Original Research

Prevalence of Abnormal Findings Associated with Components of Vertebral Subluxation in 737 Patients Referred for MRI Examination & Potential Neurological Consequences

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Abstract

Objective: This study sought to determine the prevalence of abnormal MRI findings associated with components of vertebral subluxation in a cohort of 737 patients.

Methods: This was a retrospective, cross sectional MRI imaging study. This anonymized retrospective study was determined to be exempt by the Institutional Review Board of the Foundation for Vertebral Subluxation. MRI reports on 737 consecutive cases referred by Doctors of Chiropractic were obtained from a private, free standing imaging center. MRI reports of patients referred by chiropractors who attended the imaging center in a three and one half year period were assessed for spinal pathologies. Six hundred ninety-seven spinal MRI reports and 40 extremity reports were obtained. The spinal MRI reports consisted of 325 cervical, 11 thoracic, and 361 lumbar reports. Extremity MRIs included 27 knee and 13 shoulder MRIs. The images were obtained using a low field strength (0.064T), open MRI (Toshiba Access®). All MRIs included sagittal and transaxial T1-weighted and T2-weighted sequences.

Results: Three hundred twenty-five MR studies of the cervical spine were reviewed with 91% presenting spinal abnormalities, while 28 of 325 had no abnormalities noted. These abnormalities consisted of components of vertebral subluxation including: 35% had disc degeneration, 17% exhibiting osteophytosis, 6% posterior ridging, and 1% arthrosis of Joints of Luschka. Two hundred twenty-five disc lesions were present with many reports indicating multiple lesions at different segments. Three hundred sixty-one MR lumbar spine reports were reviewed with 89% presenting with spinal abnormalities including components of vertebral subluxation, while 39 of 361 had no abnormalities noted. Two hundred fifty-one (70%) of 361 had disc degeneration. Two hundred twenty four disc lesions were identified along with 24 showing canal stenosis. There were 11 thoracic spine studies, and 40 extremity studies.

Conclusion: Degenerative and other changes in the spine may be associated with vertebral subluxations. Vertebral subluxations are changes in the position or motion of a vertebra, which result in the interference of nerve function. Possible neurobiological mechanisms associated with vertebral subluxations include compression, stretch, dysafferentation, dyskinesia, dysponesis, dysautonomia, neuroplasticity and ephaptic transmission.

Key Words: *Magnetic Resonance Imaging, cervical spine, thoracic spine, lumbar spine, vertebral subluxation, chiropractic*

Introduction

Doctors of Chiropractic are responsible for determining the safety and appropriateness of chiropractic care. This responsibility includes the detection and characterization of vertebral subluxations, congenital and developmental

anomalies which may affect the selection of chiropractic techniques, and conditions which may contraindicate certain chiropractic adjusting procedures. Magnetic Resonance Imaging (MRI) represents a useful tool to assist the chiropractor in making such determinations. Furthermore, MRI may disclose conditions requiring referral to another type of health care provider.[1]

Previous studies have studied the prevalence of MRI findings in different cohorts. Romeo et al[2] examined 350 asymptomatic young adults (18-22 years), and reported a high rate of MRI imaging findings, similar to that of the adult population. Seventy-seven percent of the 350 subjects (n=270) presented spinal MRI findings, including disc lesions and spondylosis. The entire spine of each subject was imaged.

deSchepper et al[3] studied the prevalence of spinal pathology in patients presenting for lumbar MRI as referred from general practice. Six hundred eighty-three low back pain patients were included, with a mean age of 49.9 (range 19-80 years). The authors reported that in total, 94% of patients had abnormal MRI findings. Serious pathologies were reported in 3% of patients, while 69% of the reports mentioned signs of nerve root compression.

