancement was very common (93.3%). Lack of enhancement only happened
in 6.7% of patients and held a significant statistical correlation to persistence of hernia. The most common contrast enhancement was peripheral enhancement (50.6%), yet no one enhancement had any significant statistical relations to hernia disappearance. Figs. 1–3 show some good examples of types of enhancement. There were no changes in the type of enhancement during follow-up (not shown in the table).

The most important findings associated with change of size in disc hernia during time are shown in Tables 2 and 3. Table 2 shows in time the number of disc hernias gone since CT was done. Total number of disc hernias gone was 47% out of a total of 80 (Fig. 4), of these 66% in less than 8 months and the rest in the remaining 6 months.

Table 3 shows relation between changes of size in 80 disc hernias during follow-up year. Among those that did not

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Univariate analysis of 75 disc hernias. Association between disappearance of hernia and age, gender, level of hernia, type of hernia and contrast enhancement.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td># hernias (%)</td>
</tr>
<tr>
<td>Age</td>
<td></td>
</tr>
<tr>
<td>&lt;35 years</td>
<td>18 (24)</td>
</tr>
<tr>
<td>35–44</td>
<td>13 (17.3)</td>
</tr>
<tr>
<td>45–54</td>
<td>33 (44)</td>
</tr>
<tr>
<td>&gt;54</td>
<td>11 (14.7)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>44 (58.7)</td>
</tr>
<tr>
<td>Females</td>
<td>31 (41.3)</td>
</tr>
<tr>
<td>Level of hernia</td>
<td></td>
</tr>
<tr>
<td>L3-L4</td>
<td>6 (8)</td>
</tr>
<tr>
<td>L4-L5</td>
<td>23 (30.7)</td>
</tr>
<tr>
<td>L5-S1</td>
<td>46 (61.3)</td>
</tr>
<tr>
<td>Type of hernia</td>
<td></td>
</tr>
<tr>
<td>Extruded</td>
<td>24 (32)</td>
</tr>
<tr>
<td>Protruded</td>
<td>51 (68)</td>
</tr>
<tr>
<td>Gadolinium-enhancement</td>
<td></td>
</tr>
<tr>
<td>Present</td>
<td>70 (93.3)</td>
</tr>
<tr>
<td>Absent</td>
<td>5 (6.7)</td>
</tr>
<tr>
<td>Type of gadolinium-enhancement</td>
<td></td>
</tr>
<tr>
<td>Homogeneous</td>
<td>19 (27)</td>
</tr>
<tr>
<td>Heterogeneous</td>
<td>15 (21.2)</td>
</tr>
<tr>
<td>Peripheral</td>
<td>36 (51.5)</td>
</tr>
</tbody>
</table>

* Chi-Squared test or Fisher’ Exact Test for small values.

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Natural history of disc hernia gone: evolution in time.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>Number</td>
</tr>
<tr>
<td>&lt;2 months</td>
<td>5</td>
</tr>
<tr>
<td>2–8 months</td>
<td>26</td>
</tr>
<tr>
<td>8–14 months</td>
<td>16</td>
</tr>
<tr>
<td>Total</td>
<td>47</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 3</th>
<th>Disc hernias: evolution of size.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
</tr>
<tr>
<td>Gone</td>
<td>47</td>
</tr>
<tr>
<td>Unchanged</td>
<td>17</td>
</tr>
<tr>
<td>Increase in size</td>
<td>3</td>
</tr>
<tr>
<td>Shrinking &lt; 50%</td>
<td>9</td>
</tr>
<tr>
<td>Shrinking &gt; 50%</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>80</td>
</tr>
</tbody>
</table>

Figure 1 Homogeneous enhancement. T1-weighted sequences, axial view. (A) No contrast image. Extruded disc hernia (arrow) on L5-S1 with partial occupation of left lateral recess and slightly compression of root S1. (B) Image after contrast. Homogeneous enhancement (arrow) of disc hernia.
1. Fifty-nine per cent of hernias disappeared—among these 66% in less than 8 months. Also 5% of hernias shrank >50%. Adding all up we have some 64%.

