

Evidence Based Physical Exam of the Lumbar Spine

John Gilmer, MD

Physical Medicine & Rehabilitation

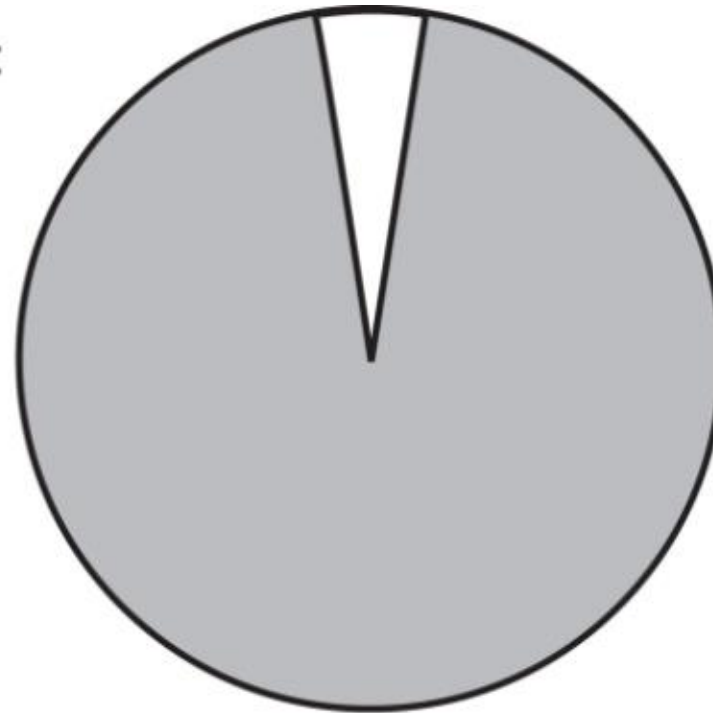
Learning Objectives

- Review pre-test probability, likelihood ratios, and post-test probability
- Review the likelihood ratios of pertinent physical exam tests of the spine
- Review an evidence-based approach to physical examination of the lumbar spine

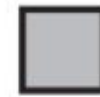
More Learning Objectives

- The physical exam is still important
- What tests for the lumbar spine exam matter and how much
- Do not anchor on a single physical exam finding
- Do a thorough physical exam while understanding what maneuvers are most important
- Physical exam may be superior to technology

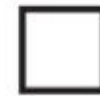
A CENTURY AGO:



Diagnostic standard:

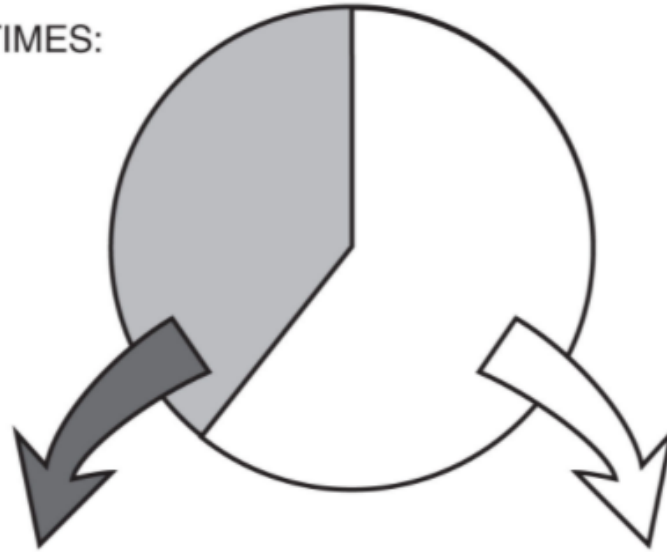


Bedside observation



Technologic test

MODERN TIMES:

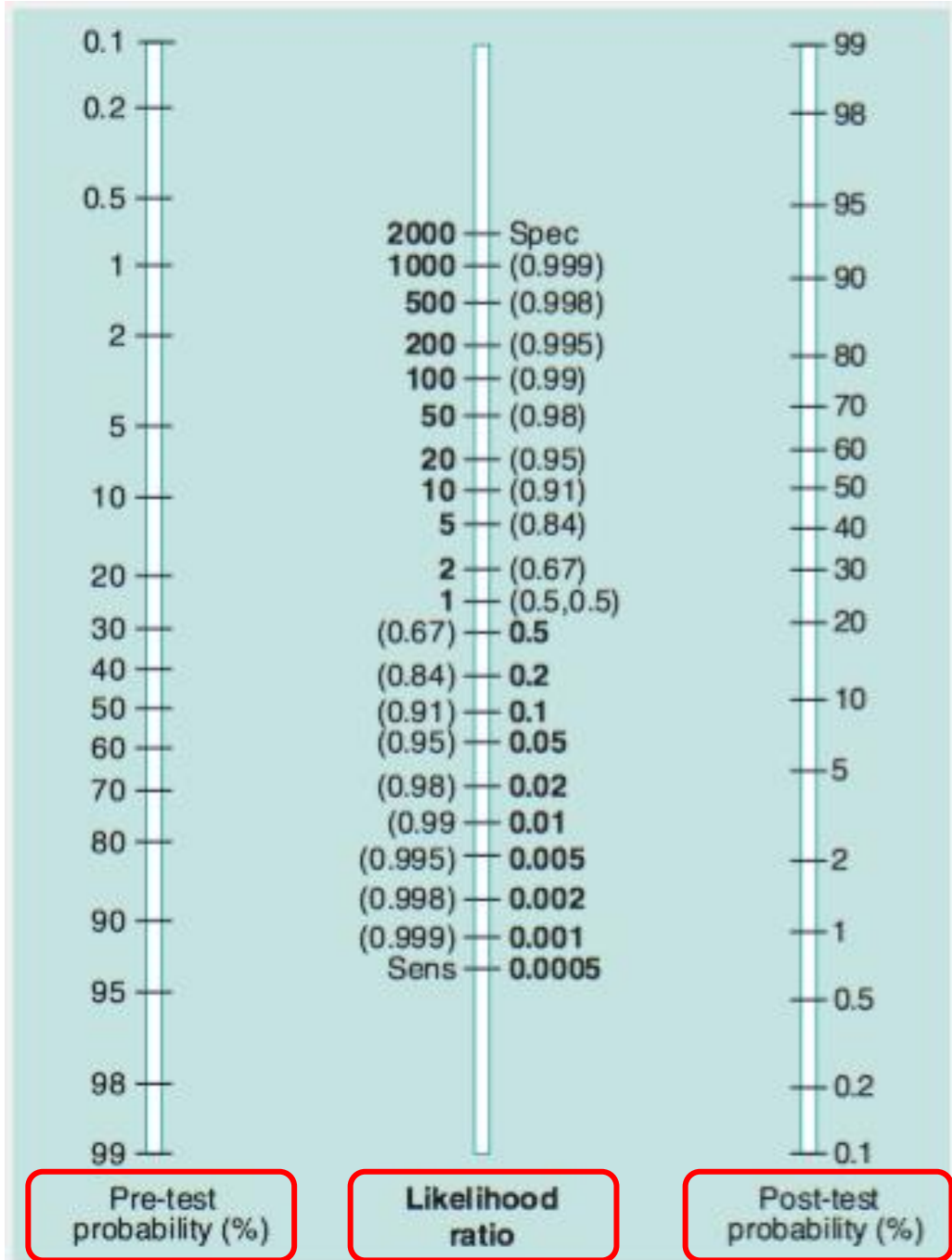


BEDSIDE OBSERVATION
is diagnostic standard

Dermatology	Rheumatology
Cellulitis	Cardiology
Psoriasis	Pericarditis
Zoster	Mitral valve prolapse
Neurology	Ophthalmology
Amyotrophic lateral sclerosis	Diabetic retinopathy
Parkinson disease	
Bell palsy	

TECHNOLOGIC TEST
is diagnostic standard

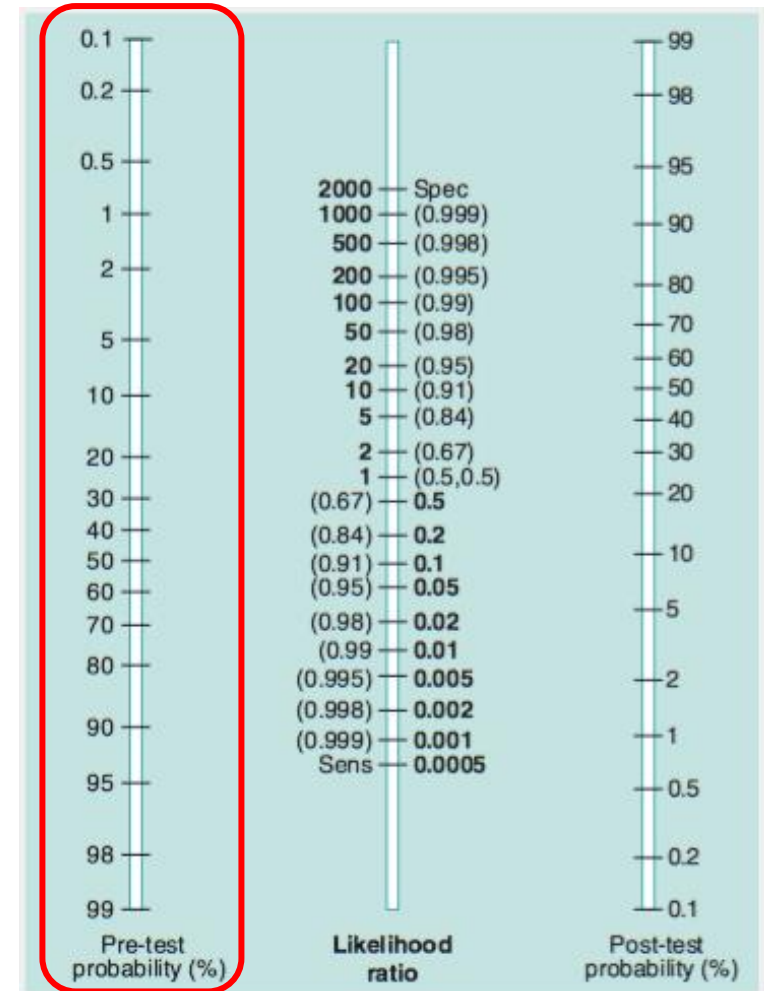
Evidence-based approach
ESSENTIAL



Likelihood ratio nomogram.