In a cross-sectional study of 1211 asymptomatic subjects (age 20-70 years) utilizing MRI of the cervical spine, Nakashima et al[4] reported that disc bulging was observed in 87.6% of subjects. Frequency, severity, and number of levels increased with age. Furthermore, most subjects in their 20s (73.3% of males and 78.0% of females) had disc bulging. Only 5.3% of asymptomatic subjects were diagnosed with spinal canal compression (SCC). Increased signal intensity was reported in 2.3%. The authors noted that these numbers increased with age, particularly after age 50 years.

In examining the MRI images of 67 individuals with no history of low-back pain, sciatica, or neurogenic claudication, Boden et al[5] reported that degeneration or bulging of a disc was observed at at least one lumbar level in 35% of the subjects between 20 and 39 years of age. In the 60–81-year subjects, all but one of the subjects demonstrated these findings.

In a review of 611 narrative reports of cervical spine MRI examinations, Jensen et al[6] noted that the most prevalent MRI findings were foraminal stenosis (77%), uncovertebral arthrosis (74%) and disc degeneration (67%) while the least prevalent findings were nerve root compromise (2%) and Modic changes type 2 (6%). The cohort consisted of patients aged 19-87 years (mean age 52 years) and 63% were women. All subjects were patients with neck pain seen in a public hospital department and had been referred to from the primary care chiropractors and general practitioners for a multidisciplinary evaluation.

This study sought to determine the prevalence of abnormal MRI findings in a cohort of patients referred for examination by Doctors of Chiropractic.

Materials and Methods

Study design

This study was a retrospective, cross sectional MRI imaging study.

Sample

This anonymized retrospective study was determined to be exempt by the Institutional Review Board of the Foundation for Vertebral Subluxation. MRI reports on 737 consecutive cases referred by Doctors of Chiropractic were obtained from a private, free standing imaging center. All MRI narrative reports used in this study were de-identified. Narrative reports were generated by a chiropractor specialized in chiropractic diagnostic imaging. The reports did not provide information concerning the age or gender of the patients.

Weaknesses

Due to de-identification of the narrative reports, gender was not obtained for each subject. In addition, the original narrative reports did not include the subject's birth date making it impossible to calculate and report age. No history or diagnosis was available.

Data Collection

MRI reports of patients referred by chiropractors who attended the imaging center in a three and one half year period were assessed for spinal pathologies. Six hundred ninety-seven spinal MRI reports and 40 extremity reports were obtained. The spinal MRI reports consisted of 325 cervical, 11 thoracic, and 361 lumbar reports. Extremity MRIs included 27 knee and 13 shoulder MRIs. The images were obtained using a low field strength (0.064T), open MRI (Toshiba Access®). All MRIs included sagittal and transaxial T1-weighted and T2-weighted sequences.

Image Acquisition--Sequences

Cervical: Sagittal images were produced at a TE of 40 msec, a TR of 1200 msec, and a flip angle of 35 degrees. Sagittal and transaxial images were also produced with a TE of 24 msec, a TR of 68 msec, and a flip angle of 60 degrees.

Thoracic: Sagittal and coronal images were acquired using a TE of 24 milliseconds, a TR of 68 milliseconds, and a flip angle of 60 degrees. Sagittal images were also produced using a TR of 1200 milliseconds, a TE of 40 milliseconds, and a flip angle of 35 degrees.

Lumbar: Sagittal and transaxial images were acquired using a TE of 24 milliseconds, a TR of 68 milliseconds, and a flip angle of 60 degrees. Sagittal images were also produced using a TR of 1200 milliseconds, a TE of 40 milliseconds, and a flip angle of 45 degrees.

Knee: Sagittal and coronal images were acquired using a TE of 24 milliseconds, a TR of 68 milliseconds, and a flip angle of 60 degrees. Sagittal and coronal images were also produced using a TE of 105 milliseconds and a TR of 2000 milliseconds.

Shoulder: Sagittal, axial and coronal images were acquired using a TE of 24 milliseconds, a TR of 68 milliseconds, and a

flip angle of 60 degrees. Coronal images were also produced using a TR of 2000 milliseconds and a TE of 105 milliseconds.

