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Secondary degenerative changes in the intervertebral disc due to zygapophyseal (para-vertebral) facet joint lesions.

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4.0 RESULTS

4.1.1 Specimen A: X-ray and dye injection into nucleus pulposus

4.1.1.1 Specimen A- Anterior posterior and lateral view of total lumbar spine

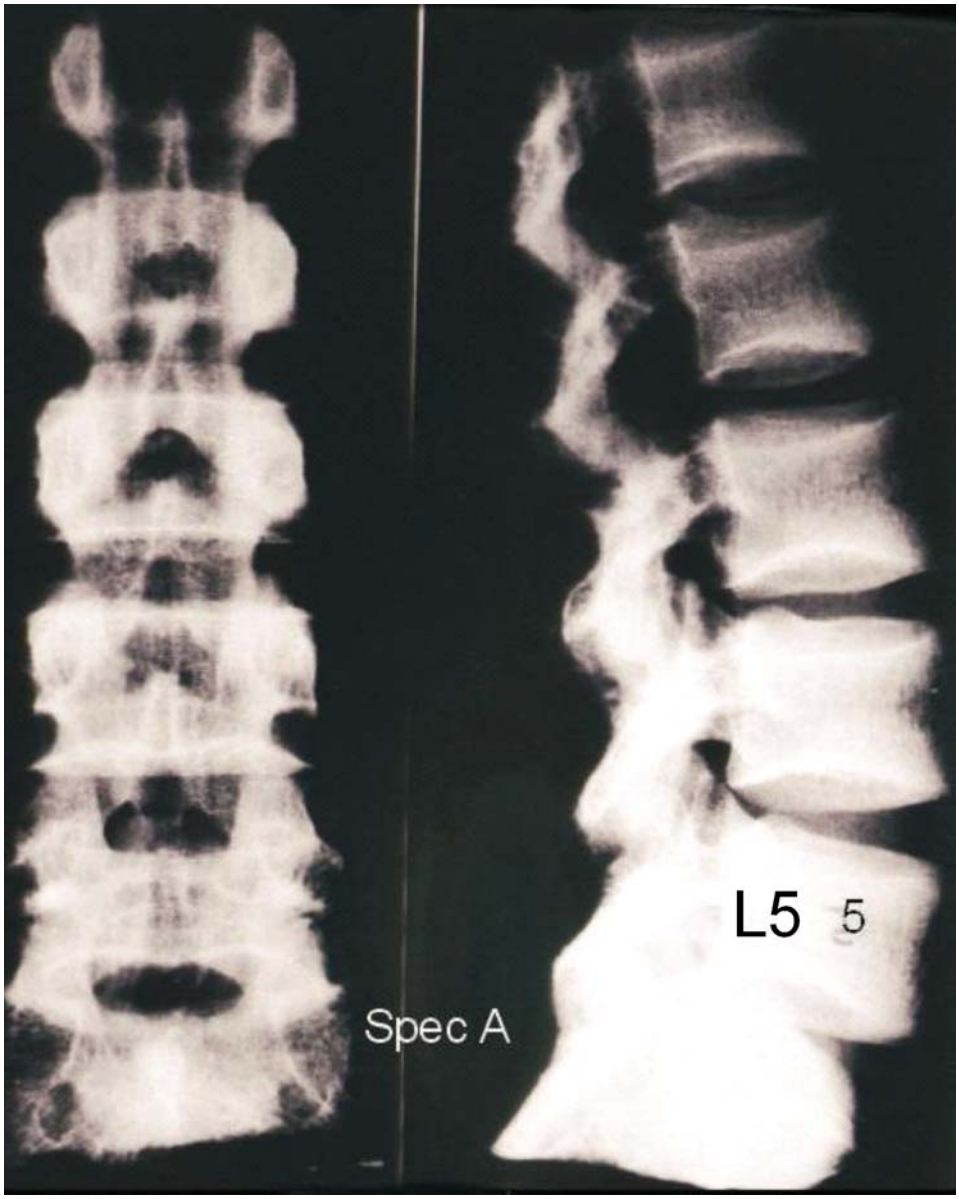


Figure 4.1: The anterior- posterior and lateral view of the lumbar spine of specimen A, prior to dissection into separate units

Note:

The light exposure of the lateral specimen was due to under exposure x ray technique.

4.1.1.2 Specimen A- L1/2, lateral and axial view

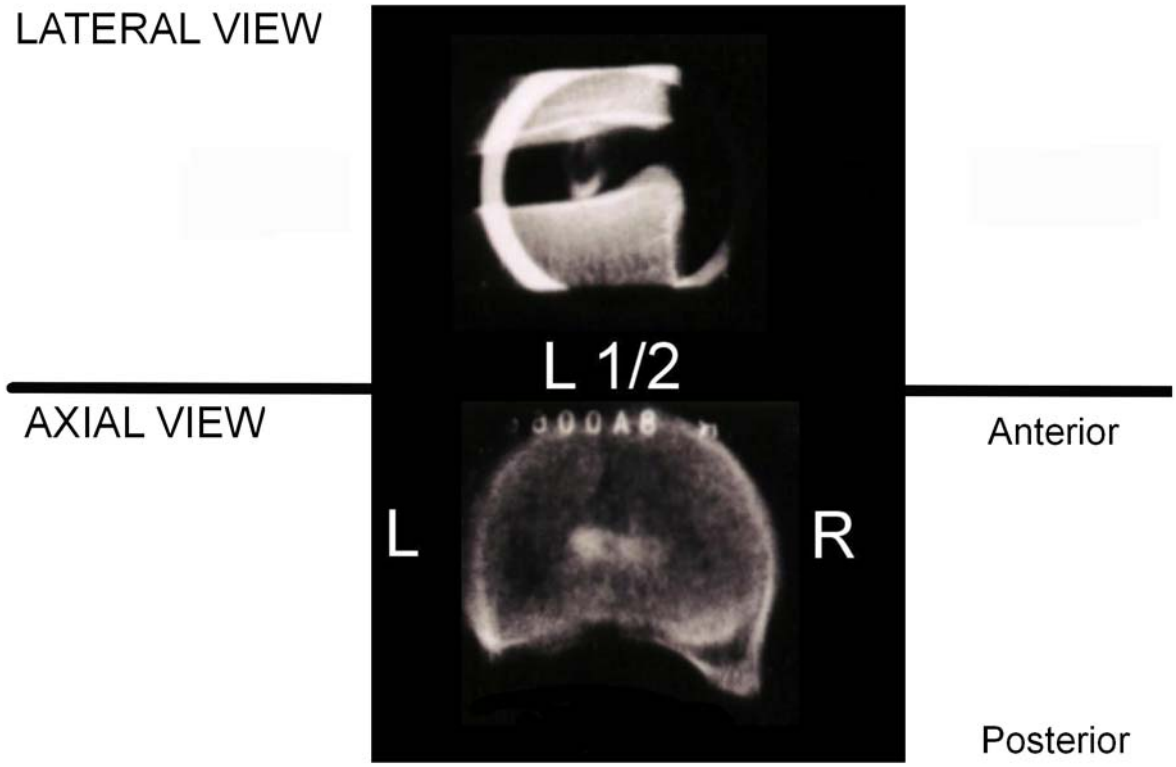


Figure 4.2: Lateral and axial x ray of L1/2, specimen A

The dye was injected from the anterior side into the nucleus pulposus. Approximately 3ml, of dye entered the nucleus pulposus and was localized centrally on the superior and inferior end plates.

Table 4.1: Position and movement of dye in specimen A, L1/2

Lateral view		**Axial view**		
Central	**Posterior**	**Left**	**Central**	**Right**
X			**X**	

4.1.1.3 Specimen A- L2/3, lateral and axial view

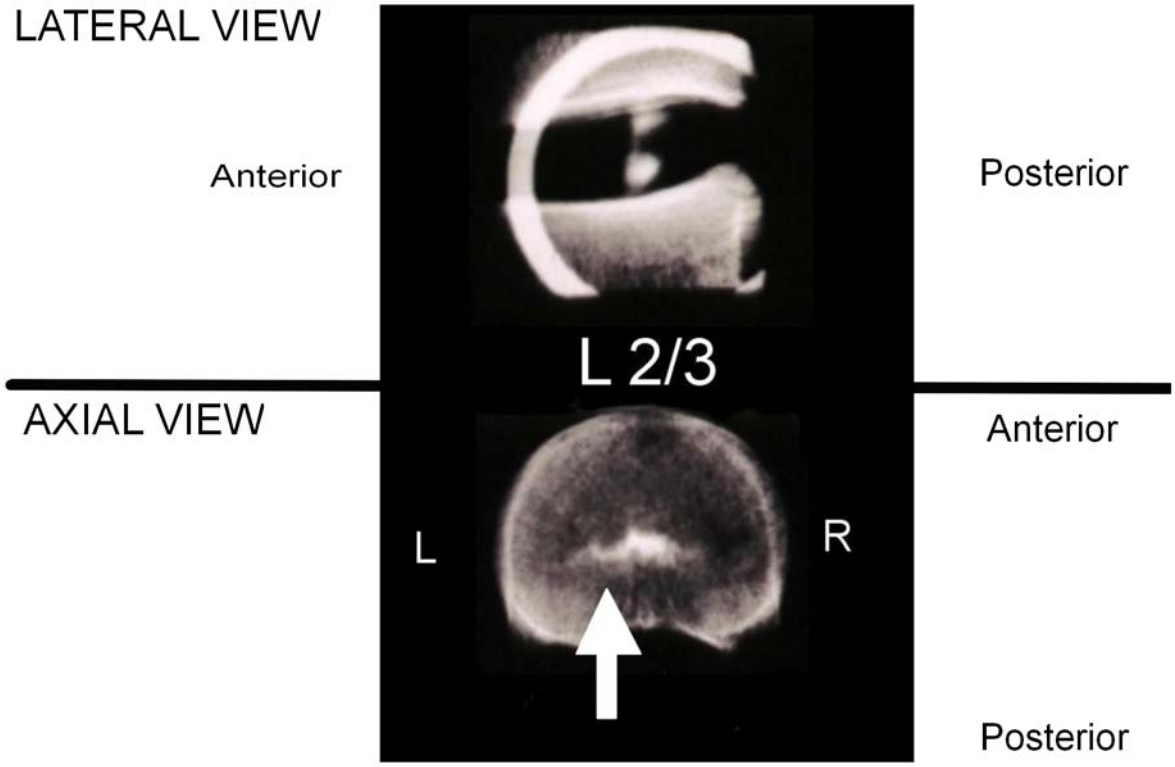


Figure 4.3: Lateral and axial x ray of L2/3, specimen A

The dye was injected from the anterior surface into the nucleus pulposus. Approximately 3ml, of dye entered the nucleus pulposus and localized centrally on the superior and inferior end plates in the lateral view. Slight left lateralization was noted in the axial view (see arrow).

Table 4.2: Position and movement of dye in specimen A, L2/3

Lateral view		**Axial view**		
Central	**Posterior**	**Left**	**Central**	**Right**
X		**X L**	**X**	

4.1.1.4 Specimen A- L3/4, lateral and axial view

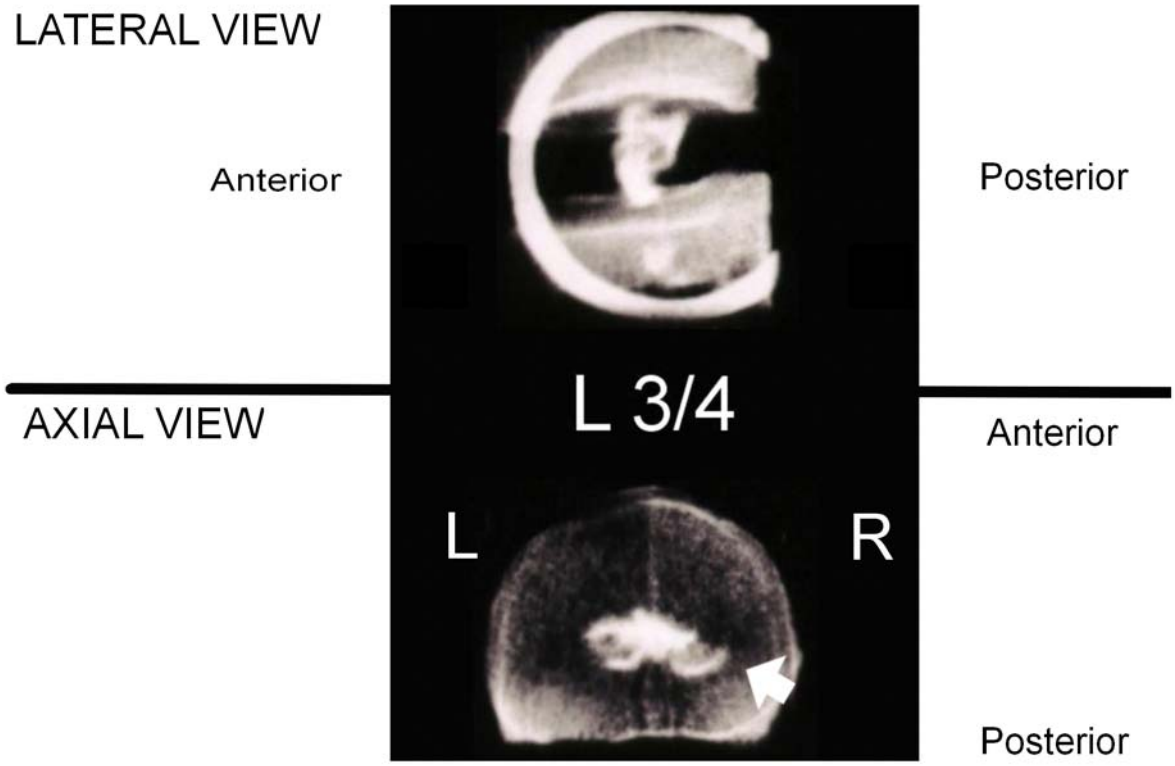


Figure 4.4: Lateral and axial x ray of L3/4, specimen A

The dye was injected from the anterior side into the nucleus pulposus. Approximately 4ml, of dye entered the nucleus pulposus and localized centrally but also extending to the superior and inferior end plates on the lateral view. Slight right posterior lateralisation was noted in the axial view. (arrow)

Table 4.3: Position and movement of dye in specimen A, L3/4

Lateral view		**Axial view**		
Central	**Posterior**	**Left**	**Central**	**Right**
X			**X**	**XP**

4.1.1.5 Specimen A- L4/5, lateral and axial view

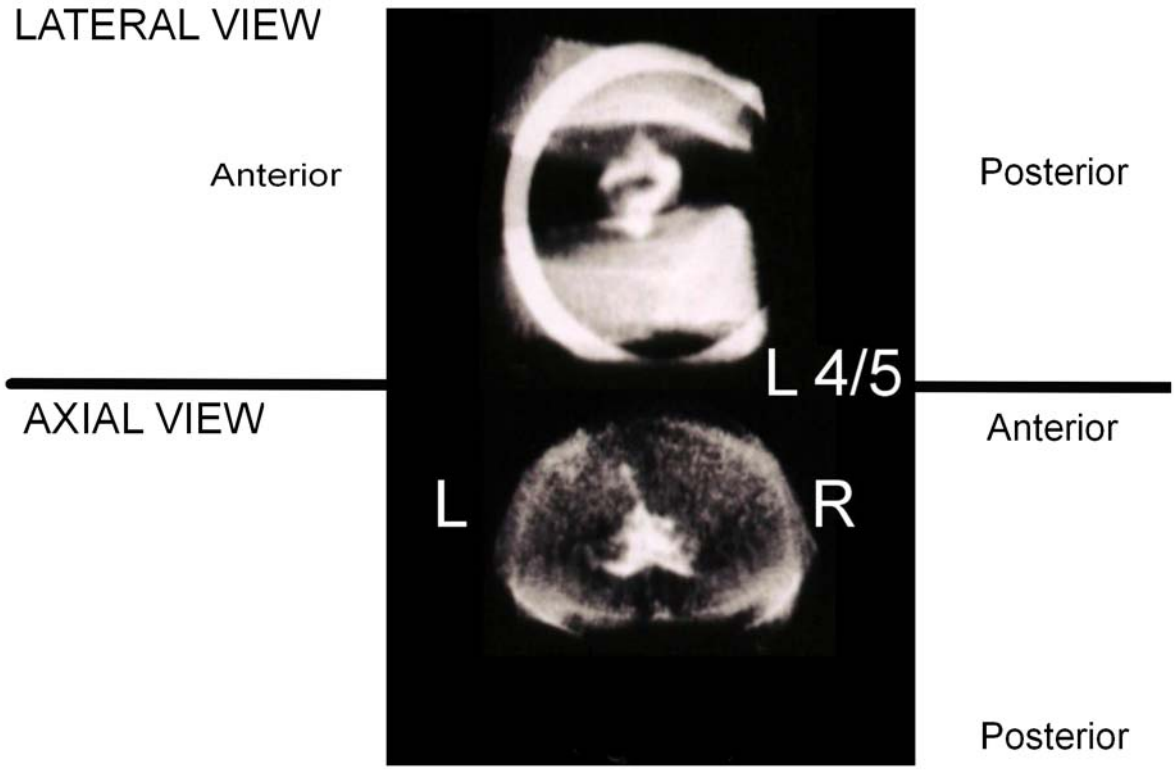


Figure 4.5: Lateral and axial x ray of L4/5, specimen A

The dye was injected from the anterior side into the nucleus pulposus. Approximately 4ml, of dye entered the nucleus pulposus and localized centrally also extending to the superior and inferior end plates on the lateral and axial views. No lateralisation of dye was noted.

Table 4.4: Position and movement of dye in specimen A, L4/5

Lateral view		**Axial view**		
Central	**Posterior**	**Left**	**Central**	**Right**
X			**X**	

4.1.1.6 Specimen A- L5/S1, lateral and axial view

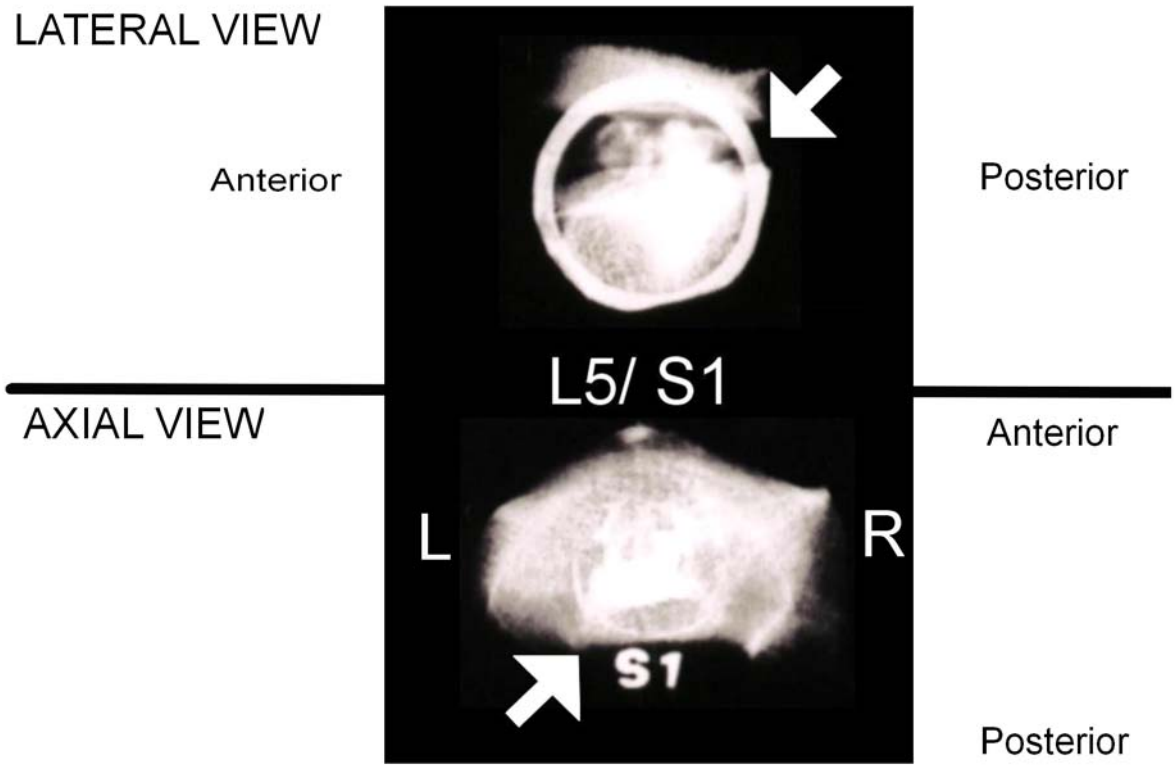


Figure 4.6: Lateral and axial x ray of L5/S1, specimen A

The dye was injected from the anterior side into the nucleus pulposus. Approximately 6ml, of dye entered the nucleus pulposus and oozed out of the S1 segment, possibly due to the degeneration of the end plate. Dye in the nucleus pulposus is central and posterior on the lateral view with posterior left migration on the axial view. (arrows)

Table 4.5: Position and movement of dye in specimen A, L5/S1

Lateral view		**Axial view**		
Central	**Posterior**	**Left**	**Central**	**Right**
X	**X**	**XP**	**X**	

4.1.1.7 Legend for results in x ray findings for the whole of specimen A

In order to report on the migration of dye within the injected nucleus pulposus, the symbols were used:

"X"	Refers to an observed migration of radio opaque dye.
"P" – Posterior.	Migration of the radio opaque dye either due to
"L" – Lateral.	early fissuring of the anulus fibrosus or degenerative changes in the transitional zone, which is the zone between the nucleus pulposus and the anulus fibrosus.

Table 4.6: Summary of position and movement of dye in specimen A

Specimen	**Lateral view**		**Axial view**		
A	**Central**	**Posterior**	**Left**	**Central**	**Right**
L1/2	**X**			**X**	
L2/3	**X**		**X L**	**X**	
L3/4	**X**			**X**	**X P**
L4/5	**X**			**X**	
L5/S1	**X**	**X**	**X P**	**X**	

4.1.2 Specimen B: X-ray and Dye Injection into Nucleus pulposus

4.1.2.1 Specimen B- Anterior posterior and lateral view of total lumbar spine

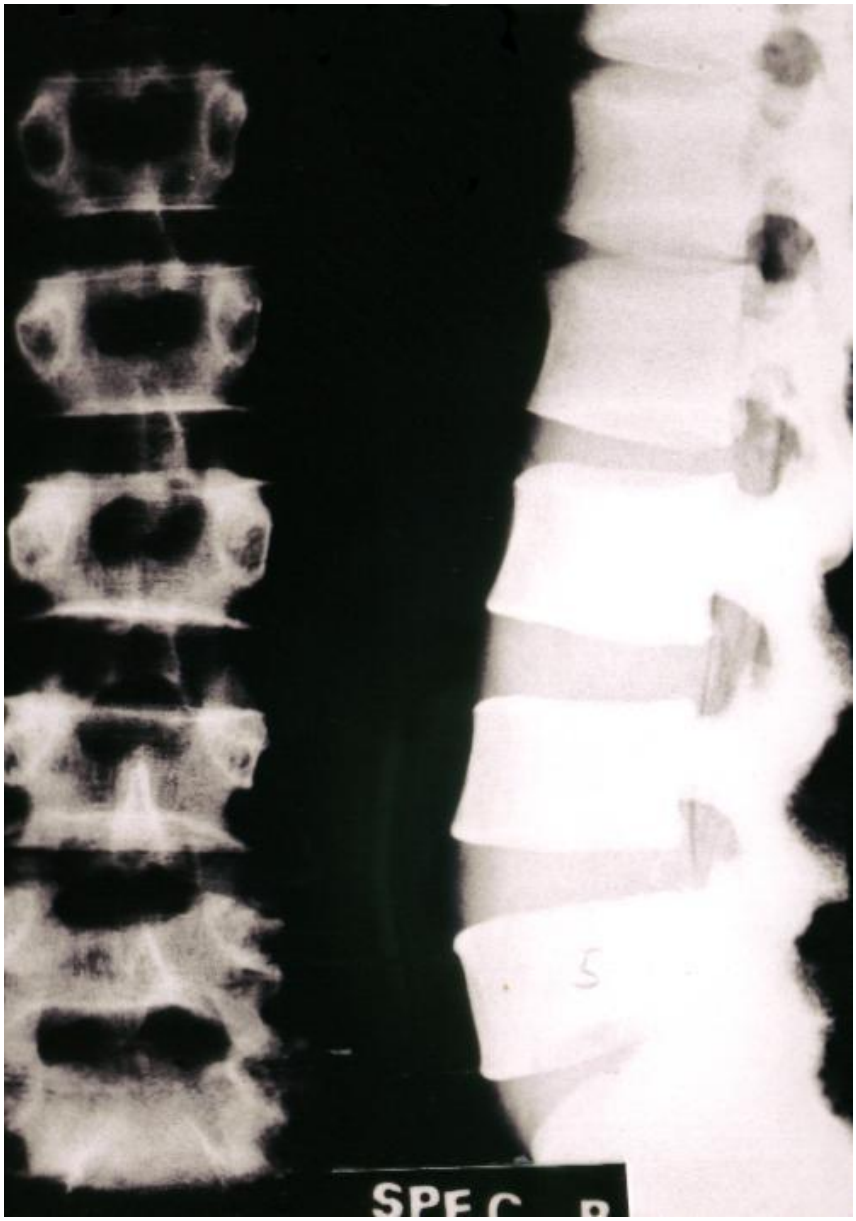


Figure 4.7: The anterior- posterior and lateral view of the lumbar spine of specimen B, prior to dissection into separate units

Note:

The light exposure of the lateral specimen was due to under exposure of the X ray technique.