Pre-test Probability

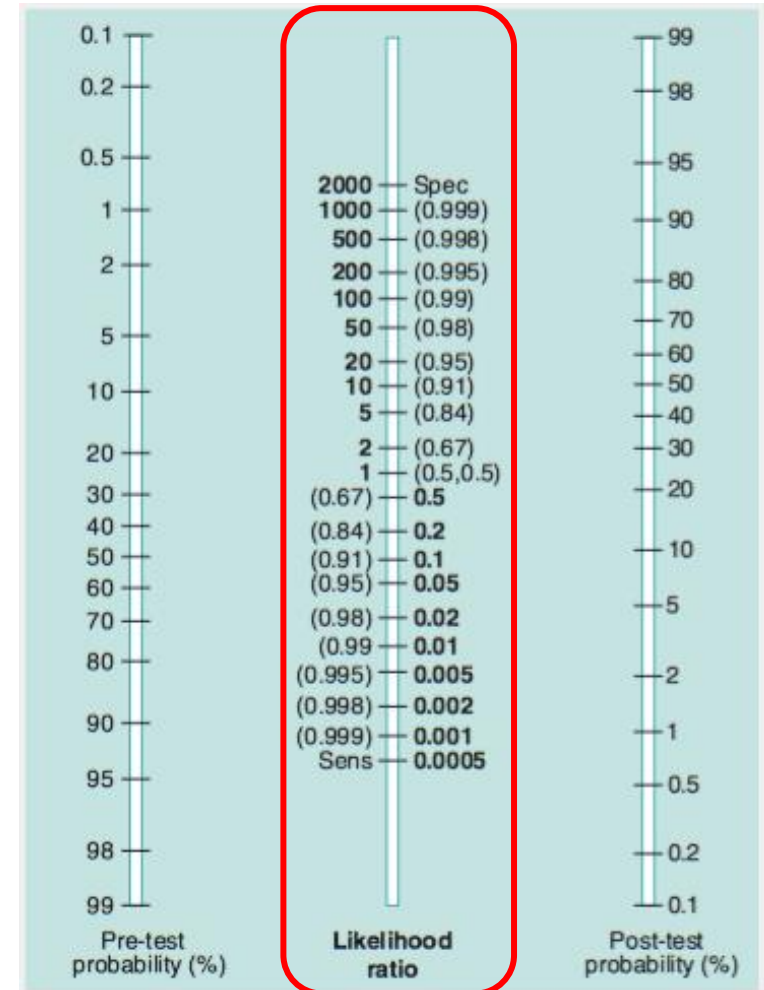
- The probability of a disease before application of your test
- Prevalence + Clinical Judgement = Pre-test prob



Likelihood ratio nomogram.

Likelihood Ratio

- *Likelihood ratios* are nothing more than diagnostic weights, numbers that convey how much a physical sign argues for or against a disease.



Likelihood ratio nomogram.

Likelihood Ratio

- Specific to a test
- Specific to a condition

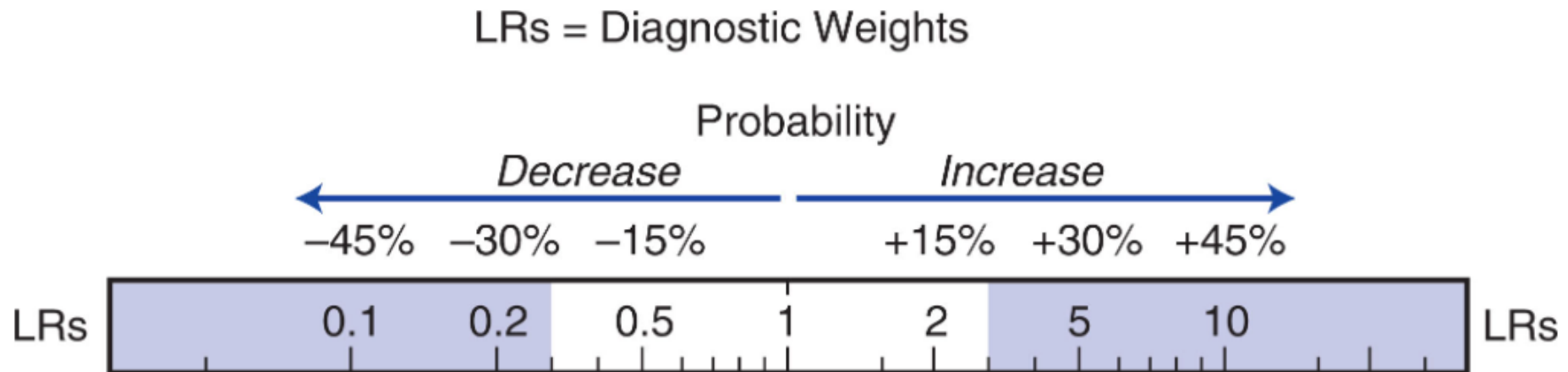
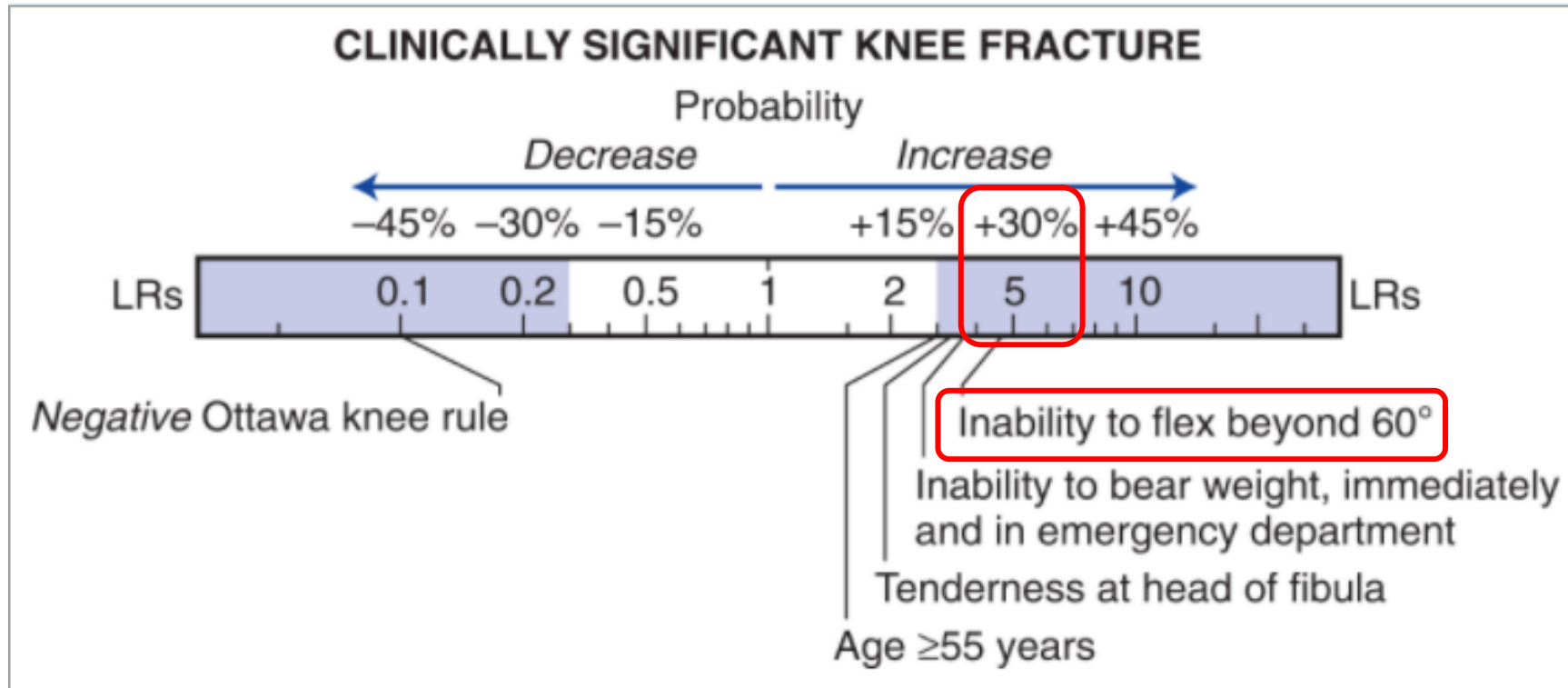