2. Twenty-one per cent of hernias remained unchanged.

3. Percentage of extruded disc hernias gone was very high (83.3%). Univariate analysis showed some significant association between disappearance of hernia and extruded hernias ($p < 0.05$).

4. Lack of hernia enhancement was associated with its persistence ($p < 0.001$).

5. The only statistically significant data on multivariate analysis was extruded disc hernia ($p < 0.006$). This analysis strengthens univariate analysis as it was done regardless of other analyzed factors like age, gender, or level of hernia. Extruded hernias are 5.4 times more likely to disappear than protruded hernias.

Analyzing data from the aforementioned tables, age, gender, location, and contrast enhancement pattern do not have statistical significance as prognostic factors of hernia disappearance.

Discussion

Former studies on the natural history of disc hernias show trend toward reducing size and disappearance in a high percentage of untreated hernias.

Cervical spine seems to have a similar natural history in a study of few patients.21 In lumbar spine hernia shrinkage or disappearance seems hard to evaluate in time and frequency hard to quantify. Busch et al. did a prospective CT-study with a large group of patients.4 CT and MR offer a similar degree of information in the evaluation of disc hernia but because of the lack of consent and normalization in the terminology
used it is hard to compare our data to the various studies shown in section ‘references’. In other studies where the sample of patients was small there was a high percentage of hernia size shrinking or disappearance. Bozzao et al. did a follow-up prospective study of 69 patients with shrinking numbers close to ours but they only did one MR-scan after 6 and 15 months making it impossible to know how fast hernia reabsorbed. Other authors only do one scan control similar to Bozzao et al.’s and with a variable time interval which implies even more difficulties of interpretation.

In one of our most extensive and easiest to compare studies for the important number of cases analyzed follow-up was done until 6 months showing spontaneous regression only in 34.7% of hernias and a 100% regression of loose fragment. Authors did not distinguish between total disappearance and regression or showed degree of regression; this is why it is difficult to compare to our data. However their numbers are similar to those shown in this study because in our cases percentage of disappearance at 6 months was 32.5%. Other authors describe percentage of disappearance below our percentages to a point they do not talk about complete disappearance. In such study follow-up periods varied.

The fact size of hernia has little relation to its possible disappearance or large hernias ending up disappearing is interesting. Most former studies show there is a little relation between size of hernia and its persistence or disappearance.

One interesting data of our study was 3 hernias increased their size which could be due to persistence of fissure through fibrous ring allowing nucleus pulposus keep coming out little by little while fissure is not healed. These data have not been very well-commented in section ‘references’; however aforementioned former study finds 9% of hernias increasing size.

When it comes to disc hernia enhancement contrast incidence was very high (93.3%) and peripheral enhancement pattern was more common (51.1%). In our analysis no enhancement pattern was significantly associated with the disappearance of hernia. In section ‘references’ you can see some studies on contrast enhancement. Modic et al. published the cases of a small subgroup of patients with a 6 week and 6 month follow-up. All of the 26 acute hernias analyzed showed peripheral enhancement. First early MR-scan done during the first 2 weeks probably exposed the difference of enhancement pattern with respect to our study. Figs. 5 and 6 show 2 cases of extruded hernias with homogeneous enhancement that disappeared. One of them extruded completely after 6 months and the other one shrank >90% in one year.

Galluci et al. studied a small sample of patients with a 6-month follow-up and the first MR-scan done the first week after patients’ presentation. Gadolinium-enhanced pattern changed from peripheral to homogeneous in 8 patients while in other 3 patients peripheral enhancement was persistent and all of them showed a decrease in the size of hernia. Komori et al. retrospectively studied 25 patients through gadolinium-enhanced MR at least with 2 studies among which there was a variable time from 27 to 856 days which makes it real hard to get to know what the real enhancement evolution was. However in 17 patients there was a change in enhancement pattern from periphery to center while 5 patients remained unchanged.