4.1.2.2 Specimen B- L1/2, lateral and axial view

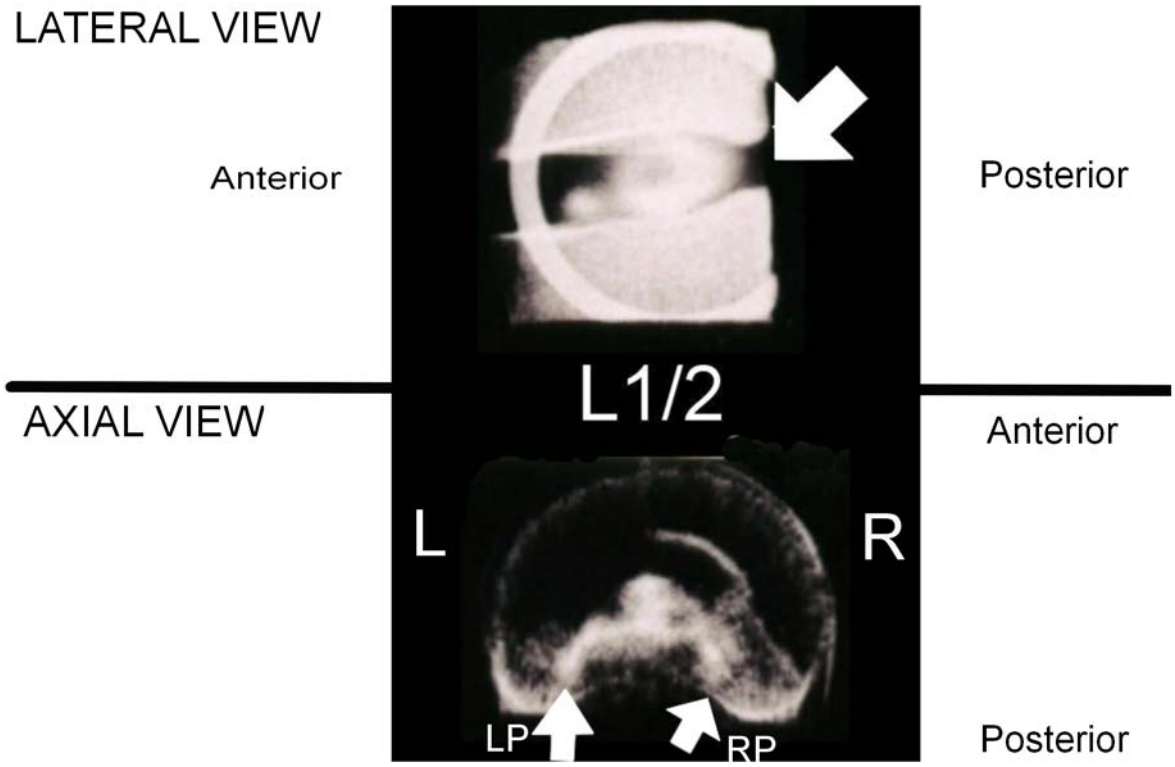


Figure 4.8: Lateral and axial x ray of L1/2, specimen B

The dye was injected from the anterior side into the nucleus pulposus. Approximately 5ml of dye entered the nucleus pulposus. On the lateral view, the dye localized centrally and posterior with a small amount migrating anteriorly on inferior end plate. On the axial view, lateral and posterior migration is noted into the anulus fibrosus, bilaterally. (arrows)

Table 4.7: Position and movement of dye in specimen B, L1/2

Lateral view		**Axial view**		
Central	**Posterior**	**Left**	**Central**	**Right**
X	**X**	**X P**	**X P**	**X P**

4.1.2.3 Specimen B - L2/3, lateral and axial view

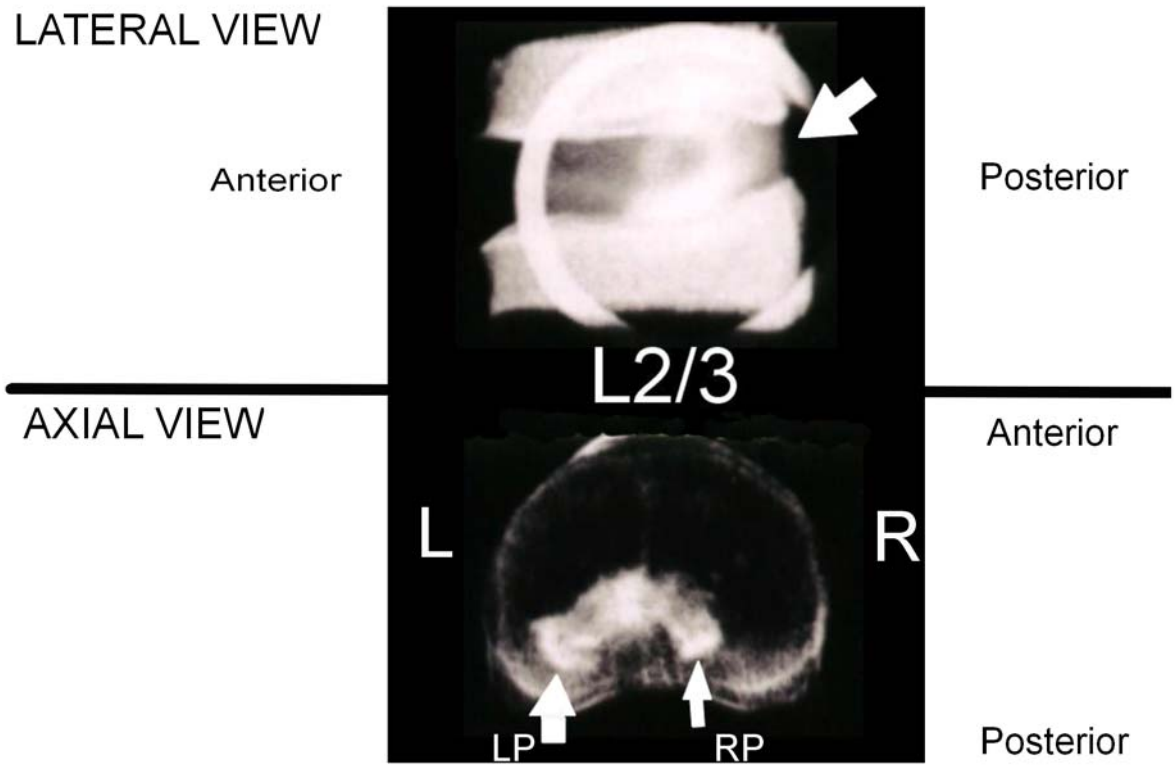


Figure 4.9: Lateral and axial x ray of L2/3, specimen B

The dye was injected from the anterior side into the nucleus pulposus. Approximately 5ml of dye entered the nucleus pulposus. On the lateral view, the dye localized posteriorly and on the inferior end plates. On the axial view, there is marked posterior lateral migration noted into the anulus fibrosus on the left and posterior central on the right

Table 4.8: Position and movement of dye in specimen B, L2/3

Lateral view		**Axial view**		
Central	**Posterior**	**Left**	**Central**	**Right**
X	**X**	**X P L**	**X L**	**X P**

4.1.2.4 Specimen B - L3/4, lateral and axial view

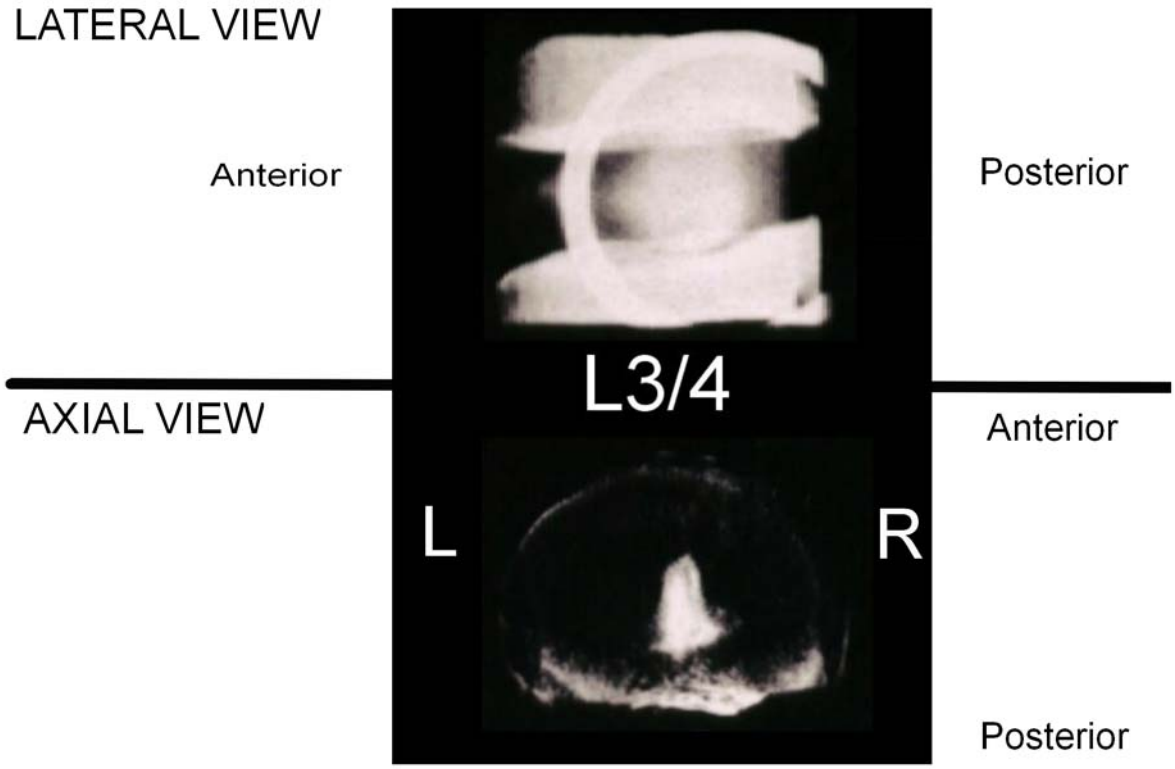


Figure 4.10: Lateral and axial x ray of L3/4, specimen B

The dye was injected from the anterior side into the nucleus pulposus. Approximately 3ml of dye entered the nucleus pulposus and was localized centrally, viewed in the lateral and axial x ray.

Table 4.9: Position and movement of dye in specimen B, L3/4

Lateral view		**Axial view**		
Central	**Posterior**	**Left**	**Central**	**Right**
X			**X**	

4.1.2.5 Specimen B- L4/5, lateral and axial view

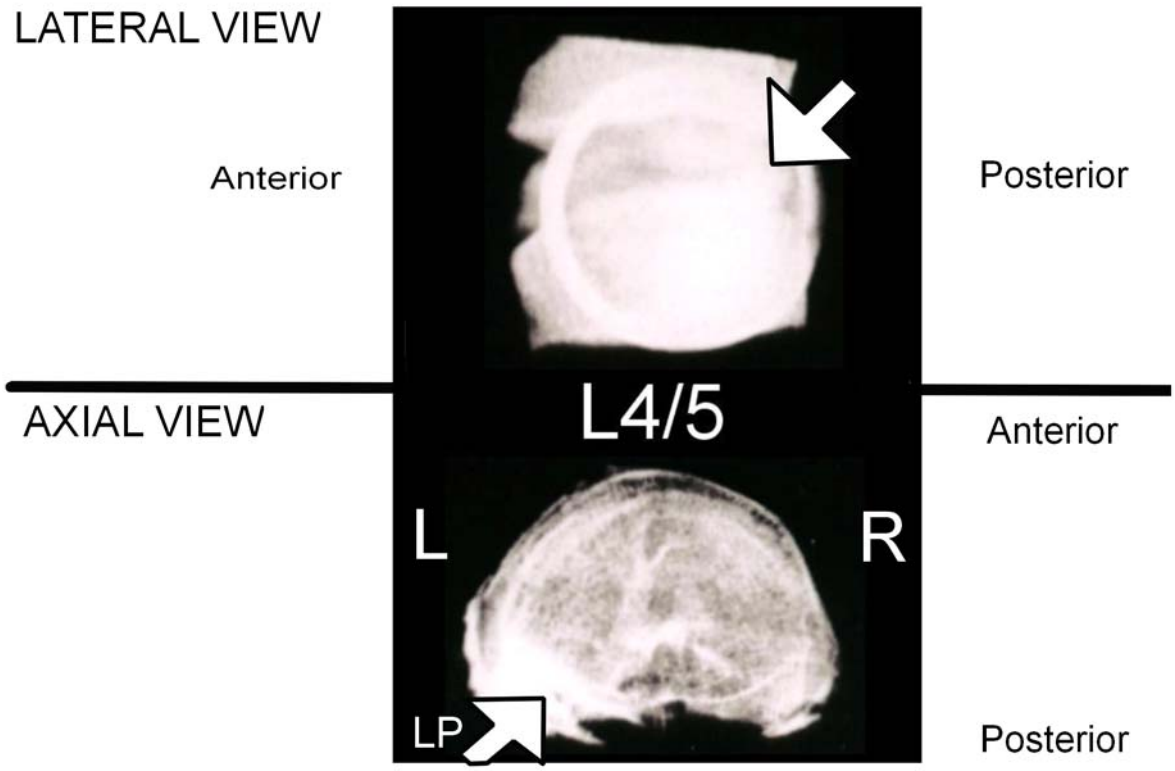


Figure 4.11: Lateral and axial x ray of L4/5, specimen B

The dye was injected from the anterior side into the nucleus pulposus. Approximately 6ml of dye entered the nucleus pulposus. On the lateral view, the dye is observed in the posterior aspect in the anulus fibrosus (arrow). On the axial view, the dye has leaked into LP part of the nucleus pulposus (arrow-LP). It is presumed that the dye leakage occurred on the end plate, possibly due to degenerative changes.

Table 4.10: Position and movement of dye in specimen B, L4/5

Lateral view		**Axial view**		
Central	**Posterior**	**Left**	**Central**	**Right**
X	**X**	**X P**		

4.1.2.6 Specimen B- L5/S1, lateral and axial view

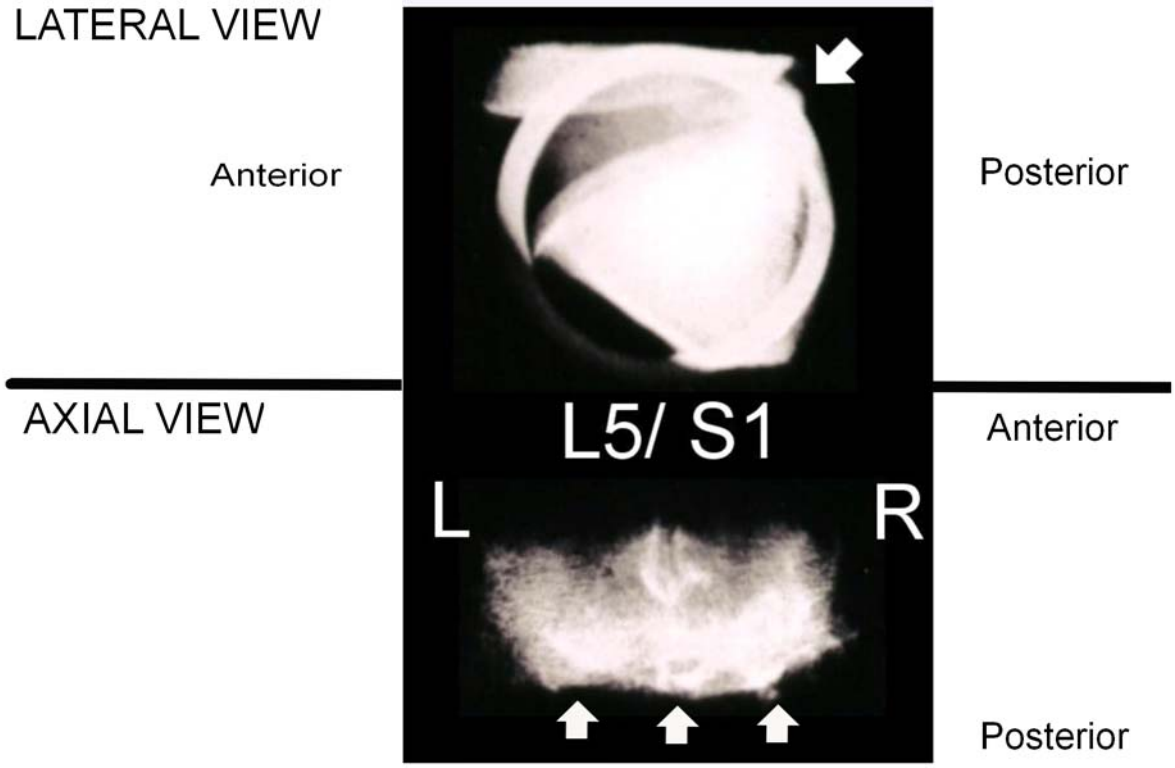


Figure 4.12: Lateral and axial x ray of L5/S1, specimen B

The dye was injected from the anterior side into the nucleus pulposus. Approximately 8ml of dye entered the nucleus pulposus. On the lateral view, there was some localisation posteriorly, but the dye had oozed out in the posterior superior aspect of the first sacral segment. Significant findings could not be recorded. On the axial view, the dye is diffuse in the posterior half of the anulus fibrosus (arrows). This could be due to end plate damage of S1.

Table 4.11: Position and movement of dye in specimen B, L5/S1

Lateral view		**Axial view**		
Central	**Posterior**	**Left**	**Central**	**Right**
	X	**X**	**X P**	**X**

4.1.2.7 Legend for results in X Ray findings for the whole of specimen B

In order to report on the migration of dye within the injected nucleus pulposus, the symbols were used:

"X"	Refers to an observed migration of radio opaque dye.
"P" – Posterior	Migration of the radio opaque dye either due to
"L" – Lateral	early fissuring of the anulus fibrosus or degenerative changes in the transitional zone, which is the zone between the nucleus pulposus and the anulus fibrosus.

Table 4.12: Summary of position and movement of dye in specimen B

Specimen	**Lateral view**		**Axial view**		
B	**Central**	**Posterior**	**Left**	**Central**	**Right**
L1/2	**X**	**X**	**X P**	**X P**	**X P**
L2/3	**X**	**X**	**X P L**	**X L**	**X P**
L3/4	**X**			**X**	
L4/5	**X**	**X**	**X P**		
L5/S1		**X**	**X**	**X P**	**X**

4.1.3 Specimen C: X-ray and dye injection into nucleus pulposus

4.1.3.1 Specimen C- Anterior posterior and lateral view of total lumbar spine

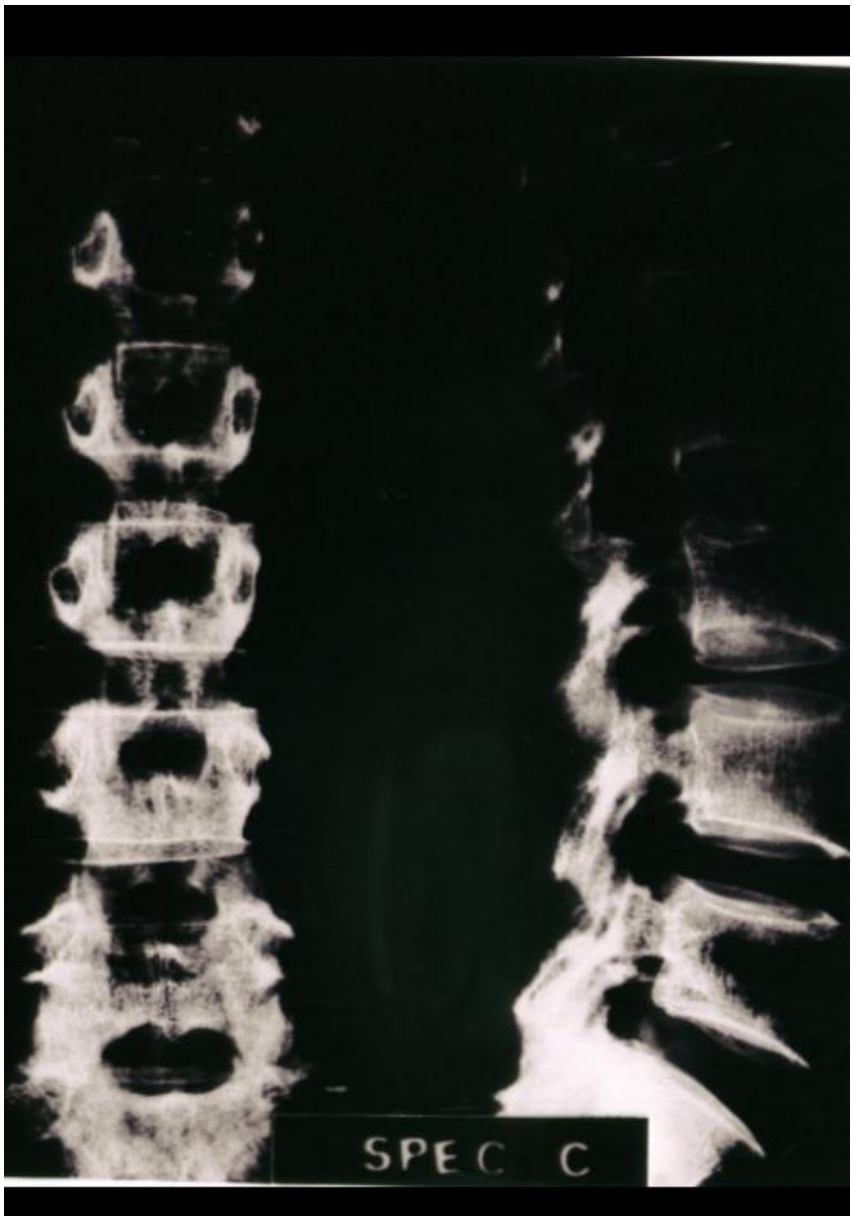


Figure 4.13: The anterior- posterior and lateral view of the lumbar spine of specimen C, prior to dissection into separate units

Note:

The loss of definition in the vertebral bodies is due to over exposure of x ray factors.

4.1.3.2 Specimen C- L1/2, lateral and axial view

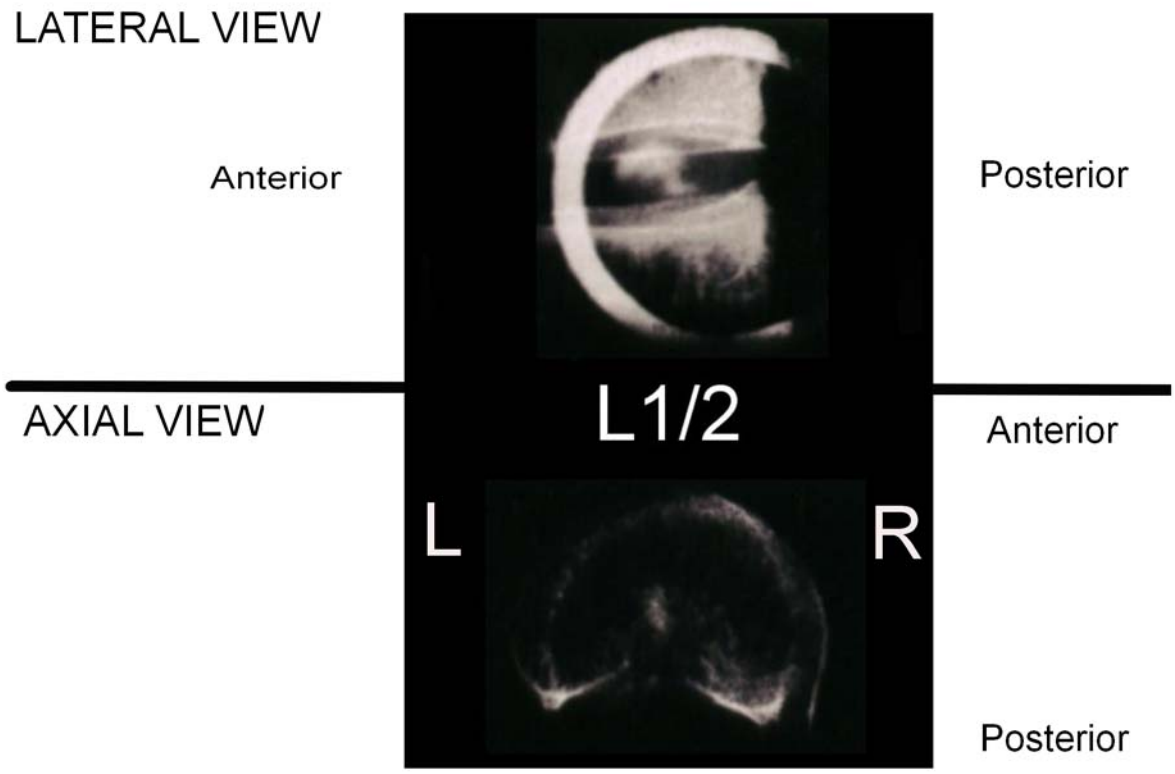


Figure 4.14: Lateral and axial x ray of L1/2, specimen C

The dye was injected from the anterior side into the nucleus pulposus. Approximately 3ml of dye entered the nucleus pulposus and localized centrally on the lateral and axial views.

