La douleur discogénique et vertébrogénique

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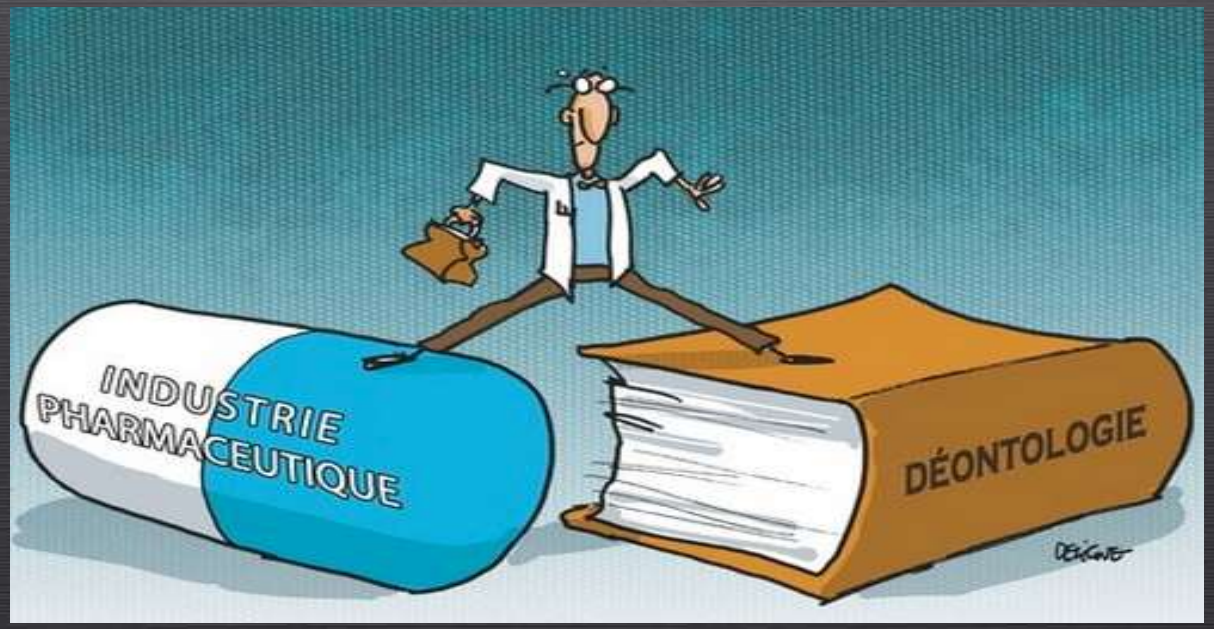
Cours MMD8800 et ARN6000

Pas de conflits d'intérêts



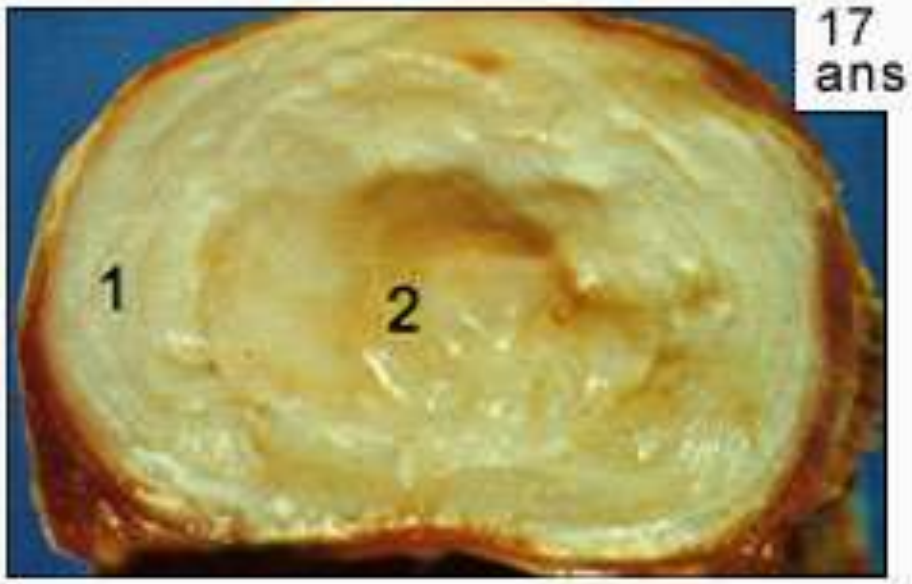
Objectifs

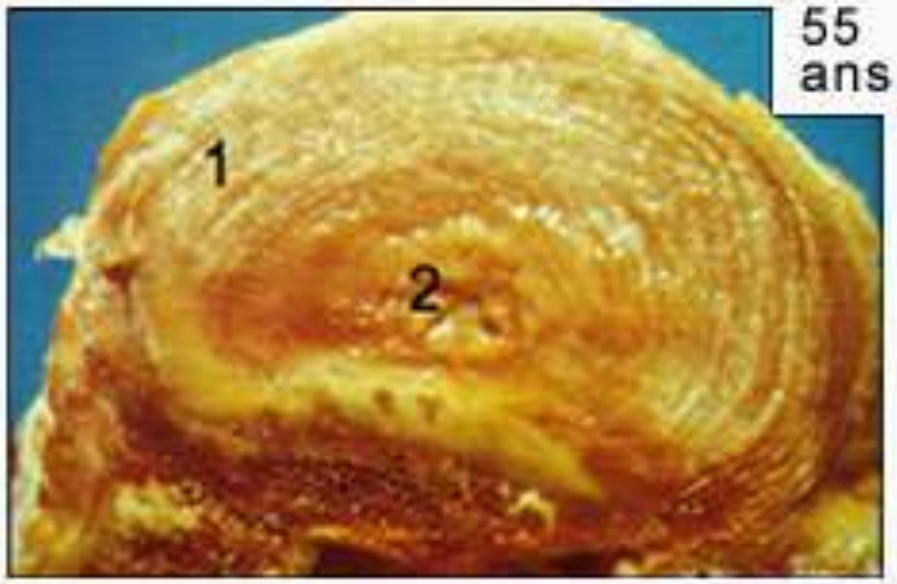
1. Distinguer la douleur d'étiologie vertébrogénique et discogénique

2. Connaître les traitements et leurs évidences:
   - Annuloplastie
   - PRP-plasma riche en plaquettes
   - Cellules souches mésenchymales
   - Ozone
   - Thermolésion du nerf vertébrogénique

3. À qui s'adresse les injections intradiscales?

Anatomie discale



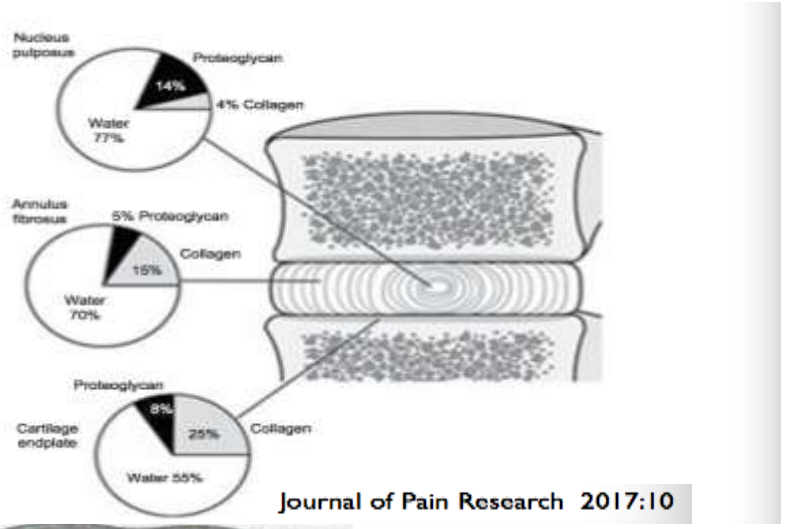


Dégénérescence du disque

A gauche: jeune disque sain avec l'anneau de cartilage fibreux (annulus fibrosus) (1) et le noyau gélatineux (nucleus pulposus) (2).

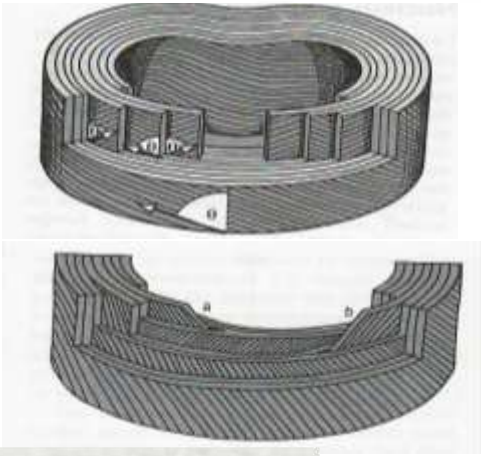
A droite : disque dégénérescent avec perte d'eau

Disque intervertébral



1-Nucleus pulposus (NP)

- **Protéoglycans (65% poids sec)**
- **Piègent molécules d'eau (70-90%)**
- Qques fibres irrégulières de **collagène (type II)** (15-20% poids sec)

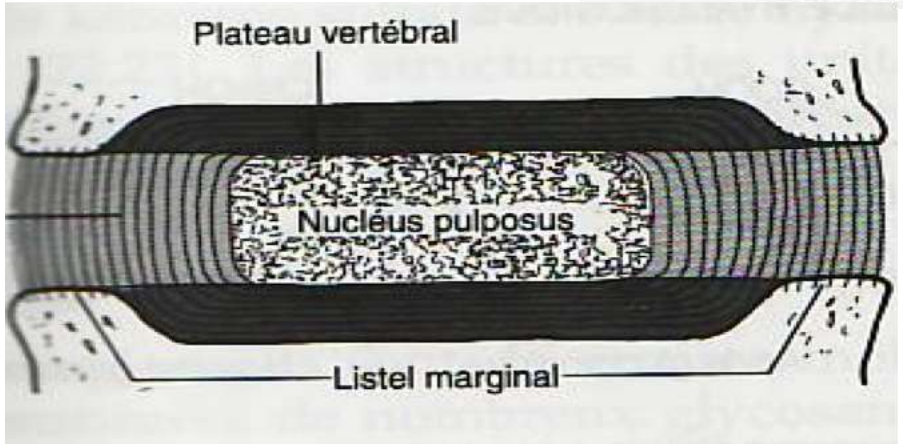


2-Annulus fibrosus (AF)

- **Eau (60-70%) et fibres collagène (types I>II) (50-60% poids sec)**
- Disposées en 10-20 lamelles concentriques

3-Plateau vertébral- cartilage hyalin (CV)

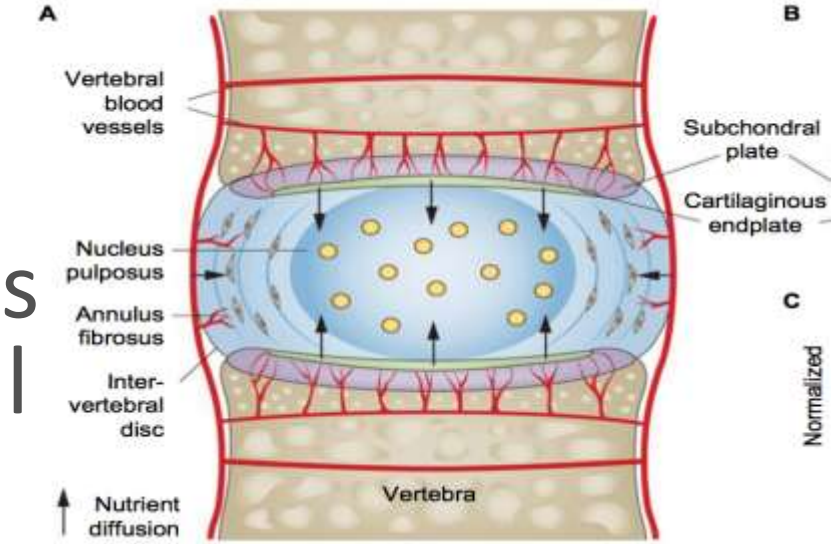
et fibrocartilage (NP)



N. Bogduk, Clinical and Radiological Anatomy of the Lumbar Spine, Elsevier Churchill Livingstone, 5th edition, 2012.

NUTRITION

- Diffusion à partir des vaisseaux sanguins de l'os médullaire vers plateau vertébral et DIV
- Crée un environnement hostile
- pH acide, peu oxygène, peu de nutriments