In a larger study of 64 patients with 72 disc hernias treated with conservative therapy and followed through a single gadolinium-enhanced MR at 6 months Splendiani et al. found enhancement in 41% of cases. In all the existence of peridiscal enhancement is described without further distinctions.

In our series the first MR-scan was done approximately 3 months after presentation and the remaining MR-scans in 6-month intervals. This likely temporal difference could explain our findings in relation to the aforementioned articles.

Explanation of disc hernia contrast-enhancement is that it seems to be due to epidural fibrosis and an attempt to heal the very hernia starting at the periphery progressing toward the remaining fragment which needs to be differentiatied from the enhancement attributed to perivenous plexus.

### Table 4 Multivariate Logistic regression analysis.

<table>
<thead>
<tr>
<th>Etharian group</th>
<th>OR</th>
<th>95% CI</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;35 years</td>
<td>1</td>
<td>-</td>
<td>0.8</td>
</tr>
<tr>
<td>45-54</td>
<td>0.5</td>
<td>0.06–4.7</td>
<td></td>
</tr>
<tr>
<td>&gt;54 years</td>
<td>0.5</td>
<td>0.09–3.3</td>
<td></td>
</tr>
<tr>
<td>35-44</td>
<td>0.3</td>
<td>0.05–2.7</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>1</td>
<td>-</td>
<td>0.7</td>
</tr>
<tr>
<td>Male</td>
<td>1.2</td>
<td>0.4–3.8</td>
<td></td>
</tr>
<tr>
<td>Level of disc hernia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L4-L5</td>
<td>1</td>
<td>-</td>
<td>0.5</td>
</tr>
<tr>
<td>L3-L4</td>
<td>0.6</td>
<td>0.07–5.9</td>
<td></td>
</tr>
<tr>
<td>L5-S1</td>
<td>0.4</td>
<td>0.03–3.7</td>
<td></td>
</tr>
<tr>
<td>Type of disc hernia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protruded</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extradured</td>
<td>5.4</td>
<td>1.6–18.4</td>
<td>0.006*</td>
</tr>
<tr>
<td>Type of gadolinium enhancement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heterogeneous</td>
<td>1</td>
<td></td>
<td>0.05</td>
</tr>
<tr>
<td>Homogeneous</td>
<td>0.9</td>
<td>0.2–3.7</td>
<td></td>
</tr>
<tr>
<td>Peripheral</td>
<td>0.5</td>
<td>0.1–1.8</td>
<td></td>
</tr>
</tbody>
</table>

CI: confidence interval; OR: odds ratio.
* Significant difference.
Figure 4  Disappearance of disc hernias. (A) Early CT, axial level. Disc hernia (arrow) L5-S1 extruded and lateralized to the left. (B) Follow-up MR, axial level at CT same level. Disappearance of hernia. (C) Early TC. Extruded disc hernia (arrow) on S1. (D) Follow-up MR, axial level at the same level of CT. Disappearance of hernia.

