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## Comparative Study of Disc Degeneration According to the Annulotomy Methodology: In Vivo Animal Study

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– Abstract –

**Study Design:** An in- vivo experiment.

**Objectives:** To compare the results of various methodologies for an annulotomy, and evaluate the relationship between the degenerative change and the volume of an extruded nucleus according to the various methodologies.

**Summary of Literature Review:** Many authors have reported that the traditional annulotomy technique is an open annulotomy.

**Material and Methods:** 16 female white New Zealand rabbits, each weighing about 4- 4.5 kg, were used. A retroperitoneal approach, using a paravertebral incision, was used. Using a number 11 blade, a 21G needle and a number 15 blade, transverse stab incisions, or puncture wounds, were made into the L3- 4, L4- 5 and L5- 6 disc through the antero- lateral annulus. At all the experimental levels, a complete annulotomy, which confirms the leakage of nucleus pulposus after an annulotomy, was used. To check the extruded nucleus volume after each annulotomy, the gross findings and histological findings of 10 disc samples from each level were analyzed. Radiological methods were used simple lumbar x- ray and MRI. From simple x- rays, the change in the disc height was measured with NIH image software, and the degeneration grade was classified using MRI.

**Results:** The gross and histological findings showed the most advanced degeneration in the number 15 blade annulotomy group (L5- 6 level), with the simple radiographs showing a fast decrease in the disc height. From the MRI findings, early degenerative findings were observed 2 months after the annulotomy in the number 11 and 15 blades groups. The largest extruded nucleus volume was observed in the number 15 blade annulotomy group.

**Conclusion:** In conclusion, the degenerative change in the disc, following an annulotomy, was related to the volume of the extruded nucleus.

**Key Words:** Degenerative disc, Annulotomy

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(discogenic back pain) 가 , 7,8) 가 (gene engi- neering) 14) (paravertebral inci- sion) (retroperitoneal approach) 3-4, 4-5, 5-6 3-4, 5-6 11 15 , 11 2 mm, 5 mm , 15 mm 3.5 mm, 5 mm 1) 21 gauge mm 4-5 1 mm, 5 mm (polymer) 6) (Fig. 1). 가 , 10 11 , 15 21 gauge , 12) , 5) , 10) , 2,3,13) 1,2,3,4,6 , NIH

**Table 1.** Change of disc height after annulotomy

Level	Month	Postop.	1 Month	2 Month	3 Month	4 Month	6 Month
11 blade (L3-4)		1.28	1.12	1.09	1.09	0.98	0.84
21G needle (L4-5)		1.32	1.17	1.16	1.13	1.1	0.89
15 blade (L5-6)		1.52	1.25	1.11	1.07	0.98	0.79

(mm)

Modified Pearce<sup>1)</sup>

1.

가 1 가  
가 6 가  
. 21 gauge 가

(Fig. 2).

H-E

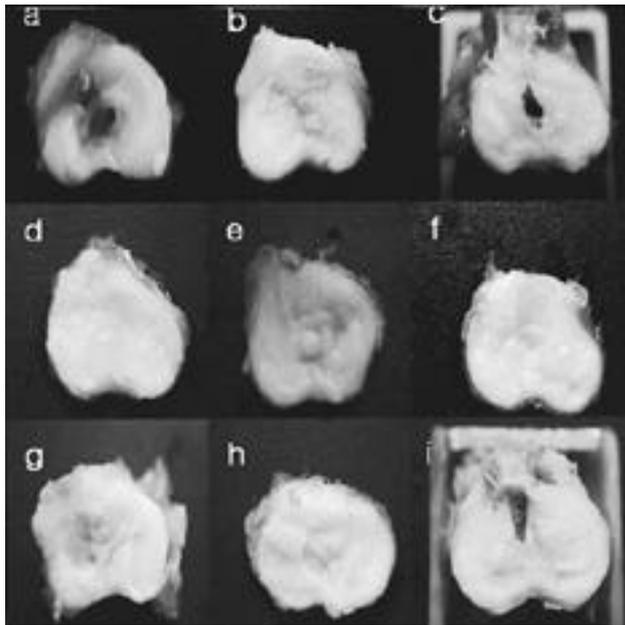
가

15

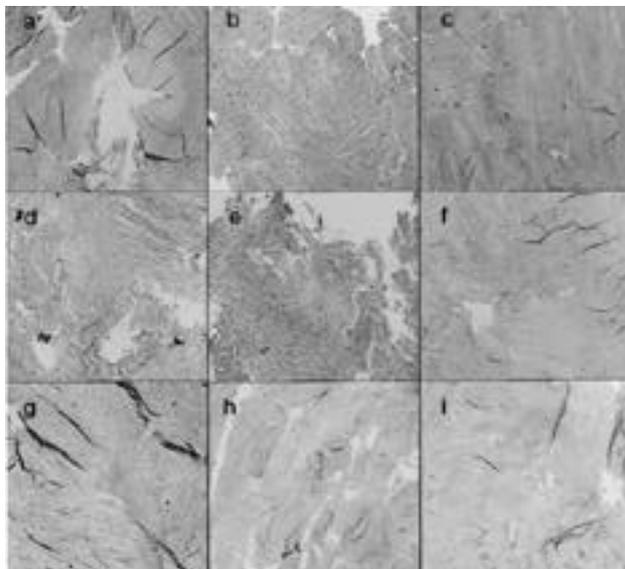
가 가 (Fig. 3).