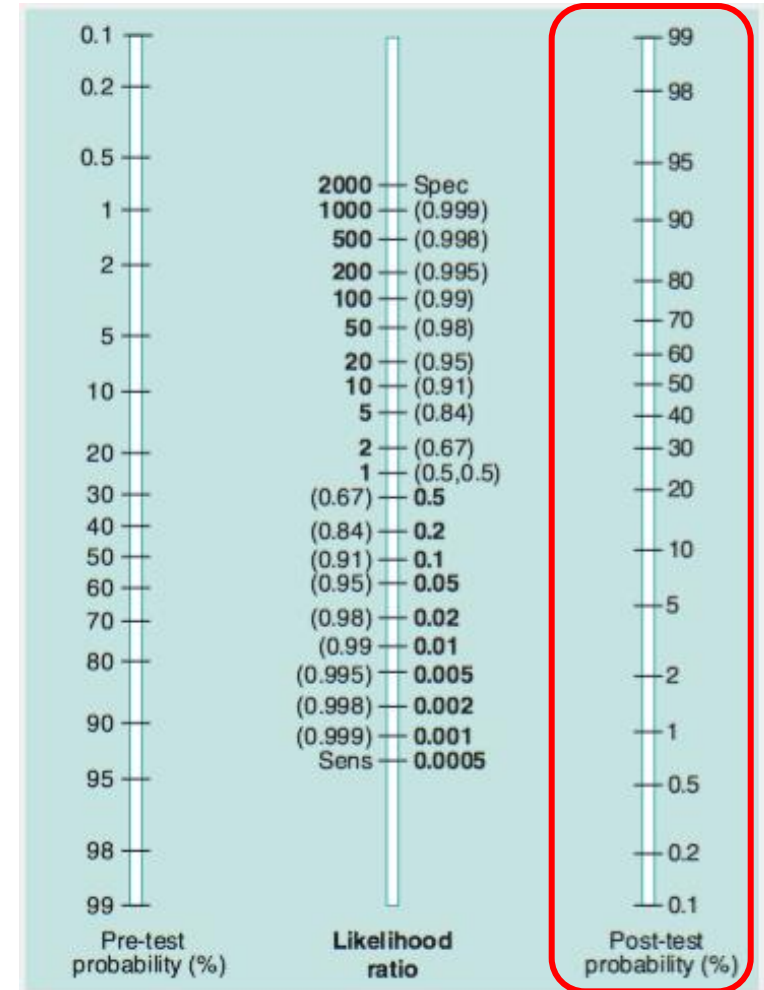
Fig. 2.5

Likelihood Ratio



Post-test Probability

- The probability of disease after application of your test.



Likelihood ratio nomogram.

Review as we go

- Review pre-test probability, likelihood ratios, and post-test probability
- Pre-test probability = Prevalence + clinical judgement
- Likelihood Ratio is a number that tells us how much to change our pretest probability.
- Post-test probability is the odds of having the condition after applying your test

Put it all together

- Lumbar pain + asymmetric reflex
- Pretest = 50%
- LR = 5
- Posttest = 80%

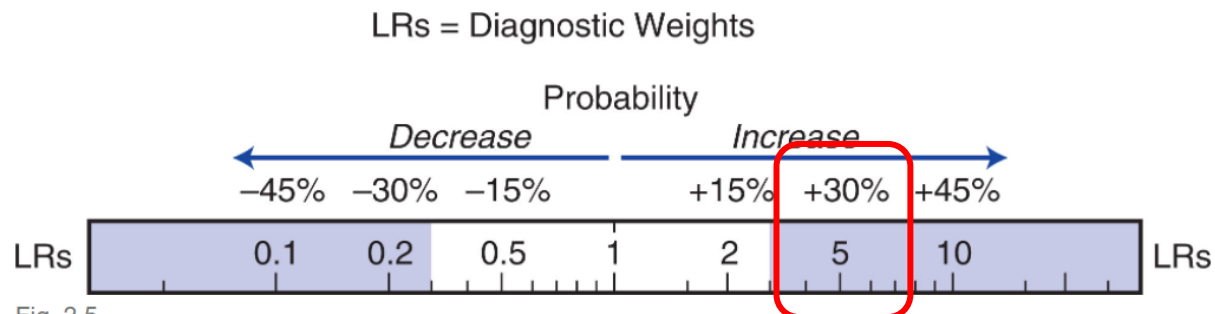
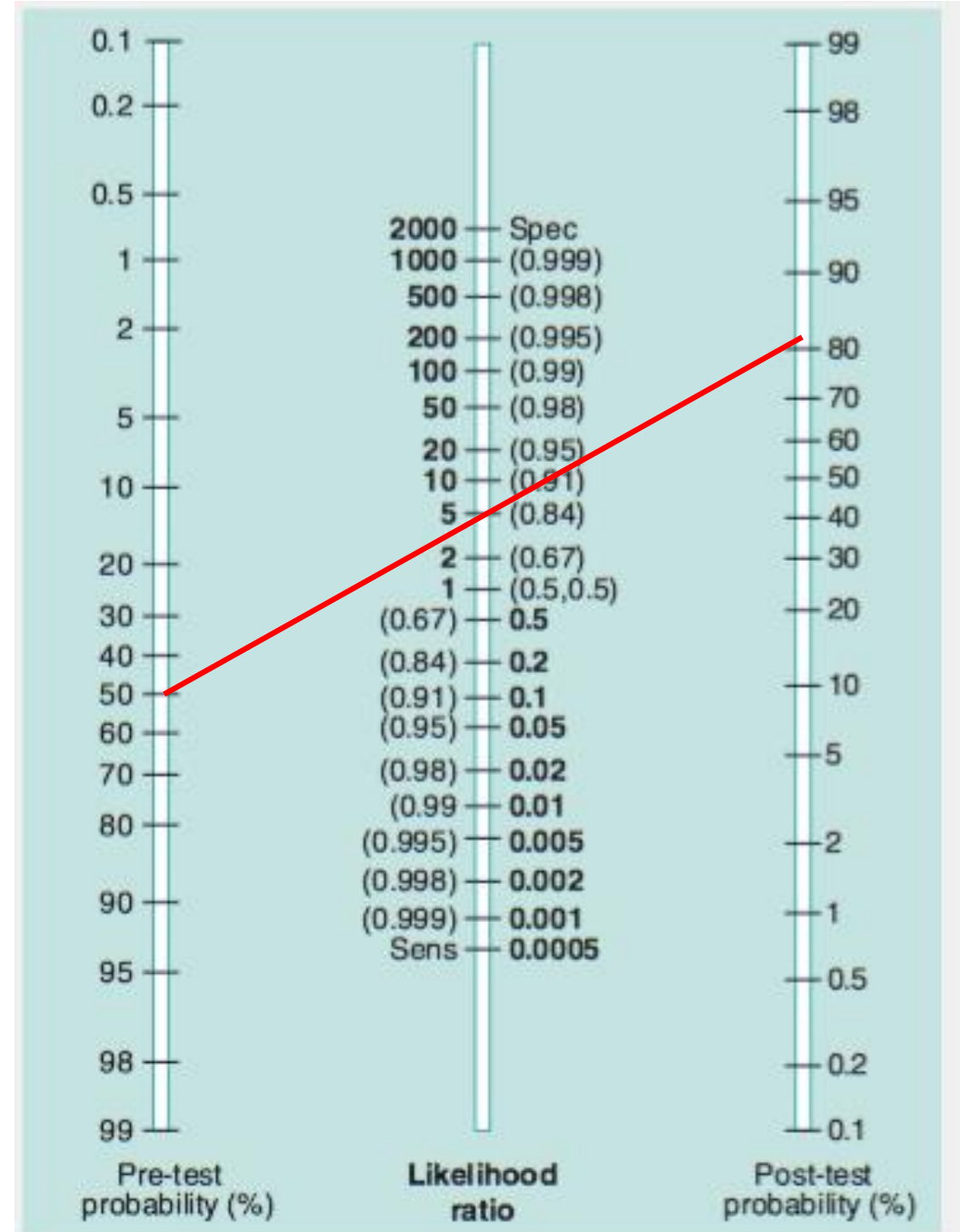


Fig. 2.5



Likelihood ratio nomogram.

