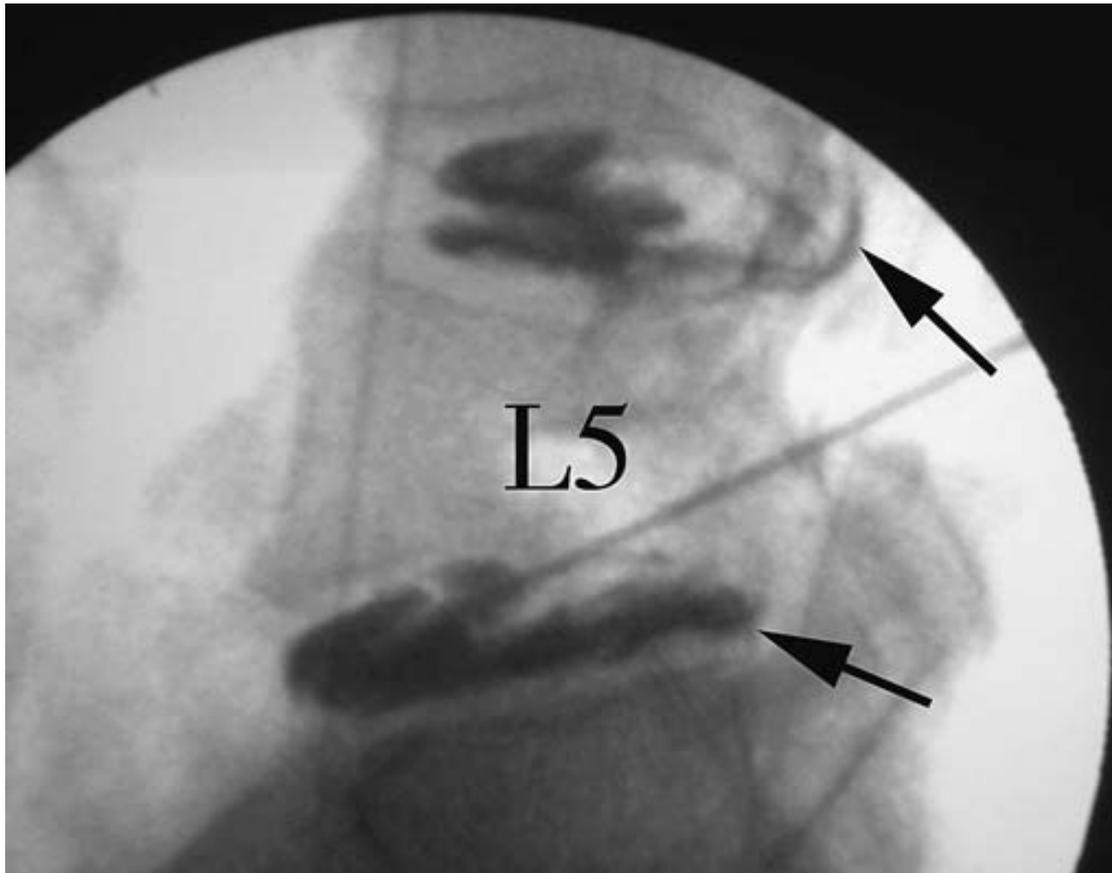




?Diagnosis

30 year old, minor lifting episode followed by low backache x 6 months.

Neurologically intact.



ANNULAR TEAR [AT]

The high signal contained within the annulus of a disc, separated from the nucleus pulposus, on lumbar spine MRI was termed as the HIZ by Aprill and Bogduk [Br J Radiol 65:361–369] in 1992. They correlated the finding with computed tomography discography and found that it had a positive predictive value of 86% for a severely disrupted, painful disc on awake discography. This appeared to be a significant breakthrough in the diagnosis of chronic low back pain.

However, it's significance is downgraded by Saifuddin [Spine 23:453–437] found that the clinical significance of the HIZ was limited as its sensitivity was as low as 26.7%. [Ricketson Spine 21:2758–2762] found no correlation between the presence of an HIZ and discographically identified annular tears.