2.

camera Nikon digital  
1.27) NIH (ver.



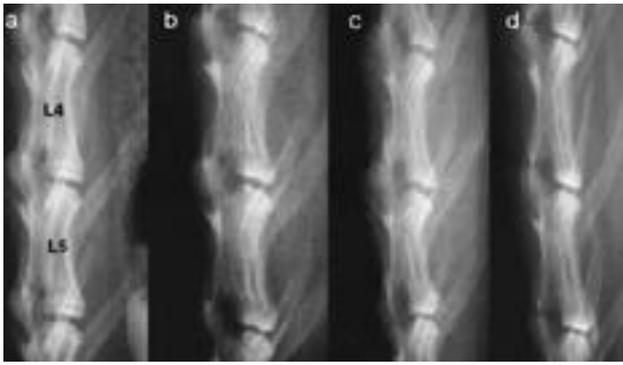
**Fig. 2.** In gross findings, it showed the findings of progressive degeneration in all specimens. In 3 month sample (b, h) of 11, 15 blade group, it showed more degeneration than the 21 gauge needle group. It showed severe degeneration in the 15 blade annulotomy 6 month group (i). (No. 11 blade annulotomy group is a, b, c. and 21 gauge needle group is d, e, f and 15 blade group is g, h, i. a, d, g is 1 month sample after annulotomy and b, e, h is 3 month sample and c, f, i is 6 month sample.)



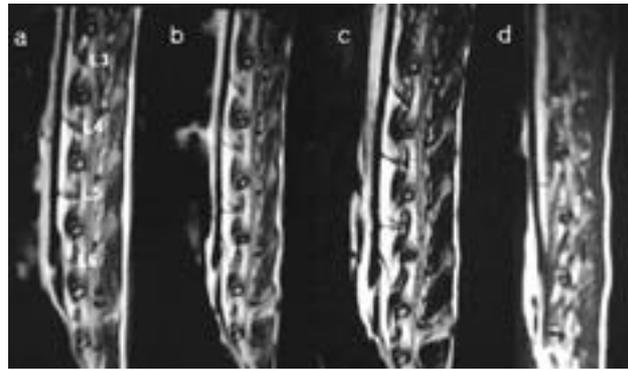
**Fig. 3.** Histologic findings showed similar result with gross samples (No. 11 blade annulotomy group is a, b, c. and 21 gauge needle group is d, e, f and 15 blade group is g, h, i. a, d, g is 1 month sample after annulotomy and b, e, h is 3 month sample and c, f, i is 6 month sample.)



**Fig. 1.** Length of annulotomy according to the various methodologies.



**Fig. 4.** The disc height of simple radiography showed progressive narrowing of all experimented disc space. (a is pre-operative film, b is 1 month film, c is 3 month film, and d is 6 month film after annulotomy.)



**Fig. 5.** In MRI films, it showed advanced degeneration in all operated disc level. And it showed most severe degeneration in 15 blade annulotomy level(L5-6). ( a is preoperative film, b is 1 month film, c is 3 month film, and d is 6 month film after annulotomy. )

(Fig. 4).

2 가 3  
 1.52 mm 가 3-4 5-6  
 4-5 1.32 mm 1.28 mm,  
 15 가 5,10,12)  
 5-6  
 (Table 1).

2

3

6

(Fig. 5).

가

3.

가

5)

(wet weight) 19.3 mg

21 gauge

0.2 mg (1.1%)

4).

chymopapain

11

2.73

mg(14.6%), 15  
 (19.3%)

3.6 mg

2,3)

proteoglycan

13)

가

15

1950

digital camera  
software(ver. 1.27)

Nikon coolpix  
NIH

4~5 mm

15

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가 (annulotomy)

: 16 4~4.5kg (female New Zealand white rabbits)  
(paravertebral incision) (retroperitoneal approach)

3-4, 4-5, 5-6

3-4

11

4-5

21 gauge

, 5-6

15

가 10

MRI

NIH image software

MRI

:

15

( 5-6 ) 가

3-4, 5-6

)

2

.. MRI

11

15

(

가

15

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249-1

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