Rheumatol 2014; 10 (9): 561-6

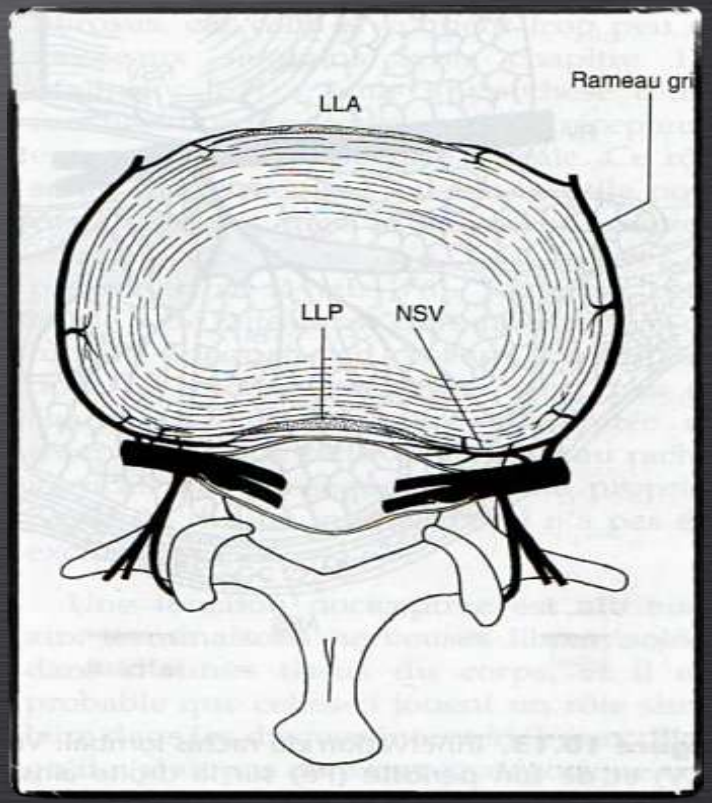
Potentiel de guérison est grandement limité

INNERVATION INTERNE DIV

Fibres nerveuses DIV ds 1/3 externe de l'AF

Plexus antérieur: Branches des rameaux communicants gris

Plexus postérieur: Nerf sinuvertébral



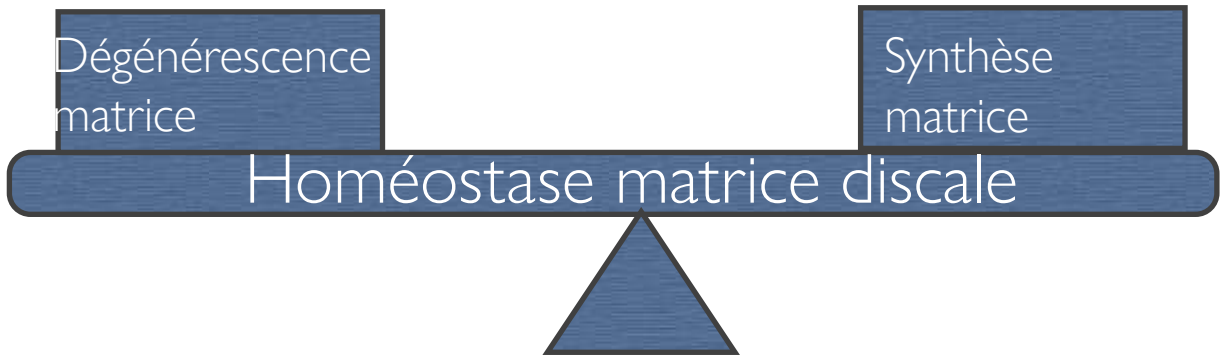
EXCEPTION:

Lors de lésion discale, fissuration cause néovascularisation et néo-innervation discale

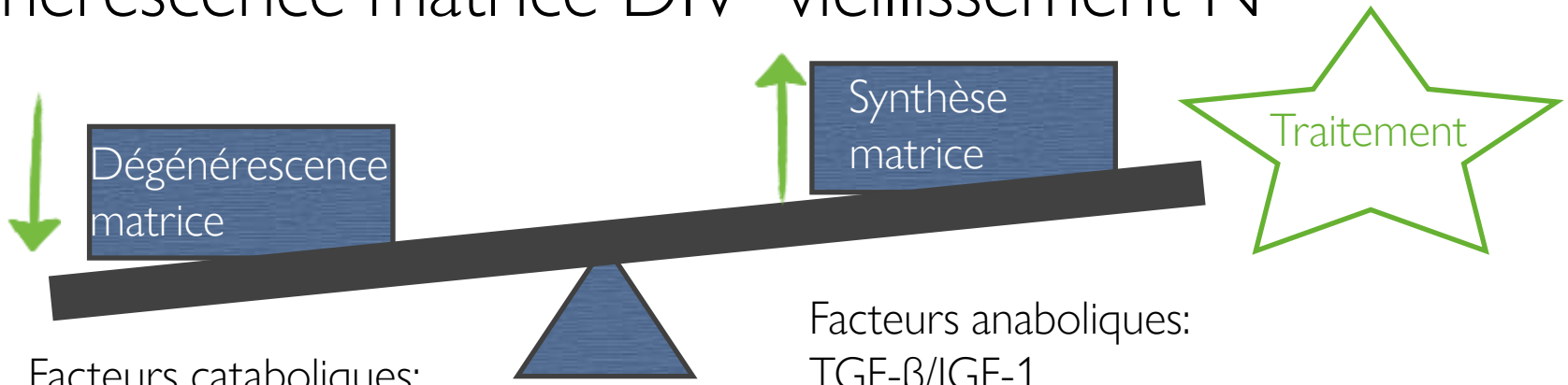
Bogduk N. Clinical Anatomy of the Lumbar Spine and Sacrum. 4th edition. Elsevier, 2005.

Structure dynamique

Normal



Dégénérescence matrice DIV=vieillissement N



Facteurs cataboliques:
MMP/ADAMTs
↓TIMPs
Prostaglandines
Cytokines- IL-1, TNFα

Facteurs anaboliques:
TGF-β/IGF-1
BMPs
Collagène
Protéoglycans

Adapté Jacobs LJ. PM&R 2011; 3 (6S): S12-17

CORPS VERTÉBRAL

Vascularisation:

- Capillaires vertébrales

Innervation:

- Nocicepteurs provenant du nerf basivertébral (NBV)-branche du nerf sinuvertébral (NSV)
  - Via foramen du mur postérieur vertébral
  - Arborisation caudale et céphalade pour innerver les plateaux vertébraux

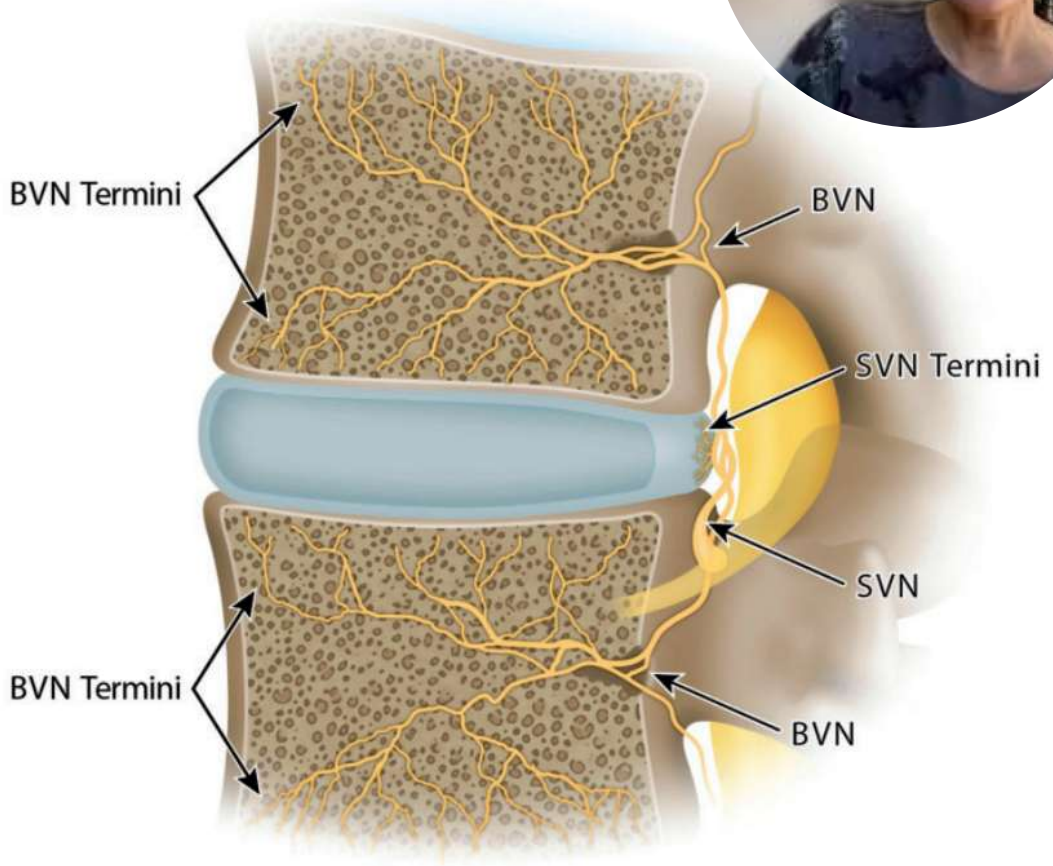


Figure 1. Neuroanatomy of the lumbar discovertebral complex. SVN = sinuvertebral nerve; BVN = basivertebral nerve.

Antonacci MD, Mody DR, Heggeness MH. Innervation of the human vertebral body. J Spinal Disord 1998;11(6):526–31.

Concept
« complexe discovertébral »

Douleur spinale
des éléments antérieurs

Douleur discogénique- 3 entités:

1-Déchirure annulaire(IDD)
2-Hernie discale (<5 mm)
3-Dégénérescence discale (DDD) (plus svt asx)

Douleur vertébrogénique
Atteinte plateau vertébral- MODIC 1 et 2

Pathophysiologie

Stress par compression répétées et sub-maximales ou charge maximale unique

↓

Microfracture PV supérieur du DIV (pas sx)

↓

Début de dégradation matrice nucléaire

et fissuration AF (30% fissures avaient une réinnervation neurale patho)

↓

Perte des propriétés mécaniques du NP

↓

Augmentation de la charge sur AF intact

Guérison et consolidation

Fuite cytokines proinflammatoires secrétés par DIV dans moelle osseuse du CV

↓

Inflammation et/ou infiltration graisseuse, fibrose PV

↓

Changements Modic 1 et 2 *

(90% PV avaient réinnervation neurale patho- 2X +innervés)

Dlr VERTÉBROGÉNIQUE

Inflammation avec innervation nociceptive AF ext/ hyperalgésie

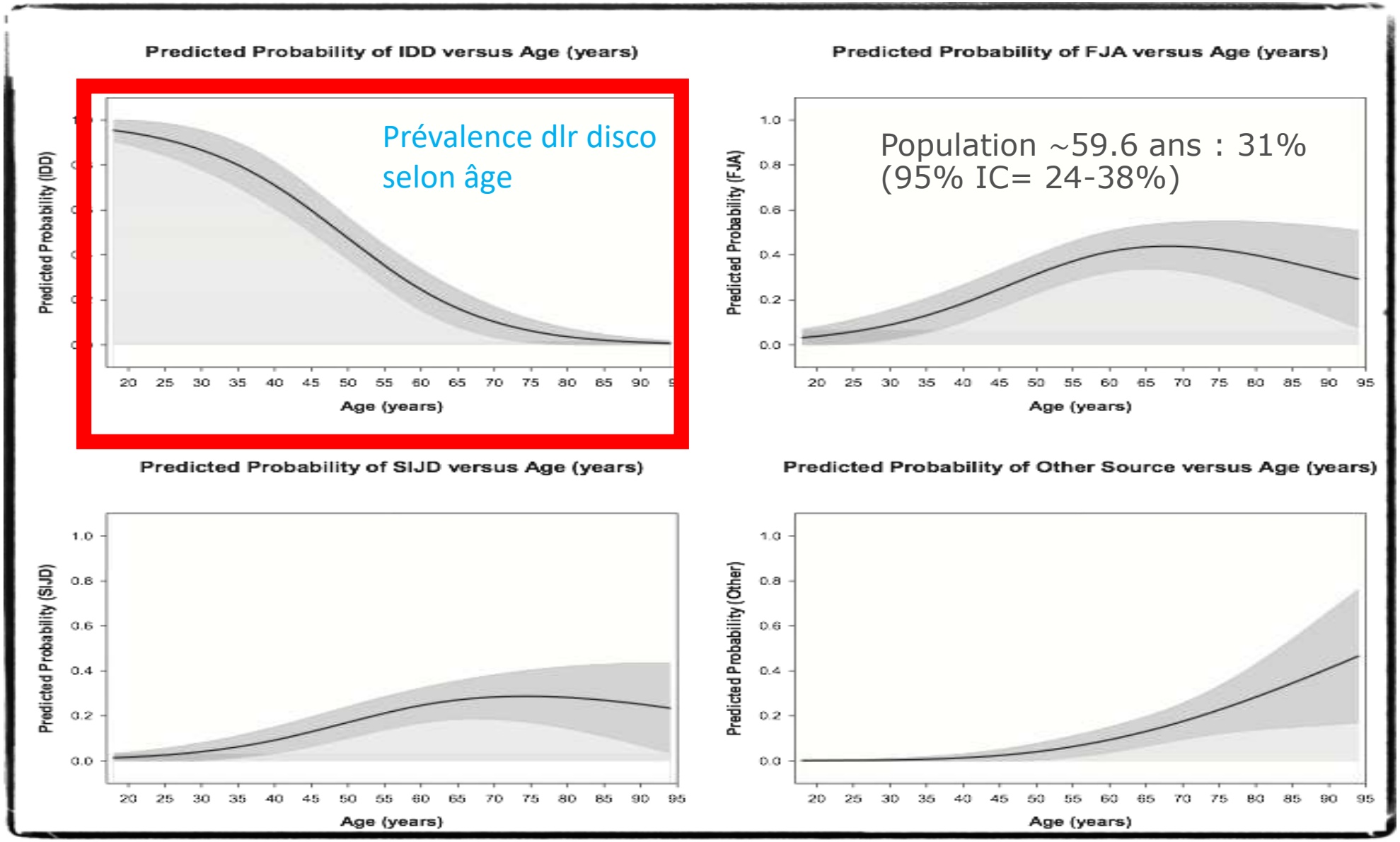
Dlr DISCOGÉNIQUE

J Spinal Disord Tech 2004; 17: 64-71
Spine 2005; 30; 174-80; Spine J 2008; 17: 289-99
Pain Med 2013; 14 (6): 813-36

*Lancet 1997; 350 (9072): 178-81 et Spine (Phila Pa 1976) 2018;43 (21):1496–501 et*Clin Orthop Relat Res* 2018;476(10):2027–36.