Figure 5  Extruded hernia disc occupying the lateral recess on L4. T1-weighted sequences, axial level. (A) No contrast image. Disc hernia (arrow) occupying the lateral recess of L4. (B) Image after contrast. Homogeneous enhancement of disc hernia. (C) Control MR (no contrast) after 6 months. Complete disappearance of hernia.
On the histological level epidural scar was identical to the one seen on surgical patients and contains a mixture of fibroblasts, collagen and small vessels.\textsuperscript{31} To many pathologists the margins of neovascularization of disc material are the only valuable data that disc hernia really occurred and they allow the pathologist to see the disc of hernia.\textsuperscript{32} Together with granulation tissue the scar is likely to reabsorb the disc material.\textsuperscript{33} Thus we could expect during the process of scarring the disc fragment to be invaded by granulation tissue that would break, fragment and reabsorb hernia. The total homogeneous enhancement we found in some patients supports the purpose of this mechanism despite not all homogeneous enhancements meant disappearance at one year. Unfortunately we do not know what would have happened during longer follow-up. According to this theory peripheral enhancement should evolve toward some other homogeneous central enhancement as long as disc material was absorbed. But this did not happen in several circumstances and peripheral enhancement persisted throughout the study. But because in the 6-month interval of subsequent monitoring many fragments were gone it is possible that peripheral evolution toward the center really happened. To support this hypothesis we would have needed shorter interval-monitoring and longer follow-up periods. Whatever the radiological–pathological correlation might be with disappearance of disc fragments and existing interrelation with acute inflammatory episodes based on our data it is impossible to predict persistence or disappearance of hernia based on the presence and type of enhancement contrast. In section 'references' there are disagreeing data on the relation between enhancement and disappearance of hernias. Modic et al.\textsuperscript{31} found a shrinkage percentage of 60% similar to ours while Splendiani et al.\textsuperscript{31} talk about 83% shrinkage.\textsuperscript{13,19} Disagreement can be partly due to enhancement percentages close to 41% in Splendiani et al.\textsuperscript{31} study, while our study and Modic et al.'s goes beyond 90%.\textsuperscript{13,19} or due to the fact that they do not distinguish between disappearance and degree of shrinkage. In our series the addition of disappearance and partial shrinkage was 75%. Other authors relate hernia disappearance to thickness of enhancement wall as an important predicting factor.\textsuperscript{18,33} However our homogeneous-enhancement cases showing maximum wall thickness we could not confirm those results.

Lack of contrast enhancement is statistically associated with persistence of hernia even though these data are of a little practical importance due to the small percentage of un-enhanced hernias both in our series and other series so systematic use of gadolinium would not be justified.\textsuperscript{13,17,19}

Enhancement difference happening at hernia level can be justified by the different histological composition of disc fragment.\textsuperscript{34} Experimental studies have proven that blood vessels from the neighboring fibrovascular tissue infiltrate the hernia tissue—not the cartilage and blood vessels and secondary inflammation produce shrinkage of the size of infiltrated ring material. Cartilaginous tissue from small vertebral plateaus causes inhibition due to inflammation and vascular episodes.\textsuperscript{34-36} Thus lack of enhancement can indicate there is a high percentage of cartilaginous material in the disc fragment. On the other hand there seems to be a good correlation between changes of signal intensity and the lower bone marrow and terminal plateaus (Modic\textsuperscript{3} criteria) and cartilaginous material at hernia level.\textsuperscript{34} We have not
assessed Modic’ criteria so it would be interesting to do a correlation study of those criteria, presence of bone defects of vertebral angles and disappearance of disc hernia.

There are several limitations in our study. Most important ones are patient selection bias, limited size of sample and lack of correlation to surgical findings. Another limitation is the fact that normal asymptomatic populations can have a 24–33% frequency of protruded hernias. Data can be important since within percentage of persistent hernias there can be a proportion of hernias found in asymptomatic populations.

In sum, in our study and in literature extruded disc hernias usually disappear and shrink; and extrusion is an important predictive factor for shrinking of hernia size. Speed of reabsorption is variable and many hernias reabsorb rapidly.

Contrast enhancement is a very common data in disc hernias and probably plays a role in hernia reabsorption even though in our series; we could not confirm a relation between type of enhancement and disappearance. These data partially disagree with the aforementioned section ‘references’.

Authors

1. Manager of the study: ARA.
2. Study concept: ARA.
3. Study design: ARA, MAM.
4. Data gathering: JLG, SFZ, RS.
5. Data analysis and interpretation: ARA, MAM.
6. Statistical treatment: AP.
7. Writing: ARA.
8. Critical review and intellectually relevant notes: ARA, MAM, RS.
9. Final version approval: ARA.

Conflicts of interest

Authors report no relevant conflicts of interest.

References

19. Splendiani A, Puglielli E, De Amicis R, Barile A, Masciocchi C, Gallucci M. Spontaneous resolution of lumbar disc hernia-
21. Maigne JY, Deligne L.Computed tomography follow-up study of 21 cervical cases of nonoperatively treated cervical interverte-
The natural history of disc herniation: Value of gadolinium