Evaluation

The MRI narrative data was compiled by region and type of finding. Spinal MRI findings across regions were chosen for this study as they were considered relevant to the research context of this study; abnormal spinal curvatures, disc degeneration, facet joint arthrosis, disc herniation, disc bulge, foraminal stenosis, central and borderline canal stenosis.

MRI findings in the knee were selected by the pathologies indicated in the reports and based on their relevance to the research context of this study; bone island, chondromalacia, chronic patellar tendinitis degenerative signal, joint effusion, lateral meniscus, lateral patellar subluxation, loose body, medial meniscus, patella alta, popliteal cyst, possible tear, OA changes, strain, thinning of ACL, and thinning of patellar cartilage.

MRI findings in the shoulder were selected by the pathologies indicated in the reports and based on their relevance to the research context of this study, degenerative changes in the acromioclavicular joint, down sloping, effusion, fluid, hypertrophic change, impingement, tear, and tendinopathy.

Results

Cervical Data

Three hundred and twenty-five MR reports were reviewed for spinal abnormalities. Two hundred ninety-seven of 325 reports (91%) presented spinal abnormalities, while 28 of 325 had no abnormalities noted. One hundred seventy-four reports indicated alterations of spinal curvatures. Spinal curvature data must be interpreted with caution as these MRI studies were performed with the patient lying supine and reference data on spinal alignment is generally derived from upright radiographs. Prevalence of abnormal spinal curvatures per region and in total can be found in **Table 1.**

One hundred thirteen (35%) of 325 had disc degeneration with 54 MRIs (17%) exhibiting osteophytosis, 21 (6%) posterior ridging, and 2 (1%) arthrosis of Joints of Luschka. Degenerative findings in the cervical reports are detailed in **Table 2**. Degenerative disc disease was indicated at spinal segments from C2 through C7, with the highest prevalence at C5/C6 (n=87), C4/C5 (n=69), and C6/C7 (n=65). Prevalence of degenerative findings are summarized in **Table 3.**

Two hundred twenty-five disc lesions were present with many reports indicating multiple lesions at different segments. One hundred one of 325 reports (31%) indicated disc bulges, 15 of 325 (5%) were specifically central disc bulges. Sixty-one (19%) indicated central herniations, 44 (14%) paracentral herniations, and 4 (1%) disc herniations were found without directionality indicated. Cervical disc lesions are described in **Table 4**. Prevalence of disc findings are summarized in **Table 5.**

Thoracic Data

Eleven MR reports were reviewed for spinal abnormalities. Dextroscoliosis was present in two cases and kyphosis was present in one case. Anterior vertebral body wedging, central herniations, and degenerative changes were present in eighteen percent of the reports. One disc bulge was indicated. Thoracic MRI findings are detailed in **Table 6**. Prevalence of abnormal spinal curvatures per region and in total are described in **Table 1.**

Lumbar Data

Three hundred and sixty-one MR reports were reviewed for spinal abnormalities. Three hundred twenty-two of 361 reports (89%) presented spinal abnormalities, while 39 of 361 had no abnormalities noted. Sixty reports indicated alterations of spinal curvatures with the most reported finding (6%) being straightening of the lumbar curve. Spinal curvature data must be interpreted with caution as these MRI studies were performed with the patient lying supine and reference data on spinal alignment is generally derived from upright radiographs. Prevalence of abnormal spinal curvatures per region and in total can be found in **Table 1.**

Two hundred fifty-one (70%) of 361 had disc degeneration with 39 MRIs (11%) exhibiting facet joint arthrosis and 14 (4%) osteophytosis. Degenerative findings in the lumbar reports are detailed in **Table 7**. Degenerative disc disease was indicated at spinal segments from T12 through L5 with the highest prevalence at L5/S1 (n=167), L4/L5 (n=123), and L3/L4 (n=49). Prevalence of degenerative findings are summarized in **Table 8.**