Symptomatologie

Douleur discogénique
Douleur vertébrogénique



Pain Medicine 2011
12(2): 224

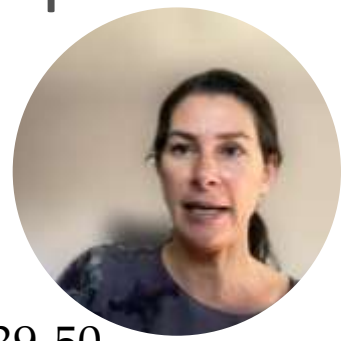
- Augmentation de l'âge associée de façon significative avec probabilité augmentée de dlr facettaire ou dlr SI (ad 70 ans)

Douleur discogénique

- Aucun symptôme spécifique
- Douleur lombaire centrale +/- douleur somatique référée (62%...)
- Hx de blocages à répétition
- Dlr au repos (nociception chimique)
- Aggravée par mouvement (nociception mécanique)
- Manoeuvre de Vasalva peut être positive

Aucun signe spécifique

- Blocage lombaire +/- imp, redressement 'biphasique'
- Pas de signe neurologique
- MMT négative



Eur Spine J 2007; 16: 1539-50
Pain Physician 2012;15:171–8

Diagnostic douleur discogénique

Déchirures annulaires: À IRM:

- Surtout L5-S1 (50%+) >>>L4-L5
- Déchirure annulaire (presque toujours sx)

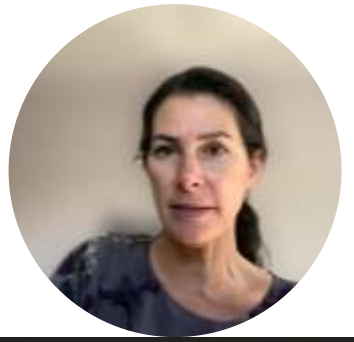
Toujours possible que patient soit asymptomatique (14%)*

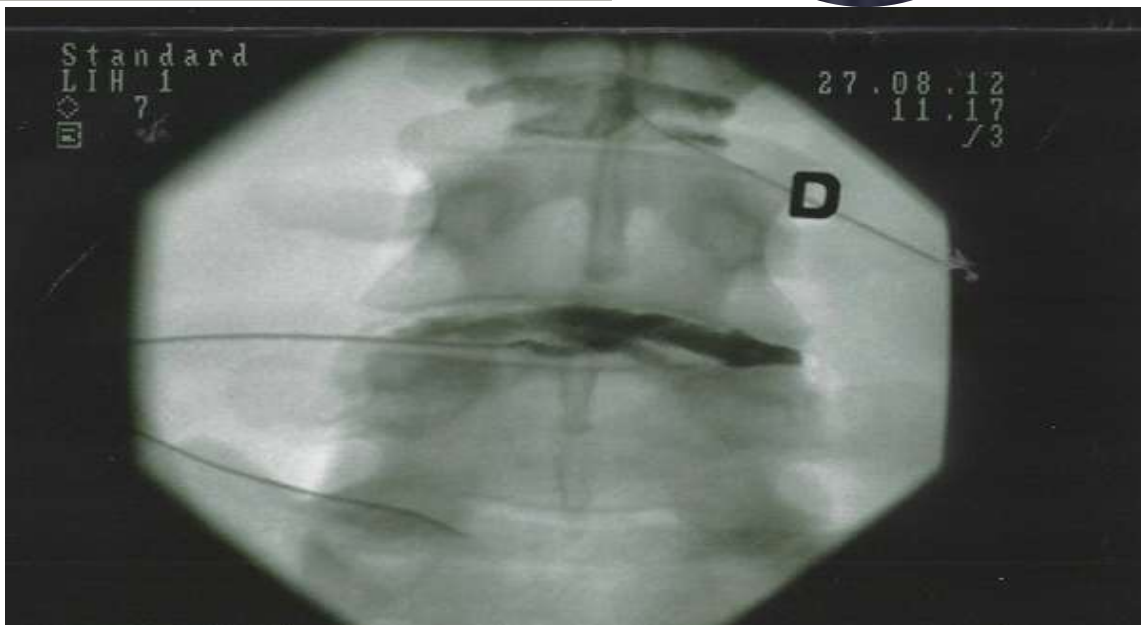
Hernie discale, dégénérescence discale: À IRM ou scan (souvent asx)

Dx: Provocation discale (pas de gold standard)

NEJM 1994; 331(2): 69-73

Provocation discale avec manométrie Dx non-équivoque de dlr discogénique (critères IPSIS 2013)



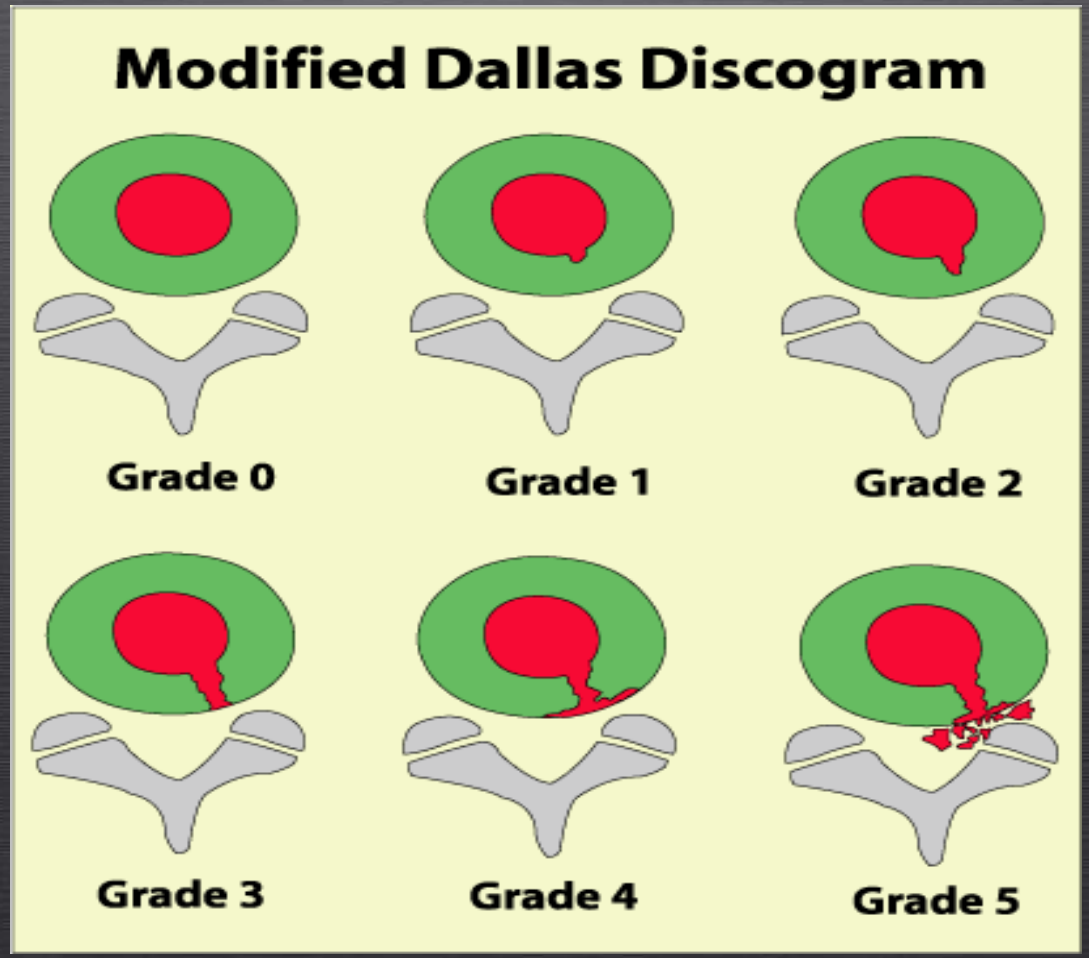


- Douleur concordante de ≥6/10
- Limite de volume de 3 ml
- Manométrie: <50 psi au-dessus pression d'ouverture
- Disques adjacents:
  - Pour 1 disque contrôle: aucune dlr ou dlr nonconcordante à une pression de >15 psi au-dessus pression d'ouverture
  - Pour 2 disques adjacents: aucune dlr 2 disques ou 1 disque sans dlr ET un disque avec dlr nonconcordante à une pression de >15 psi au-dessus pression d'ouverture

Bogduk N. Practice Guidelines for Spinal Diagnostic and Treatment Procedures. 2nd edition. San Francisco, CA: ISIS; 2013: 420-33.

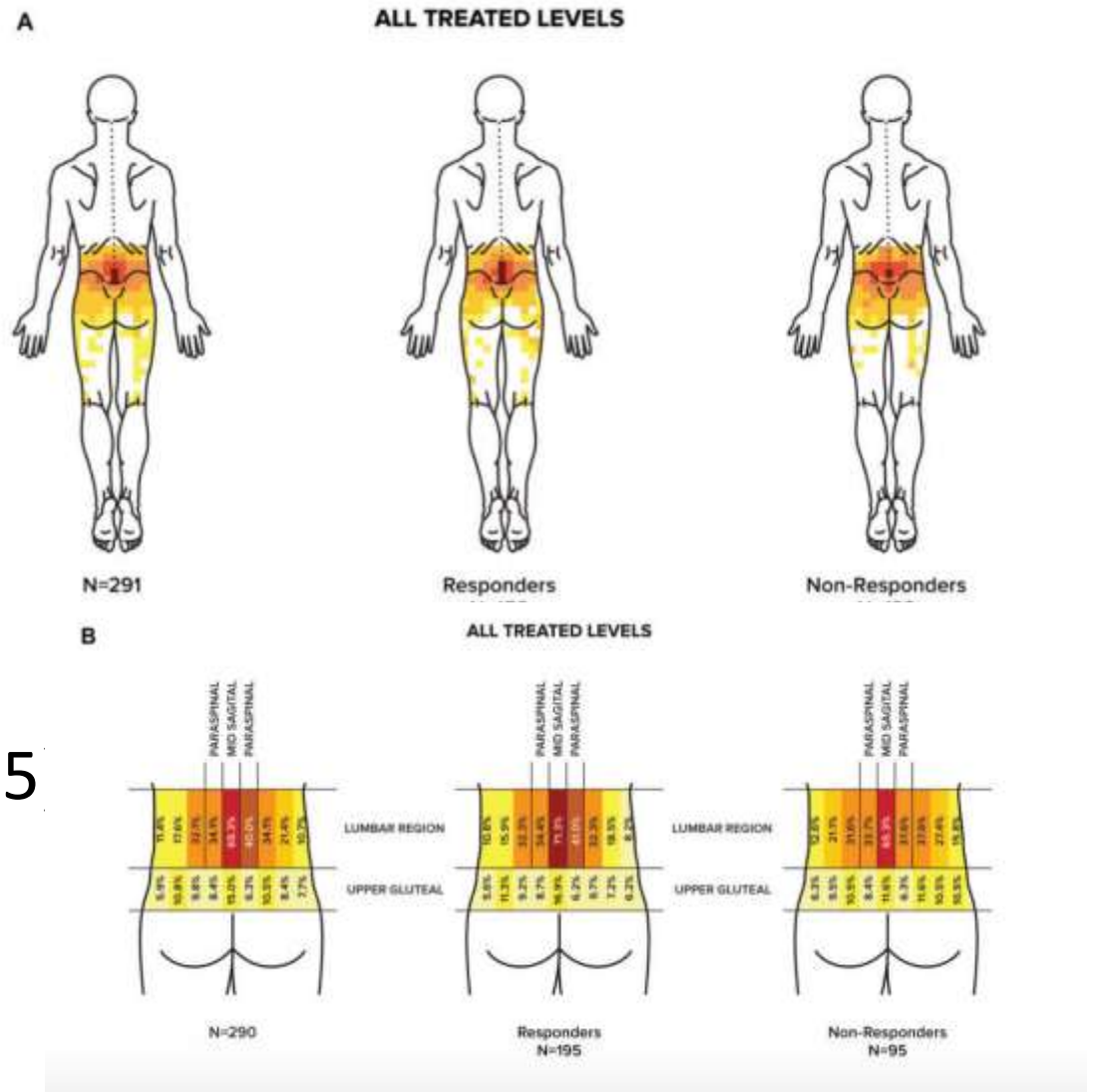
Déchirure annulaire

Scan post-provocation discale



Douleur vertébrogénique

- **Douleur lombaire centrale chronique**
  - Dlr paraspinale et/ou glutéale possible
  - Aucune dlr distale aux genoux
  - ↑ dlr à l'activité (OR 2.099)
  - Pas de dlr à l'extension lombaire (OR 1.845
  - Durée +5ans (OR 2.366)
- **Examen neuro: Normal**
- **IRM: MODIC 1 et/ou 2 &**