Put it all together

- Lumbar pain + asymmetric reflex
- Pretest = 50%
- LR = 0.2
- Posttest = 20%

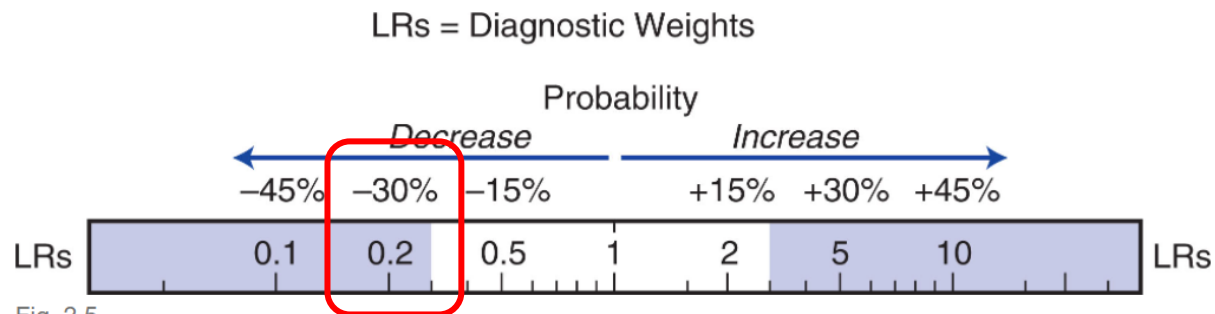
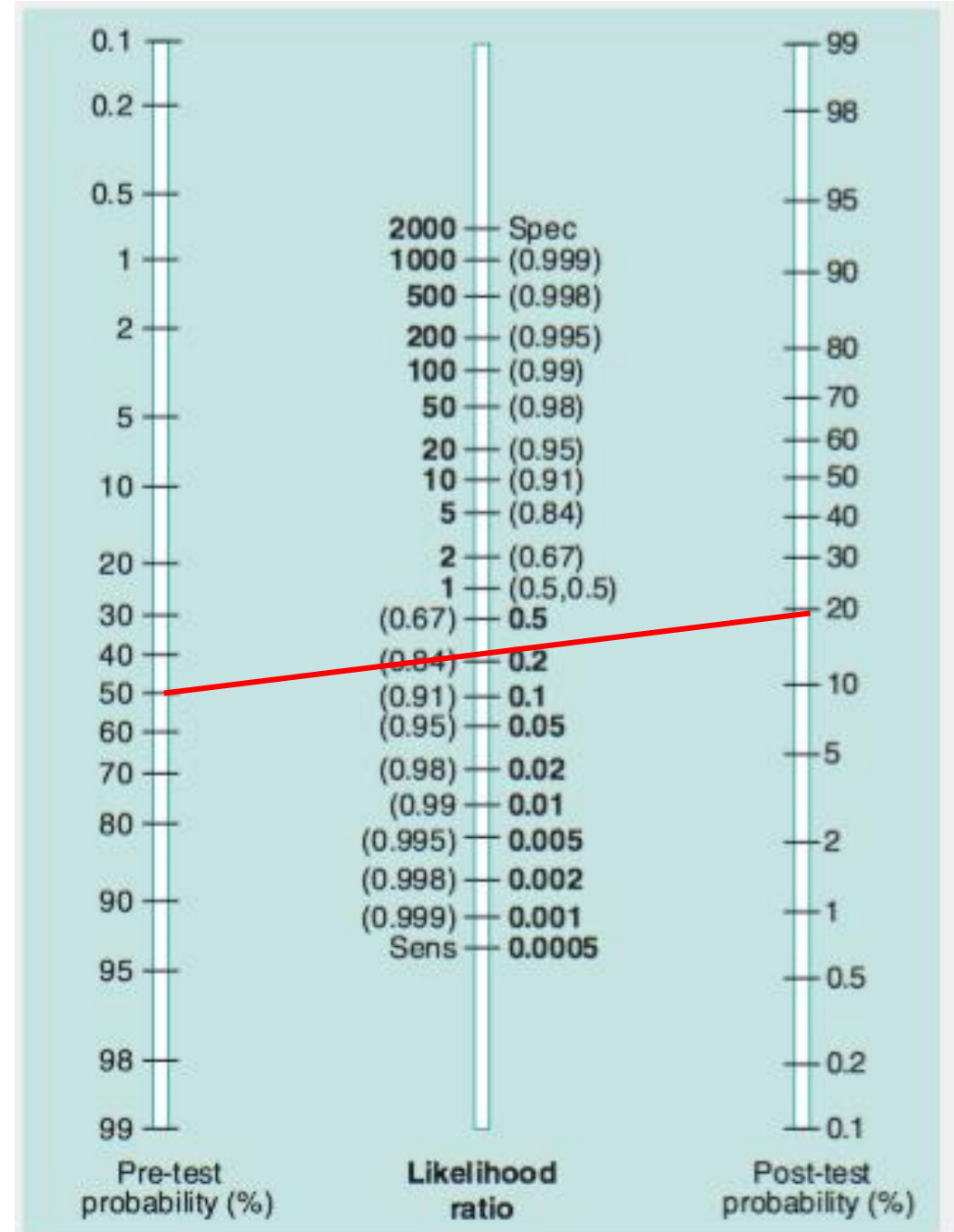
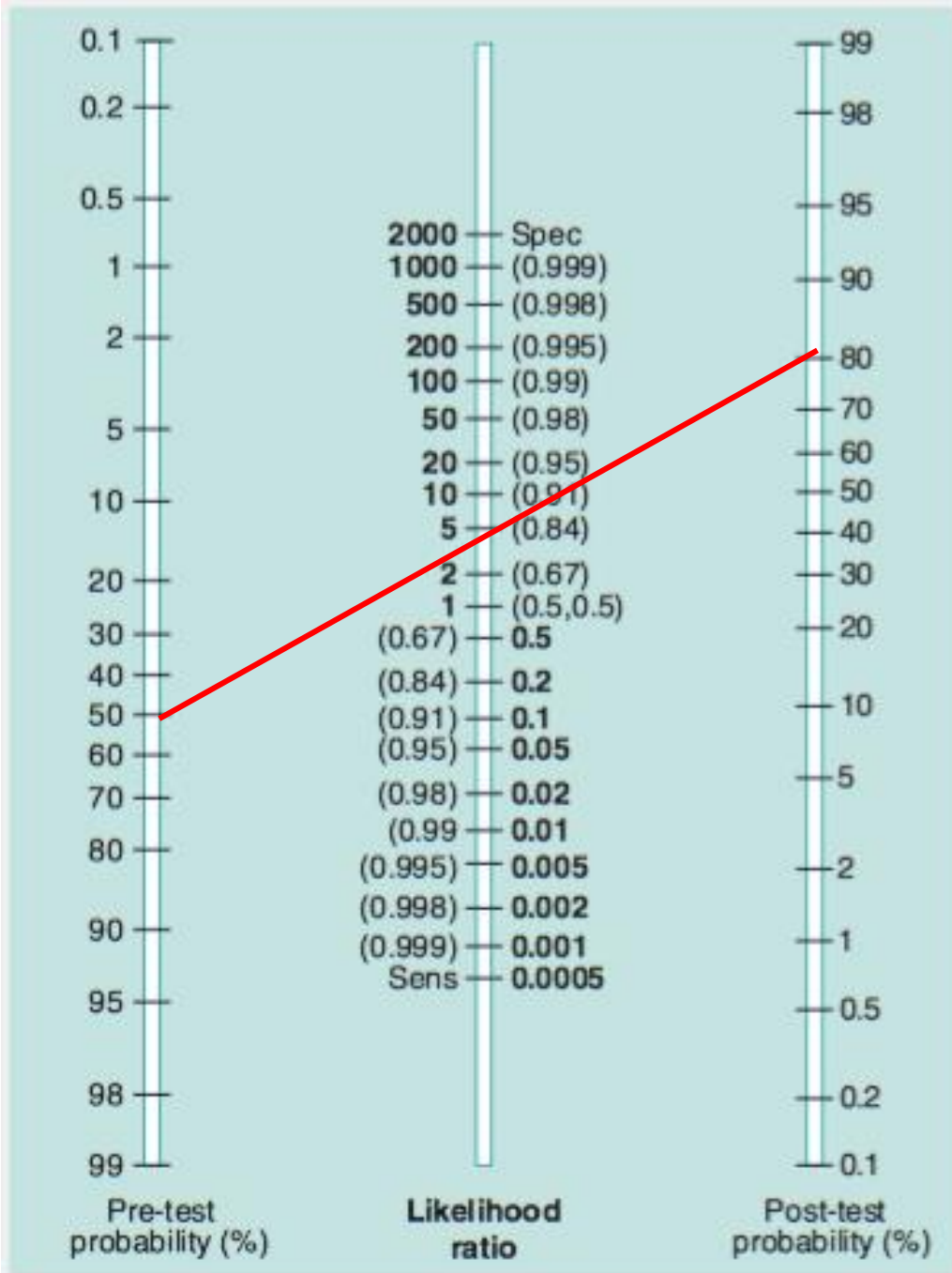