Note:
Loss of definition is due to over exposure factors and hence significant findings could not be accurately recorded.

Table 4.13: Position and movement of dye in specimen C, L1/2

Lateral view		**Axial view**		
Central	**Posterior**	**Left**	**Central**	**Right**
X			**X**	

4.1.3.3 Specimen C- L2/3, lateral and axial view

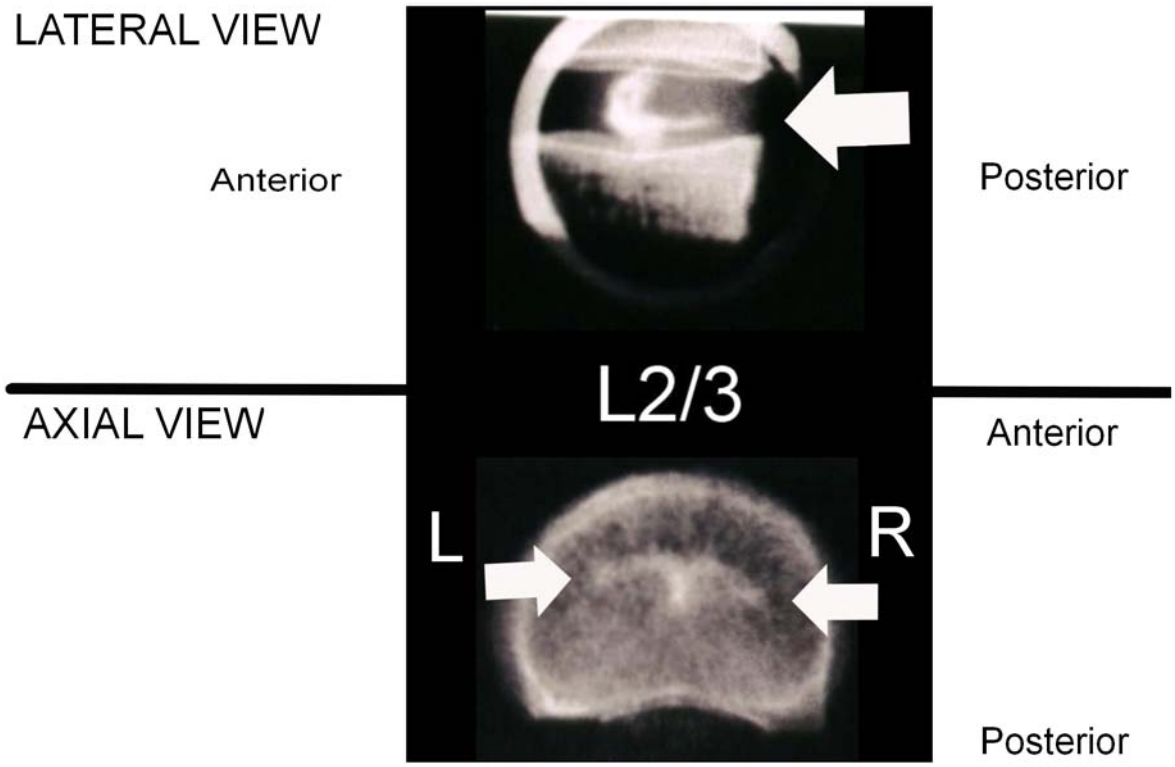


Figure 4.15: Lateral and axial x ray of L2/3, specimen C

The dye was injected from the anterior side into the nucleus pulposus. Approximately 4ml of dye entered the nucleus pulposus and localized centrally on the lateral showing posterior migration to the anulus on the inferior end plate (arrow). The axial view shows bilateral lateral migration (arrows), but not directly posterior.
This phenomenon is possibly due to dye migration on the end plate

Table 4.14: Position and movement of dye in specimen C, L2/3

Lateral view		**Axial view**		
Central	**Posterior**	**Left**	**Central**	**Right**
X	**X**	**X L**	**X**	**X L**

4.1.3.4 Specimen C- L3/4, lateral and axial view

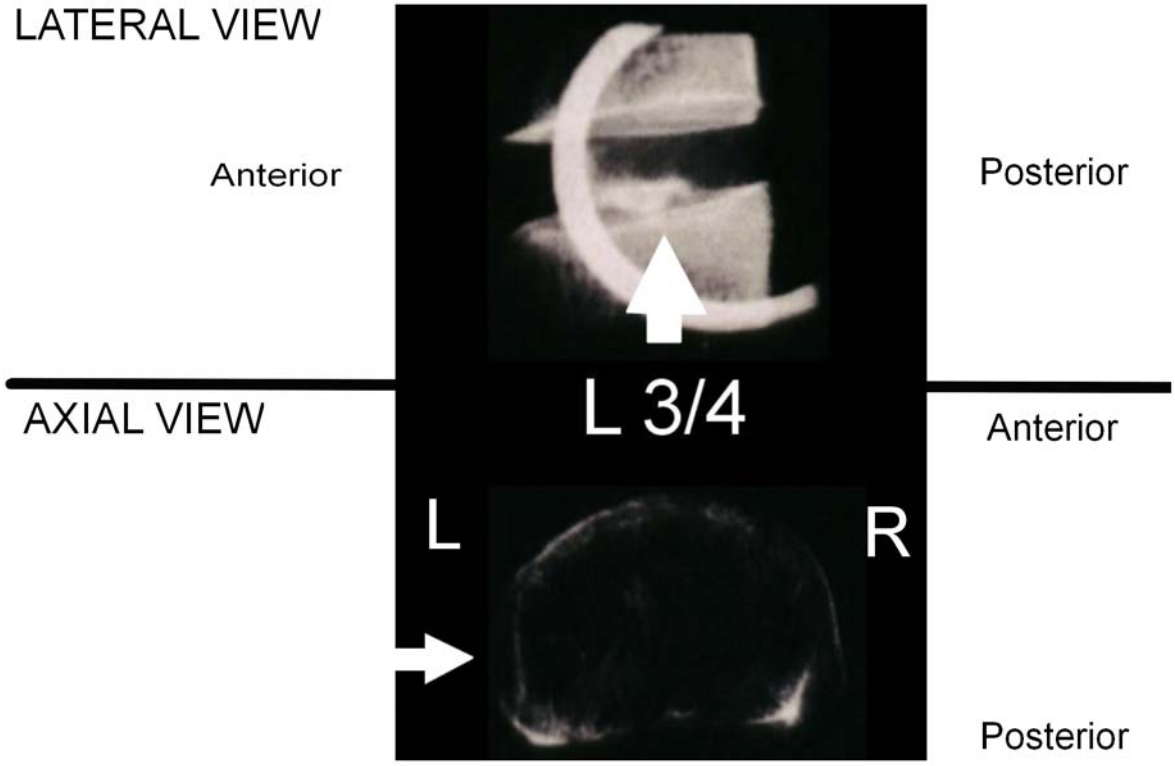


Figure 4.16: Lateral and axial x ray of L3/4, specimen C

The dye was injected from the anterior side into the nucleus pulposus. Approximately 4ml of dye entered the nucleus pulposus and localized centrally and on the inferior end plate on the lateral view (arrow). The axial view was over exposed. On the study of the original, a left migration of dye was recorded.

Table 4.15: Position and movement of dye in specimen C, L3/4

Lateral view		**Axial view**		
Central	**Posterior**	**Left**	**Central**	**Right**
X		**XL**		

4.1.3.5 Specimen C- L4/5, lateral and axial view

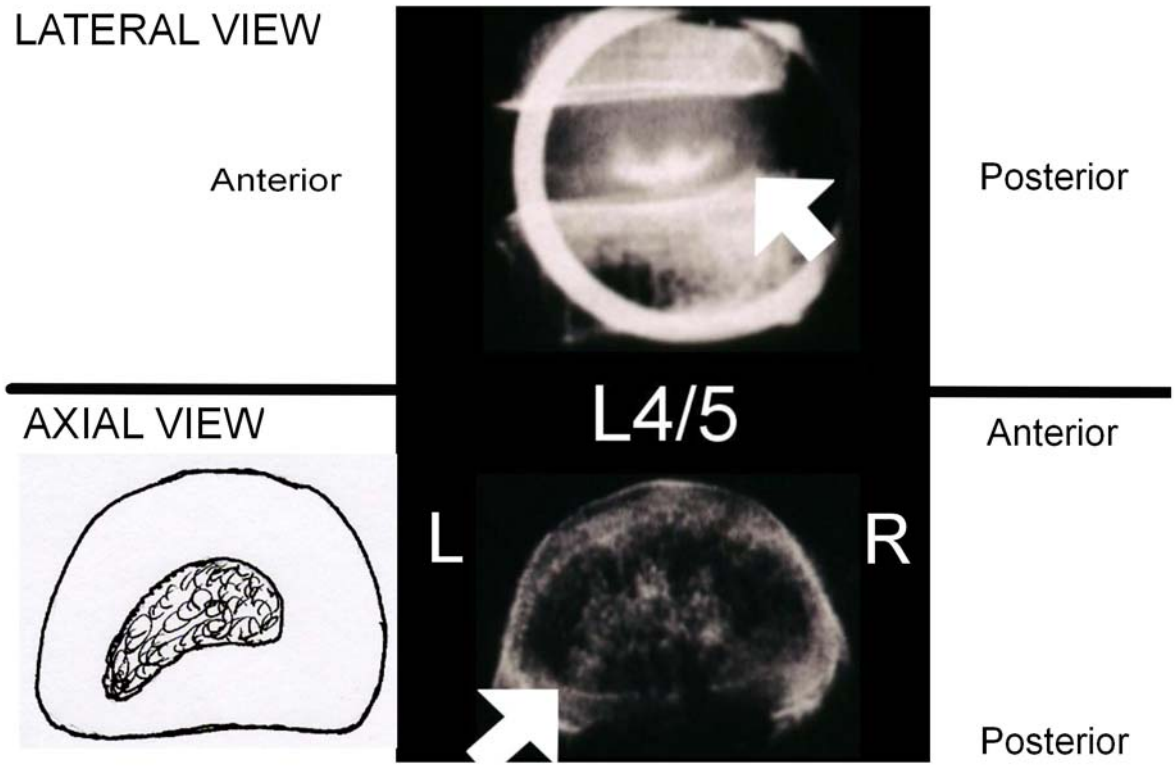


Figure 4.17: Lateral and axial x ray of L4/5, specimen C

The dye was injected from the anterior side into the nucleus pulposus. Approximately 5ml of dye entered the nucleus pulposus. On the lateral view, the dye localized to the central posterior on the inferior end plate (arrow). On the axial view the dye migrated left posteriorly into the anulus fibrosus (arrow).

Note: Some definition was lost in the copying process.

Table 4.16: Position and movement of dye in specimen C, L4/5

Lateral view		**Axial view**		
Central	**Posterior**	**Left**	**Central**	**Right**
X	**X**	**X P L**	**X**	

4.1.3.6 Specimen C- L5/S1, lateral and axial view

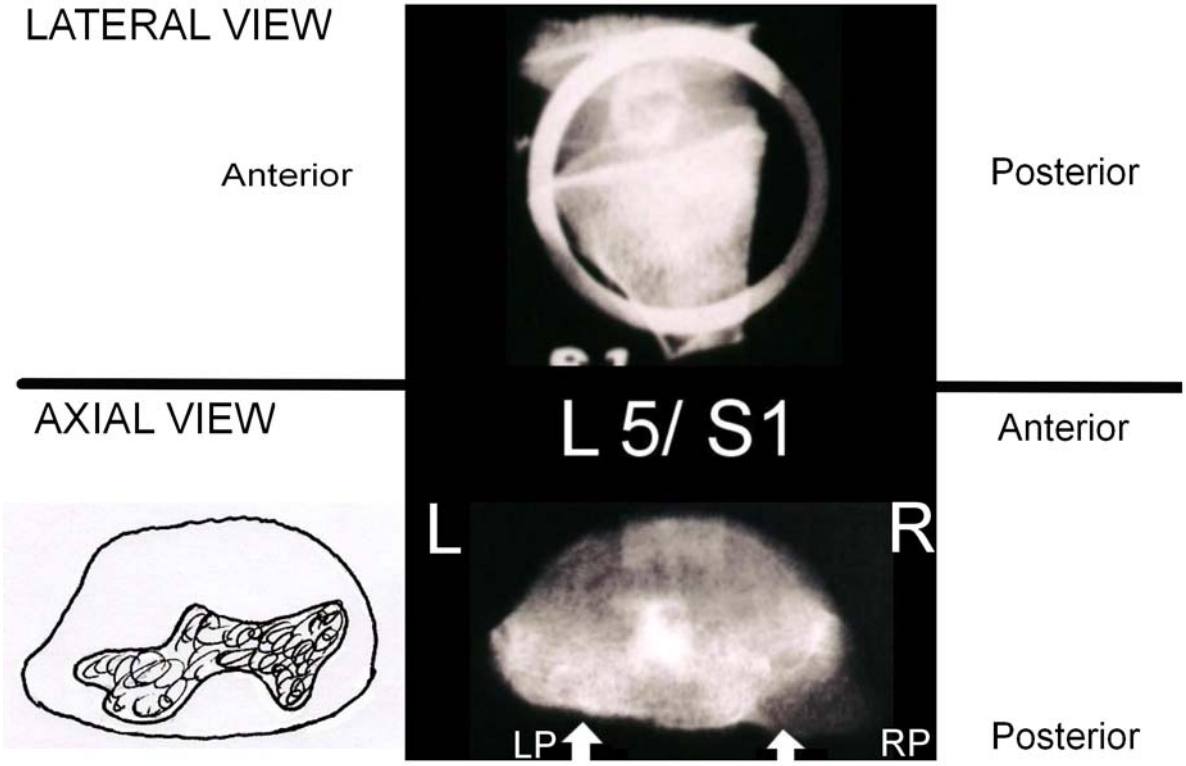


Figure 4.18: Lateral and axial x ray of L5/S1, specimen C

The dye was injected from the anterior side into the nucleus pulposus. Approximately 5ml of dye entered the nucleus pulposus. The dye oozed out into the posterior superior aspect of the S1 segment, indicating possible degeneration in the end plate. On the lateral view, there is some central localization in the nucleus pulposus. The axial view shows a central localization with bilateral post-lateral migration of dye.

Table 4.17: Position and movement of dye in specimen C, L5/S1

Lateral view		**Axial view**		
Central	**Posterior**	**Left**	**Central**	**Right**
X		**X P L**	**X**	**X P L**

4.1.3.7 Legend for results in x ray findings for the whole of specimen C

In order to report on the migration of dye within the injected nucleus pulposus, the symbols were used:

"X"	Refers to an observed migration of radio opaque dye.
"P" – Posterior	Migration of the radio opaque dye either due to
"L" – Lateral	Early fissuring of the anulus fibrosus or degenerative changes in the transitional zone, which is the zone between the nucleus pulposus and the anulus fibrosus.

Table 4.18: Summary of position and movement of dye in specimen C

Specimen	**Lateral view**		**Axial view**		
C	**Central**	**Posterior**	**Left**	**Central**	**Right**
L1/2	**X**	**X**		**X**	
L2/3	**X**	**X**	**X L**	**X**	**X L**
L3/4	**X**		**X L**		
L4/5	**X**	**X**	**X P L**	**X**	
L5/S1	**X**		**X P L**	**X**	**X P L**

4.1.4 Specimen D: X-ray and dye injection into nucleus pulposus

4.1.4.1 Specimen D- Anterior posterior and lateral view of total lumbar spine



Figure 4.19: The anterior- posterior and lateral view of the lumbar spine of specimen C, prior to dissection into separate units

Note: Loss of definition in the X ray is due to over - exposure factors.

4.1.4.2 Specimen D- L1/2, lateral and axial view

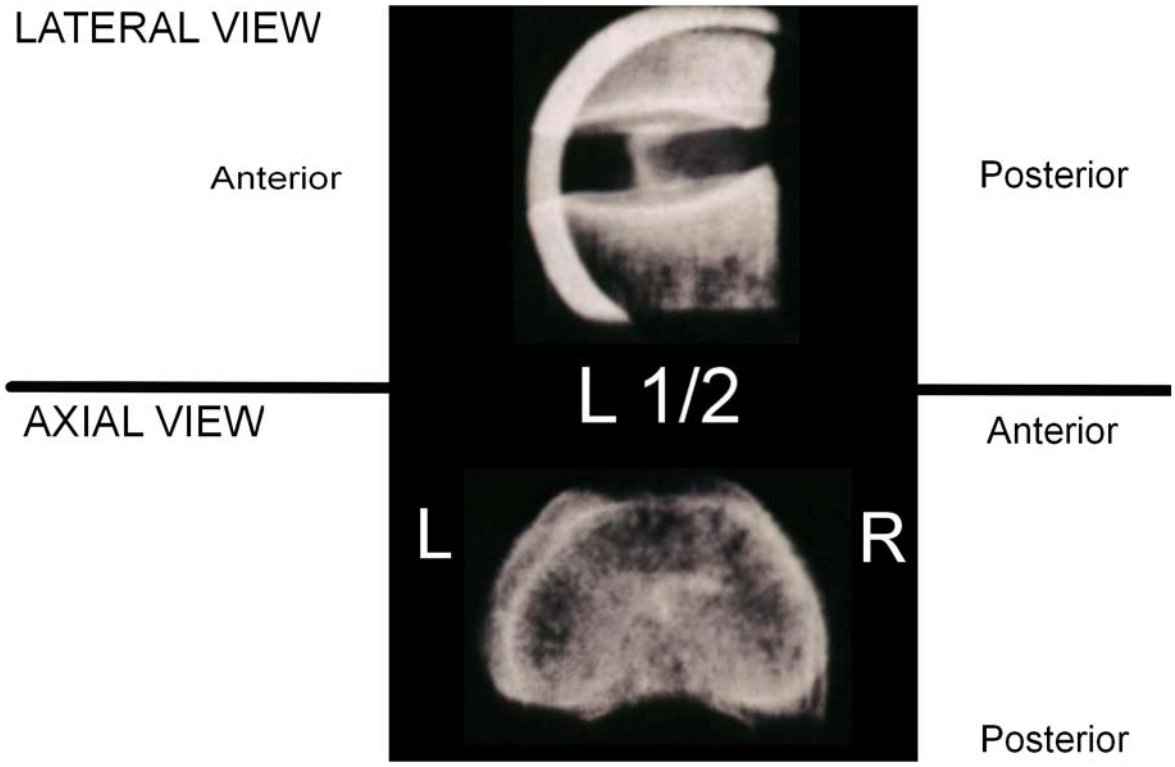


Figure 4.20: Lateral and axial x ray of L1/2, specimen D

The dye was injected from the anterior side into the nucleus pulposus. Approximately 3ml of dye entered the nucleus pulposus. The dye localized centrally on the lateral and axial views. The radio-opacity on the axial view is possibly due to dye leakage on the end plate.

Table 4.19: Position and movement of dye in specimen D, L1/2

Lateral view		**Axial view**		
Central	**Posterior**	**Left**	**Central**	**Right**
X			**X**	

4.1.4.3 Specimen D- L2/3, lateral and axial view

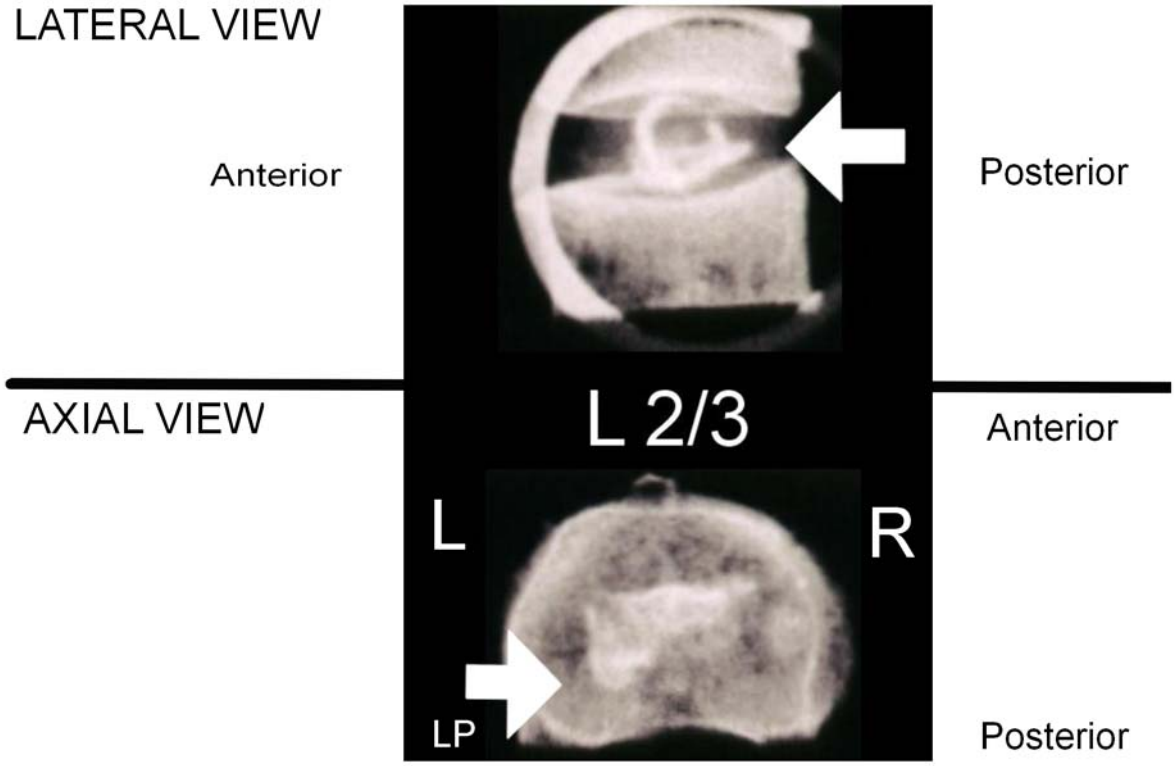


Figure 4.21: Lateral and axial x ray of L2/3, specimen D

The dye was injected from the anterior side into the nucleus pulposus. Approximately 5ml of dye entered the nucleus pulposus and localized centrally. On the lateral view, the dye located centrally with posterior migration on the inferior end plate up to the anulus fibrosus (arrow). On the axial view, there is posterior left dye migration up to the anulus fibrosus (arrow).