Yasuma demonstrated vascular invasion as a sign of aging of the intervertebral disc. In their cadaver study, they noticed capillary invasion in patients over 40 years old. Based on their study, we considered that vascular invasion into the posterior annulus could be the reason that the aging or degenerative lumbar discs of some adults

without chronic low back pain presented the HIZs.

3 types annular: [Yu Am J Neuroradiol 110:1077–1081]

concentric, transverse, and radial.

The concentric tear was a crescentic or oval cavity associated with rupture of the short transverse fibers connecting the lamellae in the annulus fibrosus.

Transverse tears were a rupture of Sharpey's fibers near their attachments to the ring apophysis.

The radial tear was a fissure extending from the nucleus to the outermost surface of the annulus.

Presently it is a contentious issue as importance of annular tear [AT] is not clear in literature. This condition is over diagnosed and over treated.

Importance of Annular tear has been questioned

1. Carragee. Orthop Clin North. 2004;35:7–16.
2. Munter. Am J Neuroradiol. 2002;23:1105–9.
3. Rankine. Spine. 1999;24:1913–9.]

AT is very often seen on MRI, more so in degenerated disc. It's presentation may be

1. Asymptomatic and incidental finding
2. Chronic Backache
3. Backache with leg pain: Many patients presenting with back pain with referred lower leg pain show no evidence of nerve root compression. Inflammation of nerve roots (**chemical radiculopathy**) adjacent to annular tears has been suggested as a cause of sciatica, but there is little supporting evidence from imaging studies in humans and still remains hypothesis.

The T1- weighted sequences were repeated following intravenous gad. A new sign on enhanced lumbar spine MRI [**Eur Spine J (1999) 8 :34–39**], which author believes represents extradural inflammation adjacent to peripheral radial annular tears. **However, this has not been validated.**

Crock promoted the concept of ‘**internal disc disruption**’, suggesting that trauma to the intervertebral disc resulted in the production of inflammatory substances within the nucleus pulposus that could have local autoimmune effects causing back pain, and chemical effects on the adjacent nerve roots resulting in leg pain, but typically no neurological deficit. Such clinical symptoms are often referred to as ‘**discogenic**’ in nature. However, this is difficult to identify on MRI. Hence cannot be objectively diagnosed.

Relation of annular tear to pain [SPINE Volume 29, Number 23, pp 2668–2676]

1. Can annular tear changes seen without injury?

Yes. In fact, quite common and seen as an incidental finding on an MRI.

a. **J Korean Neurosurg Soc 53 : 31-38, 2013:** There are many papers on MRI changes in asymptomatic population in evidence based medicine. Recent Korean study, showed the prevalence of Disc herniation [HD], Annular Fissure [AF], and Nuclear degeneration were 81.4%, 76.1%, and 75.8% respectively in asymptomatic [18-82 average 46 y]

b. **Spine Volume 29, Number 23, pp 2668–2676]: <20 years.**

Asymptomatic MRI Magnetic resonance imaging (MRI):

“ documented disc pathology in adolescence has also been reported to reach a risk of 0.35 among **asymptomatic** and 0.57 among **symptomatic** patients by the age of 20 years. The risk of disc pathology among asymptomatic 11 year olds was found to be 0.09 (Smith F, Jeffrey J, Porter RW)

2. Finnish Study

3. Radiology 1998;209:661–6

Asymptomatic patients, 67% had disc protrusions, 33% had high signal intensity zones [Annular tear] , and 18% had disc extrusions based on MRI.

4. **Lancet 1986; 2:1366–7:** Powell *et al* showed that disc degeneration was present in over one-third of women aged 21 to 40 years.

5. Cadaveric study Spine: Volume 29, Number 23, 2004: pp 2668–2676

In conclusion, more than half of the cadavers at the age of 20 to 34 years showed some degenerative annular findings, indicating that identifiable structural change within the lumbar discs begin in early adulthood or earlier.