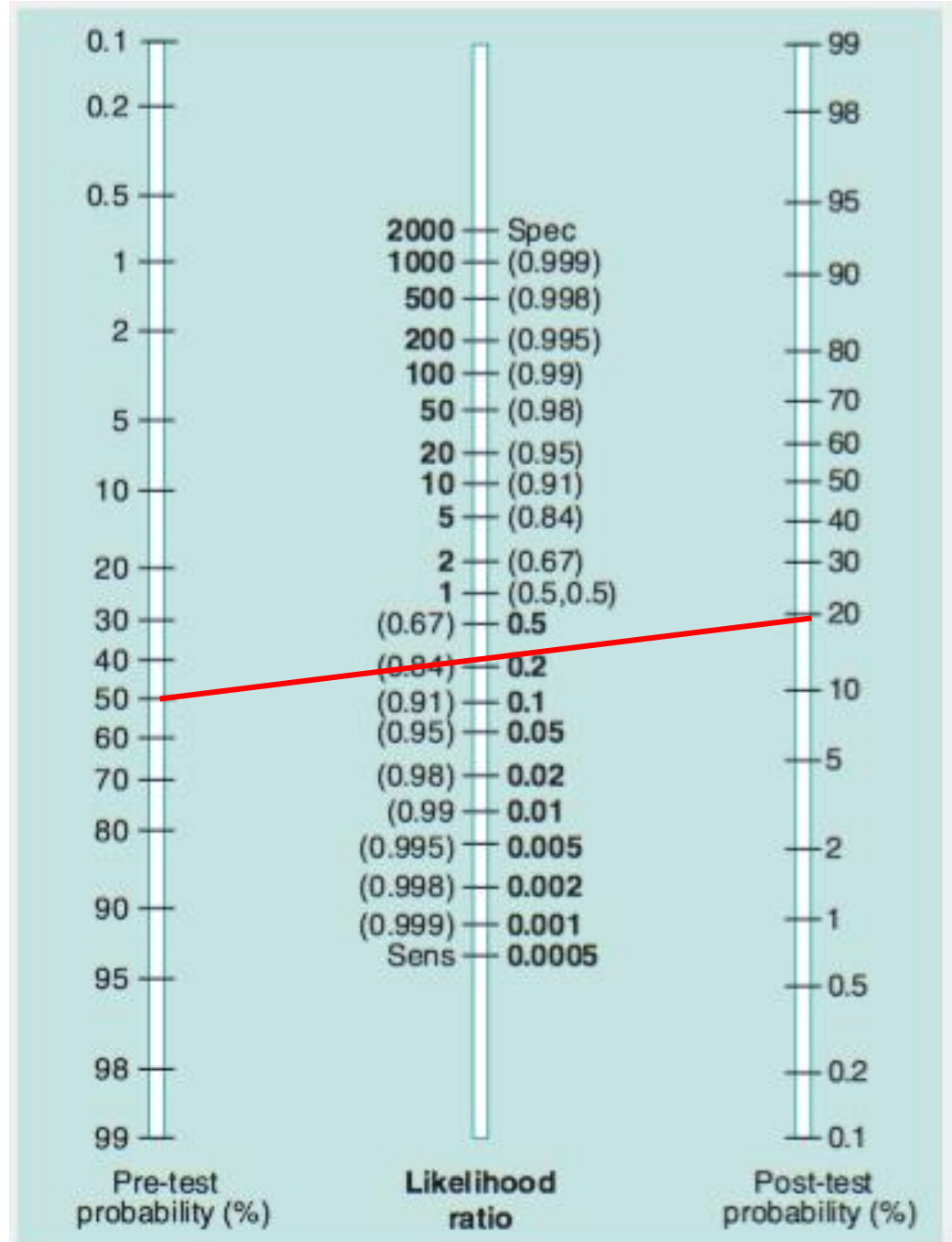
Fig. 2.5



Likelihood ratio nomogram.



Likelihood ratio nomogram.



Likelihood ratio nomogram.

Finding [†] (Reference)	Sensitivity (%)	Specificity (%)	Likelihood Ratio [‡] if Finding Is	
			Present	Absent
Detecting anterior cruciate ligament tear				
Anterior drawer sign 37 49 54 55 95 96 97 98	27–94	91–99	12.2	0.4
Lachman sign 37 49 54 55 95 97 98	48–96	90–99	20.5	0.2
Pivot shift sign 37 54 95 97 98	6–61	94–99	8.2	0.7
Detecting posterior cruciate ligament tear				
Posterior drawer sign 36 99	90–95	99	97.8	0.1

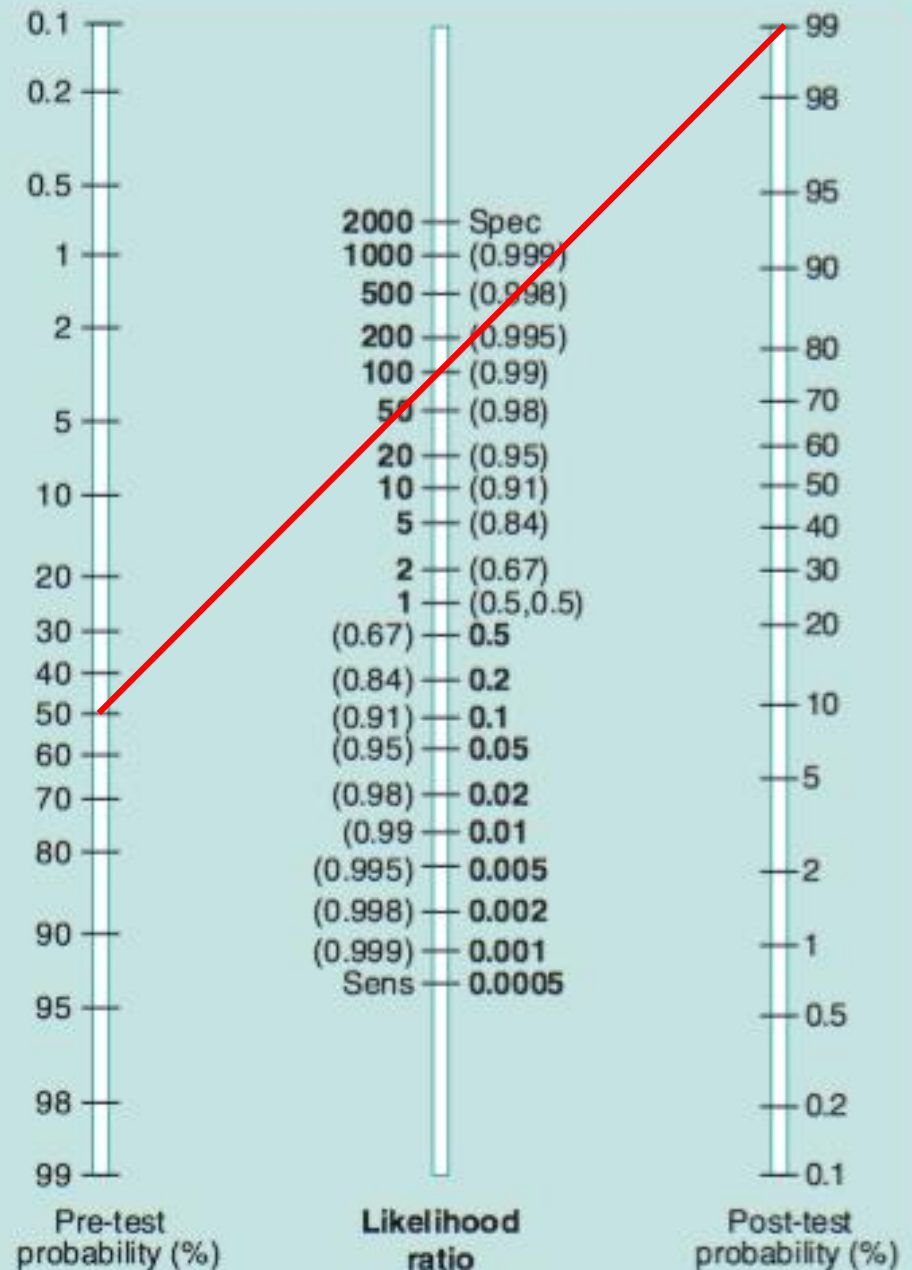
Research | [Open access](#) | Published: 13 January 2022

The accuracy of MRI in diagnosing and classifying acute traumatic multiple ligament knee injuries

Xusheng Li, Qian Hou, Xuehua Zhan, Long Chang, Xiaobing Ma & Haifeng Yuan [✉](#)

BMC Musculoskeletal Disorders 23, Article number: 43 (2022) | [Cite this article](#)

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Likelihood ratio nomogram.

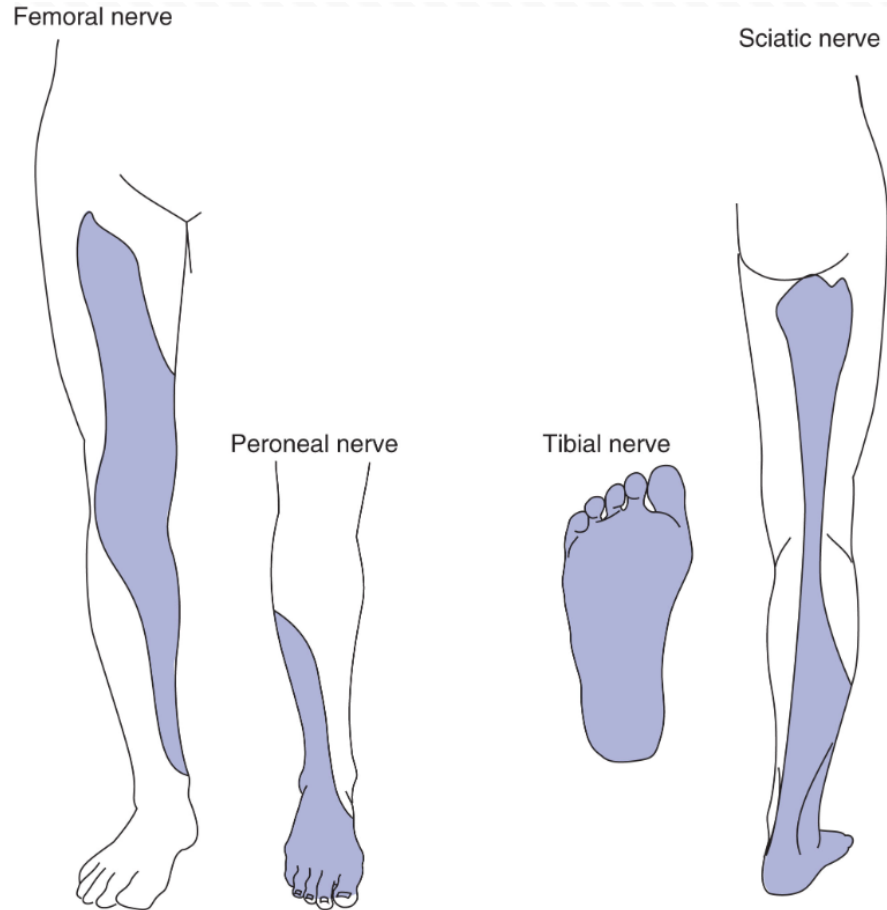
Evidence Based approach to Physical Exam of the Lumbar Spine

- What tests matter and how much do they matter for certain diagnoses?
- Disclaimer! This is not a substitute for thorough physical exam.
- Always do a complete exam involving inspection, palpation, ROM, strength, sensation, reflexes, and special tests.