Barrett S Boody et al. Pain Med 23 (S2), 2022; S2-S13
McCormick ZL et al. Pain Med 23 (S2), 2022: S14-S33
&McCormick ZL et al. Pain Med 23 (S2), 2022: S34-49

Changements MODIC

Type 1: Oédème inflammatoire autour du disque. Associé avec fissuration du plateau vertébral et présence de IL-6,8 et PGE2

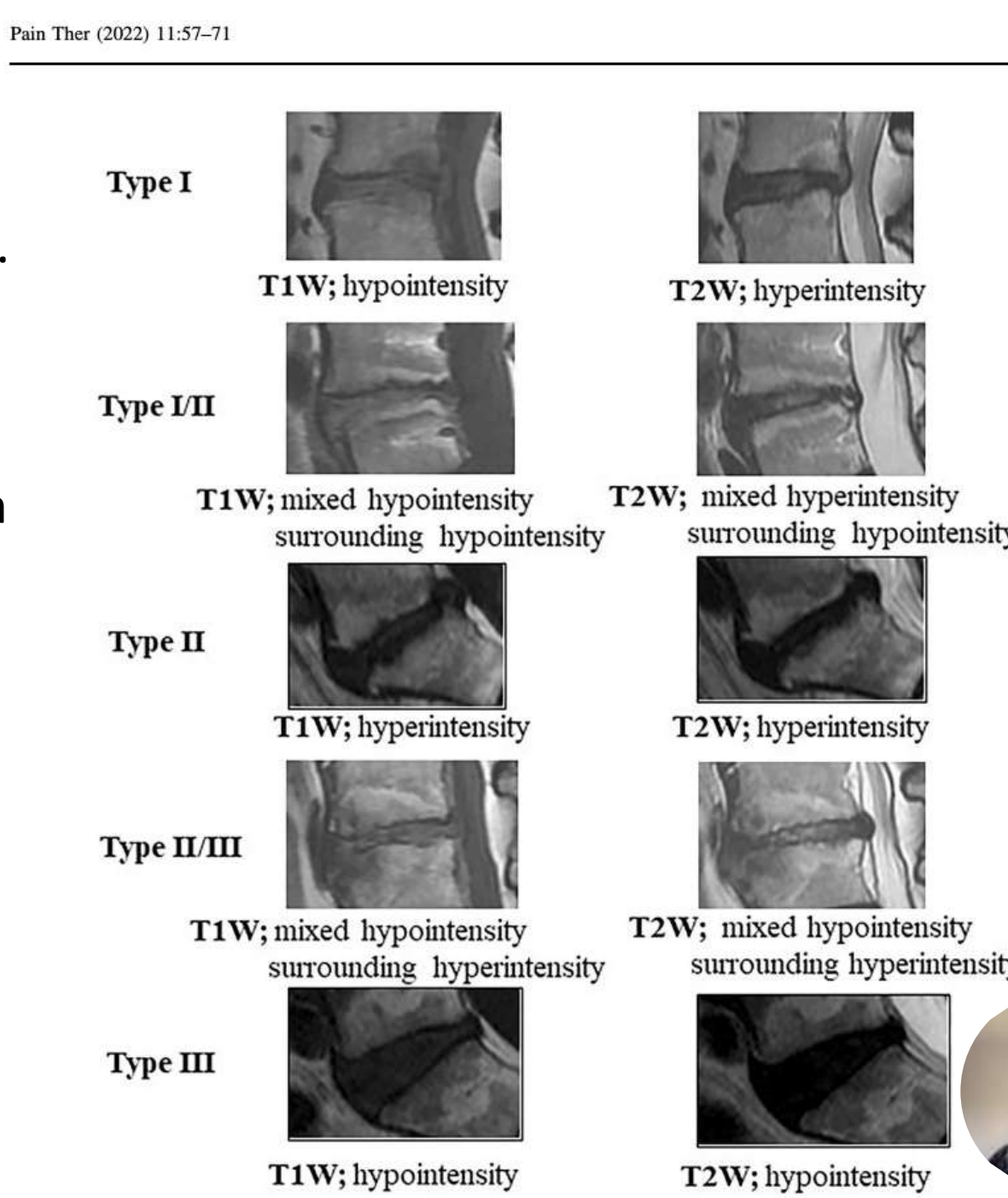
- Résolution possible ou évolution vers type 2

Type 2: Infiltration graisseuse après inflammation aiguë

Type 3: Sclérose du corps vertébral

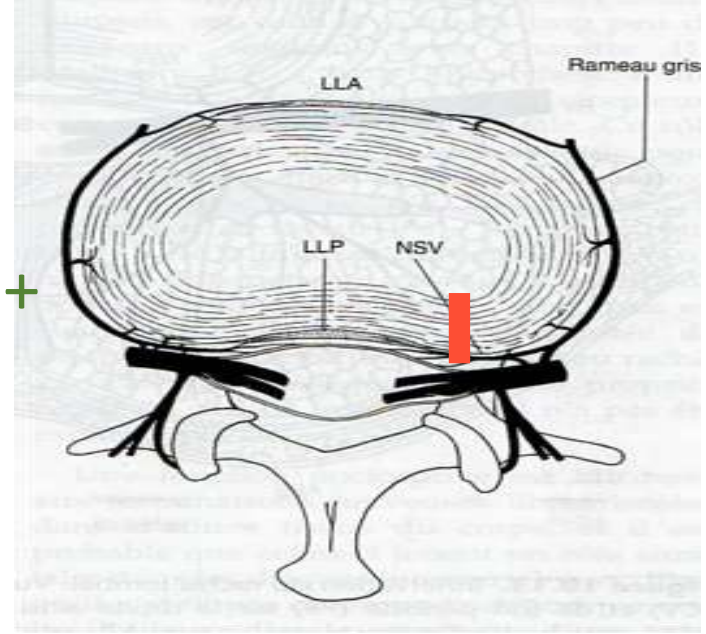
- Type 1 et 2 reliés à la douleur
- Changements Modic cz 19-59% des pts avec lombalgie chronique (prévalence 36%)
- Type 1/2 plus associé à dlr lombaire**

AJNR 2008; 29: 838-42
*Pain Ther 2022; 11(1):57-71



Avant de conclure à dlr discovertébrogénique...

EXS
stabilisation
lombaire +++



Infiltrations à tenter pour éliminer autres sources de douleur

1. Épidurale caudale/épidurales TF bilatérales
   - ↓ inflammation épidurale rétrodiscal en bloquant les NSV
2. Blocs facettaires et/ou BBM
   - Éliminer dlr origine facettaire
3. Infiltration sacro-iliaques et/ou BBL

Traitements intradiscaux et leurs évidences

Annuloplastie
PRP-plasma riche en plaquettes
Ozone

2010
Ozone

2013
Annuloplastie

2016
PRP

2022- dlr vertébrogénique
TL n. basivertébrale

The intervertebral disc

~~Washington~~ is a place where good ideas go to die.

Barack Obama

quotefancy

Annuloplastie par radiofréquence

Annuloplastie par radiofréquence bipolaire au froid

- Dénervation nocicepteurs a/n couches externes
- Coagulation des fibres de collagène
- Produit lésion plus étendue de tout l'anneau postérieur et sur toute sa hauteur

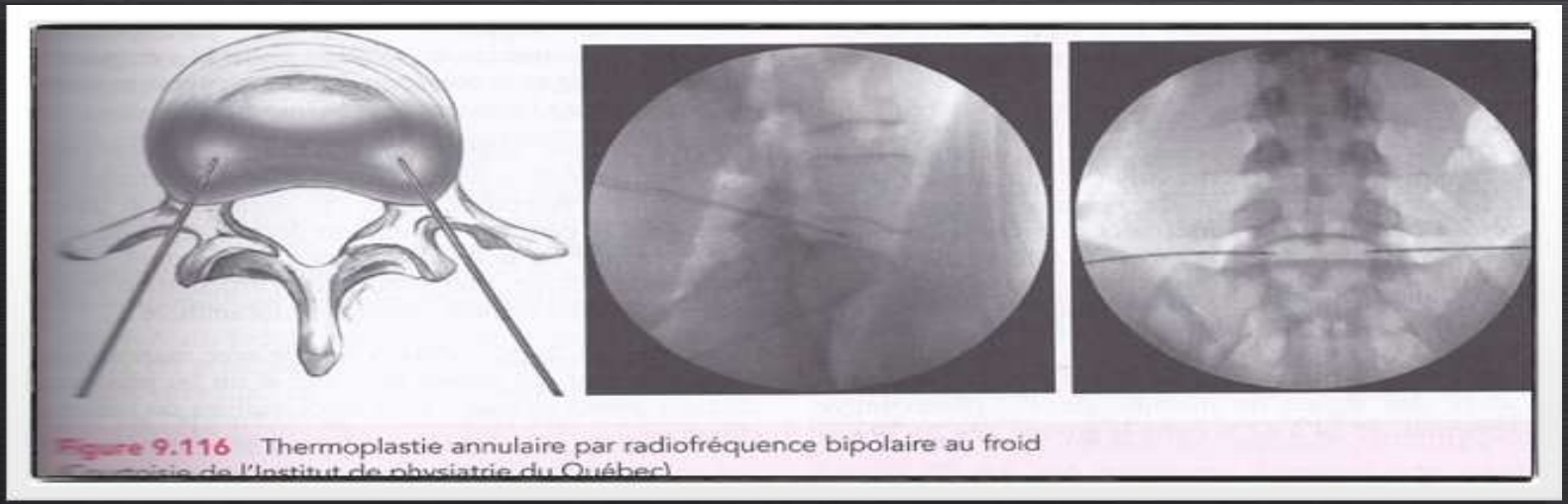


Figure 9.116 Thermoplastie annulaire par radiofréquence bipolaire au froid

Bergeron, Fortin, Leclaire. Pathologie médicale de l'appareil locomoteur. 2 édition. Edisem 2008