2. Importance of annular tear

a. **Aprill and Bogduk [Br J Radiol 65:361–369]** in 1992. They correlated the finding with computed tomography discography and found that it had a positive predictive value of 86% for a severely disrupted, painful disc on awake discography.

b. **Lam. Eur Spine J 9:36–41**

Found that there was a significant correlation between HIZ [Hyperintense zone; ? annular tear] and an exact or similar pain reproduction.

They believed that the HIZ in patients with low back pain is likely to represent painful internal disc disruption.

c. **Saifuddin et al. [Spine 23:453–437]** found that the clinical significance of the HIZ was **limited** as its sensitivity was as low as 26.7%.

d. **Ricketson et al. [Spine 21:2758–2762]**

Found no correlation

e. **Spine Volume 29, Number 23, pp 2668–2676**

Although annular tears and ruptures are common targets for diagnostic and therapeutic approaches, the relationship between disc findings and back pain has been weak or non-existent.

e. **Eur Spine J (2006) 15: 583–587**

Still do not know the true significance of the HIZ

3. Is an annular tear a predictor for accelerated disc degeneration?

a. **Eur Spine J. 2014 Mar 13.**

Serial MRI follow up for 4 years: One-fourth (25 %) of the 36 discs with an Annular tear on the initial MRI exam progressed in degeneration. This was similar to the rate of the matched control discs with no Annular tear, in which also around one-fourth

(22 %) showed a progression of degeneration ($p = 1.00$), also without any difference in the degree of degeneration.

b. *Acta Radiol* 1995;36:497–504; *AJNR Am J Neuroradiol* 1989;10:1077–81 Annular tears and nuclear degeneration often occur concurrently, but their temporal association remains unknown. Annular tears occur in the early stages of disk degeneration and are associated with a faster subsequent nuclear degeneration.

4. Acute annular tear is an entity? Orthop Rev (Pavia). May 9, 2012; 4(2)

In all instances, MRI indicated normal to mild degeneration of intervertebral discs and no clear sign of an annular defect; however, discography demonstrated an annulus fibrosus tear. These patients shared several clinical and demographic features: i) otherwise healthy individuals approximately 30 years of age; ii) no previous distinct history of low-back pain; iii) initiation of pain was associated with an abnormal low-back movement, heavy lifting, or exercise

As noted in our cases, discography can also be used as a provocative test. Injection of contrast material into the intervertebral disc typically results in increased intradiscal pressure. This can cause severe pain and may pinpoint the source of a patient's low-back pain. [dye do not easily escape into the epidural space]

The treatment algorithm for patients with confirmed AAR is the same as that used in cases of painful black disc disease. The first step in treating AAR is conservative treatment with minimum 6 weeks of conservative treatment and bed rest. The second step is to use techniques such as intradiscal electrothermal treatment, and these may be helpful. For patients who do not respond to steps 1 or 2 of treatment, surgical stabilization of the painful segment is the next option. However, logic behind this management has been questioned and not followed by most of the spinal surgeons.