Lumbosacral Radiculopathy

- If you could only pick one?
 - Inspection
 - Motor
 - Sensory
 - Reflex
 - Special Tests

Sensory Testing



EBM BOX 64.4

Diagnosing Lumbosacral Radiculopathy in Patients with Sciatica *

Finding (Reference) †	Sensitivity (%)	Specificity (%)	Likelihood Ratio ‡ if Finding Is	
			Present	Absent
Motor examination				
Weak ankle dorsiflexion ⁵¹	54	89	4.9	0.5
Ipsilateral calf wasting ⁵¹	29	94	5.2	0.8
Sensory examination				
Leg sensation abnormal ^{51 60 61 68}	16–50	62–86	NS	NS
Reflex examination				
Abnormal ankle jerk ^{51 60 61 68}	14–48	73–93	2.1	0.8
Other tests				
Straight leg raising maneuver ^{48 51 61 68 69 70 71 72}	53–98	11–89	1.5	0.4
Crossed straight leg raising maneuver ^{51 69 70 71 73}	22–43	88–98	3.4	0.8

Achilles Reflex

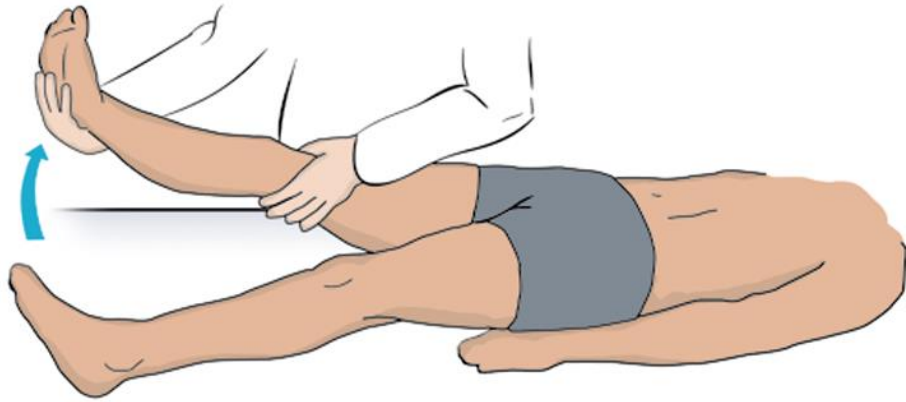


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Special Tests



EBM BOX 64.4

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Motor Exam



EBM BOX 64.4

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LUMBOSACRAL RADICULOPATHY

Probability

Decrease

Increase

-45% -30% -15%

+15% +30% +45%

LRs



LRs

Straight leg raising maneuver *negative*

Ipsilateral calf wasting
Weak ankle dorsiflexion

Crossed straight leg
raising maneuver positive
Abnormal ankle jerk

What about localizing?

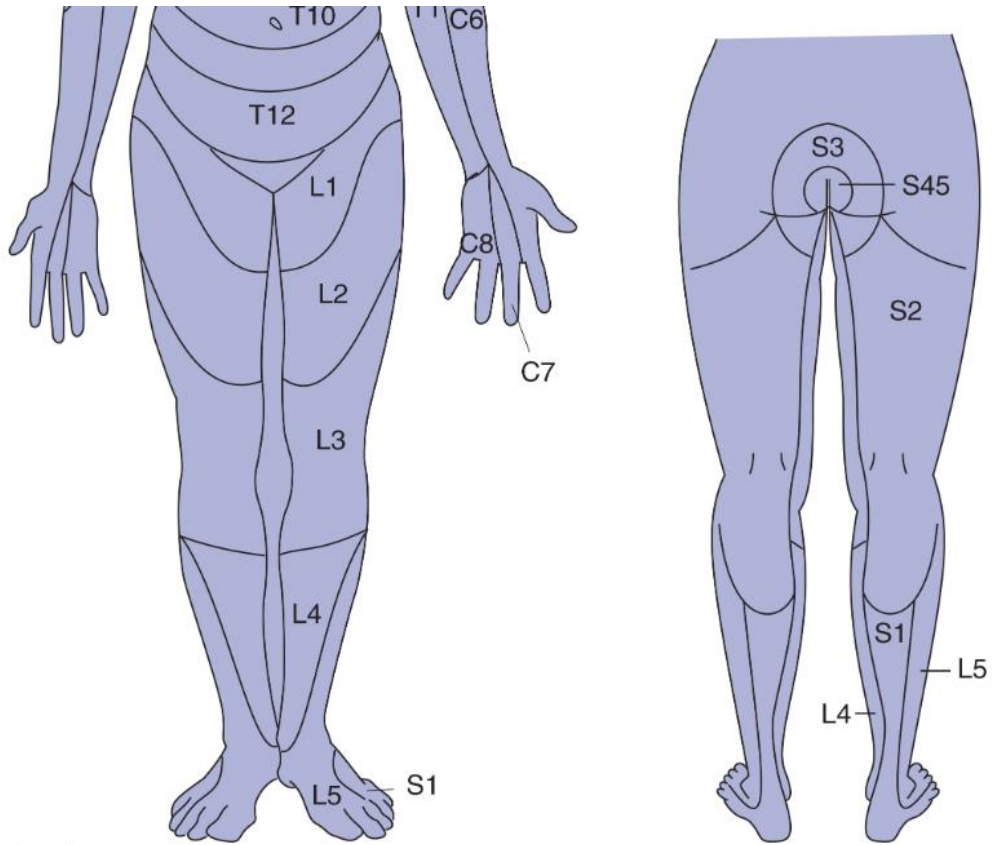
Finding (Reference) [†]	Sensitivity (%)	Specificity (%)	Likelihood Ratio [‡] if Finding Is	
			Present	Absent
Motor Examination				
Weak knee extension, detecting L3 or L4 radiculopathy 60 66 74	38–48	89–90	4.0	0.6
Weak hallux extension, detecting L5 radiculopathy 47 51 60 66	12–62	54–91	1.7	0.7
Weak ankle dorsiflexion, detecting L5 radiculopathy 51 75	37–62	51–77	NS	NS
Weak ankle plantarflexion, detecting S1 radiculopathy 51 60	26–45	75–99	NS	0.7
Ipsilateral calf wasting, detecting S1 radiculopathy ⁵¹	43	82	2.4	0.7
Sensory Examination				
Sensory loss L5 distribution, detecting L5 radiculopathy 47 51 75	20–53	77–98	3.1	0.8
Sensory loss S1 distribution, detecting S1 radiculopathy 47 51 75	32–49	70–90	2.4	0.7
Reflex Examination				
Asymmetric quadriceps reflex, detecting L3 or L4 radiculopathy 47 60 66 76	29–56	93–96	8.5	0.7
Asymmetric medial hamstring reflex, detecting L5 radiculopathy ⁷⁷	57	91	6.2	0.5
Asymmetric Achilles reflex, detecting S1 radiculopathy 47 51 60 75 76 78	45–91	53–94	2.7	0.5
Other Tests				
Femoral stretch test, detecting L2-L4 radiculopathy ⁶⁶	52	98	31.2	0.5

Motor

SPINAL SEGMENTS	L2	L3	L4	L5	S1	S2
Proximal nerves						
Gluteus medius (gluteal nerves; internal rotation and abduction of hips)			■	■	■	
Gluteus maximus (gluteal nerves; extension of hips)				■	■	■
Femoral nerve						
Iliopsoas	■	■				
Quadriceps	■	■	■			
Obturator nerve						
Thigh adductors	■	■	■			
Sciatic nerve trunk*						
Hamstrings (knee flexion)				■	■	
Peroneal nerve*						
Tibialis anterior (dorsiflexion of ankle)			■	■		
Extensors of toes				■	■	
Peroneal longus (eversion of ankle)				■	■	
Tibial nerve*						
Tibialis posterior (inversion of ankle)			■	■		
Gastrocnemius				■	■	■
Flexor digitorum (curl toes)					■	■

Finding (Reference) [†]	Sensitivity (%)	Specificity (%)	Likelihood Ratio [‡] if Finding Is	
			Present	Absent
Motor Examination				
Weak knee extension, detecting L3 or L4 radiculopathy 60 66 74	38–48	89–90	4.0	0.6
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Ipsilateral calf wasting, detecting S1 radiculopathy ⁵¹	43	82	2.4	0.7

Sensory



Dermatomes.