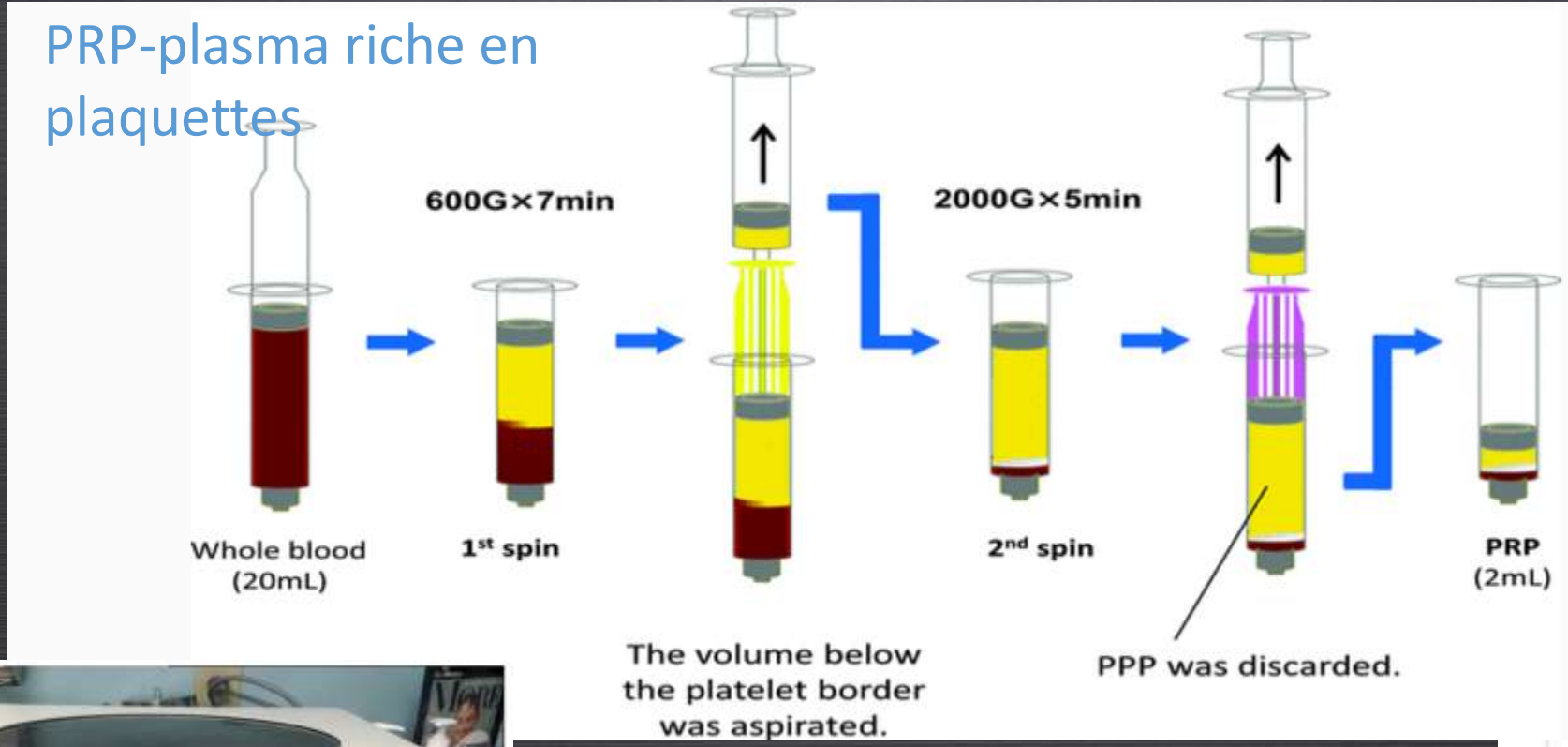
A Randomized, Placebo-Controlled Trial of Transdiscal Radiofrequency, Biacuplasty for Treatment of Discogenic Lower Back Pain

- ÉCR; BID (29 pts) vs BID placebo (30pts) cz pts avec lombalgie chronique >6 mois (PD+)
- Suivis 1,3,6 mois
- Pas efficace à 1 et 3 mois
- À 6 mois: BID: amélioration SS pour SF-36 (↑15 pts) et EVA(↓2.2 pts)
  - Sous-groupe de <40ans: SS pour ODI (↓11 pts) à 6 mois
- **Rx très peu efficace pour la lombalgie (malgré sélection très stricte)**
  - Pas applicable pour les obèses, fumeurs et ceux avec compensation (exclus de l'étude)

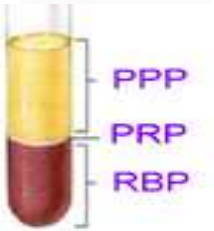
Pain Med 2013; 14 (3): 362-373

Plasma riche en plaquettes-PRP

PRP-plasma riche en plaquettes



Idéalement, 4X PLUS DE PLTS QUE DANS LE SANG (150-350x10^3) X4= 600-1400x10^3/mm^3



Concentration des facteurs de croissance parralèle concentration des plaquettes dans le PRP

Riche ou pauvre en leucocytes

PRP ID

FC relâchés des granules plaquettaires: platelet-derived GF, transforming GF-béta, insulin-like GF, vasoendothelial GF, epithelial GF, basic fibroblast GF

Médiateurs pro-inflammatoires (cytokines)- GB

Inflammation locale et cascade de guérison

Études in vitro/in vivo

- Synthèse MEC du NP
- Migration/prolifération cellules NP
- ↓cytokines anti-inflammatoires IL-1 et TNFα
- Formation collagène II ds NP
- Synthèse protéoglycans
- ↑contenu hydrique/↑ hauteur discale à IRM

EFFET RÉGÉNÉRATIF

Anti-inflammatoire

Moshiri A, Oryan A. Role of tissue engineering in tendon reconstructive surgery and regenerative medicine: current concepts, approaches and concerns. Hard Tissue 2012;1(2):11.

PM R 8 (2016) 1-10

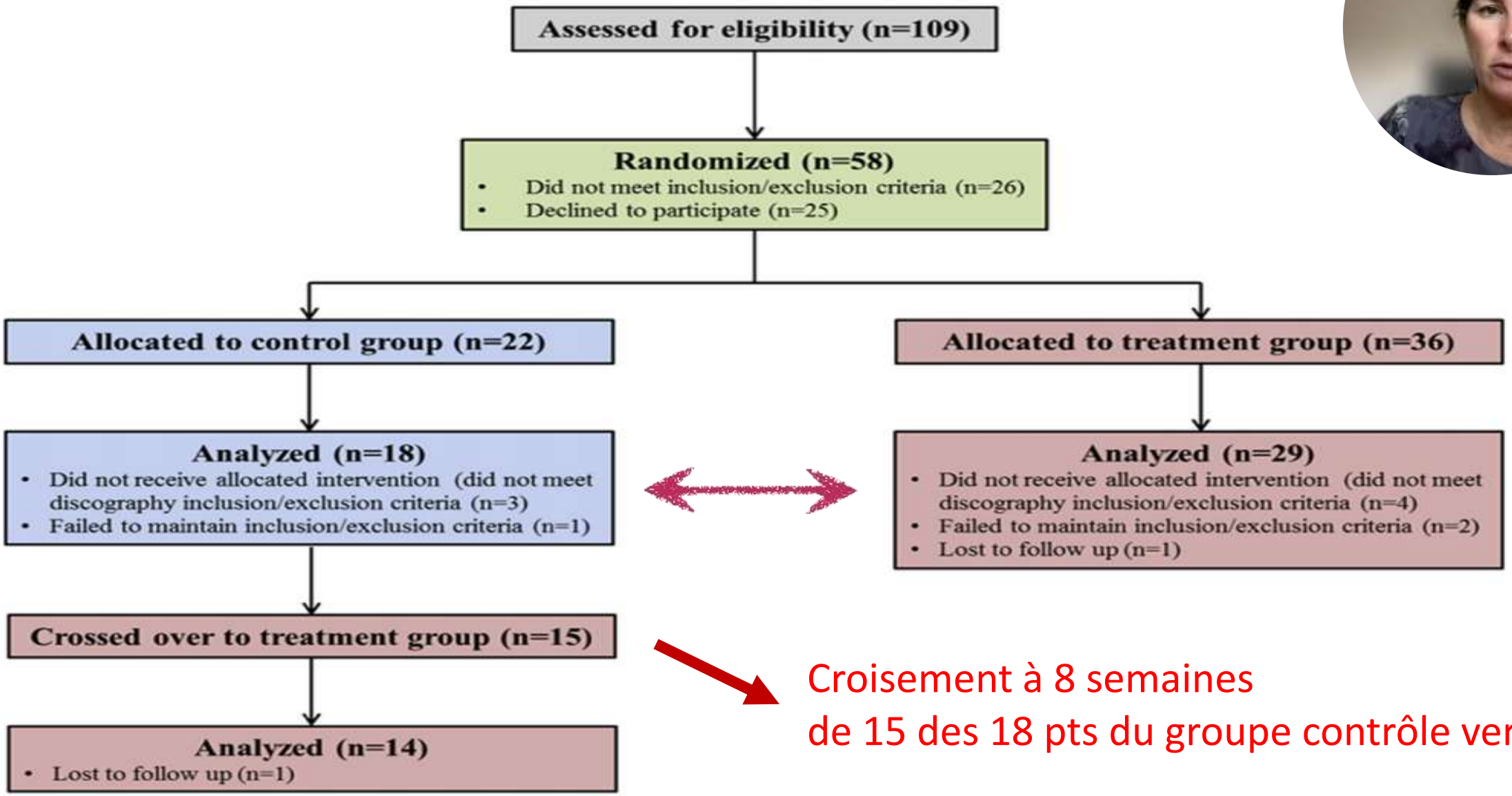
www.pmrjournal.org

Original Research—CME

Lumbar Intradiskal Platelet-Rich Plasma (PRP) Injections: A Prospective, Double-Blind, Randomized Controlled Study

Yetsa A. Tuakli-Wosornu, MD, MPH, Alon Terry, MD, Kwadwo Boachie-Adjei, BS, CPH, Julian R. Harrison, BS, Caitlin K. Gribbin, BA, Elizabeth E. LaSalle, BS, Joseph T. Nguyen, MPH, Jennifer L. Solomon, MD, Gregory E. Lutz, MD

- Étude prospective, double-insu, randomisée, 58pts
  - 2:1 Tx:contrôle
- Financement: Harvest
- Discographie +



Croisement à 8 semaines
de 15 des 18 pts du groupe contrôle vers PRP

Figure 1. Flow chart of study participant enrollment, randomization, and analysis.

À 8 semaines

n= 47 pts (29 PRP; 18 contrôle)

Table 3
Results of patient-reported outcome scores between control and PRP groups over time

Outcome	Time	Control Mean	SD	PRP Mean	SD	*P* Value*
FRI	Baseline	45.37	15.61	51.47	15.62	.027
	1 wk	45.99	15.74	49.83	15.72	
	4 wk	44.17	17.14	43.25	16.68	
	8 wk	44.45	19.60	37.99	19.60	
SF-36 Pain	Baseline	47.92	21.13	43.28	21.11	.079
	1 wk	47.22	21.76	40.52	21.76	
	4 wk	47.22	19.98	55.17	19.98	
	8 wk	52.78	22.19	61.29	22.19	
SF-36 Physical Function	Baseline	56.11	18.54	56.40	18.52	.435
	1 wk	51.28	20.04	51.63	20.46	
	4 wk	60.97	21.43	58.43	21.17	
	8 wk	57.08	22.91	61.70	22.89	
Current Pain	Baseline	4.61	2.21	4.74	2.21	.157
	1 wk	4.78	1.99	4.21	1.99	
	4 wk	4.61	2.21	4.00	2.21	
	8 wk	4.39	2.59	3.09	2.59	
Best Pain	Baseline	2.08	1.74	2.81	1.78	.015
	1 wk	2.44	1.82	2.88	1.83	
	4 wk	2.28	1.82	2.53	1.83	
	8 wk	2.72	2.12	2.00	2.06	
Worst Pain	Baseline	7.72	1.53	7.98	1.56	.086
	1 wk	7.39	1.95	6.86	1.94	
	4 wk	7.11	1.91	6.41	1.88	
	8 wk	6.83	2.33	5.82	2.33	

PRP = platelet-rich plasma; SD = standard deviation; FRI = Functional Rating Index; SF-36 = 36-Item Short Form Health Survey.
* *P* value indicates significance of interaction effect of treatment over time.

Pas de complication

Groupe original de PRP

6 mois (n=28 pts)

EVA-pire dlr (-1.66) p<0.01

(MCID=2)

FRI (-12.92) p<0.01

(MCID=9)

SF-36 dlr (+14.67) p=0.03

(MCID=10)

1 an (n=21 pts)

EVA-pire dlr (-2.12) p<0.01

FRI (-17.49) p<0.01

SF-36 dlr (+24.51) p<0.01

SF-36 fct (+16.80) p<0.01

(MCID=5)

Aucune donnée catégorique
Pas analyse du PRP
Pas analyse par IRM
Pas de cx à 1 an

Pain Medicine 2016; 17: 1010–1022
doi: 10.1093/pm/pnv053

OXFORD

SPINE SECTION

Original Research Articles

Intradiscal Platelet-Rich Plasma Injection for Chronic Discogenic Low Back Pain: Preliminary Results from a Prospective Trial

David Levi, MD,* Scott Horn, DO,* Sara Tyszko, PA,* Josh Levin, MD,† Charles Hecht-Leavitt, MD,‡ and Edward Walko, DO*

levels, two at 3 levels, and one at 5 levels. Categorical success rates were as follows: 1 month: 3/22 = 14% (95% CI 0% to 28%), 2 months: 7/22 = 32% (95% CI 12% to 51%), 6 months: 9/19 = 47% (95% CI 25%

Étude prospective, 22 pts; pts qui ont payé 950$x1 niveau et 1150$x 2 niveaux- pas de subvention

Injection fluoroscopique ID 1.5 cc PRP autologue

Dx: Provocation discale OU dlr lombaire centrale, dlr assis, déchirure annulaire à IRM, protrusion, MODIC 1 ou 2 . Autres sources dlr lombaire éliminés

Succès: ≥50% ↓EVA *et* ≥30% ↑ODI

Table 7 Number and proportions (95% confidence intervals) of patients who reported the combinations of categorical changes indicated in back pain scores on visual analog scale (VAS) and Oswestry Disability Index (ODI) after treatment with intradiscal platelet-rich plasma

	Outcomes				
	Back pain (VAS)				ODI
Follow-up	100%	>50%	<50%	Worse	
1 month		**3**		1	**>30%**
		14% (0-28)		5% (0–13)	
		2	8	1	**<30%**
	22 pts	9% (0–21)	36% (16–57)	5% (0–13)	
		2	3	2	**worse**
		9% (0–21)	14% (0–28)	9% (0–21)	
2 months	1	6	2	1	**>30%**
	5% (0–13)	**27% (9–46)**	9% (0–21)	5% (0–13)	
	1		5		**<30%**
	5% (0–13)	32%	23% (5–40)		
	22 pts	2	1	3	**worse**
		9% (0–21)	5% (0–13)	14% (0–28)	
6 months	1	8	1		**>30%**
	6% (0–15)	**42% (20–64)**	6% (0–15)		
			3	3	**<30%**
			17% (0–32)	17% (0–32)	
	19 pts	1	48%	2	**worse**
		6% (0–15)		11% (0-24)	

Regions highlighted in bold indicate numbers and proportions of patients who satisfied the combined criteria of 50% improvement in VAS and 30% improvement in ODI score.