5. Annular fissure (AF) and high-signal intensity zone (HIZ or AT)

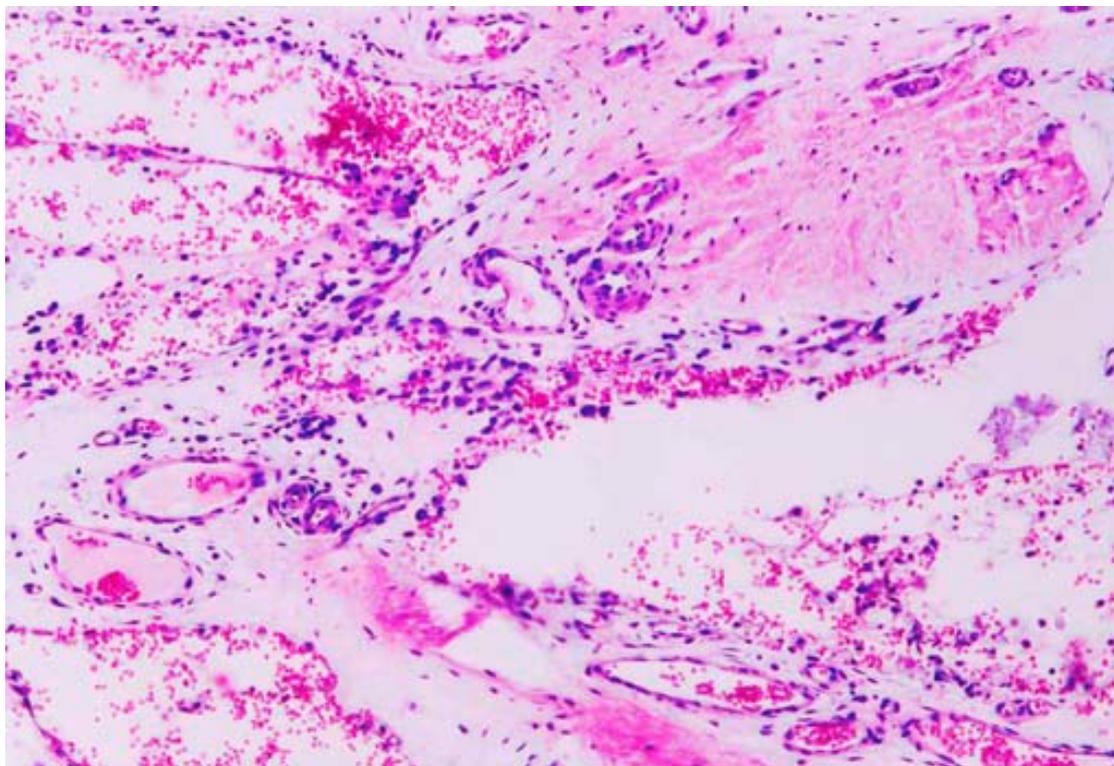
AF was defined as a high signal at **the fibrous ring** of an intervertebral disc on

T2WI. In addition, high-signal intensity zone (HIZ) is a high-intensity signal (bright white) **located in the substance** of the annulus fibrosus, clearly dissociated from the signal of the nucleus pulposus.

At mean 42 years: Annular fissure 36% and HNZ 8% [incidence increase with age.

6. Pathology of the Annular tear /HIZ [Hyperintensity zone] Eur Spine J (2006) 15: 583–587

A notable histologic feature of the formation of vascularized granulation tissue in the outer region of the annulus fibrosus.



7. Recent Experimental study 2014 Australian Study [at press Spine]

IVDD was reproducibly induced with a 6 x 20mm annular lesion, with focal dysregulation of MMP gene expression, cell cloning in the inner AF, loss of NP aggrecan and disc height. Loss of aggrecan from the NP was not attributable to increased proteolysis in the interglobular domain by MMPs or ADAMTS.

SUMMARY

Definition of AT: The presence of any hyperintense signal intensity on T2 within the

peripheral annulus was considered to represent an annular tear.

1. More in the lower lumbar
2. Vast majority: a vast majority 95.6% demonstrated annular tears at both the L4–5 and L5–S1 levels.
3. The mean signal-intensity grade [Pfirferman] for disks with annular tears was noted to be Grade 3, which was significantly higher than the corresponding value of 1.43 for disks without annular tears
4. Ten percent of all tears occurred in disks without any loss of signal intensity.
5. Disc degeneration is more in the annular tear. ? accelerate degeneration
6. In contrast, it was rare to find disks with more advanced nuclear degeneration in the absence of annular tears.
 - The presence of biochemical changes in the nucleus occurring at a relatively young age, leading investigators to hypothesize that degenerative changes in the nucleus precede the annular tears.[*Radiology* 1990;**177**:332–33, *Spine* 2006;**31**:1522– 31]

Our results indicate that annular tears are probably one of the earlier imaging manifestations of the degenerative process affecting the intervertebral disks, and their presence is associated with a more rapid appearance of nuclear degeneration in subsequent imaging studies.