Sensory Examination

Sensory loss L5 distribution, detecting L5 radiculopathy 47 51 75	20–53	77–98	3.1	0.8
Sensory loss S1 distribution, detecting S1 radiculopathy 47 51 75	32–49	70–90	2.4	0.7

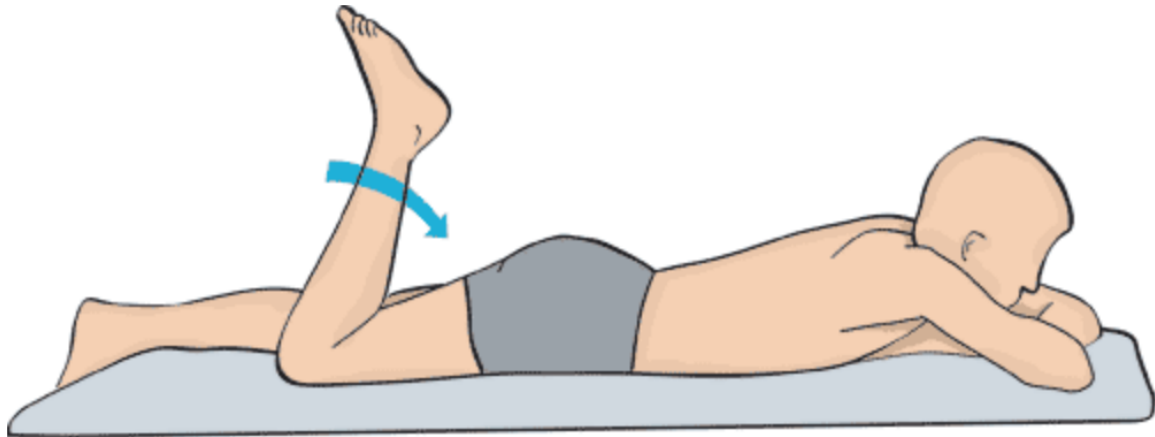
Reflexes

Name of Reflex	Peripheral Nerve	Spinal Level
Brachioradialis	Radial	C5-C6
Biceps	Musculocutaneous	C5-C6
Triceps	Radial	C7-C8
Quadriceps (patellar)	Femoral	L2-L4
Medial hamstring *	Sciatic	L5, S1
Achilles (ankle)	Tibial	S1

Reflex Examination

Asymmetric quadriceps reflex, detecting L3 or L4 radiculopathy 47 60 66 76	29–56	93–96	8.5	0.7
Asymmetric medial hamstring reflex, detecting L5 radiculopathy 77	57	91	6.2	0.5
Asymmetric Achilles reflex, detecting S1 radiculopathy 47 51 60 75 76 78	45–91	53–94	2.7	0.5

Femoral Stretch Test



Other Tests

Femoral stretch test, detecting L2-L4 radiculopathy ⁶⁶

52

98

31.2

0.5

Slump Test

Diagnostic Accuracy of the Slump Test for Identifying Neuropathic Pain in the Lower Limb

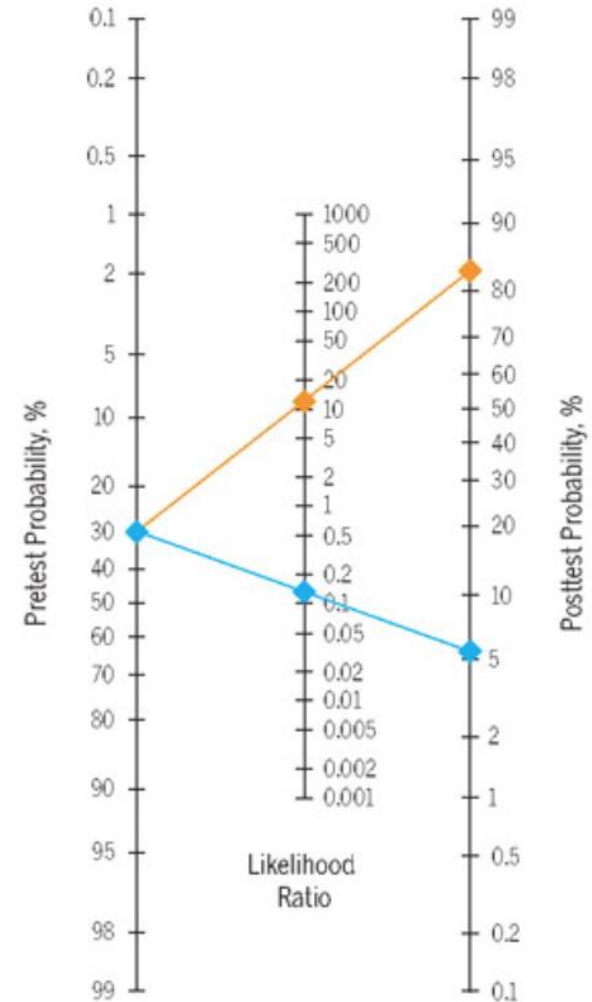
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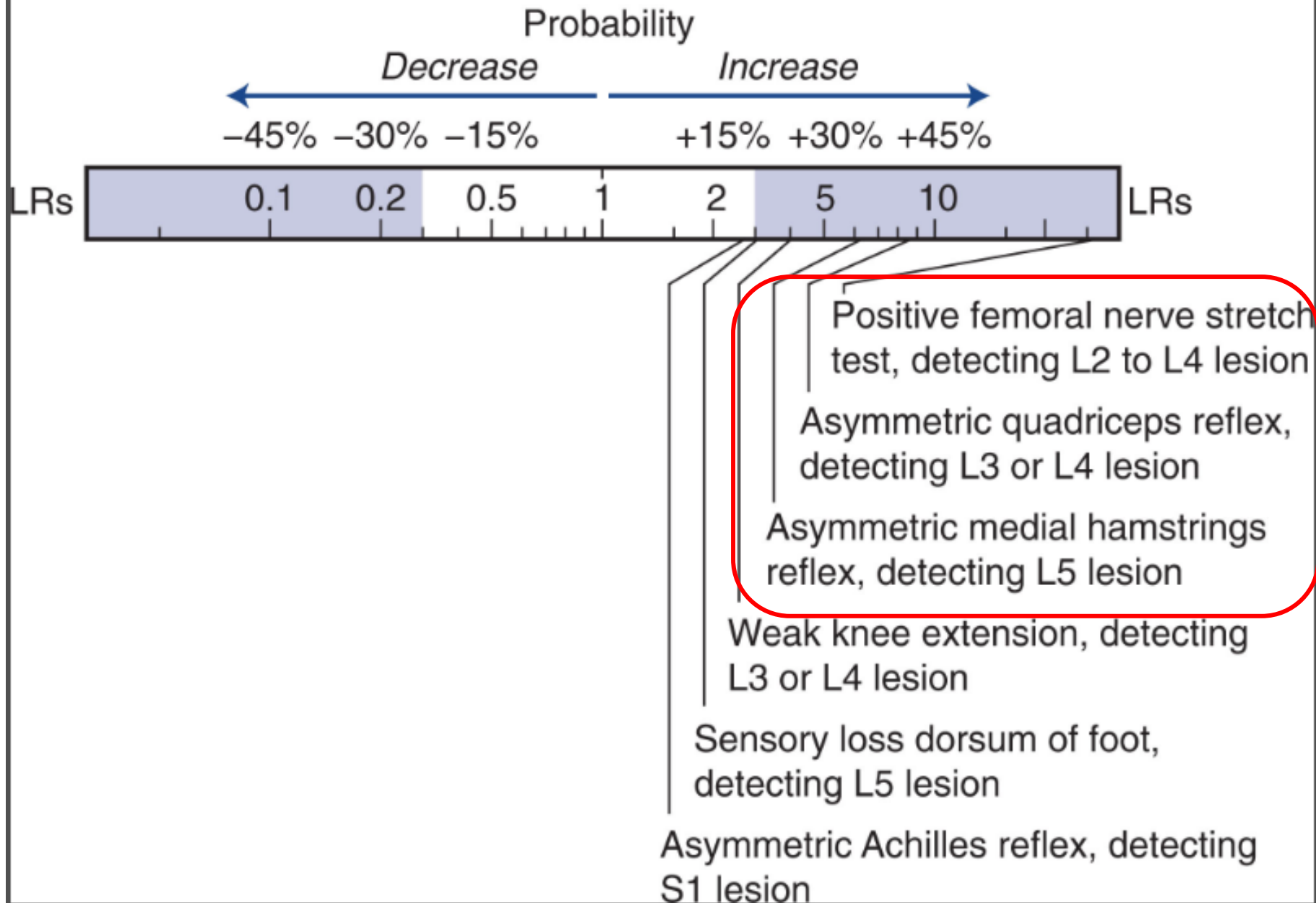
Journal of Orthopaedic & Sports Physical Therapy

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<https://www.jospt.org/doi/10.2519/jospt.2015.5414>



LOCALIZING LUMBOSACRAL RADICULOPATHY



Facet Arthropathy – Facet Loading

▶ [J Can Chiropr Assoc.](#) 2014 Sep;58(3):258–267.