Table 4.20: Position and movement of dye in specimen D, L2/3

Lateral view		**Axial view**		
Central	**Posterior**	**Left**	**Central**	**Right**
X	**X**	**X P**	**X**	

4.1.4.4 Specimen D- L3/4, lateral and axial view

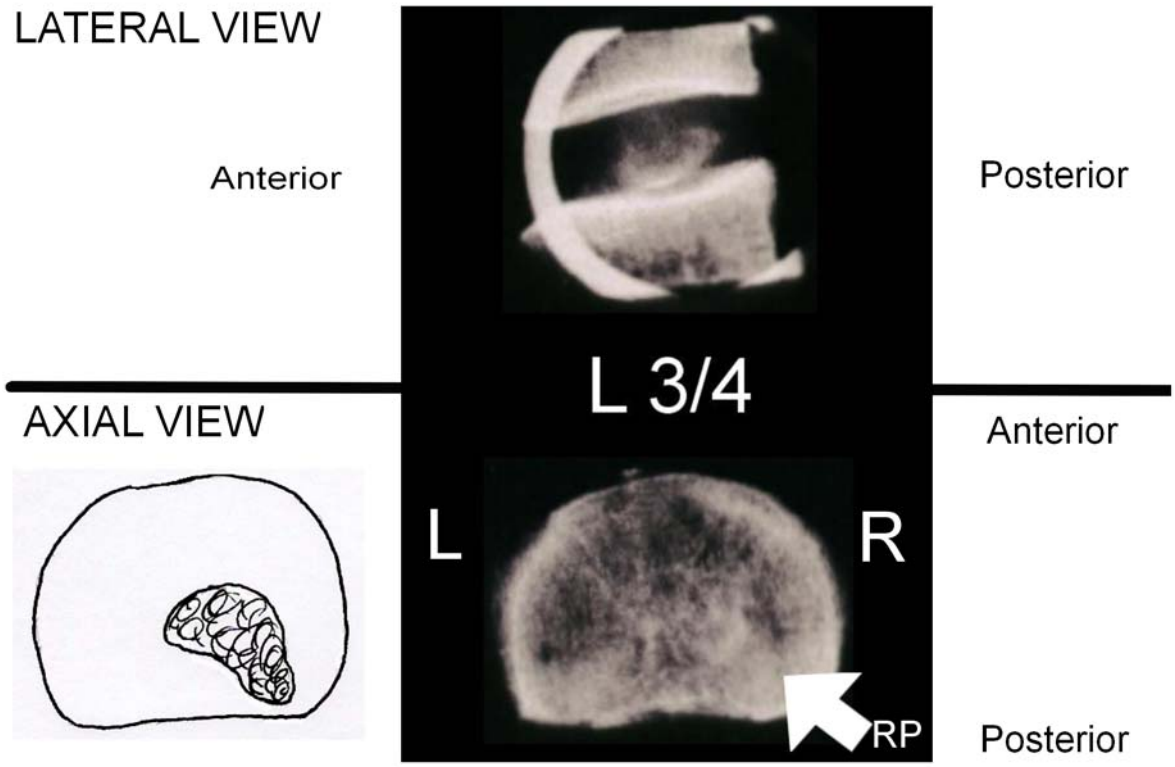


Figure 4.22: Lateral and axial X Ray of L3/4, specimen D

The dye was injected from the anterior side into the nucleus pulposus. Approximately 4ml of dye entered the nucleus pulposus and localized centrally. On the lateral, view the dye located centrally on the inferior end plate, with some posterior migration. On the axial view, the dye migrated to the right up to the anulus fibrosus (arrow).

Table 4.21: Position and movement of dye in specimen D, L3/4

Lateral view		**Axial view**		
Central	**Posterior**	**Left**	**Central**	**Right**
X			X	X P

4.1.4.5 Specimen D- L4/5, lateral and axial view

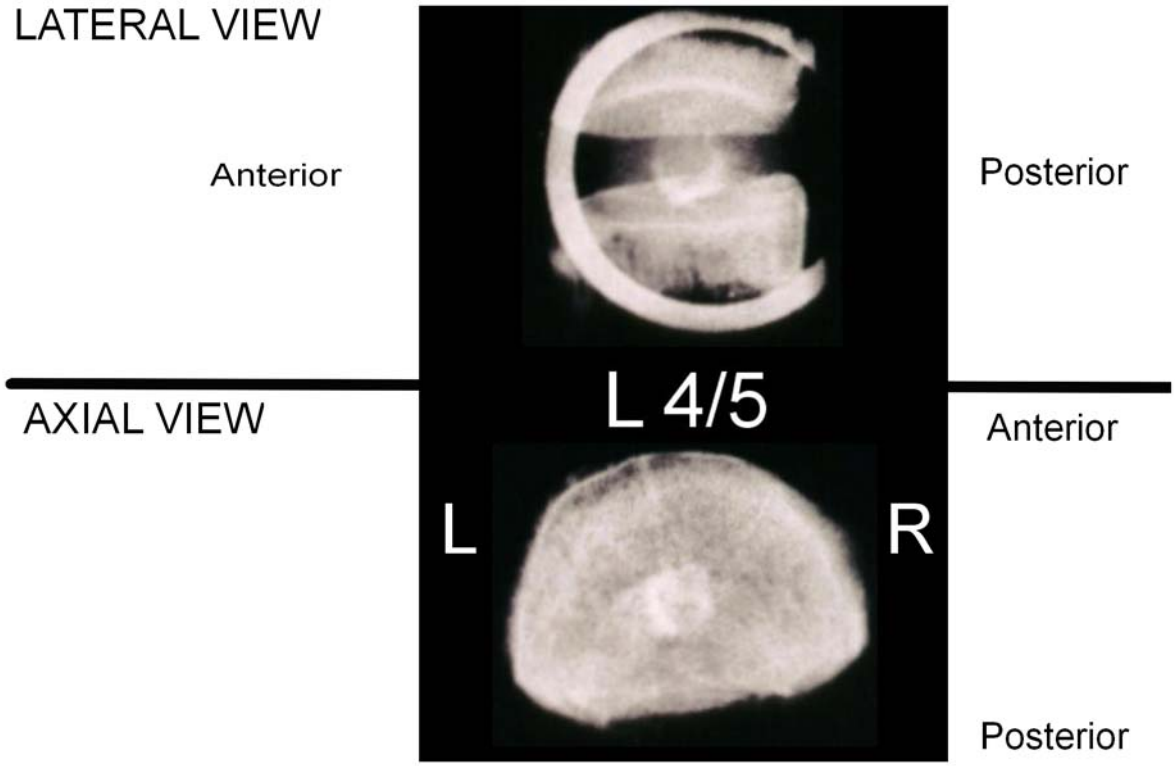


Figure 4.23: Lateral and axial x ray of L4/5, specimen D

The dye was injected from the anterior side into the nucleus pulposus. Approximately 3ml of dye entered the nucleus pulposus and localized centrally. On the lateral view and the axial view, the dye was centrally located without lateralization or dye migration.

Table 4.22: Position and movement of dye in specimen D, L4/5

Lateral view		**Axial view**		
Central	**Posterior**	**Left**	**Central**	**Right**
X			X	

4.1.4.6 Specimen D- L5/S1, lateral and axial view

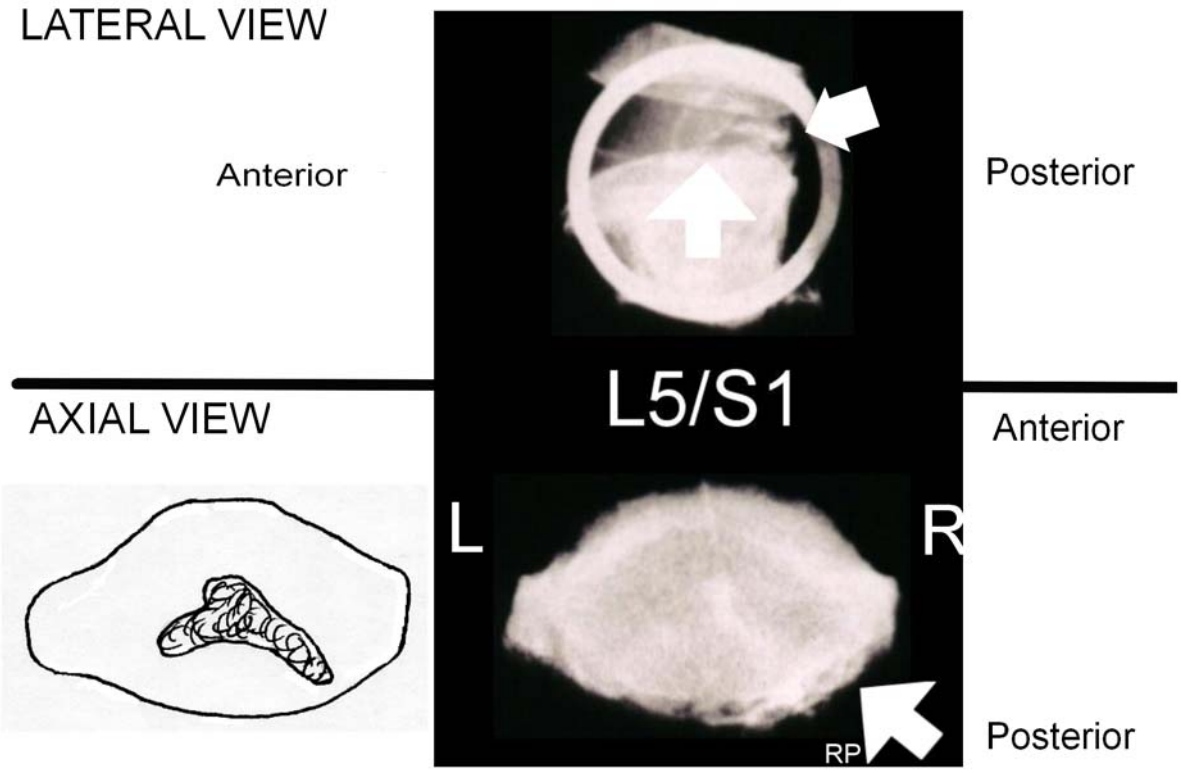


Figure 4.24: Lateral and axial x ray of L5/S1, specimen D

The dye was injected from the anterior side into the nucleus pulposus. Approximately 5ml of dye entered the nucleus pulposus and localized centrally. On the lateral view, the dye shows posterior migration into the anulus fibrosus (arrow). On the axial view, there is right posterior lateralisation into the anulus fibrosus (arrow). End plate damage is apparent, as there is radio-opacity on the superior body of S1

Table 4.23: Position and movement of dye in specimen D, L5/S1

Lateral view		**Axial view**		
Central	**Posterior**	**Left**	**Central**	**Right**
X	**X**		**X**	**X P L**

4.1.4.7 Legend for results in X Ray findings of the whole of specimen D

In order to report on the migration of dye within the injected nucleus pulposus, the symbols were used:

"X"	Refers to an observed migration of radio opaque dye.
"P" – Posterior	Migration of the radio opaque dye either due to
"L" – Lateral	Early fissuring of the anulus fibrosus or degenerative changes in the transitional zone, which is the zone between the nucleus pulposus and the anulus fibrosus.

Table 4.24: Summary of position and movement of dye in specimen D

Specimen	**Lateral view**		**Axial view**		
D	**Central**	**Posterior**	**Left**	**Central**	**Right**
L1/2	**X**			**X**	
L2/3	**X**	**X**	**X P**	**X**	
L3/4	**X**			**X**	**X P**
L4/5	**X**			**X**	
L5/S1	**x**	**X**		**x**	**X P L**

4.1.5 Specimen E: X-ray and dye injection into nucleus pulposus

4.1.5.1 Specimen E- Anterior posterior and lateral view of total lumbar spine



Figure 4.25: The anterior- posterior and lateral view of the lumbar spine of specimen E, prior to dissection into separate units

4.1.5.2 Specimen E- L1/2, lateral and axial view

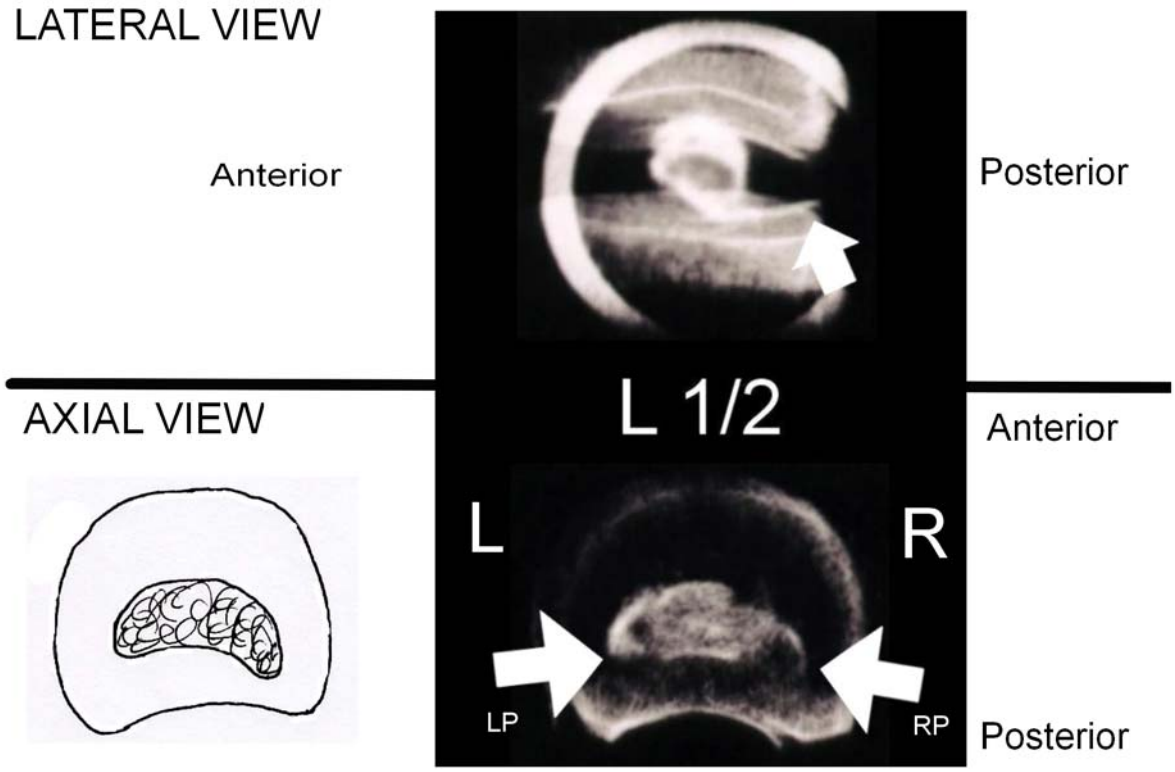


Figure 4.26: Lateral and axial x ray of L1/2, specimen E

The dye was injected from the anterior side into the nucleus pulposus. Approximately 4ml of dye entered the nucleus pulposus and localized centrally. On the lateral view, the dye located centrally with posterior migration on the inferior end plate (arrow). The axial view shows bilateral lateralisation with the posterior migration to the right and posterior. The RP migration is suggestive of a narrow fissure.

Table 4.25: Position and movement of dye in specimen E, L1/2

Lateral view		**Axial view**		
Central	**Posterior**	**Left**	**Central**	**Right**
X		**X L**	**X**	**X P L**

4.1.5.3 Specimen E- L2/3, lateral and axial view

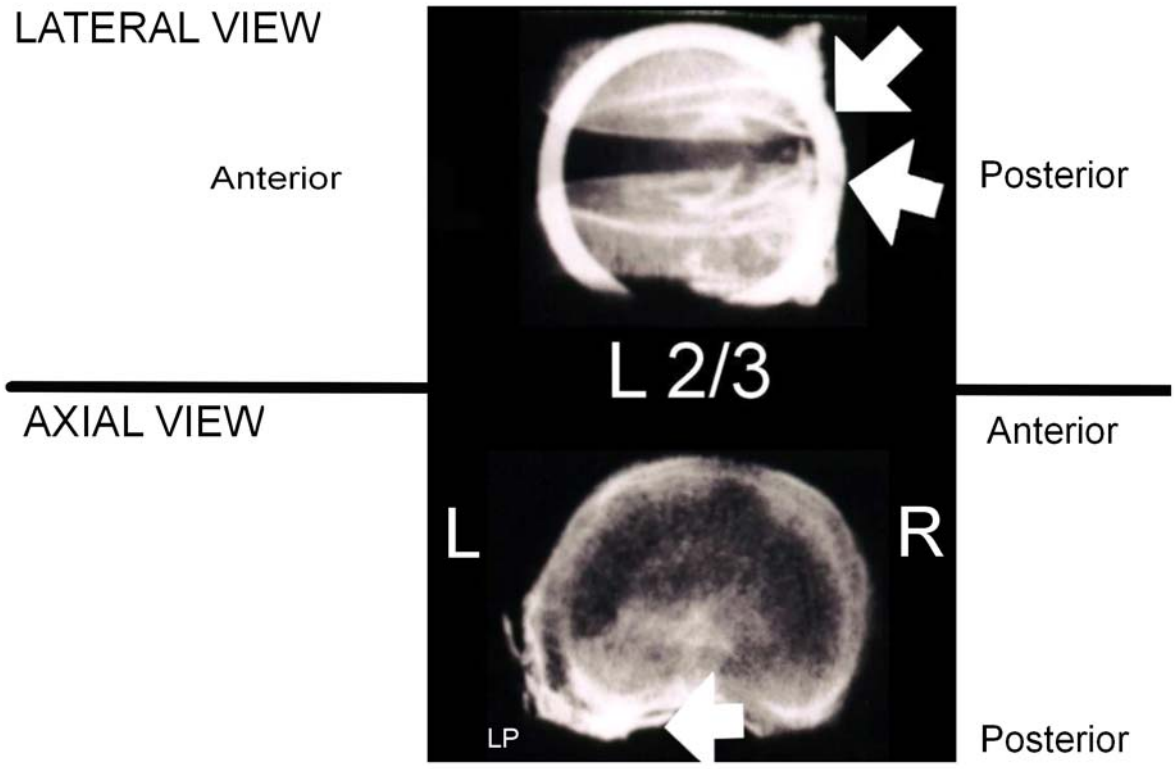


Figure 4.27: Lateral and axial x ray of L2/3, specimen E

The dye was injected from the anterior side into the nucleus pulposus. Approximately 3ml of dye entered the nucleus pulposus and localized centrally. On the lateral view, the dye located posteriorly on the superior and inferior end plates through the anulus fibrosus (arrow). On the axial view there is left posterior lateralisation through the anulus fibrosus.

Table 4.26: Position and movement of dye in specimen E, L2/3

Lateral view		**Axial view**		
Central	**Posterior**	**Left**	**Central**	**Right**
	X P	**X P L**		

4.1.5.4 Specimen E- L3/4, lateral and axial view

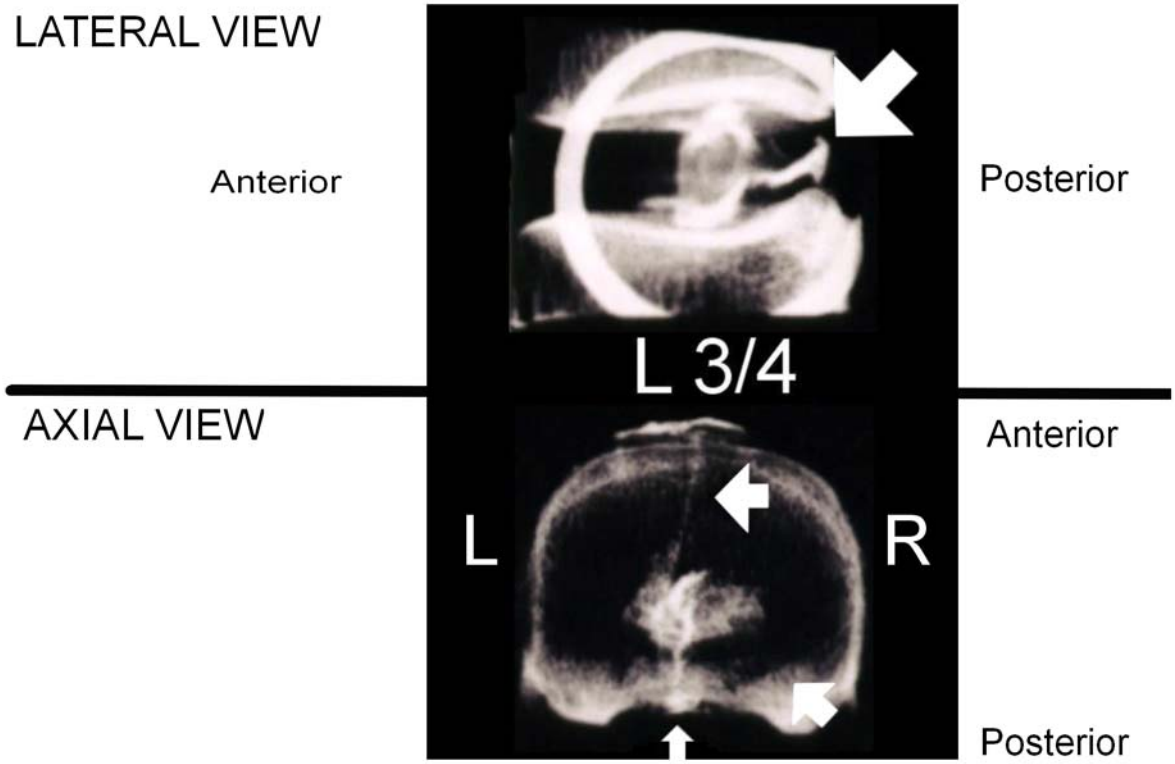


Figure 4.28: Lateral and axial x ray of L3/4, specimen E

The dye was injected from the anterior side into the nucleus pulposus. Approximately 4ml of dye entered the nucleus pulposus and localized centrally. On the lateral view, the dye located centrally with posterior fissure into and through the anulus fibrosus (arrow). The axial view shows a central nucleus again with a posterior fissure through the anulus fibrosus (arrow).

Note: A thin hairline radio opaque line is visible in the anterior aspect. This was from the injection needle (arrow)

Table 4.27: Position and movement of dye in specimen E, L3/4

Lateral view		**Axial view**		
Central	**Posterior**	**Left**	**Central**	**Right**
X			**X P**	

4.1.5.5 Specimen E- L4/5, lateral and axial view

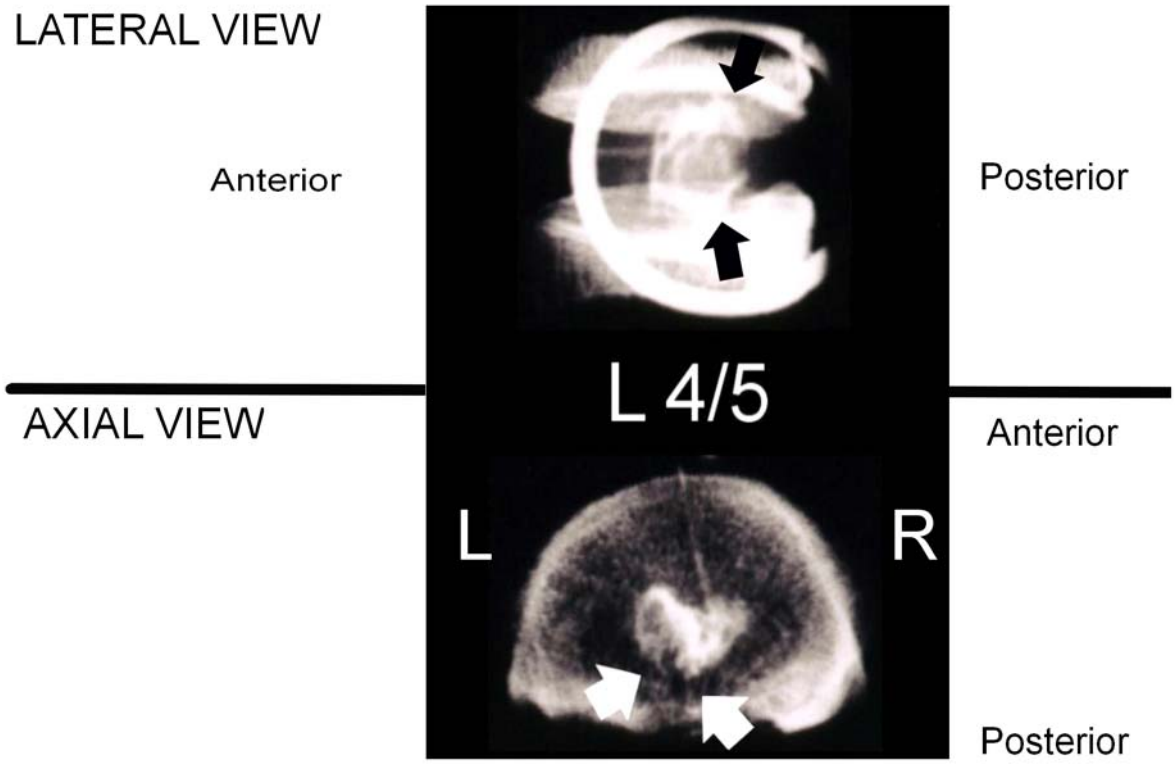


Figure 4.29: Lateral and axial x ray of L4/5, specimen E

The dye was injected from the anterior side into the nucleus pulposus. Approximately 3ml of dye entered the nucleus pulposus and localized centrally. On the lateral view, the dye located centrally with migration of dye into the end plates (black arrows). The axial view shows a posteriorly located nucleus pulposus (white arrow), with posterior dye migration onto the anulus fibrosus.