Two hundred eighty-one disc lesions were present with many reports indicating multiple lesions at different segments. One hundred forty six of 361 reports (40%) indicated disc bulges, 10 (3%) anterior disc protrusion, 58 (16%) central herniation, 13 (4%) lateral disc bulge, 11 (3%) lateral herniation, 44 (12%) paracentral herniation and 24 (7%) indicated borderline canal stenosis. Lumbar disc lesions and segmental distribution data are described in **Table 9.**

Extremity Data

MR reports were provided for multiple extremities with the highest number of reports provided for shoulder and knee examinations. Twenty-seven MR reports were reviewed for knee pathologies and/or degeneration. Joint effusion was the most prevalent abnormality present in 18 (67%) reports followed by 4 (14%) degenerative signal, 4 (14%) medial meniscus, 4 (14%) possible tear, and 3 (11%) osteoarthritic (OA) changes.

Other pathologies indicated included bone island, chondromalacia, chronic patellar tendinitis, lateral meniscus, lateral patellar subluxation, loose bodies, patella alta, popliteal cyst, strain, thinning of the ACL, and thinning of the patellar cartilage. Prevalence of pathological and/or degenerative changes in knee MRI findings are described in **Table 10.**

Thirteen MR reports were reviewed for shoulder pathologies and/or degeneration. Nine of 13 reports (69%) indicated

degenerative changes in the acromioclavicular joint, 3 of 13 (23%) effusion, 2 (15%) impingement and 2 (15%) tearing. Other pathologies indicated included down sloping, fluid, hypertrophic change, and tendinopathy. Prevalence of pathological and/or degenerative changes in shoulder MRI findings are described in **Table 11.**

Discussion

Degenerative changes and symptoms

The high prevalence of abnormal spinal MRI findings in asymptomatic subjects has caused some to question the clinical significance of degenerative bone and disc lesions. Borenstein et al[7] reported that of 67 asymptomatic subjects with no history of low back pain, 31% (n=21) had an identifiable abnormality of a disc or the spinal canal. Seven years later, 50 of the 67 returned a questionnaire reporting that 58% (n=29) had no back pain. The original scans demonstrated normal findings in 12. The authors concluded that "The findings on magnetic resonance scans were not predictive of the development or duration of low-back pain. Individuals with the longest duration of low-back pain did not have the greatest degree of anatomical abnormality on the original scans."

In performing MRI examinations on 98 asymptomatic subjects, Jensen et al[8] reported that 36% had normal discs at all levels, while 52% of the subjects had a bulge at at least one level, 27% had a protrusion, and 1% had an extrusion. The authors concluded, "On MRI examination of the lumbar spine, many people without back pain have disk bulges or protrusions but not extrusions. Given the high prevalence of these findings and of back pain, the discovery by MRI of bulges or protrusions in people with low back pain may frequently be coincidental."

Brinjikji et al[9] compared the prevalence of MR imaging features of lumbar spine degeneration in adults 50 years of age and younger with and without self-reported low back pain. They wrote, "Meta-analysis demonstrates that MR imaging evidence of disc bulge, degeneration, extrusion, protrusion, Modic 1 changes, and spondylolysis are more prevalent in adults 50 years of age or younger with back pain compared with asymptomatic individuals." While such findings may be more prevalent in pain patients than asymptomatic subjects, clinical correlation is needed.

In a review of MRI for low back pain, Sheehan[10] stated, "Follow-up studies of asymptomatic subjects have shown no, or only weak, correlation between either baseline structural abnormalities or progressive lumbar disc degeneration visualized on MRI and the development of LBP (low back pain)."

The clinical relationship of degenerative changes between the cervical and lumbar spine was the objective of a retrospective observational, case series of 152 patients with symptoms related to cervical and lumbar spondylosis. Morishata et al[11] concluded, "Our study shows that participants with degenerative changes in the upper lumbar segments are more likely to have a certain amount of cervical spondylosis. This information could be used to lower the incidence of a missed diagnosis of cervical spine disorders in patients presenting with lumbar spine symptomology."