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The diagnostic accuracy of the Kemp's test: a systematic review

[Kent Stuber](#)^{1,8}, [Caterina Lerede](#)², [Kevyn Kristmanson](#)³, [Sandy Sajko](#)⁴, [Paul Bruno](#)⁵

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PMCID: PMC4139762 PMID: [25202153](#)



Author, year of publication	Sensitivity	Specificity	LR+	LR–	PPV	NPV
Laslett, 2006 ¹² – 95% pain relief standard	100%	22.3%	1.29	0.00	13.0%	100%
Laslett, 2006 ¹² – 75% pain relief standard	85.7%	21.8%	1.10	0.66	26.1%	82.6%
Manchikanti, 2000 ²²	32.1%	67.3%	0.98	1.01	43.5%	55.8%
Revel, 1992 ²³	31.8%	22.2%	0.41	3.07	33.3%	21.1%
Revel, 1998 ¹³	23%	51.7%	0.48	1.49	17.7%	60%
Schwarzer, 1994 ²⁴	100%	11.6%	1.13	0.00	17.6%	100%

Facet Arthropathy – Revel's Criteria

- Age > 65
- Pain relieved by recumbency
- No pain exacerbation with:
 - Cough/sneezing
 - Hyperextension
 - Forward flexion
 - Rising from flexion
 - Extension-rotation

▶ [Eur Spine J. 2007 Jun 14;16\(10\):1539–1550. doi: 10.1007/s00586-007-0391-1](#)

Systematic review of tests to identify the disc, SIJ or facet joint as the source of low back pain

[M J Hancock](#)^{1,8}, [C G Maher](#)¹, [J Latimer](#)¹, [M F Spindler](#)¹, [J H McAuley](#)¹, [M Laslett](#)², [N Bogduk](#)³

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PMCID: PMC2078309 PMID: [17566796](#)

Author	Controlled double block / % pain relief	Sensitivity	Specificity	+LR	–LR
Facet joint studies					
Revel's criteria					
Revel et al. [38]	No / >75%	96 (71–100)	65 (46–81)	2.8 (1.7–4.5)	0.06 (0.00–0.85)
Laslett et al. [23]	No / abolition of pain	18 (5–43)	93 (86–97)	2.6 (0.8–8.6)	0.88 (0.70–1.10)
Manchikati [31]	Yes / >75%	13 (7–22)	84 (76–90)	0.8 (0.4–1.7)	1.03 (0.92–1.16)
Revel et al. [39]	No/ >75%	63 (41–82)	87 (64–98)	4.8 (1.4–15.9)	0.43 (0.24–0.75)

Discogenic

- Spinous Process Bony Vibration
- LR: 1.5-2.7

▶ [Eur Spine J. 2007 Jun 14;16\(10\):1539–1550. doi: 10.1007/s00586-007-0391-1](#)

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Spinous process bony vibration

Vanharanta et al. [54]	No	Not stated*	71 (57–82)	60 (39–80)	1.8 (1.1–3.0)	0.49 (0.29–0.82)
		Not stated (per disc)	63 (51–73)	77 (69–84)	2.7 (1.9–3.9)	0.48 (0.36–0.65)
Yrjama et al. [63]	No	Not stated*	60 (39–80)	64 (24–94)	1.7 (0.60–4.8)	0.62 (0.29–1.29)
Yrjama et al. [62]	No	Not stated*	65 (44–82)	58 (28–84)	1.5 (0.8–3.1)	0.61 (0.31–1.22)
Yrjama et al. [61]	No	Not stated*	71 (54–84)	63 (38–83)	1.9 (1.0–3.4)	0.47 (0.26–0.85)

Discogenic

- Centralization – progressive retreat of referred pain towards spinal midline in response to repeated movement.
- LR 2.8

Systematic review of tests to identify the disc, SIJ or facet joint as the source of low back pain

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Clinical examination - Centralisation

Donelson et al. [12]	Yes	Not stated*	64 (46–79)	70 (50–86)	2.1 (1.1–3.9)	0.52 (0.32–0.86)
Young et al. [60]	Yes	Not stated*	47 (22–73)	95 (62–100)	9.4 (0.6–146.9)	0.56 (0.35–0.91)
Laslett et al. [25]	Yes	Partial & full exam*	38 (26–51)	89 (69–98)	3.5 (1.0–11.7)	0.70 (0.55–0.89)
		Full examination*	40 (27–55)	92 (69–99)	4.9 (1.0–23.3)	0.65 (0.50–0.84)
Laslett et al. [26]	Yes	Complete & partial centralisers*	35 (22–51)	86 (62–98)	2.6 (0.8–8.7)	0.75 (0.56–0.99)
		Complete centralisers*	23 (12–38)	97 (77–100)	8.2 (0.5–133.0)	0.78 (0.67–0.95)

Sacroiliac Joint: Distraction

▶ J Man Manip Ther. 2008;16(3):142–152. doi: [10.1179/jmt.2008.16.3.142](https://doi.org/10.1179/jmt.2008.16.3.142) 

Evidence-Based Diagnosis and Treatment of the Painful Sacroiliac Joint


[Mark Laslett](#)¹

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PMCID: PMC2582421 PMID: [19119403](https://pubmed.ncbi.nlm.nih.gov/19119403/)



Sacroiliac Joint: Compression

▶ J Man Manip Ther. 2008;16(3):142–152. doi: [10.1179/jmt.2008.16.3.142](https://doi.org/10.1179/jmt.2008.16.3.142) 

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PMCID: PMC2582421 PMID: [19119403](https://pubmed.ncbi.nlm.nih.gov/19119403/)



Sacroiliac Joint: Thigh Thrust

▶ J Man Manip Ther. 2008;16(3):142–152. doi: [10.1179/jmt.2008.16.3.142](https://doi.org/10.1179/jmt.2008.16.3.142) 

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PMCID: PMC2582421 PMID: [19119403](https://pubmed.ncbi.nlm.nih.gov/19119403/)



Sacroiliac Joint: Gaenslen's

▶ J Man Manip Ther. 2008;16(3):142–152. doi: [10.1179/jmt.2008.16.3.142](https://doi.org/10.1179/jmt.2008.16.3.142) 

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Sacroiliac Joint: Sacral Thrust

▶ J Man Manip Ther. 2008;16(3):142–152. doi: [10.1179/jmt.2008.16.3.142](https://doi.org/10.1179/jmt.2008.16.3.142) 

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PMCID: PMC2582421 PMID: [19119403](https://pubmed.ncbi.nlm.nih.gov/19119403/)



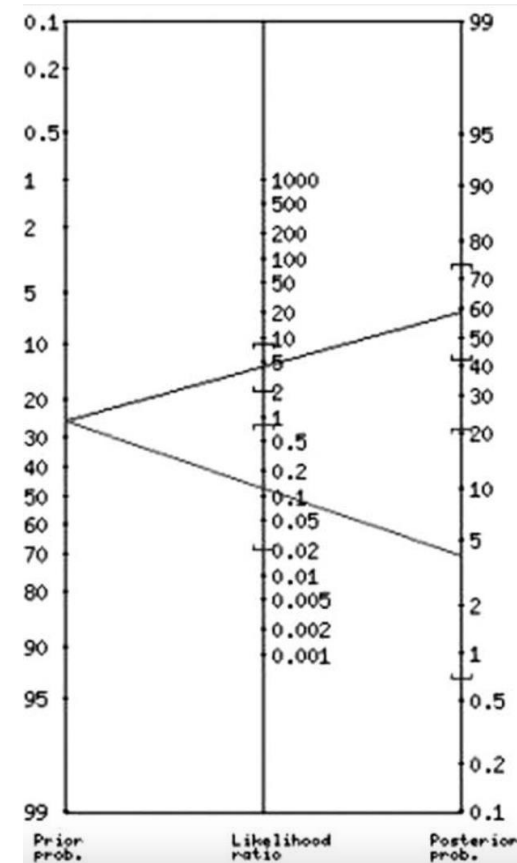
Evidence-Based Diagnosis and Treatment of the Painful Sacroiliac Joint

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Diagnostic accuracy statistic	Number of positive provocation SIJ tests							
	1 or more		2 or more		3 or more		4 or more	
	ML	PvW	ML	PvW	ML	PvW	ML	PvW
Sensitivity %	100	100	93	93	91	85	60	26
Specificity %	44	42	66	58	78	79	81	82
Positive LR	1.8	1.7	2.7	2.2	4.3	4.0	3.2	1.4
Negative LR	0.0	0.0	0.10	0.13	0.08	0.19	0.49	0.91



Review evidence-based findings

- Lumbar Radiculopathy: Atrophy, weak ankle dorsiflexion, *crossed* straight leg raise
- Facet Arthropathy: None, consider diagnostic MBBs
- Discogenic: Centralization
- Sacroiliac joint: 3 or more SIJ provocative maneuvers

Things we shouldn't do

- Let non-dermatomal sensory changes influence diagnosis of radiculopathy
- Diagnose facet arthropathy based on facet loading
- Diagnose SIJ based on palpation

Changes on MRI don't correlate well with symptoms

> [Spine \(Phila Pa 1976\)](#). 2001 May 15;26(10):1158-66. doi: 10.1097/00007632-200105150-00014.

The Longitudinal Assessment of Imaging and Disability of the Back (LAIDBack) Study: baseline data

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Affiliations + expand

PMID: 11413431 DOI: [10.1097/00007632-200105150-00014](#)

Of 148 subjects, 69 (46%) had never experienced low back pain. There were 123 subjects (**83%**) with moderate to severe desiccation of one or more discs, 95 (**64%**) with one or more bulging discs, and **83 (56%) with loss of disc height**. Forty-eight subjects (32%) had at least one disc protrusion and 9 (6%) had one or more-disc extrusions.

Summary

- The physical exam is still important
- What tests for the lumbar spine exam matter and how much
- Do not anchor on a single physical exam finding
- None of these maneuvers are good at ruling *out* a condition
- Do a thorough physical exam while understanding what maneuvers are most important
- Physical exam may be superior to technology

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