Table 4.28: Position and movement of dye in specimen E, L4/5

Lateral view		**Axial view**		
Central	**Posterior**	**Left**	**Central**	**Right**
X	**X**		**X P**	

4.1.5.6 Specimen E- L5/S1, lateral and axial view

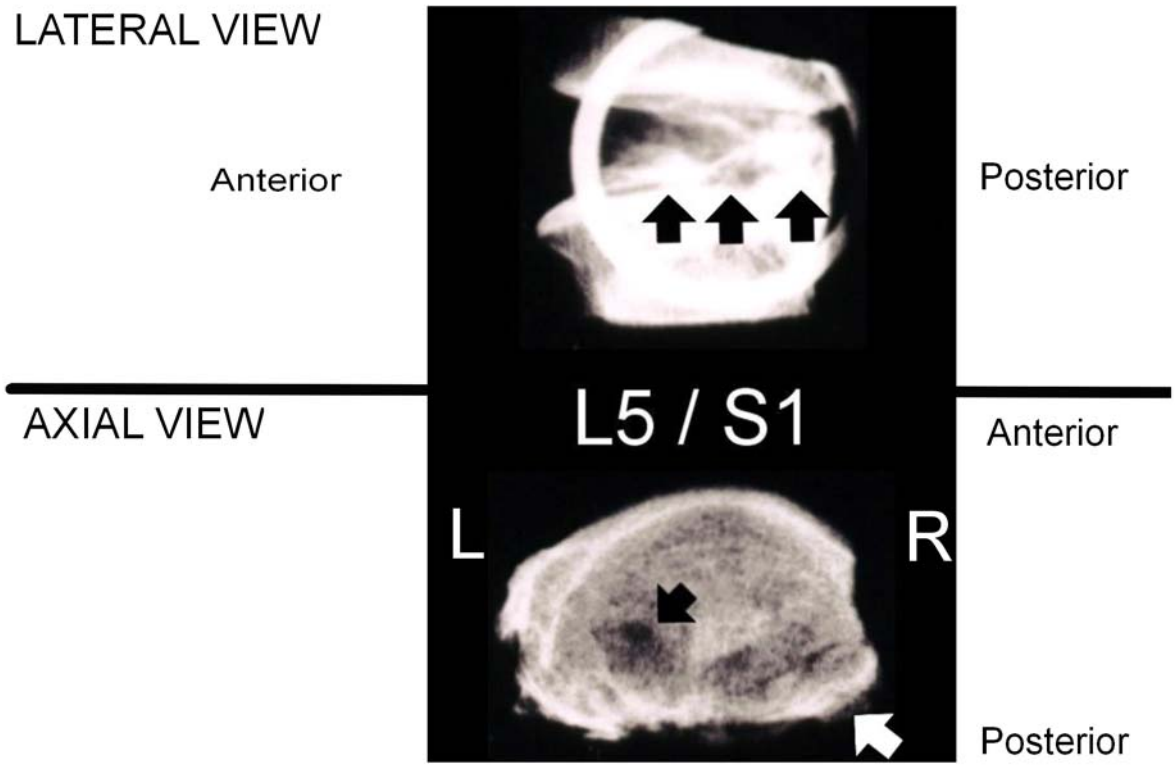


Figure 4.30: Lateral and axial x ray of L5/S1, specimen E

The dye was injected from the anterior side into the nucleus pulposus. Approximately 5ml of dye entered the nucleus pulposus and localized centrally. The dye oozed out into the S1 segment indicating possible degeneration of the end plate. On the lateral view, the dye is diffuse in the nucleus pulposus and located posterior inferiorly (black arrows). The axial view shows fragmentation in the bodies of the vertebra (white and black arrow).

Table 4.29: Position and movement of dye in specimen E, L5/S1

Lateral view		**Axial view**		
Central	**Posterior**	**Left**	**Central**	**Right**
X	**X**		**x**	

4.1.5.7 Legend for results in x ray findings for the whole of specimen E

In order to report on the migration of dye within the injected nucleus pulposus, the symbols were used:

"X"	Refers to an observed migration of radio opaque dye.
"P" – Posterior	Migration of the radio opaque dye either due to
"L" – Latera.	Early fissuring of the anulus fibrosus or degenerative changes in the transitional zone, which is the zone between the nucleus pulposus and the anulus fibrosus.

Table 4.30: Summary of position and movement of dye in specimen E

Specimen	**Lateral view**		**Axial view**		
E	**Central**	**Posterior**	**Left**	**Central**	**Right**
L1/2	**X**		**X L**	**X**	**X P L**
L2/3		**X P**	**X P L**		
L3/4	**X**			**X P**	
L4/5	**X**	**X**		**X P**	
L5/S1	**x**	**X**		**X**	

Correlation of findings will be shown in a summary chart in Chapter 5 – Discussion.

4.2 Macroscopic studies of the intervertebral disc

The following models are representative of 15 of the 25 dissected specimens where definite migration of the nucleus pulposus was observed with degenerative changes in the anulus fibrosus. This represents a 54 percentile. The summary at the end of this chapter will be incorporated into the correlation of findings in Chapter 5 – Discussion.

4.2.1 Macroscopic dissection of specimen A, L2/3

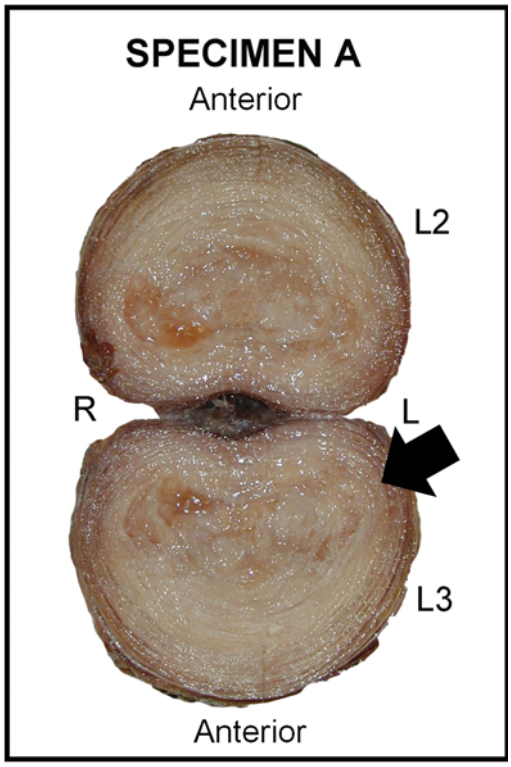


Figure 4.31: Macroscopic dissection of specimen A, L2/3

Visible concentric rings in the anulus with loss in definition and compression of the annular rings bilaterally (arrow).

Nucleus pulposus is visible and has signs of lateral displacement bilaterally.

Table 4.31: Summary of macroscopic findings of specimen A, L2/3

Nucleus pulposus displacement		**Anular impression**
Lateral	Left and right	
Posterior		Left

4.2.2 Macroscopic dissection of specimen A, L5/S1

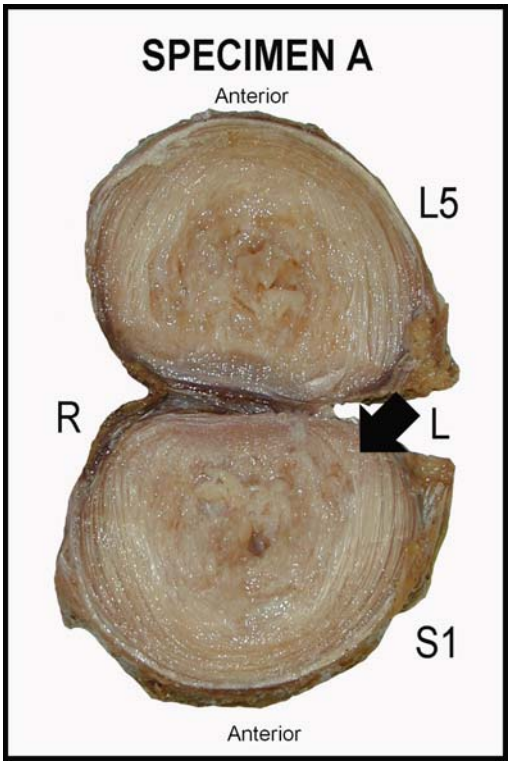


Figure 4.32: Macroscopic dissection of specimen A, L5/S1

The anular rings are visible and angulated posterior lateral to the left. Marked thinning is noted posteriorly on the left with loss of definition in the anular rings (arrow)

The nucleus pulposus is visible with posterior left lateralisation (arrow)

Table 4.32: Summary of macroscopic findings of specimen A, L5/S1

Nucleus pulposus displacement		**Anular impression**
Lateral	Left	
Posterior	Left	Left posterior

4.2.3 Macroscopic dissection of specimen B, L1/2

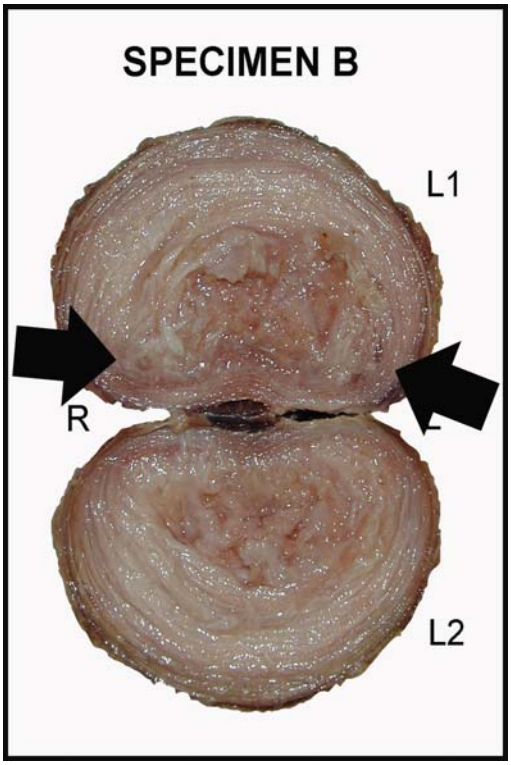


Figure 4.33: Macroscopic dissection of specimen B, L1/2

Anular rings are visible, sharp angulation posterior lateral with posterior thinning of the anulus and loss of definition in the transitional zone (arrow).

The nucleus pulposus is visible with bilateral posterior lateral displacement, more evident on the left.

Table 4.33: Summary of macroscopic findings of specimen B, L1/2

Nucleus pulposus displacement		**Anular impression**
Lateral	Left and right	Thinning left and right
Posterior	Left and right	Left and right

4.2.4 Macroscopic dissection of specimen B L2/3

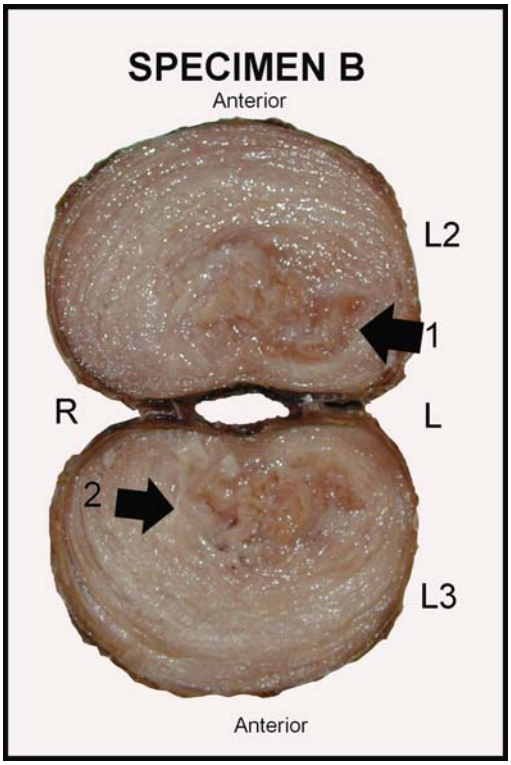


Figure 4.34: Macroscopic dissection of specimen B L2/3

Loss of clear definition in anular rings posteriorly, with marked degenerative changes on the left (arrow 2).

The nucleus pulposus shows invasion of fibrous material from the anulus right posterior and lateral (arrow 1).

Table 4.34: Summary of macroscopic findings of specimen B, L2/3

Nucleus pulposus displacement		**Anular impression**
Lateral	Left	Left
Posterior	Left	

4.2.5 Macroscopic dissection of specimen B L4/5

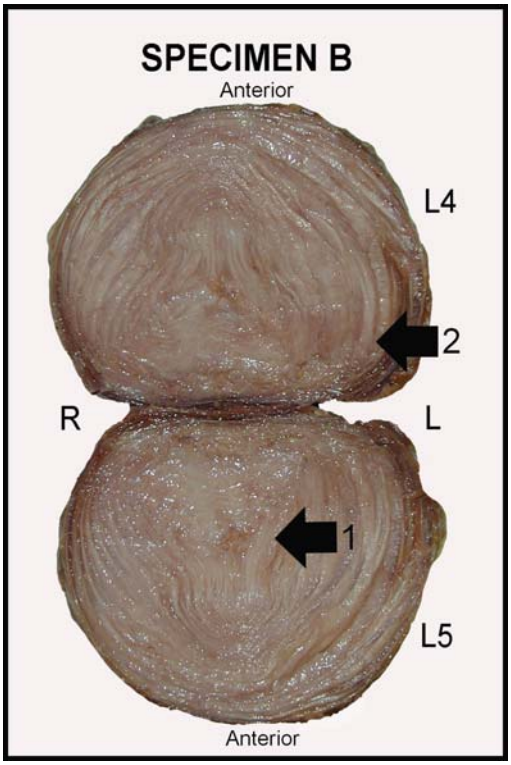


Figure 4.35: Macroscopic dissection of specimen B L4/5

An example of a disc that has been infiltrated with anular material showing minimal remnants of the nucleus pulposus (arrow 1).

Thinning of the anulus fibrosis, left posterior (arrow 2).
Specimen B L4/5

Table 4.35: Summary of macroscopic findings of specimen B, L4/5

Nucleus pulposus displacement		**Anular impression**
Lateral	Left and right	Left
Posterior	Left and right	Left

4.2.6 Macroscopic dissection of specimen C L1/2

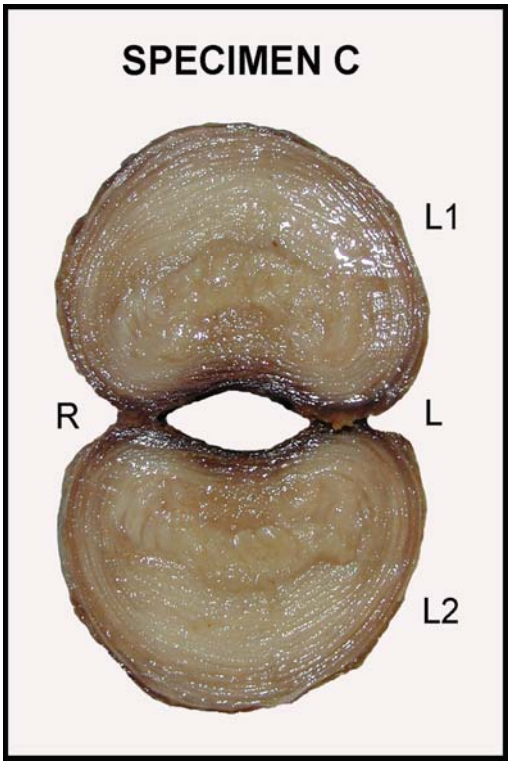


Figure 4.36: Macroscopic dissection of specimen C L1/2

Visible concentric rings of the anulus and limited posterior thinning.

The nucleus pulposus is bilaterally, laterally displaced.

Table 4.36: Summary of macroscopic findings of specimen C, L1/2

Nucleus pulposus displacement		**Anular impression**
Lateral	Left and right	Thinning
Posterior	Left and right	Right

4.2.7 Macroscopic dissection of specimen C L3/4

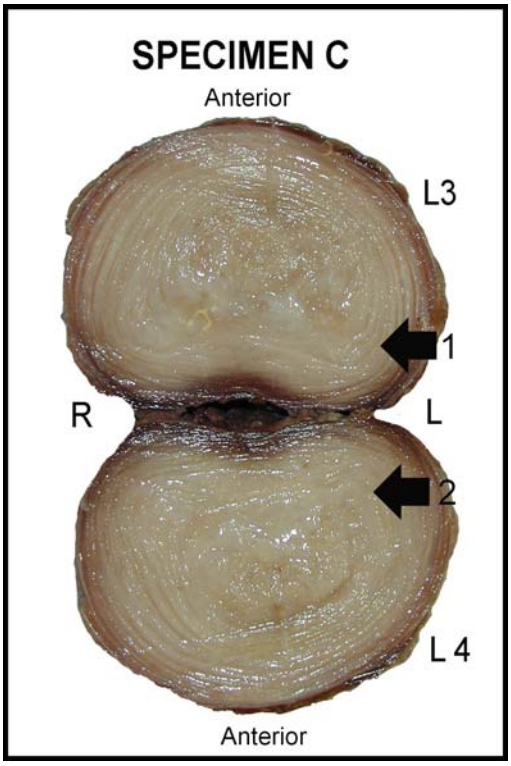


Figure 4.37: Macroscopic dissection of specimen C L3/4

Visible concentric rings with posterior lateral angulations on the left side (arrow 1)

Nucleus pulposus is broad based, predominantly left but also right (arrow 2).

Table 4.37: Summary of macroscopic findings of specimen C, L3/4

Nucleus pulposus displacement		**Anular impression**
Lateral	Left	Left
Posterior	Left	Left

4.2.8 Macroscopic dissection of specimen C L4/5

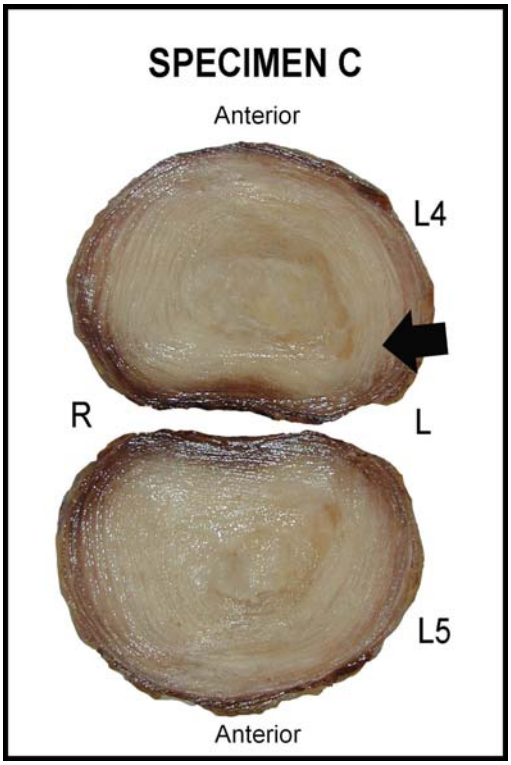


Figure 4.38: Macroscopic dissection of specimen C L4/5

Visible concentric anular rings, angulated posterior.

The nucleus pulposus is migrating left posterior lateral, invagination into the anular rings (arrow)

Table 4.38: Summary of macroscopic findings of specimen C, L4/5

Nucleus pulposus displacement		**Anular impression**
Lateral	Left	
Posterior	Left	Left

4.2.9 Macroscopic dissection of specimen C L5/S1

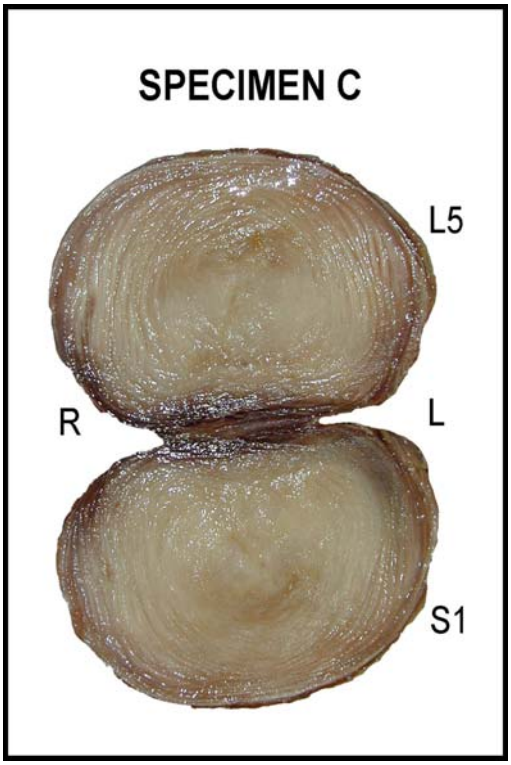


Figure 4.39: Macroscopic dissection of specimen C L5/S1

The anulus is visible and concentric with loss of definition posteriorly in the transitional zone.

Nucleus pulposus appears homogenous with the anulus fibrosus, especially in the transitional zone.

Table 4.39: Summary of macroscopic findings of specimen C, L5/S1

Nucleus pulposus displacement		**Anular impression**
Lateral	Left	Left and Right
Posterior		Left

4.2.10 Macroscopic dissection of specimen D L3/4

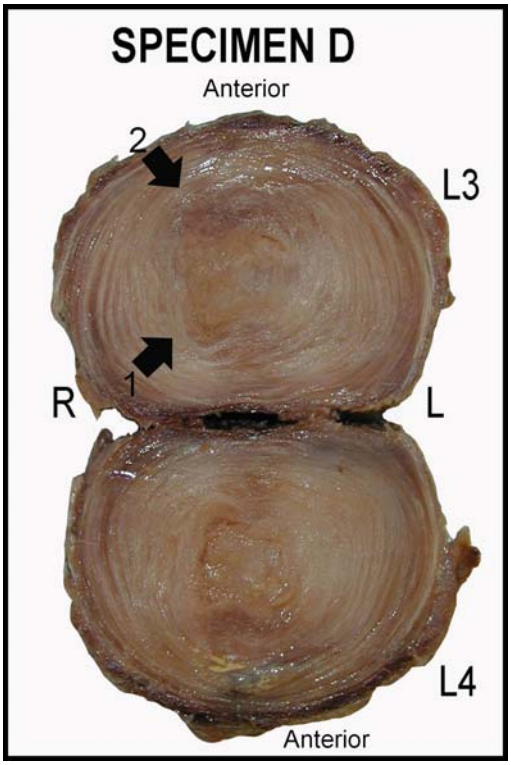


Figure 4.40: Macroscopic dissection of specimen D L3/4

The anular rings are concentric.

The nucleus pulposus is showing signs of degeneration. There is evidence of posterior right invagination into the anulus (arrow 1)

Degenerative changes in the anterior anulus (arrow 2).

Table 4.40: Summary of macroscopic findings of specimen D, L3/4

Nucleus pulposus displacement		**Anular impression**
Lateral	Right	Right
Posterior	Right	Right

4.2.11 Macroscopic dissection of specimen D L5/S1

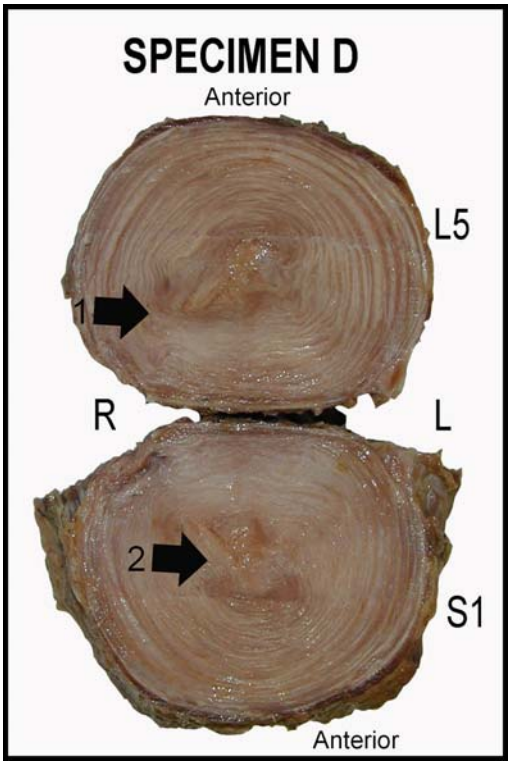


Figure 4.41: Macroscopic dissection of specimen D L5/S1

The anular rings are concentric and angulated right, posterior. There is loss of definition in the anular rings right posterior on the angulation (arrow 1).

Fibrous invasion into the nucleus pulposus with right lateral invagination into the anular rings to the periphery (arrow 2).