Chepurin, et al[12] published a retrospective, case-control study of 130 patients under 25 years of age. Fifty-five consecutive patients with bony stress were compared to a control group of 75 consecutive patients. The authors reported that bony stress in the lumbar spine was prevalent in 11% of patients under 25 years of age. It was commonly undiagnosed in radiology reports. They concluded, "Patients with bony stress had over twofold (OR 2.3, 95% CI [1.1–4.8]) and fivefold (OR 5.3, 95% CI [2.11–13.3]) higher likelihood of having IVD degeneration and LBP, respectively, when compared with the control group."

MRI examinations with follow-up have been reported in elite athletes. Baranto et al[13] examined a total of 71 male athletes, including weightlifters, wrestlers, orienteers, and ice-hockey players. Twenty-one non-athletes were used as controls. The findings were "Disc degeneration was found in more than 90% of the athletes and deterioration had occurred in 88% of the athletes, with the highest frequency in weightlifters and ice-hockey players. 78% of the athletes and 38% of the non-athletes reported previous or present history of back pain at baseline and 71% and 75%, respectively at follow-up. There was no statistically significant correlation between back pain and MRI changes."

Baranto et al[14] selected 20 elite divers between 10 and 21 years of age for a five-year longitudinal study of the thoraco-lumbar spine. They reported, "Sixty-five percent of the divers had MRI abnormalities in the thoraco-lumbar spine already at baseline. Only one diver without abnormalities at baseline had developed abnormalities at follow-up. Deterioration of any type of abnormality was found in 9 of 17 (53%) divers. Including all disc levels in all divers, the total number of abnormalities increased by 29% at follow-up, as compared to baseline."

Alteration of curves

X-ray methods are typically used for measuring cervical sagittal parameters. Lee et al[15] compared the reliability of x-ray, CT, and MRI in evaluating C2-C7 distance, C2-C7 Cobb angle, T1 slope, thoracic inlet angle, and neck tilt. Fifty sets of three examinations were measured by three experienced spine surgeons. The authors found that all three imaging modalities had excellent interobserver and intraobserver reliability (.770-.999). Correlation was highest between CT and MRI. Jackson et al[16] reported intra- and inter- examiner reliability measurements greater than .70, and as high as .99 when performing measurements on lateral cervical radiographs.

Liu et al[17] examined 143 adults with cervical disc herniation. Each patient had both an x-ray and MRI examination. Cervical sagittal parameters were measured and compared on x-ray and MRI including: C2-C7 Cobb angle, C2-C7 sagittal vertical axis (C2-C7 SVA), cervical tilt (CT), T1 Slope (T1S), and neck tilt (NT). The authors wrote, "[B]ecause MRI examination of patients is performed in a supine position while x-ray examination takes place in the upright position, the effect of this change in body position and center of gravity is bound to have a nonnegligible impact on the final

measurement results…Although MRI and x-ray measurements of cervical sagittal parameters were different, there were significant correlations between the results. MRI could be used to evaluate the sagittal balance of the cervical spine with great reliability."

Forward head posture (FHP) and decreased cervical spine lordosis may be clinically significant regardless of the presence or absence of symptoms. In a randomized, controlled study of 72 patients, Moustafa et al[18] reported that normalizing the cervical sagittal had a favorable effect on dizziness, neck pain, and cervicocephalic kinesthetic sensibility. Tully[19] conducted a review to identify potential pathological conditions associated with forward head posture and decreased cervical lordosis. The paper noted that "Forward head posture and a decreased cervical curve affect the biomechanics of the spine. This can accelerate cervical spine degeneration, contribute to cervical myelopathy, affect proprioception, and contribute to neurodegenerative diseases."