Aucune complication

Critères inclusion:

Lombalgie ≥6 mois avec ÉVA: ≥40mm/100mm

1- 4 pts: Discographie positive- SIS

OU

2- 18 pts:: Dlr lombaire centrale+ manœuvres de centralisation et IRM:

HIZ, ↓intensité signal en T2, protrusion discale, MODIC 1-2

PRP-haute concentration

Étude rétrospective 37 pts- ID PRP (>10X)
VS cohorte hx 29 pts- ID PRP (<5X)

› Int Orthop. 2022 Jun;46(6):1381-1385. doi: 10.1007/s00264-022-05389-y. Epub 2022 Mar 28.

Clinical outcomes following intradiscal injections of higher-concentration platelet-rich plasma in patients with chronic lumbar discogenic pain

Cole Lutz [1], Jennifer Cheng [2], Meredith Prysak [3], Tyler Zukofsky [3], Rachel Rothman [2], Gregory Lutz [4 5]

60 ml sang= 4 ml PRP (plt >10x)

Injection ID 2 ml/ disque sur 1-2 min
Pts ont reçu PRP- leukocyte rich ou poor

Age moyen: 42.7+/- 18.2 ans (14-72)
Suivi moyen à 18.3 +/- 13.3 mois (variable…)

Succès= : ≥2 pts EVA ET ≥9-pts FRI ET satisfaction pt
- À ~18 mois: 70% pts (26/37 pts) ; échec 19% (7/37pts) (aucun critère rempli)
- Satisfaction 81% (30/37pts) (>10X) vs 55% (cohorte hx 29 pts (<5X)) p=0.032

1 cas de spondylodiscite

ELSEVIER

Check for updates

The SPINE JOURNAL

The Spine Journal 22 (2022) 226–237

Systematic Review/Meta-Analysis

The effectiveness of intradiscal biologic treatments for discogenic low back pain: a systematic review

Byron J. Schneider, MD[a,*], Christine Hunt, DO[b], Aaron Conger, DO[c], Wenchun Qu, MD, PhD[d], Timothy P. Maus, MD[e], Yakov Vorobeychik, MD, PhD[f], Jianguo Cheng, MD, PhD[g], Belinda Duszynski, BS[h], Zachary L. McCormick, MD[i]

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[c] *Division of Physical Medicine and Rehabilitation, University of Utah, Salt Lake City, UT, USA*
[d] *Department of Pain Medicine, Center of Regenerative Medicine, Mayo Clinic Florida, Jacksonville, FL, USA*
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[f] *Penn State Health, Milton S. Hershey Medical Center, Department of Anesthesiology and Perioperative Medicine, Department of Neurology, Hershey, PA, USA*
[g] *Departments of Pain Management and Neurosciences, Cleveland Clinic, Cleveland, OH, USA*
[h] *Spine Intervention Society, Hinsdale, IL, USA*
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Received 18 May 2021; revised 20 July 2021; accepted 22 July 2021

- Revue systématique, méta-analyse non faite car études trop hétérogènes
- Fait en 2018, update 2020
- 3063 études(après lecture abstract)= 37 études
- Patients avec douleur discogénique confirmé par discographie provocatrice OU clinique et imagerie consistent avec dlr discogénique
- Thérapies inclus:
  - Cellules souches mésenchymales
  - PRP
  - Cellules souches mésenchymales avec gras microfragmenté
  - Injectat membrane amniotique
  - Sérum autologue conditionné
- Outcome primaire: ↓ ≥50% dlr à 6mois
- Outcome secondaire: ↓ ≥ 2 pts EVA; satisfaction pt; fct, ↓ utilisation analgésiques/chx; cahngements discaux à IRM

PRP – analyse globale des données

- 1 RCT et 4 études de cohorte
- Soulagement >50% dlr lombaire avec un suivi minimum de 6 mois:
  - 54.8% (IC95%: 40-70%) (23/42 pts)
  - Pas d'autres analyses possibles à cause de l'hétérogénéité des outcomes

- Évidence GRADE: Évidence de très basse qualité (*very low)*
  - ECR: problème de randomisation, outcomes manquants chez ≥20% pts
  - Pas étude de plus de 30 pts
  - Intervalles de confiance très larges
  - Études avec manque de puissance pour détecter des changements significatifs entre les groupes

Systematic Review and Meta-Analysis

Medicine

OPEN

Efficacy of intradiscal injection of platelet-rich plasma in the treatment of discogenic low back pain

A single-arm meta-analysis

Bing Peng, MD[a], Baoshan Xu, MD[b], Weiyong Wu, MD[a], Lilong Du, MD[b], Tongxing Zhang, MD[b], Jianqiang Zhang, MM[c,*]

- 3ECR et 3 études prospectives

↓ DOULEUR >30%

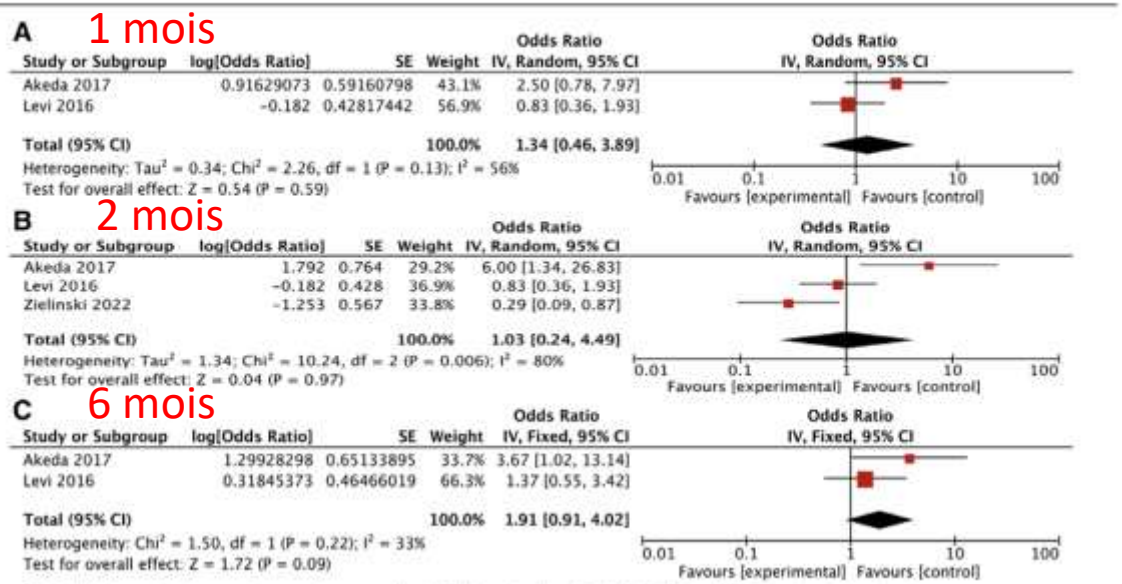


Figure 3. The incidence rate when pain scores decreased by >30% from baseline after (A) 1, (B) 2, and (C) 6 months of treatment.

ODI >30%

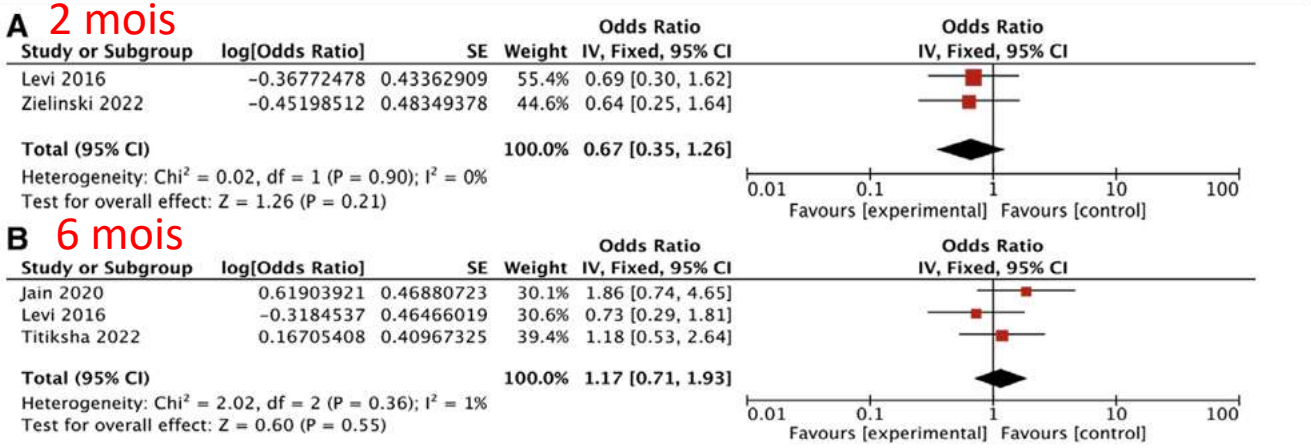
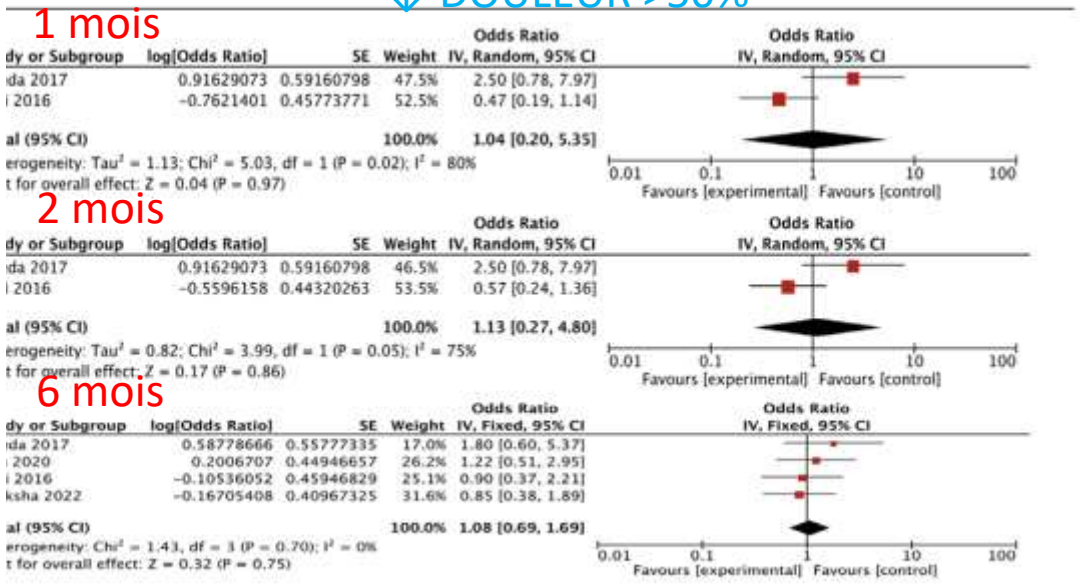


Figure 5. The incidence rates when ODI scores decreased (A) by >30% from baseline after 2 months of treatment and (B) by >50% from baseline after 6 months of treatment. ODI = Oswestry Disability Index.

↓ DOULEUR >50%



The incidence rates when pain scores decreased by >50% from baseline after (A) 1, (B) 2, and (C) 6 months of treatment.