Table 4.41: Summary of macroscopic findings of specimen D, L5 /S1

Nucleus pulposus displacement		**Anular impression**
Lateral	Right	Right
Posterior	Right	Right

4.2.12 Macroscopic dissection of specimen E L1/2

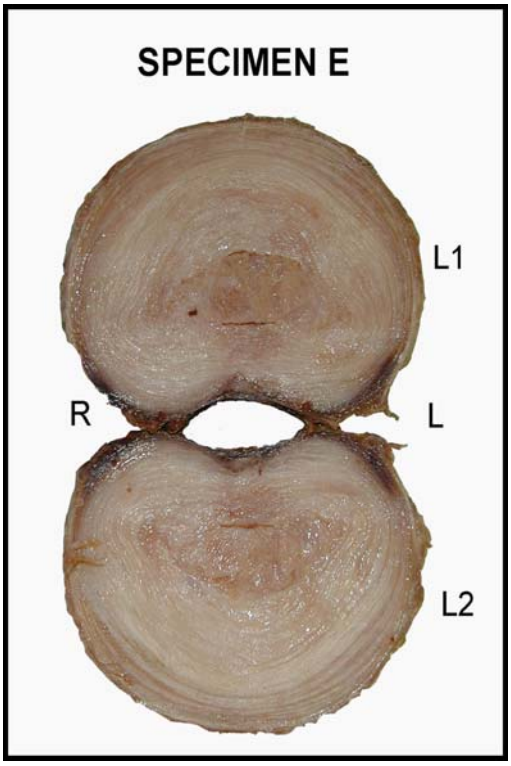


Figure 4.42: Macroscopic dissection of specimen E L1/2

Concentric anular rings with lateral angulation and lateral compression in anulus.

The nucleus pulposus is showing signs of fibrous invasion and loss of hydration.

Table 4.42: Summary of macroscopic findings of specimen E, L1/2

Nucleus pulposus displacement		**Anular impression**
Lateral	Left and right	Left and right
Posterior		

4.2.13 Macroscopic dissection of specimen E L2/3

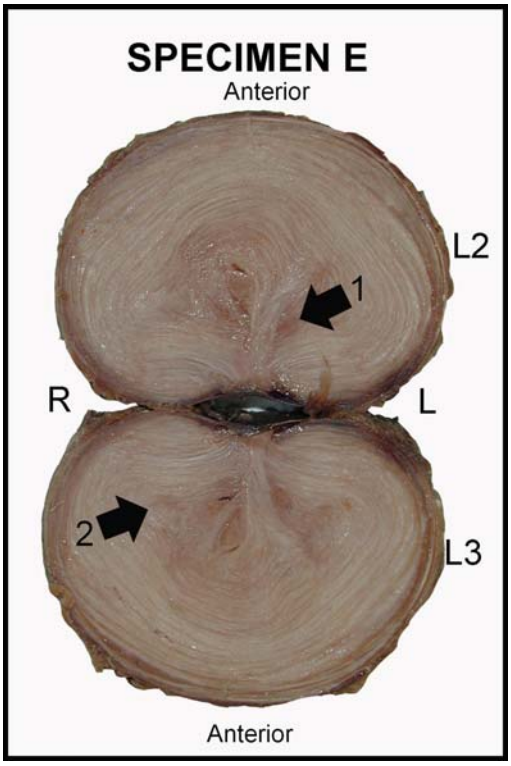


Figure 4.43: Macroscopic dissection of specimen E L2/3

The anular rings are visible, showing angulations, lateral. In the dissection of the intervertebral discs, many forms of anomalies were noted. This specimen shows invasion of the nucleus pulposus by anular fibrous material (arrow 1).

The nucleus pulposus is diminished and shows lateralisation into the left and right anulus (arrow 2).

Table 4.43: Summary of macroscopic findings of specimen E, L2/3

Nucleus pulposus displacement		**Anular impression**
Lateral		
Posterior		

4.2.14 Macroscopic dissection of specimen E L4/5

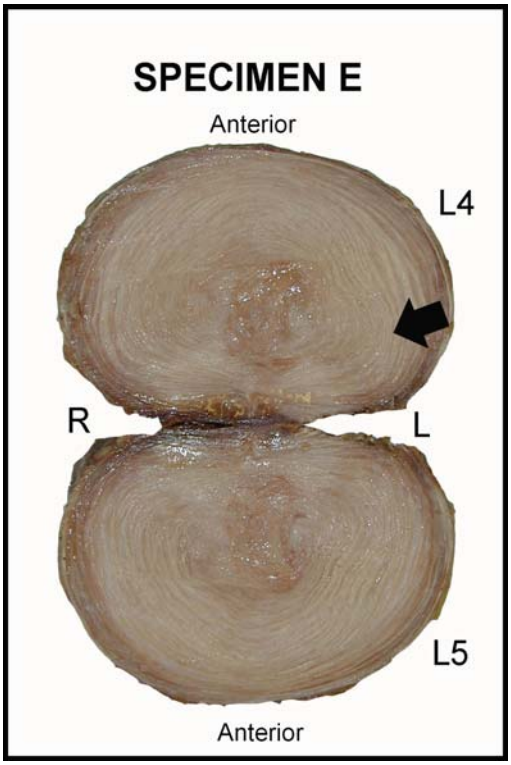


Figure 4.44: Macroscopic dissection of specimen E L4/5

The anular rings are concentric with left lateral angulation (arrow).

There is evidence of anular invasion into the nucleus pulposus.

Table 4.44: Summary of macroscopic findings of specimen E, L4/5

Nucleus pulposus displacement		**Anular impression**
Lateral	Left	Left
Posterior		Left

4.2.15 Macroscopic dissection of specimen E L5/S1

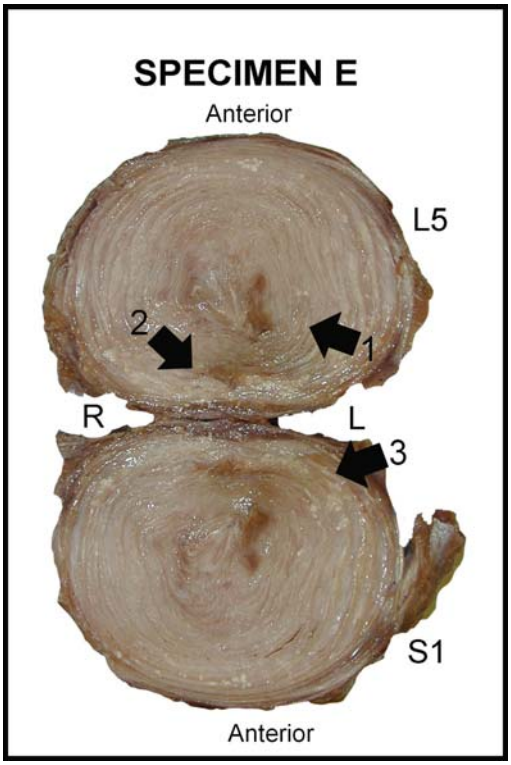


Figure 4.45: Macroscopic dissection of specimen E L5/S1

Degenerative changes in the anulus fibrosus with signs of fatty plaques (arrow 1).

Loss of definition in posterior central anulus fibrosus – transitional zone (arrow 2).

The nucleus pulposus is infiltrated with anular material and showing signs of posterior left migration (arrow 3).

Table 4.45: Summary of macroscopic findings of specimen E, L5 / S1

Nucleus pulposus displacement		**Anular impression**
Lateral	Left	Left and posterior
Posterior	Left	Left

Table 4.46 Table of summary of all specimen's macroscopic intervertebral discs

	Nucleus pulposus Displacement		
Spec **A**	**Post**	**Lat**	**Anulus**
L1/2			
L2/3		L + R	LP
L3/4			
L4/5			
L5/S1	X	L	LP

	Nucleus pulposus Displacement		
Spec **D**	**Post**	**Lat**	**Anulus**
L1/2			
L2/3			
L3/4	Ant	R	R
L4/5			
L5/S1	X	R	RP

	Nucleus pulposus Displacement		
Spec **B**	**Post**	**Lat**	**Anulus**
L1/2	X	L + R	BP
L2/3	X	L	L + R
L3/4	X	L	
L4/5	X	L + R	
L5/S1	X		

	Nucleus pulposus Displacement		
Spec **E**	**Post**	**Lat**	**Anulus**
L1/2		L + R	Degenerative changes
L2/3		R	Disc anomaly
L3/4		R	
L4/5	X	L	
L5/S1	X	L	Disc anomaly

	Nucleus pulposus Displacement		
Spec **C**	**Post**	**Lat**	**Anulus**
L1/2	X	R	R
L2/3			
L3/4	L	L	LP
L4/5	X	L	LP
L5/S1		L + R	

4.3 Microscopic studies of the intervertebral disc

The result of this aspect of the study was very unsatisfactory. The slicing/peeling of the tissue at 5 microns continually destroyed the tissue. Various techniques were tried, such as the application of ice, but the specimen continually became fragmented. Of the 50 histological slides made, only 9 could be used for comparative study and they were at the levels of specimen B L2/3, C L4/5 and D L5/S1.

As a result, little reliance can be placed upon the findings in this part of the study

A demarcation line was shown to indicate the transition zone between the nucleus pulposus and the anulus fibrosus – visual and may be subjective.

Table 4.47: Summary table of microscopic findings

Level	Left		Right		Magnification	
	Superior	Inferior	Superior	Inferior	Left	Right
B L2/3	L2 - X		L2 - X	L3 _ X	10X	20X
C L4/5	L4 - X (12.5)	L5 - X (16x)	L4 - X		12.5 X 16.0 X	9X
D L5/S1				S1 - XXX		

NOTE
Superior: Refers to the disc on the inferior of the vertebra above – L2 for L2/3
Inferior: Refers to the disc on the superior of the vertebra below – L3 for L2/3

Comment:
This concludes the extent to which microscopic slides could be reported on the specimen. The findings were limited. Although little reliance may be placed on the microscopic findings, the specimen studied seemed to support the hypothesis of the study

The Area of thinning and fragmentation found in the anulus fibrosus (a). Bulging of the nucleus pulposus (b) onto the anulus fibrosus. The transitional zone is marked (c) which is an area of mixed tissue cells between the anulus fibrosus and the nucleus pulposus.

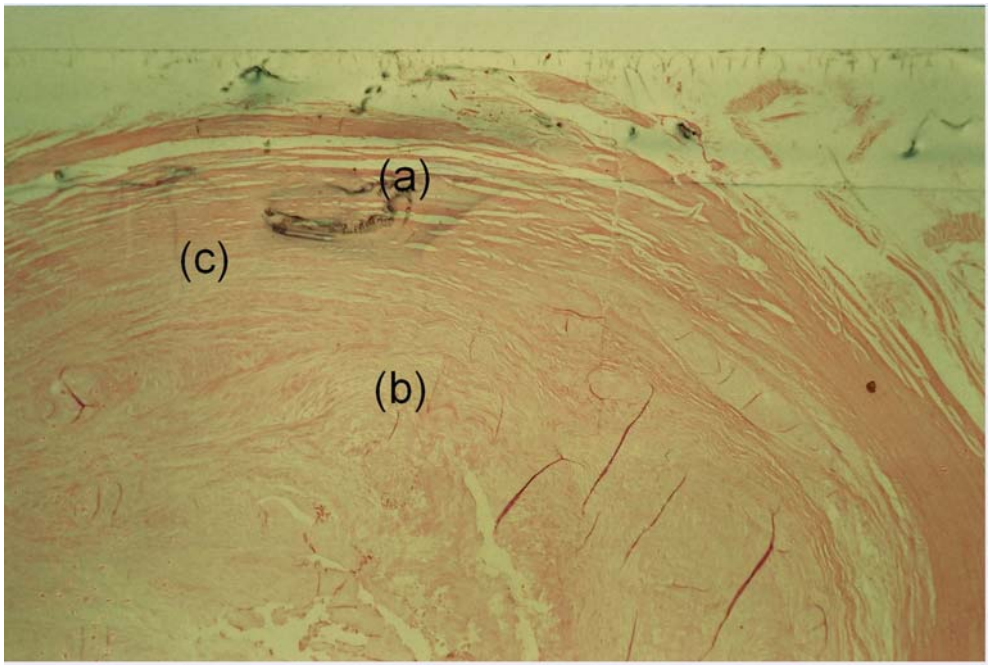


Figure 4.46: Microscopic section of specimen B L2/3 Left Superior inter vertebral disc. 10 X magnification

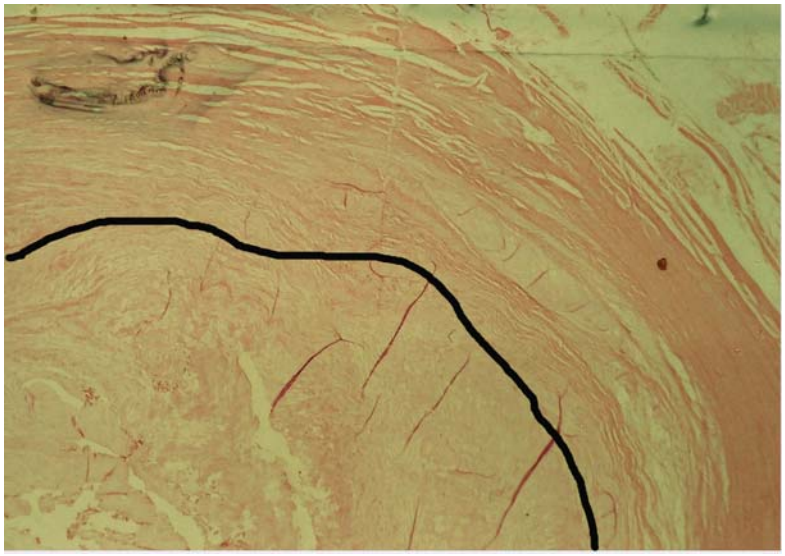


Figure 4.47: Demarcation line between nucleus pulposus and anulus fibrosus of Specimen B L2/3 Left Superior inter vertebral disc

The Area of thinning in the anulus fibrosus with peripheral fragmentation(a). The nucleus pulposus is encroaching on the anulus fibrosus at this point (b). The transitional zone is marked (c).

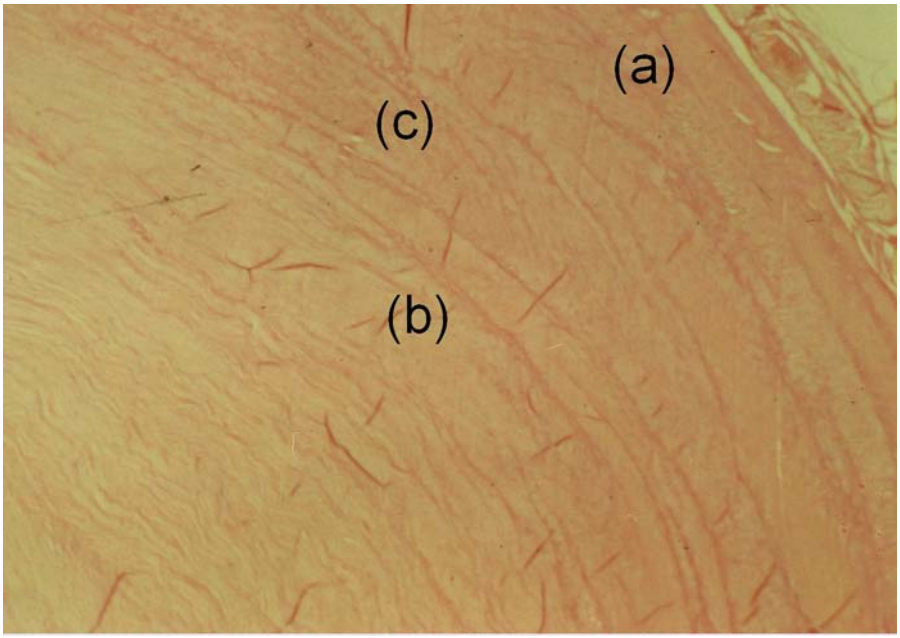


Figure 4.48: Microscopic section of specimen B L2/3 Right Superior inter vertebral disc. 20 X magnification

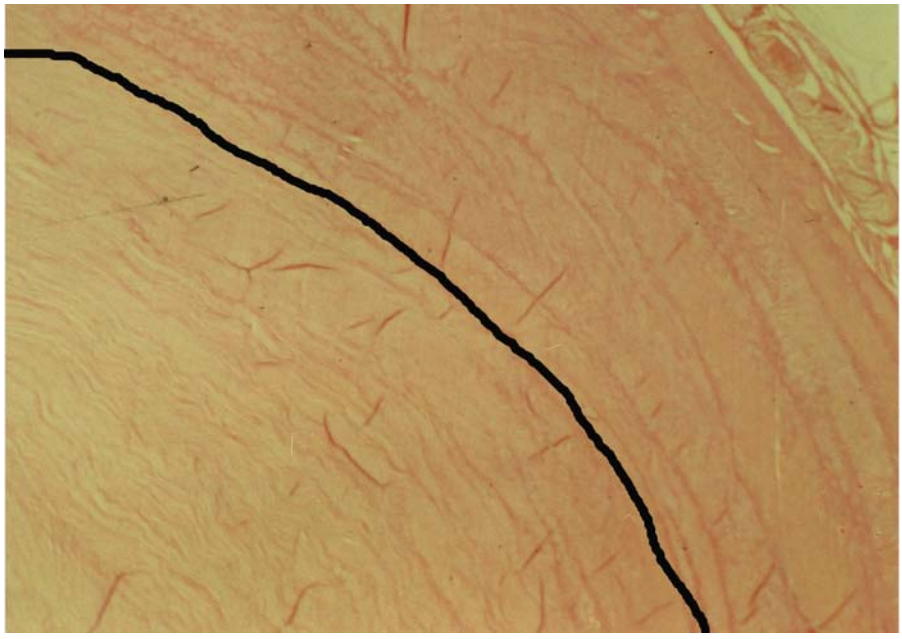


Figure 4.49: Demarcation line between nucleus pulposus and anulus fibrosus of Specimen B L2/3 Right Superior inter vertebral disc

A sharply angulated point of narrowing with marked thinning and circular fragmentation of the anulus fibrosus (a) from the nucleus pulposus (b). The transitional zone is barely visible, except on the periphery (c).

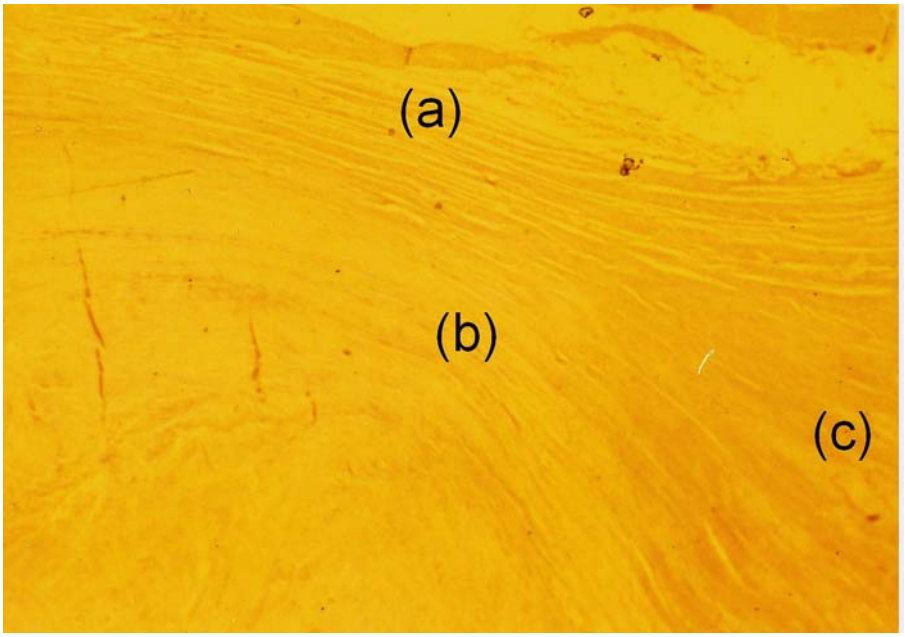


Figure 4.50: Microscopic section of specimen B L2/3 Right Inferior inter vertebral disc. 20 X magnification

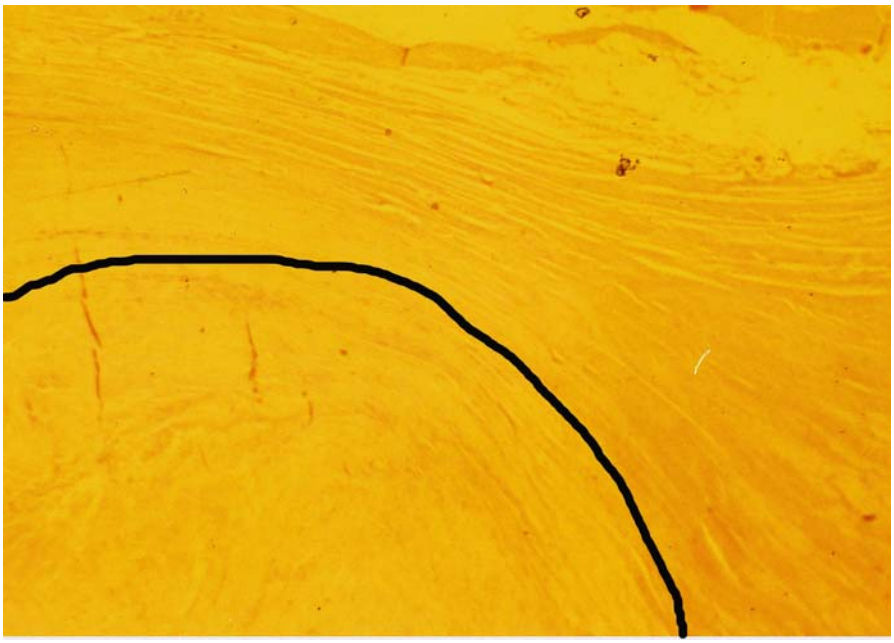


Figure 4.51: Demarcation line between nucleus pulposus and anulus fibrosus of B L2/3 Right Inferior inter vertebral disc

A sharply angulated impression of nucleus pulposus (b) into the anulus fibrosus (a). There is marked loss of definition in the fragmented anulus and the structure is represented by the transitional zone material (c). This is a representation of pending herniation of the nucleus pulposus through the anulus fibrosus.

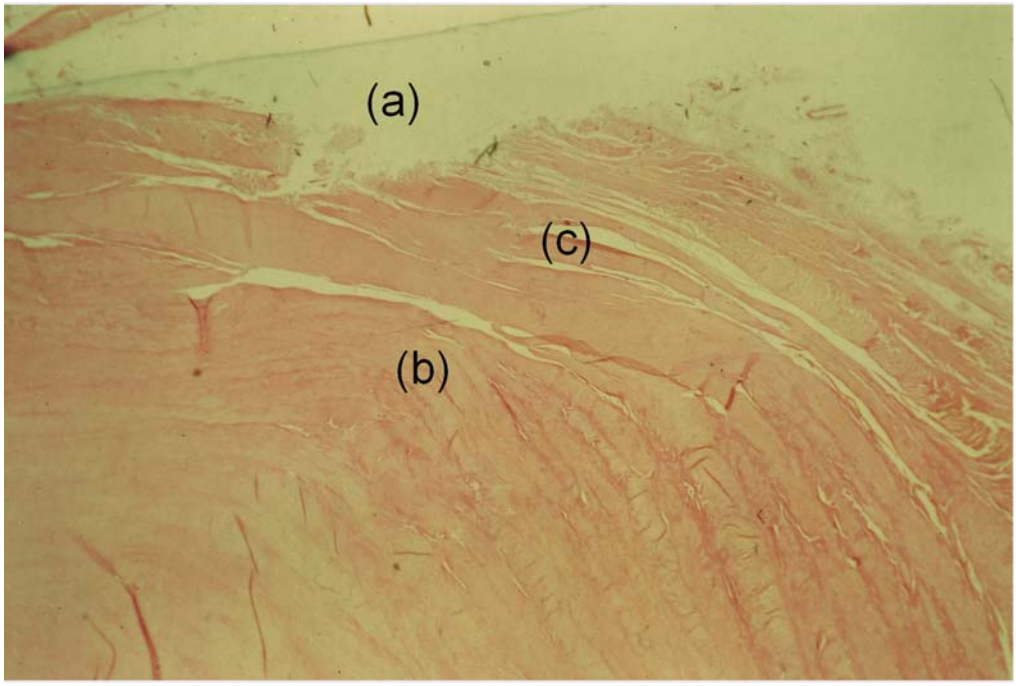


Figure 4.52: Microscopic section of specimen C L4/5 Left Inferior inter vertebral disc. 12.5 X magnification

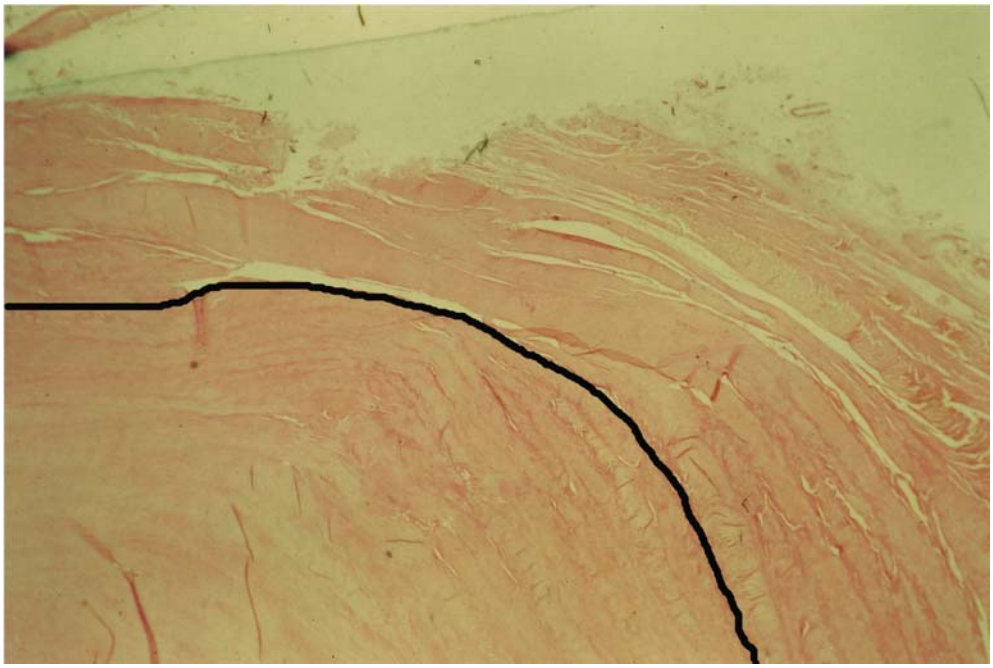


Figure 4.53: Demarcation line between nucleus pulposus and anulus fibrosus of Specimen C L4/5 Left Inferior intervertebral disc

This is the superior component of figure 4.39. Marked destruction of the anulus fibrosus (a) with loss of definition and damage to the transitional zone (c). (Angulated). Impingement of the nucleus pulposus into the anulus fibrosus (b).