Gao et al[20] studied 300 patients aged 16-40 years with neck pain. All patients underwent x-ray and MRI examination. The authors concluded, "The degree of disc herniation and cervical spinal cord compression are inversely correlated to cervical lordosis in young neck pain patients, and the degree of disc herniation and height of disc space can recover with the recovery of cervical lordotic curvature. These findings may indicate [sic] a link between cervical curvature and degenerative changes which have important clinical implications."

Autonomic nervous system function and cervical sensorimotor control may be affected by forward head posture. Moustafa et al[21] assessed skin sympathetic response (SSR) and left and right repositioning accuracy in 80 subjects with a craniovertebral angle less than 50 degrees, and 80 age, gender, and BMI matched subjects with normal head alignment. The craniovertebral angle significantly correlated with all measured variables (P less than 0.001). The authors concluded, "Participants with FHP exhibited abnormal sensorimotor control and autonomic nervous system dysfunction compared to those with normal head alignment."

Katz et al[22] reported an increase in cerebral blood flow indicated by increased cerebral arterial area and pixel intensity on brain magnetic resonance angiograms following correction of cervical lordosis. The authors conducted a retrospective consecutive case series of seven patients, aged 28-58 years. It was concluded that "[C]orrection of cervical lordosis may be associated with an immediate increase in cerebral blood flow."

Vertebral subluxations

Vertebral subluxations are changes in the position or motion of a vertebra, which result in the interference with nerve function.[23] As Lantz[24] noted, "Common to all concepts of subluxation are some form of kinesiologic dysfunction and some form of neurologic involvement." According to Stephenson's 1927 definition,[25] vertebral subluxation is: "the condition of a vertebra that has lost its proper juxtaposition with the one above the one below, or both; to an extent less than a luxation; which impinges nerves and interferes with the transmission of mental impulses."

In addition to the mechanisms described above, the first author (CK) has described other mechanisms potentially associated with vertebral subluxations. These include dysafferentation, dyskinesia, dysponesis, dysautonomia, ephaptic transmission, nerve compression, and nerve stretch.[23, 26]

Conclusion

There was a high prevalence of abnormalities disclosed by MRI in this cohort. MRI is a useful tool in chiropractic practice for determining the safety and appropriateness of chiropractic care. This responsibility includes the detection and characterization of vertebral subluxations, congenital and developmental anomalies which may affect the selection of chiropractic techniques, and conditions which may contraindicate certain chiropractic adjusting procedures. Clinically significant abnormalities may exist regardless of the presence or absence of pain.

Competing interests

None.

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Table 1 Prevalence of abnormal spinal curvatures in MRI findings per region and in total (n = 697)

Curvatures	Cervical	Thoracic	Lumbar	Percentage of study total
Exaggerated	3	--	17	3%
Straightening	137	--	22	23%
Reversal	27	--	--	4%
Kyphosis	--	1	--	--
Dextroscoliosis	5	2	4	2%
Levoscoliosis	2	--	16	3%
Scoliosis	--	--	1	--

Cervical Tables

Table 2 Degenerative Cervical MRI findings from 325 narrative reports and totals (n = 325)

MRI finding	Total	% of total
Disc degeneration	113	35%
Non-specified DDD	15	5%
Arthrosis of Luschka joints	2	1%
Osteophytes	54	17%
Posterior ridging	21	6%

Table 3 Prevalence of degenerative changes in cervical MRI findings per segment and in total (n = 325)

MRI finding	C2/C3	C3/C4	C4/C5	C5/C6	C6/C7	C7/Th1	No. of patients with pathology	Percentage of total
DDD	5	28	69	87	65	26	113	35%
Osteophytes	3	8	26	41	33	10	54	17%
Posterior Ridging	0	5	10	14	13	7	21	6%

Posterior ridging is accounted for in the disc degeneration total and patients may have had multiple segmental levels of degenerative findings and are only accounted for once in total.