Intradiscal Platelet-Rich Plasma Injections for the Treatment of Discogenic Chronic Low Back Pain : A Prospective Clinical Trial

IPSIS Vancouver 2022

Carl Majdalani, MD, BSc[1], Christopher Mares, MD, BSc, FRCPC[1,2], Isabelle Denis MD, BSc, FRCPC[1,2]

Institut de Physiatrie du Québec

[1] Division of Physical Medicine and Rehabilitation, University of Montréal, Centre Hospitalier de l'Université de Montreal, Montreal, Québec (QC), Canada
[2] Institut de Physiatrie du Québec, Montréal, Québec, Canada

Introduction

Intradiscal Platelet-Rich Plasma (PRP) for chronic low back pain (CLBP) is safe and shows moderate efficacy in improving pain levels and function between 6 to 12 months.

The interest behind the use of PRP is increasingly growing.

Objectives

To assess the efficacy of intradiscal PRP injection in chronic low back pain subjects at up to 18 months

Methods

10 patients were followed prospectively for 18 months after initial unsuccessful management for confirmed discogenic pain (9/10 had a positive provocative discography).

Leucocyte-poor PRP intradiscal injections were done as per the SIS guidelines

Primary outcomes: changes in low back pain (Visual Analog Scale (VAS)) and function (Oswestry Disability Index (ODI)). Statistically significant changes included ↓2 pts or ↓50% on the VAS and ↓30% on the ODI

Secondary outcomes: return to work, intake of opioids, and use of physical therapy.

Outcomes were evaluated at 6, 12, and 18 months.

Results

Demographics: 10 patients (5 women; 5 men)

Average age: 41 years old ± 10.1 years

Average LBP duration: 53.5 months ± 34 months

Injection levels: 2 at L3-L4; 3 at L4-L5; 8 at L5-S1

Mean PRP injectate volume: 2.26cc ± 0.78cc

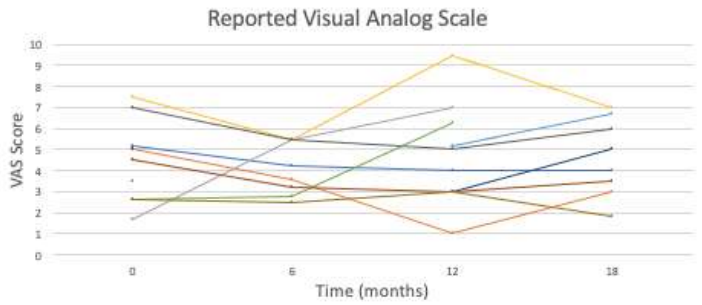
89% of patients with High Intensity Zone (HIZ) on MRI

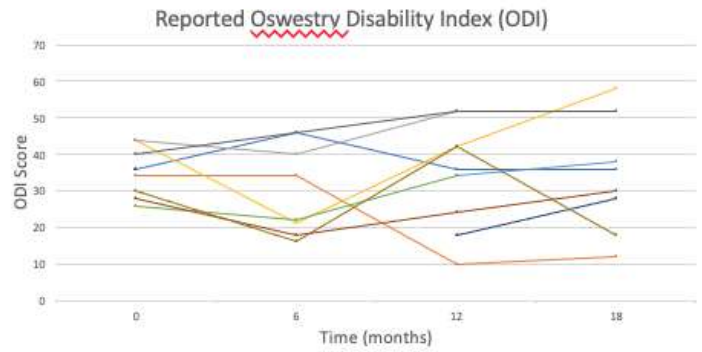
Maximal benefit seen at 6 months in VAS and ODI scores

Outcome / Time	6 months	12 months	18 months
VAS (MCID : ↓2 pts or ↓50%)	13%	30%	25%
ODI (MCID : ↓30%)	25%	20%	25%

Outcome / Time	Baseline	18 months	Net change
Currently working	50%	60%	+10%
Taking opioids	40%	40%	0%
Doing physical therapy	50%	30%	-20%

Please note that losses at follow up are found in our data points





Please note the gaps in the graphics above are secondary to missing data points at the set follow up dates

Conclusion

The prospective data gathered during a longitudinal follow-up of 18 months demonstrated modest pain relief and functional improvements in patients with long-lasting discogenic low back pain.

Secondary outcomes demonstrated minute but favorable changes in adjuvant treatment and return to work.

Safety of this procedure has been noted in the absence of complications.

Acknowledgements

Special thanks to Dr. Marc Filiatrault, Dr. Claude Bouthillier, Dr. Richard Lambert, Dr. Yves Bergeron, and Dr. Mathieu Boudier-Revéret for their contributions to this project

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2. Levi D, Horn S, Tvszko S, Levin J, Hecht-Leavitt C, Walko E. Intradisc Injection for Chronic Discogenic Low Back Pain: Preliminary Result Trial. Pain Med. 2016;17(6):1010-1022
3. Tuakli-Wosornu YA, Terry A, Boachie-Adjei K, et al. Lumbar Intradiskal (PRP) Injections: A Prospective, Double-Blind, Randomized Controlled St 2016;8(1):1-10.

Étude prospective, 10 patients (2016-9)

41 ans ± 10.1 ans

Durée moyenne dlr 53.5 months ± 34 months

Provocation discale + : 9/10 pts

89% avaient une déchirure annulaire à IRM

5 pts avec MODIC 1
2 pts avec MODIC 2
3 pts sans MODIC

Niveaux injectés: 2 at L3-L4; 3 at L4-L5; 8 at L5-S1

Volume moyen PRP injecté: 2.26cc ± 0.78cc (Harvest Smart-Prep2)

Outcome / Time	6 months	12 months	18 months
VAS (MCID : ↓2 pts or ↓50%)	13%	30%	25%
ODI (MCID : ↓30%)	25%	20%	25%

Outcome / Time	Baseline	18 months	Net change
Currently working	50%	60%	+10%
Taking opioids	40%	40%	0%
Doing physical therapy	50%	30%	-20%

Please note that losses at follow up are found in our data points

Beaucoup de questions sur le PRP

- Grande variation interpersonnelle de plts (et donc, de FC)- âge, comorbidités, médication (AINS), statut nutritionnel
- Composition PRP optimale-GR et GB?
- Effet du contraste, ATB, anesthésiant avec PRP- effets délétères?
- Injection dans AF, NP ou plateau vertébral?
- Système utilisé:
  - 1 ou 2 spins (centrifugation)
  - Concentration plaquettaire basse vs haute

- Concentration plaquettaire basse (2.5-3Xbaseline)-Arthrex ACP (2-3×), Cascade PPR therapy (1-1.5×), PRGF by Boitech Institute Vitoria, Spain (2-3×), Regen PRP (Regen Laboratory, Mollens, Switzerland) vs haute (5-9Xbaseline)-Biomet GPS II and III (platelet count 3-8×), Harvest **SmartPRep 2 APC+ (4-6×)**, ArterioCyte-Medtronic Magellan (3-7×)

J AM Acad Orthop Surg 2016 24 (7): e62-78

OZONE-GAZ

Mélange O_2 95-98% et O_3 à 2-5%

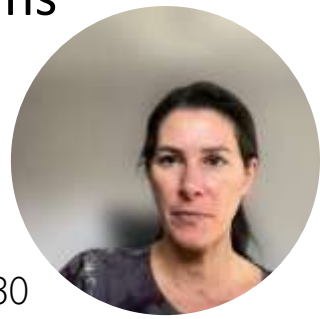
Mécanismes action ozone

1- Oxygénation tissulaire

2- Effet anti-inflammatoire

- Interromps la cascade acide arachidonique en prostaglandines
- ↑ cytokines immunosuppresseurs (TGFβ1, IL-10)
- ↑ relâche antagonistes neutralisant cytokines proinflammatoires (IL-1, 8, 12, 15, IFNα, TNFα)

3. *Momification discale*- déshydratation de matrice→ ↓ brise chaînes de glycoaminoglycans



EFFET ANALGÉSIQUE

Neuroradiol 2001; 14 (suppl 1): 23-30
Lymphokine Cytokine Res 1993; 12: 121-6
Acta neurochir Suppl 2011; 108: 123

Complications

1- Acute Bilateral Vitreo-retinal hemorrhages following oxygen-ozone therapy for lumbar disk herniation. Lo Giudice G et al. Am J Opthalmol 2004; 138: 175-77

2- Thunderclap Headache Caused by Minimally Invasive Medical Procedures: Description of 2 Cases. Chalaupka FD et al. Headache 2007; 47: 293-5

3- Ventral and dorsal root injury after oxygen-ozone therapy for lumbar disk herniation. Ginanneschi F et al. Surgical Neurology 2006; 66: 619-621

4- Fulminating Septicemia secondary to oxygen-ozone therapy for lumbar disc herniation Gazzeri R. et al. Spine 2007; 32(3): E121-3

5- A Pyogenic Discictis at C3-C4 With Associated Ventral Epidural Abscess Involving C1-C4 After Intradiscal Oxygen-ozone Chemonucleolysis. Wu B and al. Spine 2009, 34 (8): E298-E304.

6- L5-S1 *Achromobacter xylosoxidans* Infection Secondary to Oxygen-Ozone Therapy for th Lumbosacral Disc Herniation. A Case Report and Review of the Literature. Fort NM and al. S (6), p. E413-6

Original Article

INR INTERVENTIONAL NEURORADIOLOGY

Interventional Neuroradiology
2017, Vol. 23(4) 444–450

DOI: 10.1177/1591019917703784
journals.sagepub.com/home/ine
SAGE

MRI findings in lumbar spine following O_2–O_3 chemiodiscolysis: A long-term follow-up

Federico Bruno, Fernando Smaldone, Marco Varrassi, Francesco Arrigoni, Antonio Barile, Ernesto Di Cesare, Carlo Masciocchi and Alessandra Splendiani

Abstract

Intradiscal O_2–O_3 injections are conventionally used as a minimally invasive treatment for lumbar disc herniation in patients not responding to conservative treatments. The aim of the present study is to report data of long-term imaging follow-up (3 years) of patients treated with intradiscal O_2–O_3 lumbar chemiodiscolysis. We evaluated the changes of disc volume and the modifications in disc appearance (in terms of disc degeneration) and endplate changes (according to Modic), comparing the results with a control group of patients. Our results showed a stable reduction of the disc herniation volume in patients treated compared with the control group, while we did not find statistically significant differences in terms of disc degeneration and endplate changes (Modic). We concluded that the O_2–O_3 discolysis, despite leading to a significant shrinkage of the disc herniation, does not involve – in the long term – biomechanical changes of the spine in terms of acceleration of the disc degeneration process in comparison with the natural course.

Étude rétrospective. 50 pts ozone, 50 pts contrôle (inj cortico périradiculaire)

Intervalle IRM de 11 mois:
- Résorption de 70% des HD importantes et modérées
- À 3 ans post-O3: Réduction volume discal vu dans 84% des HD
- 81% des disques avait ↓ >50%- ↓ SS plus importante ds gr ozone vs contrôle

DD (changement de Pfirmann): pas accélération vs hx naturelle dans les disques adj non rx vs gr contrôle
MODIC: Pas de changement entre ozone ID et gr contrôle

Conclusion:
Ozone ID est associé à une réduction volume SS des HD avec des effets stables dans l
-O3 plus efficace à réduire le volume des petites HD
Pas de changements biochimiques en terme d'accélération du processus DD ou MODIC vs contrôle.

Metaanalysis of the effectiveness and safety of ozone treatments for herniated lumbar discs

Steppan J. J Vasc Interv Radiol 2010; 21: 534-48

11 études avec injections ID ozone pour rx HD:

- Démonstration que rx à l'ozone est efficace et sécuritaire (cx<0.1%) pour le rx des HD

- Données ~8000 pts, multiples centres, pls pays

- Effet comparable aux HD lombaires traitées avec micro/discectomie chx sans les taux de cx

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The SPINE JOURNAL

The Spine Journal 22 (2022) 895–909

Clinical Study

Intradiscal oxygen-ozone chemonucleolysis versus microdiscectomy for lumbar disc herniation radiculopathy: a non–inferiority randomized control trial

Alexis Kelekis, MD[a], Giuseppe Bonaldi, MD[b], Alessandro Cianfoni, MD[c,d], Dimitrios Filippiadis, MD[a], Pietro Scarone, MD[c,d], Claudio Bernucci, MD[b], David M. Hooper, PhD[e], Hadas Benhabib, MD[f], Kieran Murphy, MD[f,*], Josip Buric, MD[g]

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[b] *Azienda Ospedaliera Papa Giovanni XXIII, Bergamo, Lombardia 24127, Italy*
[c] *Department of Neuroradiology, Neurocenter of Southern Switzerland, Lugano 6900, Switzerland*
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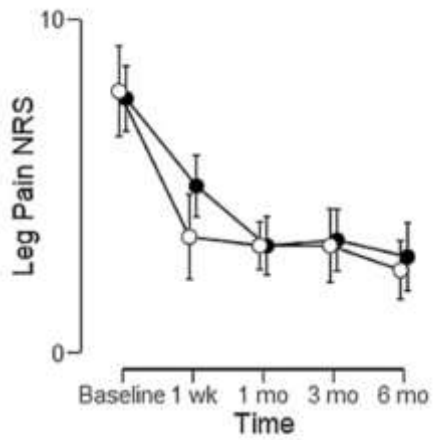
[e] *Spinafx Medical, Vaughan, Ontario, Canada*
[f] *Toronto Western Hospital, University Health Network, Toronto, Canada*
[g] *Casa di Cura San Camillo, Forte dei Marmi, Lucca 55042, Italy*

Received 13 August 2021; revised 26 November 2021; accepted 29 November 2021



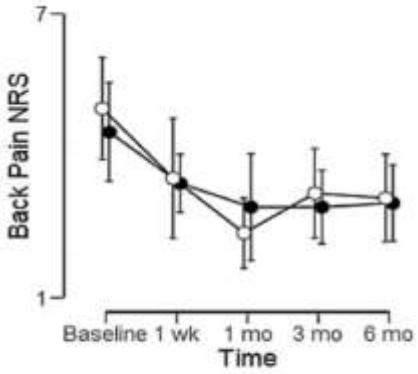


Fig. 5 Leg pain scores through six months. NRS, 0 is no pain, and 10 is maximum pain. Means confidence limits are shown. Time effect was significant (p<.001). Treatment difference betwe was not significant (p=.529). No significant changes after 1 month.