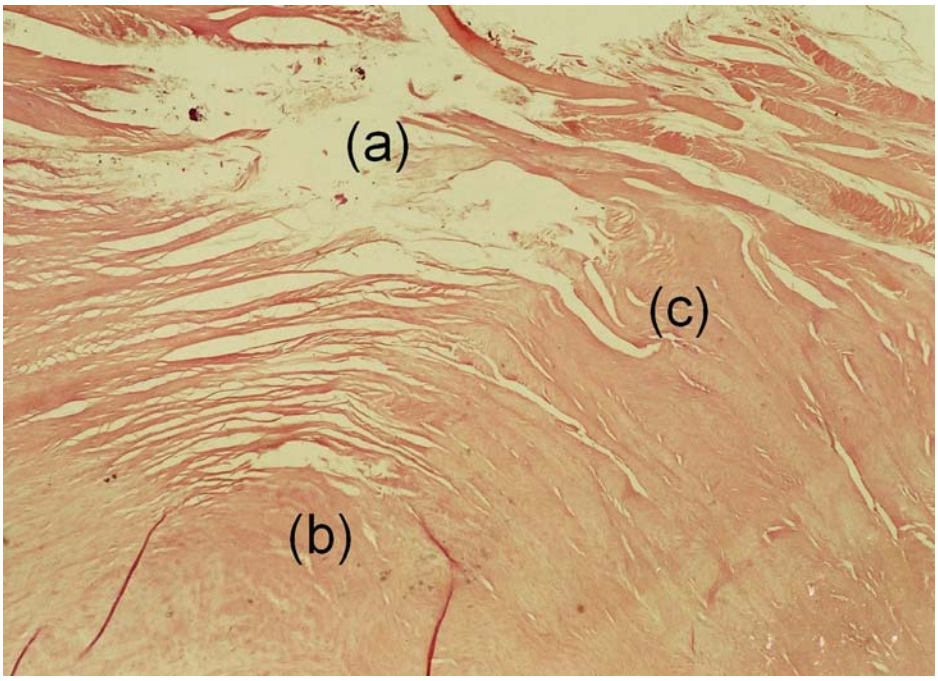


Figure 4.54: Microscopic section of specimen C L4/5 Left Superior intervertebral disc. 12.5 X magnification

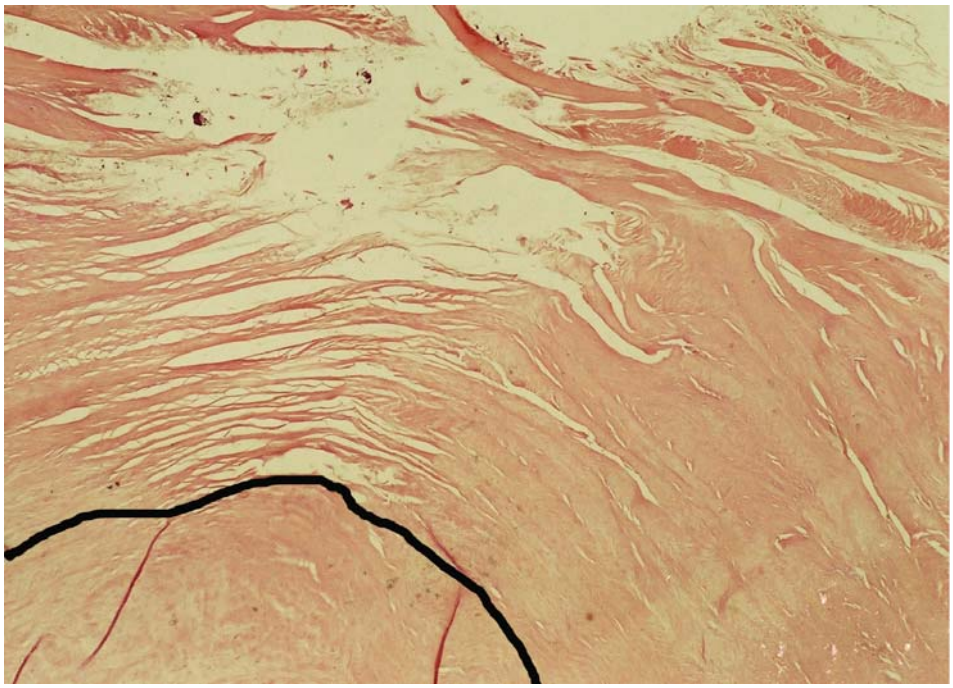


Figure 4.55: Demarcation line between nucleus pulposus and anulus fibrosus of Specimen C L4/5 Left Superior intervertebral disc

Fragmentation of the anulus fibrosus (a1) and (a2) with loss of definition of the transitional zone at (a1). The nucleus pulposus is broad based (b) and the transitional zone is visible at (c).

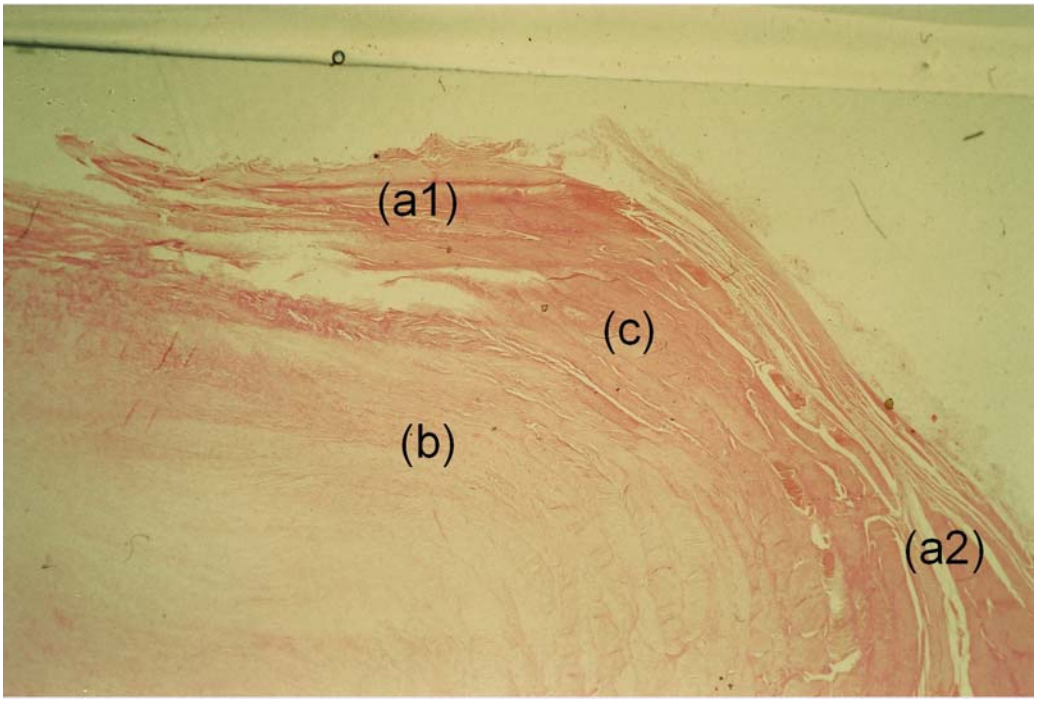


Figure 4.56: Microscopic section of specimen C L4/5 Right Superior intervertebral disc. 9 X magnification

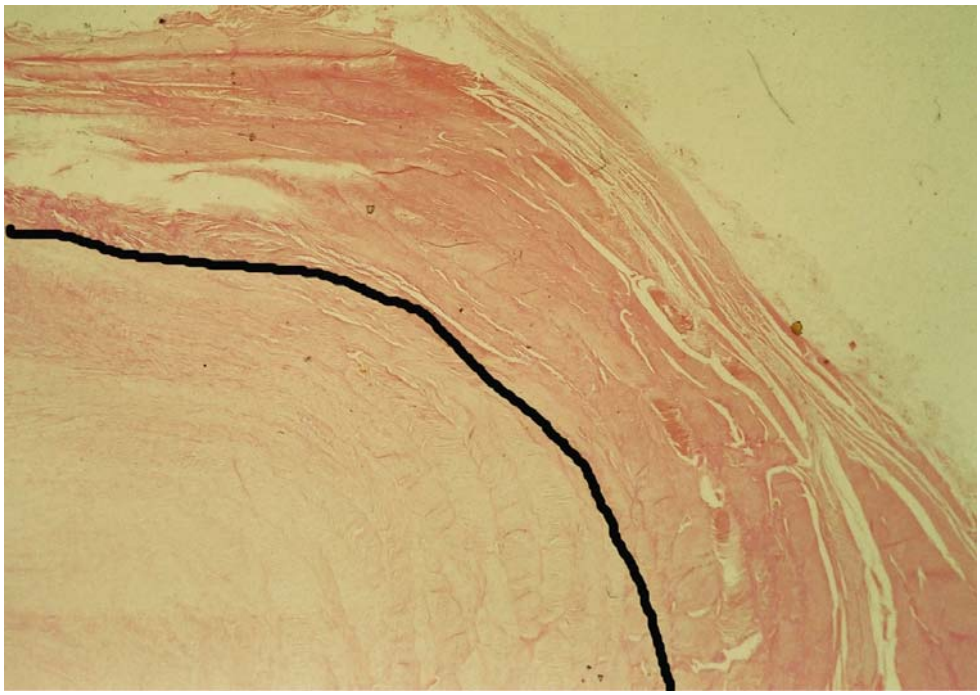


Figure 4.57: Demarcation line between nucleus pulposus and anulus fibrosus of Specimen C L4/5 right Superior intervertebral disc

Destruction of the anulus fibrosus (a) with loss of the transitional zone (c). The nucleus pulposus is at the point of herniating through the fragmented area (b).

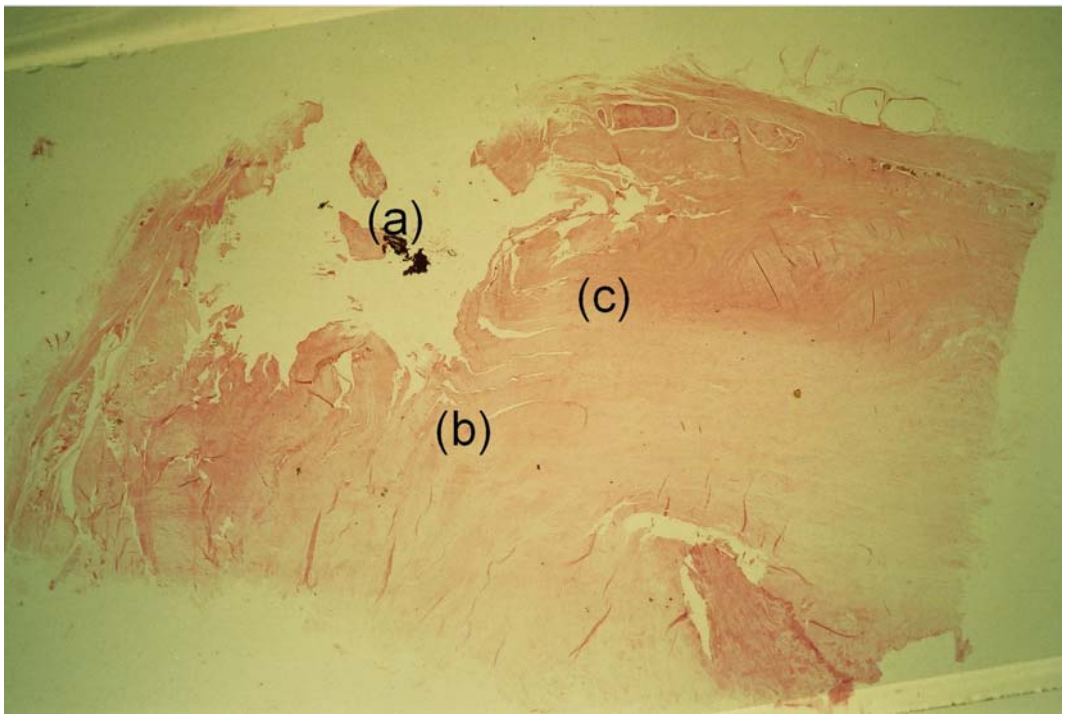


Figure 4.58: Microscopic section of specimen D L5/S1 Right Inferior intervertebral disc. 6.5 X magnification



Figure 4.59: Demarcation line between nucleus pulposus and anulus fibrosus of Specimen D L5/S1 Right Inferior intervertebral disc

4.4 Macroscopic findings of the facet joints

Varying degrees of degenerative changes were observed in the components of the facet joints. These consisted of fibrous invasion, pannus formation, and destruction of hyaline cartilage, peripheral osteoarthritis and detachment of the capsule.

The following specimen: A Right L1/2, B Left L4/5, C Left L1/2, C Left L5/S1, C Right L5/S1, D Right L1/2, D Left L5/S1, E Left L1/2 represent a sample of the cross section of the findings observed with comments and grading of degeneration. The results of all the findings are summarised in tables 4.43 and 4.44.

4.4.1 Joint rating scale

The joint rating scale refers to the state of the complete facet joint. The rating of the condition of the facet joint were done according to the values in table 4.33

Ratings were applied to the various components of the joints, namely: hyaline cartilage, synovium, capsule, bone and invasive tissue.

Table 4.48: Description of joint rating scale values

1 – Normal Surface	No apparent erosion of hyaline cartilage with a visible shiny surface.
2 – Peripheral Erosion	Visible erosion on the periphery at the capsular attachment.
3 – Early Erosion	A patch or small patches of erosion in hyaline cartilage
4 – Moderate Erosion	Loss of a third to a half of hyaline cartilage surface.
5 – Advanced Erosion	Loss of more than half of the hyaline cartilage surface.
6 – Peripheral Arthritis	Bony arthritic enlargement at the periphery of the facet.
7 – Moderate Fibrosus in Tissue Joint	Adhesions , flaking, intra- articular fibrous adhesions
8 – Extensive Fibrosus in Tissue Joint	
9 – Pannus a) Early b) Moderate c) Large	 Fat or synovial invagination into the joint less than a third. A third to a half More than a half

4.4.2 Extent of surface degeneration

Legend used in grading area of degeneration of facet cartilaginous surface was as follows:

Table 4.49: Summary table of grading of surface degeneration

0	X	X X	X X X	X X X X	X X X X X
Clear	0-15%	15-20%	20-30%	30-45%	45%+

4.4.3 Normal facet joint surface

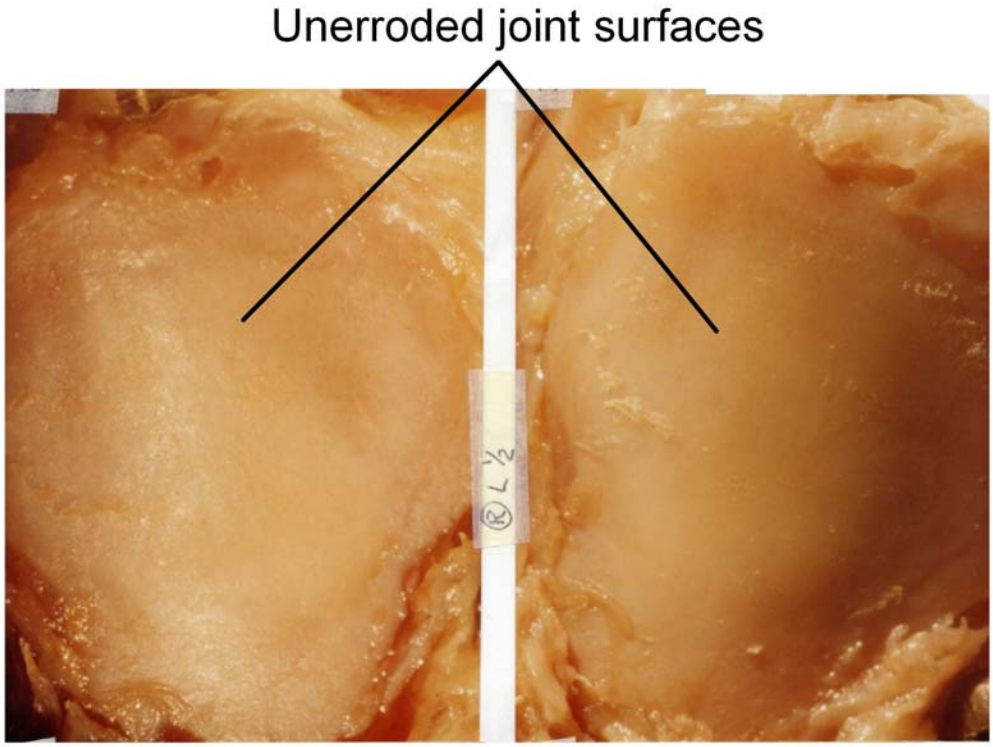


Figure 4.60: Normal facet joint surface

Specimen: A

Articulation level: Lumbar L1/2

Facet: Right

This joint surface has a normal smooth appearance. The periphery shows some inclusion tissue on the surface, which is loose and not considered to be intra articular.

Table 4.50: Summary of joint rating scale and surface degeneration of a normal facet joint surface

Rating Scale	Value
Joint Rating Scale	1, 2
Surface Degeneration	0

4.4.4 Pathological joint surface

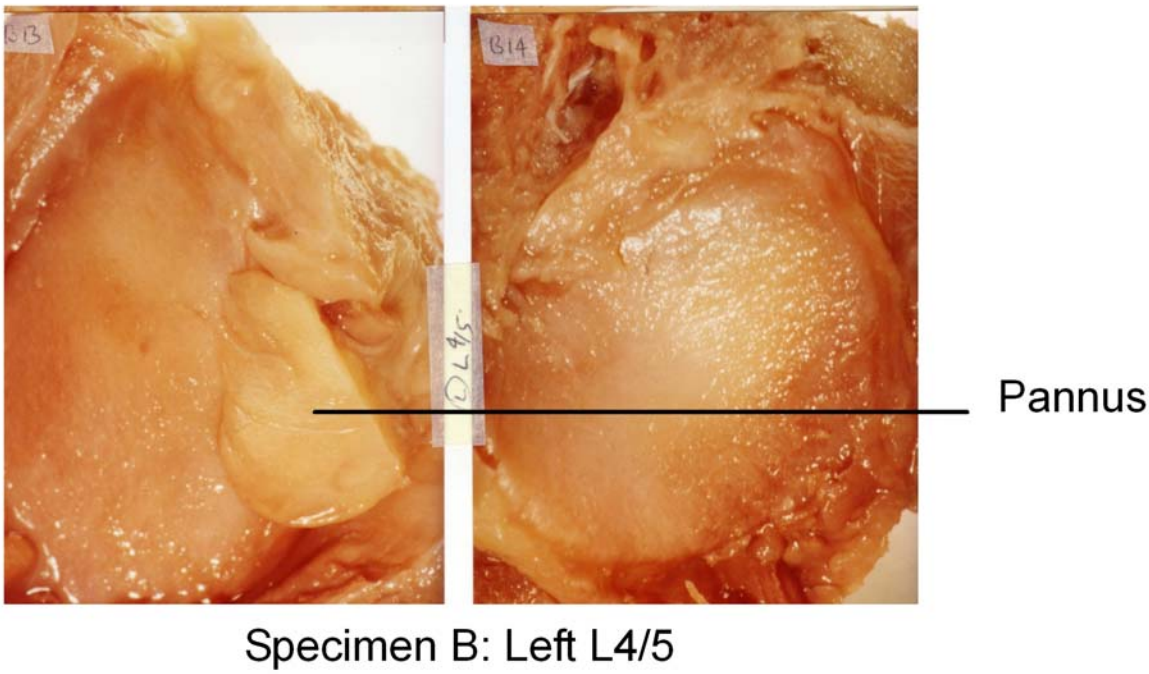


Figure 4.61: Pathological joint surface

Specimen: B
Articulation level: Lumbar L 4/5
Facet: Left

An early sign of degeneration of the hyaline cartilage and erosion on the joint periphery and pannus formation with fibrous intra capsular invasion is noted.

Table 4.51: Summary of joint rating scale and surface degeneration of a pannus formation in a joint

Rating Scale	Value
Joint Rating Scale	1, 2, 9b
Surface Degeneration	2, (X)

The pannus phenomenon is well described in the literature and is an enlargement of fat, synovium and blood vessels into the joint. It was observed in both healthy and degenerative joints.

4.4.5 Pathological joint, with destruction of the joint surface

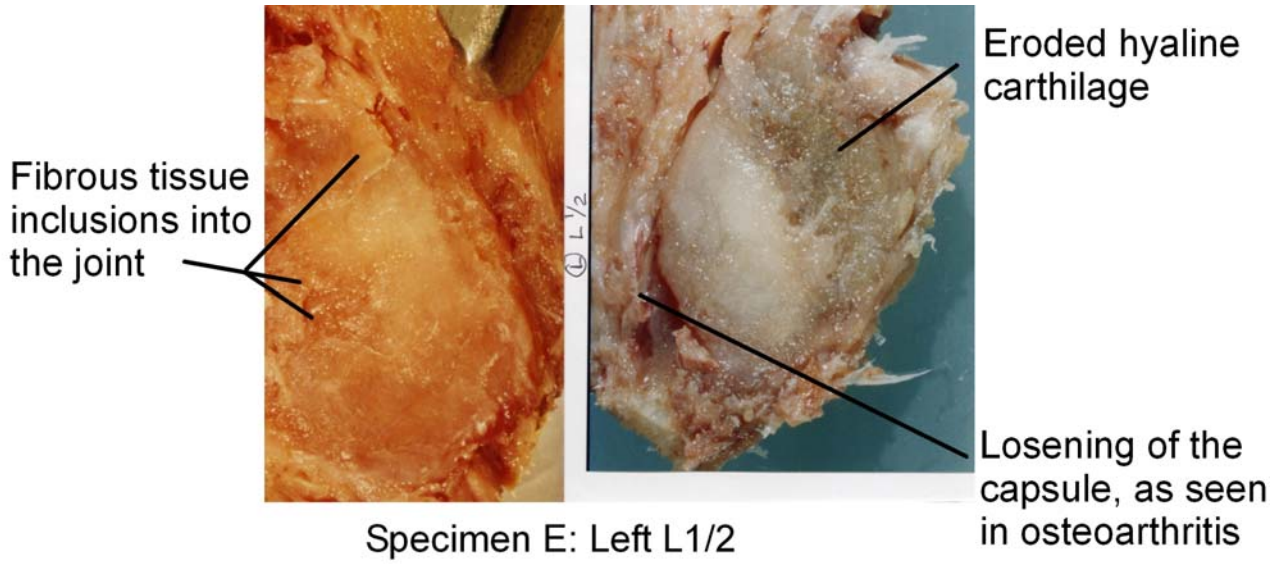


Figure 4.62: Pathological joint with destruction on both sides of the joint surface

Specimen: E

Articulation level: Lumbar L 1/2

Facet: Left

Destruction of more than half of the hyaline cartilage, peripheral exostosis and loosening of the capsule. Gross fibrous infiltrations into the joint of loose bodies are noted.