Table 4 Cervical disc lesion MRI findings from narrative reports and totals (n = 325)

MRI finding	Total	% of total
Central disc bulge	15	5%
Central herniation	61	19%
Disc bulge	101	31%
Disc herniation	4	1%
Paracentral herniation	44	14%

Table 5 Prevalence of disc lesions in cervical MRI findings per segment and in total (n = 325)

MRI finding	C2/C3	C3/C4	C4/C5	C5/C6	C6/C7	C7/Th1	No. of patients with pathology	Percentage of total
Central Disc Bulge	1	2	3	6	3		15	5%
Central Herniation	2	13	25	21	13		61	19%
Disc Bulge	2	26	42	55	28	2	101	31%
Paracentral Herniation		3	10	20	13	2	44	14%

Patients may have had multiple segmental levels of disc lesions and are only accounted for once in total.

Table 6 Thoracic MRI findings from 11 narrative reports

MRI finding	Total	% of total
Anterior vertebral body wedging	2	18%
Central herniation	2	18%
Disc bulge	1	9%
Degenerative changes	2	18%

Lumbar Tables

Table 7 Lumbar MRI findings from 361 narrative reports

MRI Findings	No. of patients with specified pathology	% Exhibiting specified pathology
Disc degeneration	251	70%
Facet joint arthrosis	39	11%
Osteophytes	14	4%
Anterior disc protrusion	10	3%
Central herniation	58	16%
Disc bulge	146	40%
Lateral disc bulge	13	4%
Lateral herniation	11	3%
Paracentral herniation	44	12%
Borderline Canal Stenosis	24	7%

Osteophytes accounted for in the disc degeneration total

Table 8 Prevalence of degenerative changes in lumbar MRI findings per segment and in total (n = 361)

MRI finding	T12/L1	L1/L2	L2/L3	L3/L4	L4/L5	L5/S1	No. of patients with pathology	Percentage of total
DDD	9	26	26	49	123	167	251	70%
Facet joint arthrosis				1	5	18	39	11%
Osteophytes		1	6	5	5	4	14	4%

Patients may have had multiple segmental levels of degenerative findings and are only accounted for once in total.

Table 9 Prevalence of disc lesions in lumbar MRI findings per segment and in total (n = 361)

MRI finding	T12/L1	L1/L2	L2/L3	L3/L4	L4/L5	L5/S1	No. of patients with pathology	Percentage of total
Anterior disc protrusion		1	5	5	2	1	10	3%
Disc Bulge	6	15	19	24	54	82	146	40%
Central herniation	1	4	4	7	32	16	58	16%
Lateral disc bulge			1	2	6	4	13	4%
Lateral herniation			1	1	6	3	11	3%
Paracentral herniation	2	4	5	3	16	19	44	12%

Extremity Tables

Table 10 Prevalence of pathological and/or degenerative changes in knee MRI findings (n = 27)

Knee Pathology	No. of patients with pathology	Percentage of total
Bone Island	2	7%
Chondromalacia	2	7%
Chronic patellar tendinitis	2	7%
Degenerative Signal	4	14%
Joint Effusion	18	67%
Lateral Meniscus	1	4%
Lateral patellar subluxation	2	7%
Loose Body	1	4%
Medial Meniscus	4	14%
Patella Alta	1	4%
Popliteal Cyst	2	7%
Possible Tear	4	14%
OA Changes	3	11%
Strain	1	4%
Thinning of ACL	1	4%
Thinning of Patellar Cartilage	2	7%

Table 11 Prevalence of pathological and/or degenerative changes in shoulder MRI findings (n = 13)

Shoulder Pathology	No. of patients with pathology	Percentage of total
Degenerative changes in the acromioclavicular joint	9	69%
Down sloping	1	8%
Effusion	3	23%
Fluid	1	8%
Hypertrophic Change	1	8%
Impingement	2	15%
Tear	2	15%
Tendinopathy	1	8%