Table 4.52: Summary of joint rating scale and surface degeneration of an erosive changed facet joint

Rating Scale	**Value**
Joint Rating Scale	2, 7
Surface Degeneration	(X X X X X)

4.4.6 Pathological destruction of the joint surface

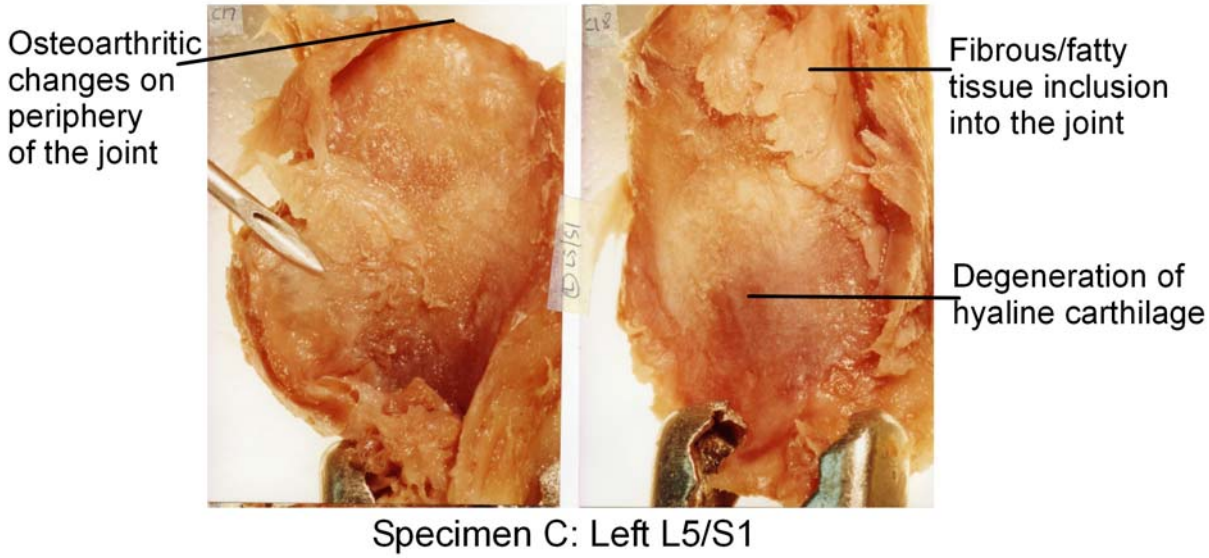


Figure 4.63: Pathological destruction of the joint surface

Specimen: C

Articulation level: Lumbar L5 / S1

Facet: Left

The needle pointer shows fibrous invasion and adherence to the joint surface. Destruction of the joint surface. Peripheral exostosis with loosening of the capsule and pannus invasion

Table 4.53: Summary of joint rating scale and surface degeneration of a fibrous tissue invading into a facet joint

Rating Scale	**Value**
Joint Rating Scale	2, 5, 6, 8
Surface Degeneration	(X X X X X)

4.4.7 Early degenerative changes on the joint surface

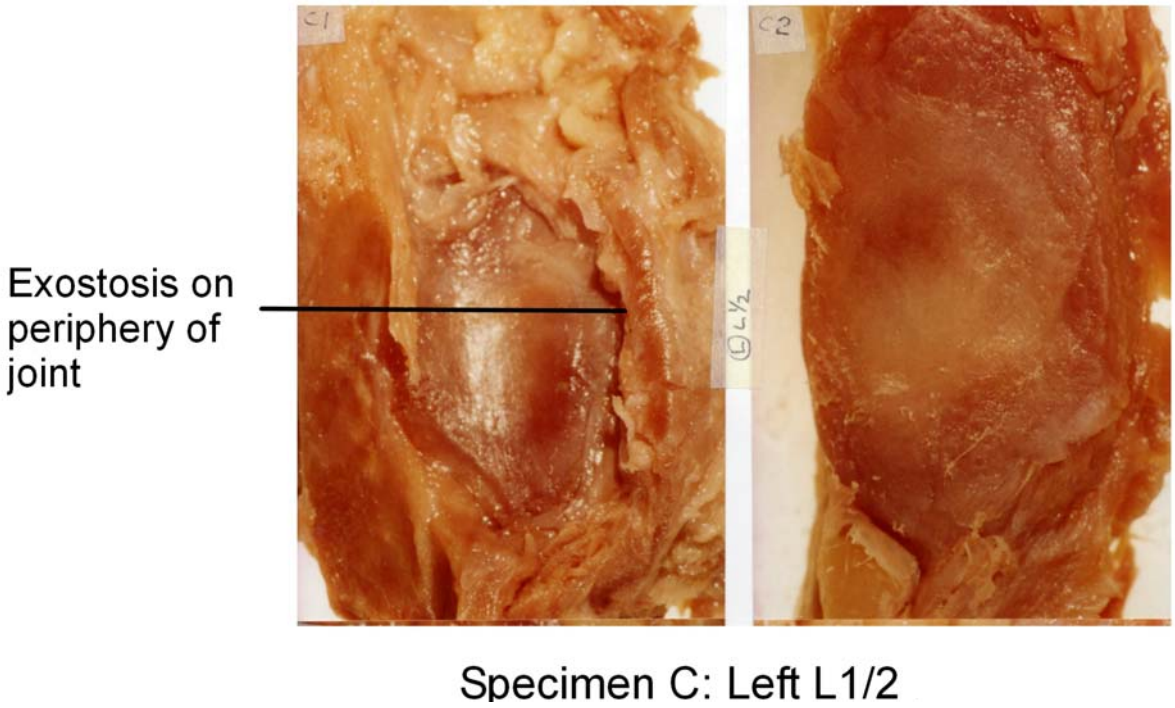


Figure 4.64: Early degenerative changes on the joint surface

Specimen: C

Articulation level: Lumbar L 1/2

Facet: Left

Gross peripheral degenerative changes with loosening of the capsule. The joint surface is showing degenerative change with erosions into the underlying bone

Table 4.54: Summary of joint rating scale and surface degeneration of a peripheral osteoarthritic joint

Rating Scale	**Value**
Joint Rating Scale	2
Surface Degeneration	X

4.4.8 Unilateral degeneration of a facet joint

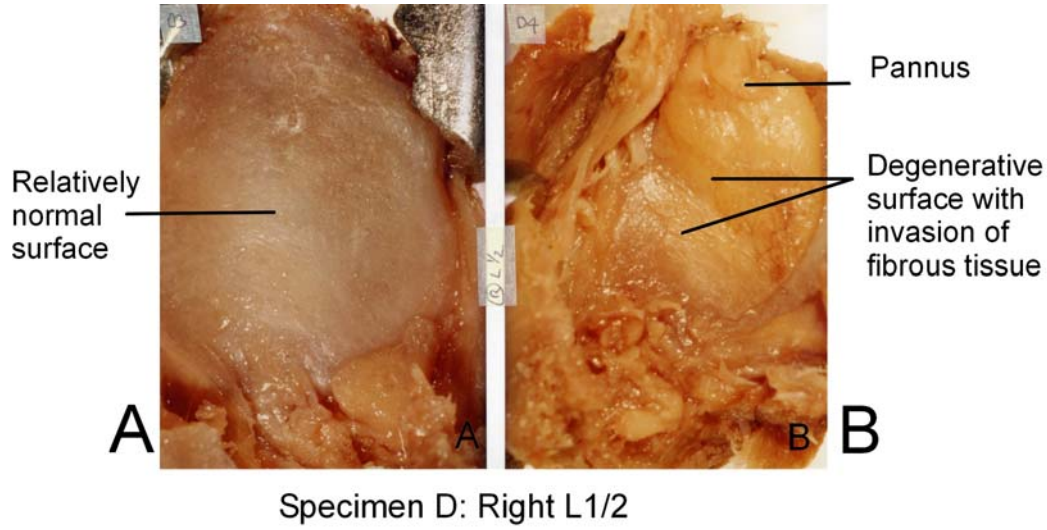


Figure 4.65: Unilateral degeneration of a facet joint of specimen B on the right

Specimen: D Articulation level: Lumbar L 1/2

Facet: Right

Early degenerative changes to the joint surface with small pannus of the facet surface on the left (A). The juxta opposing facet shows erosion of the surface with more than 50% fibrous invasion into the joint

This phenomenon was observed in the study where one side of the facet joint surface shows degenerative change whilst the opposite surface appears relatively normal. Compare A and B of the same joint.

Table 4.55: Summary of joint rating scale and surface degeneration of a unilateral degeneration of a facet joint

A

Rating Scale	Value
Joint Rating Scale	1, 2
Surface Degeneration	(X)

B

Rating Scale	Value
Joint Rating Scale	5, 8, 9c
Surface Degeneration	(X X X X)

4.4.9 Pathological joint destruction with loose fibrous inclusion or degenerative pannus

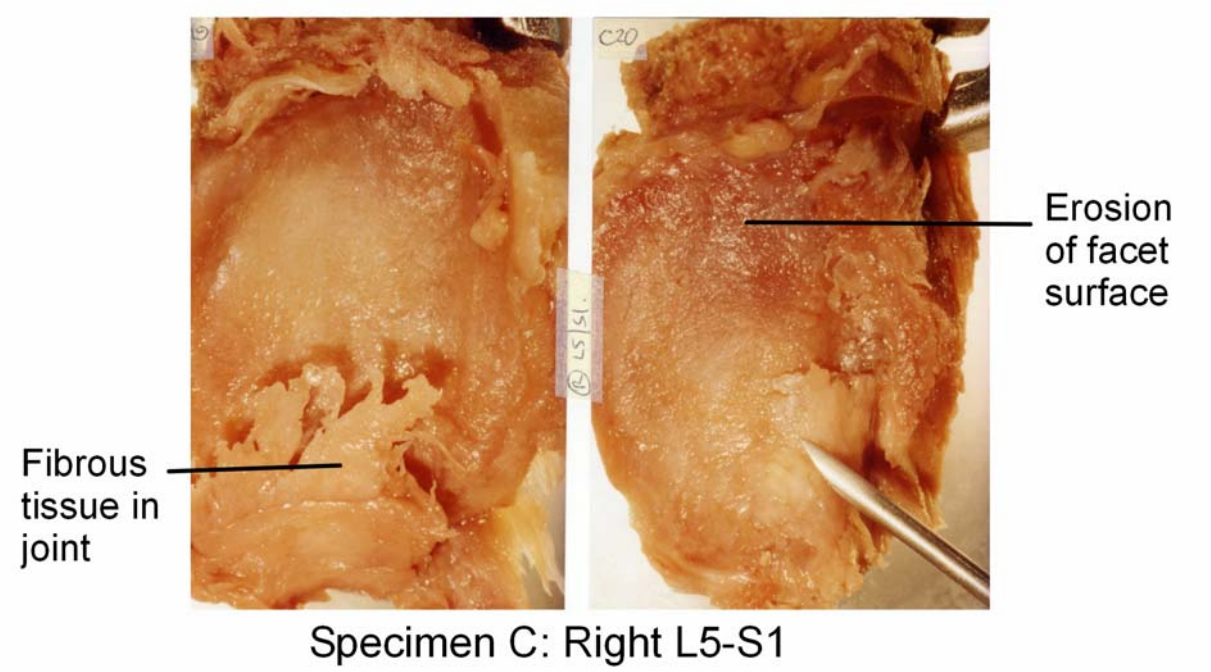


Figure 4.66: Pathological joint destruction with loose fibrous inclusion or degenerative pannus

Specimen: C
Articulation level: Lumbar L5 / S1
Facet: Right

Erosion of the hyaline cartilage, peripheral erosion of the joint with exostosis and capsular loosening. The needle indicates a large loose fibrous invasion of degenerative or fibrosed pannus.

Table 4.56: Summary of joint rating scale and surface degeneration of a bilateral degenerated facet joint

Rating Scale	Value
Joint Rating Scale	2, 4, 6, 8
Surface Degeneration	(X X X X)

4.4.10 Gross pathological destruction of the joint

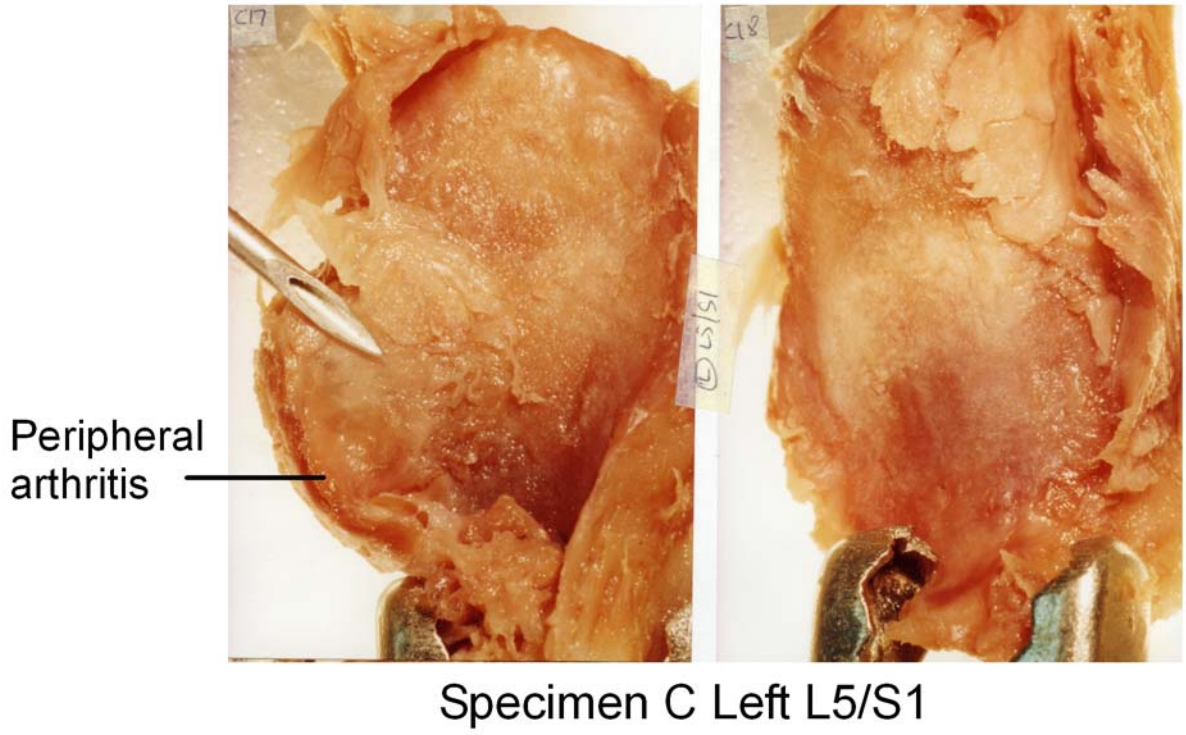


Figure 4.67: Gross pathological destruction of both sides of the joint

Specimen: C

Articulation level: Lumbar L 5/ S1

Facet: Left

Gross destruction of the entire joint. The degree of function in this joint is questionable.

Table 4.57: Summary of joint rating scale and surface degeneration of a extensively degenerated facet joint

Rating Scale	**Value**
Joint Rating Scale	2, 5, 6, 8
Surface Degeneration	(X X X X X)

4.4.11 Gross pathological destruction of the one facet, with 50% degeneration of the juxta- opposing facet joint

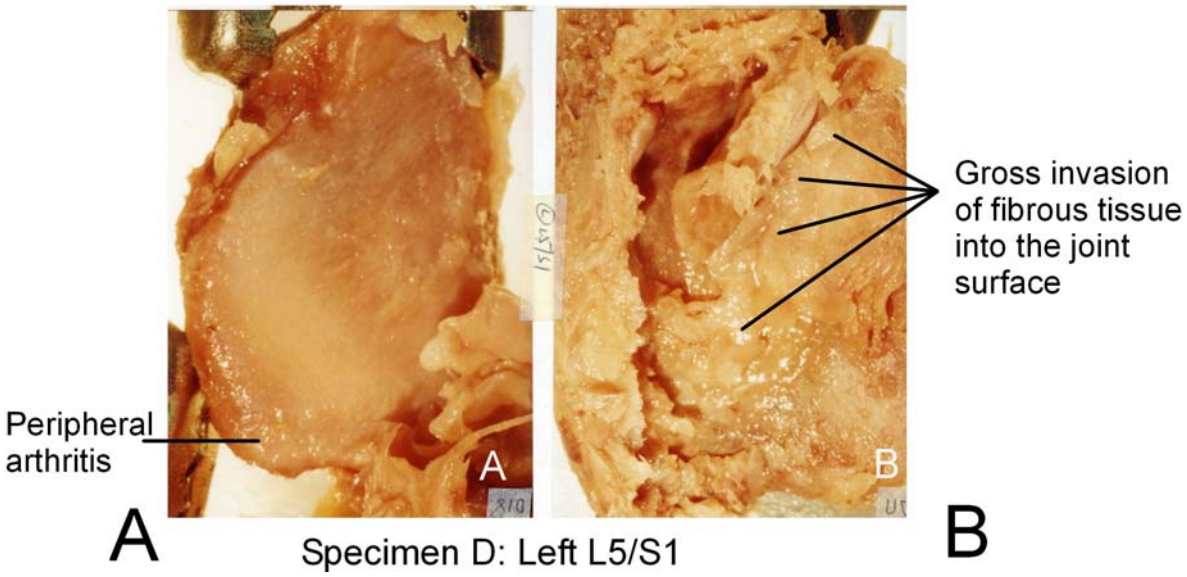


Figure 4.68: Grossly degenerative facet joint:

Specimen: D

Articulation level: Lumbar L5 /S1

Facet: Left

Gross destruction of the one surface (B), with loss of definition in structure and severe capsular erosion. The juxta opposing facet surface shows 50 % erosion of the hyaline cartilage.

Table 4.58: Summary of joint rating scale and surface degeneration of a grossly degenerated facet joint

A

Rating Scale	Value
Joint Rating Scale	2, 5, 8
Surface Degeneration	(X X X X)

B

Rating Scale	Value
Joint Rating Scale	2, 4, 6, 7
Surface Degeneration	(X X X X X)

Table 4.59: Summary of findings of the joint rating scale

	LEFT FACET		RIGHT FACET	
LEVEL	**A**	**B**	**A**	**B**
A- L1/2	1	1	1	1
A 2/3	2,3	1	1	1,2
A 3/4	1	1	1,2	1
A 4/5	1,2	1,2	1	2,3
A 5/S1	1,2	1,2	1	1
B 1/2	2,7,9b	5	1	2
B 2/3	1,2	1	2,3	2
B 3/4	1,2,7	1,2	1,2	1,2
B 4/5	1,2,9b	2	2,3,9b	2
B 5/S1	2	2	2,3	2,3
C 1/2	2	2	2	2,5
C 2/3	2	9a	2,3	1,2
C 3/4	2,7	2,3	2,3	3,7
C 4/5	5,6,8	2,5	2,4	2,4
C 5/S1	5,6,8	5,6,8	4,6,8	4,6,8
D 1/2	1,2	1,2,9a	2	5,8,9c
D 2/3	1,2	1,2	2	2
D 3/4	2,3,9a	2,3,7,9b	5,6,8	3,6,8
D 4/5	2,4	2,4,8	3,9a	2,4
D 5/S1	2,5,8	2,4,7	2,3,7	2,4,7
E 1/2	2,5,7	2,5	2,3	2,3,9a
E 2/3	2,3	2,4,7	2,3	2,3
E 3/4	2,4	2,4	2,3,9a	2,5,7
E 4/5	2,5,7	2,5,7	2,4	2,5,8
E 5/S1	2,5,6,7	2,5,6,7	2,4,7	4,5,7

Table 4.60: Summary of findings of the extent of surface degeneration

	LEFT FACET		RIGHT FACET		JOINT RATING	
LEVEL	**A**	**B**	**A**	**B**	**A**	**B**
A- L1/2	X	X	X	X	1	1
A 2/3	X	X X X	-X	X X	2	1
A 3/4	X	X	X X	X	2	1
A 4/5	X X	X	X X	X	2	3
A 5/S1	X X	X	X	X	2	1
B 1/2	X	X X X X X	X	X	3	2
B 2/3	X	X	X X X	X	1	2
B 3/4	X	X	X	X	1	1
B 4/5	X	X	X X X	X X	2	3
B 5/S1	X	X	X X X	X X X	2	4
C 1/2	X	X	X	X X X X X	3	5
C 2/3	X	X	X X X	X	2	4
C 3/4	X X	X X X	X X X	X X X	6	5
C 4/5	X X X X X	X X X X X	X X X X	X X X X		
C 5/S1	X X X X X	X X X X X	X X X X	X X X X		
D 1/2	X	X	X	X X X X		
D 2/3	X	X	X X	X X		
D 3/4	X X X	X X X	X X X X X	X X X		
D 4/5	X X X X	X X X X	X X X	X X X X		
D 5/S1	X X X X X	X X X X	X X	X X X X		
E 1/2	X X X X X	X X X X X	X X X	X X X		
E 2/3	X X X	X X X X	X X X	X X X		
E 3/4	X X X X	X X X X	X X	X X X X X		
E 4/5	X X X X X	X X X X X	X X X X	X X X X X		
E 5/S1	X X X X X	X X X X X	X X X X	X X X X		

The possibility of microscopic examination of the quality of the hyaline cartilage of the surface area was thoroughly discussed, but due to the thin material, undulating surface and volume of study, this project was abandoned as not being feasible or of added value.

This concluded the examination of the articulating facet joint surface examination.

Summary:
Foregoing findings in Figure 4.31-45 illustrates a variety of disc specimens observed in the study of the dissections. It was interesting to note the invasion of anular material into the nucleus pulposus and total fibrous changes illustrating discal anomalies. It is not without doubt that the condition of the disc must have an effect on the function of the vertebral unit. It is however difficult to comprehend why the disc would transform in the light of full range of movement. This has not been shown in the literature.

This concludes the extent to which microscopic slide studies could be made of the specimens studied. The correlation to facet and macroscopic disc evaluation is very enlightening in supporting the hypothesis. The following is a table summarising the findings on facet, disc, x-ray and micro studies. This will be discussed in more detail in the summary of findings.

4.5 Correlation of findings

Table 4.61: Summary of the correlation of findings of all specimen

Disc level	Anular impression	Facet degeneration		Pannus	Micro	X-ray of dye migration in nucleus pulposus					Comment
		Left	Right			Central Posterior		Axial			
A						**C**	**P**	**Left**	**Centre**	**Right**	
L1/2	None	-	-			X			X		
L2/3	L, post	3X	-	R		X		XL	X		
L3/4	None	-	-			X			X	XP	
L4/5	None	-	X			X			X		
L5/S1	L, post R. post	X	-			X	X	XP	X		
B											
L1/2	L & R	2X	-	L		X	X	XP	XP	XP	
L2/3	L	-	2X		R – Sup R - Inf	X	X	XPL	XL	XP	Posterior thinning of anulus
L3/4	L	-	-	L		X			X		
L4/5	L & R	X	2X	L		X	X	XP			Disc anomaly
L5/S1		X	2X				X	X	XP	X	Disc anomaly
C											
L1/2	R	X	4X			X			X		Thinning of anulus – right
L2/3	R	X	2X	L		X	X	XL	X	XL	
L3/4	L	3X	2X			X		XL			Fibrous tissue invasion of NP
L4/5	L	5X	2X		L	X	X	XPL	X		Fibrous tissue invasion of NP & rupture in annular rings, left.
L5/S1	L & R	5X	4X			X		XPL	X	XPL	Fibrous tissue invasion of anulus fibrosus

Disc level	Anular impression	Facet degeneration		Pannus	Micro	X-ray of dye migration in nucleus pulposus					Comment
		Left	Right			Central Posterior		Axial			
D						**C**	**P**				
L1/2	None	-	X	L & R		X			X		
L2/3	None	X	2X			X	X	XP	X		
L3/4	R	X	3X	L		X			X	XP	
L4/5	None	2X	2X	L & R		X			X		
L5/S1	R	5X	4X		R	X	X		X	XPL	Rupture in anulus fibrosus on micro
E											
L1/2	L & R	5X	2X	R		X		XL	X	XLP	
L2/3	None	3X	2X	L			XP	XLP			Disc anomaly
L3/4	R	2X	3X	R		X			XP		Disc anomaly
L4/5	L	5X	4X			X	X		XP		
L5/S1	L	5X	3X			X	X		X		