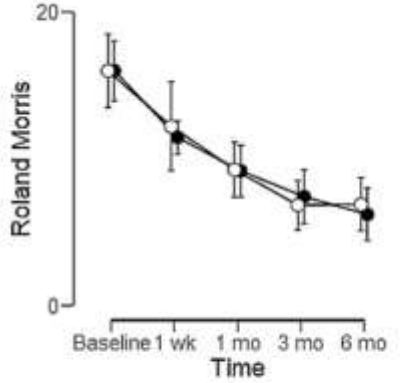


Fig. 7 Roland Morris Disability Index scores through 6 months. 0 is no disability and 24 is complete disability. Means and 95% confidence limits are shown. Time effect was significant (p<.001) while treatment difference between groups was not (p=.566).

1ere ECR multicentrique européenne
Ozone ID vs microdiscectomie pour LS réfractaire- HD 1 niveau
49 pts (moyenne 40 ans) HD contenue 1 niveau, rx conservateur ≥ 6 sem
25 pts O3ID et 24 pts microdiscectomie

Amélioration SS ds les 2 groupes à 6 mois: dlr radiculaire, lombaire et fct
Test de non-infériorité qui supporte O3 ID vs microdiscectomie à 6 mois pour dlr radiculaire
Suivi à 6mois, 71% des pts avec O3 ID ont pu éviter une discectomie
O3 ID procédure + rapide de 58 min. Pas de cx dans les 2 groupes

AT population: -0.31 (SE, 0.84) poin
ITT population: 0.32 (SE, 0.88) pts
La différence entre O3 et MD n'a pa
IC95% de différence de rx des popula

Drs Bergeron, Bouthillier, Denis, Filiatrault, Fortin, Raymond

But étude à IPQ 2011: Traiter douleur discogénique en lien avec déchirure annulaire sx

Critères inclusion

- Patients âgés entre 18 et 65 ans
- Douleur lombaire avec ou sans irradiation aux MI (dlr lombaire prédominante)
- Provocation discale positive selon les critères de l'ISIS/IASP:
  - Douleur concordante de ≥ 7/10
  - Déchirure annulaire de grade 3 ou 4 (échelle de Dallas) à la discographie suivie d'une tomodensitométrie axiale
  - Disque(s) adjacent(s) contrôle(s) asymptomatique(s)
  - Manométrie: <50 psi au-dessus de la pression d'ouverture
- Durée des symptômes ≥ 3 mois
- Échelle visuelle analogue ≥ 5
- Échec du traitement conservateur (physiothérapie, ostéopathie, ergothérapie, médication, infiltrations)

Patients' Characteristics ID Ozone

Number of patients	20	Duration of lumbar pain (month)	
Gender		Average+/-SD	101+/- 88
Male	5 (25%)	Range	24-300
Female	15 (75%)	Medication	20
Age (years)		Narcotics	8
Average	44 +/-9	Schober (cm)	
Range	29-64	On 10 cm	13.8
Scolarity		On 15 cm	19.5
Primary/Secondary	7 (35%)	Levels of ID ozone	
Collegial/University	13 (65%)	1 level :	13
Type of work		L3-L4 :	1
Sedentary	18 (90%)	L4-L5 :	3
Manual	2 (10%)	L5-S1 :	9
		2 levels :	7
		L3-L4 + L4-L5	1
		L4-L5 + L5-S1	6

Succès

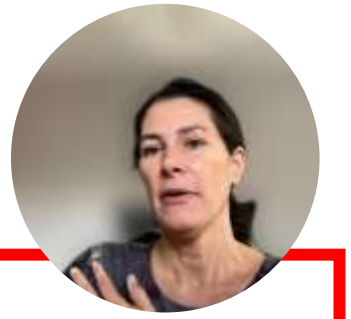
↓≥50% EVA **et** ↑20% fonction
À 3 mois (n=19): 2 pts- 11%
À 6 mois (n=18): 3pts- 17%
↓≥20% EVA **et** ↑20% fonction
À 3 mois (n=19): 5pts- 26%
À 6 mois (n=18): 7pts- 39%

Fonctionnerait mieux chez pt avec DD sx?

PAS DE COMPLICATION

Étude prospective ozone- 28 pts (2016-2019)

~8 ans dlr



Indications: IRM: HD ≥5mm, dégénérescence discale sx

	T2	T6	T12	T18	T24
Pain (↓2 pts or 50%)	17%	10%	29%	13%	40%
ODI (↓ 30%)	17%	32%	35%	7%	47%
Nb of Patients at F/U	23	19	17	16	15

	BASELINE	END	CHANGE
Return to Work	45%	58%	13%
Use of Therapy	54%	38%	-16%
Use of Opioid	54%	45%	-9%

Merci à Dr Majdalani

DONNÉES POUR AUTRES TRAITEMENTS?

ELSEVIER

Check for updates

The SPINE JOURNAL

The Spine Journal 22 (2022) 226–237

Systematic Review/Meta-Analysis

The effectiveness of intradiscal biologic treatments for discogenic low back pain: a systematic review

Byron J. Schneider, MD[a,*], Christine Hunt, DO[b], Aaron Conger, DO[c], Wenchun Qu, MD, PhD[d], Timothy P. Maus, MD[e], Yakov Vorobeychik, MD, PhD[f], Jianguo Cheng, MD, PhD[g], Belinda Duszynski, BS[h], Zachary L. McCormick, MD[i]

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[g] *Departments of Pain Management and Neurosciences, Cleveland Clinic, Cleveland, OH, USA*
[h] *Spine Intervention Society, Hinsdale, IL, USA*
[i] *Division of Physical Medicine and Rehabilitation, University of Utah, Salt Lake City, UT, USA*

Received 18 May 2021; revised 20 July 2021; accepted 22 July 2021

Cellules Souches Mésenchymales autologues- Analyse globale des données (Pettine et Wolff)

- Analyse impossible avec autres types de traitements (pas assez de données)

- Évidence GRADE: Évidence de qualité très basse (*very low)* pour douleur et fonction
  - Risque de biais
  - Sélection imprécise des pts
  - Imprécision des mesures de résultats
  - Aucune étude de plus de 33 pts dans chaque groupe étudié
  - IC très larges
  - Études avec manque de puissance pour détecter une différence entre les groupes
  - Critèes de sélection très hétérogènes
  - Composition de l'injectat très variable

	6 mois	12 mois
Soulagement >50% dlr (données originales)	53.5% (IC95%: 38.6-68.4%) (23/43 pts)	52.3% (IC95%: 37.5%–67.0%) (23/44 pts)
Soulagement >50% dlr (Worst-case analysis)	39.0% (IC95%: 26.5-51.4%) (23/59 pts)	39.0% (IC95%: 26.5-51.4%) (23/59 pts)
↓>30% ODI (données originales)	74.3% (IC95%: 59.8%–88.7%) (26/35 pts)	64.1% (IC95%: 49.0%–79.2%)
↓>30% ODI (worst-case analysis)	44.1% (IC95%: 28.1%–53.2% (26/59 pts)	

Pain Medicine, 2024, **25**, 33–46
https://doi.org/10.1093/pm/pnad127
Advance access publication 22 September 2023
Review Article

OXFORD

The effectiveness of intradiscal corticosteroid injection for the treatment of chronic discovertebral low back pain: a systematic review

Scott Miller, MD[1,*], Marc Caragea, MD[1], Dan Carson, DO[1], Mary M. McFarland[2], Masaru Teramoto, PhD, MPH[1], Daniel M. Cushman, MD[1], Amanda N. Cooper, PhD[1], Taylor Burnham, DO, MSCI[1], Zachary L. McCormick, MD[1], Aaron Conger, DO[1]

[1]Department of Physical Medicine and Rehabilitation, University of Utah, Salt Lake City, UT 84108, United States
[2]Eccles Health Sciences Library, University of Utah, Salt Lake City, UT 84112, United States

**Corresponding author:* Department of Physical Medicine and Rehabilitation, University of Utah, 590 Wakara Way, Salt Lake City, UT 84108, USA.
E-mail: scott.m.miller@hsc.utah.edu

Abstract

Objective: Determine the effectiveness of intradiscal corticosteroid injection (IDCI) for the treatment of discovertebral low back pain.

Design: Systematic review.

Population: Adults with chronic low back pain attributed to disc or vertebral end plate pain, as evidenced by positive provocation discography or Modic 1 or 2 changes on magnetic resonance imaging.

Intervention: Fluoroscopically guided or computed tomography–guided IDCI.

Comparison: Sham/placebo procedure including intradiscal saline, anesthetic, discography alone, or other active treatment.

Outcomes: Reduction in chronic low back pain reported on a visual analog scale or numeric rating scale and reduction in disability reported by a validated scale such as the Oswestry Disability Index.

Methods: Four reviewers independently assessed articles published before January 31, 2023, in Medline, Embase, CENTRAL, and CINAHL. The quality of evidence was evaluated with the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) framework. The risk of bias in randomized trials was evaluated with the Cochrane Risk of Bias tool (version 2).

Results: Of the 7806 unique records screened, 6 randomized controlled trials featuring 603 total participants ultimately met the inclusion criteria. In multiple randomized controlled trials, IDCI was found to reduce pain and disability for 1–6 months in those with Modic 1 and 2 changes but not in those selected by provocation discography.

Conclusion: According to GRADE, there is low-quality evidence that IDCI reduces pain and disability for up to 6 months in individuals with chronic discovertebral low back pain as evidenced by Modic 1 and 2 changes but not in individuals selected by provocation discography.

Study registration: PROSPERO (CRD42021287421).

Keywords: end plate; vertebrogenic; Modic; spine; steroid.

- 6 ECR + 3 études de cohorte
GRADE: Évidence Basse qualité

Bénéfice court-terme (1-6 mois) chez pts avec MODIC 1-2:
-EVA: ↓ dlr moyenne de 2-4 pts ds groupe stéroïde sur 6 ECR
-ODI: Pas d'amélioration ds 4/6 ECR

Pas de bénéfice chez ceux sélectionnés par provocation discale

Intradiscal Therapies → Future

structural augmentation

Hydrogel Augmentation of the Lumbar Intervertebral Disc: An Early Feasibility Study of a Treatment for Discogenic Low Back Pain

J Vasc Interv Radiol 2024; 35:51–58
https://doi.org/10.1016/j.jvir.2023.09.018

Douglas P. Beall, MD, Kasra Amirdelfan, MD, Pierce D. Nunley, MD, Tyler R. Phillips, MD, Luis Carlos Imaz Navarro, MD, PhD, and Alfonso Spath, MD

RESEARCH ARTICLE

ADVANCED HEALTHCARE MATERIALS
www.advhealthmat.de

Injectable Radiopaque Hyaluronic Acid Granular Hydrogels for Intervertebral Disc Repair

Victoria G. Muir, Matthew Fainor, Brianna S. Orozco, Rachel L. Hilliard, Madeline Boyes, Harvey E. Smith, Robert L. Mauck, Thomas P. Schaer, Jason A. Burdick, and Sarah E. Gullbrand**

precision biologics

Contents lists available at ScienceDirect

North American Spine Society Journal (NASSJ)

journal homepage: www.elsevier.com/locate/xnsj

Advances in Spinal Regenerative Therapies

North American Spine Society Journal (NASSJ) 14 (2023) 100210

Intervertebral disc cell fate during aging and degeneration: apoptosis, senescence, and autophagy

Takashi Yurube, M.D., Ph.D.*, Yoshiki Takeoka, M.D., Ph.D., Yutaro Kanda, M.D., Ph.D., Ryosuke Kuroda, M.D., Ph.D., Kenichiro Kakutani, M.D., Ph.D.

endplate repair

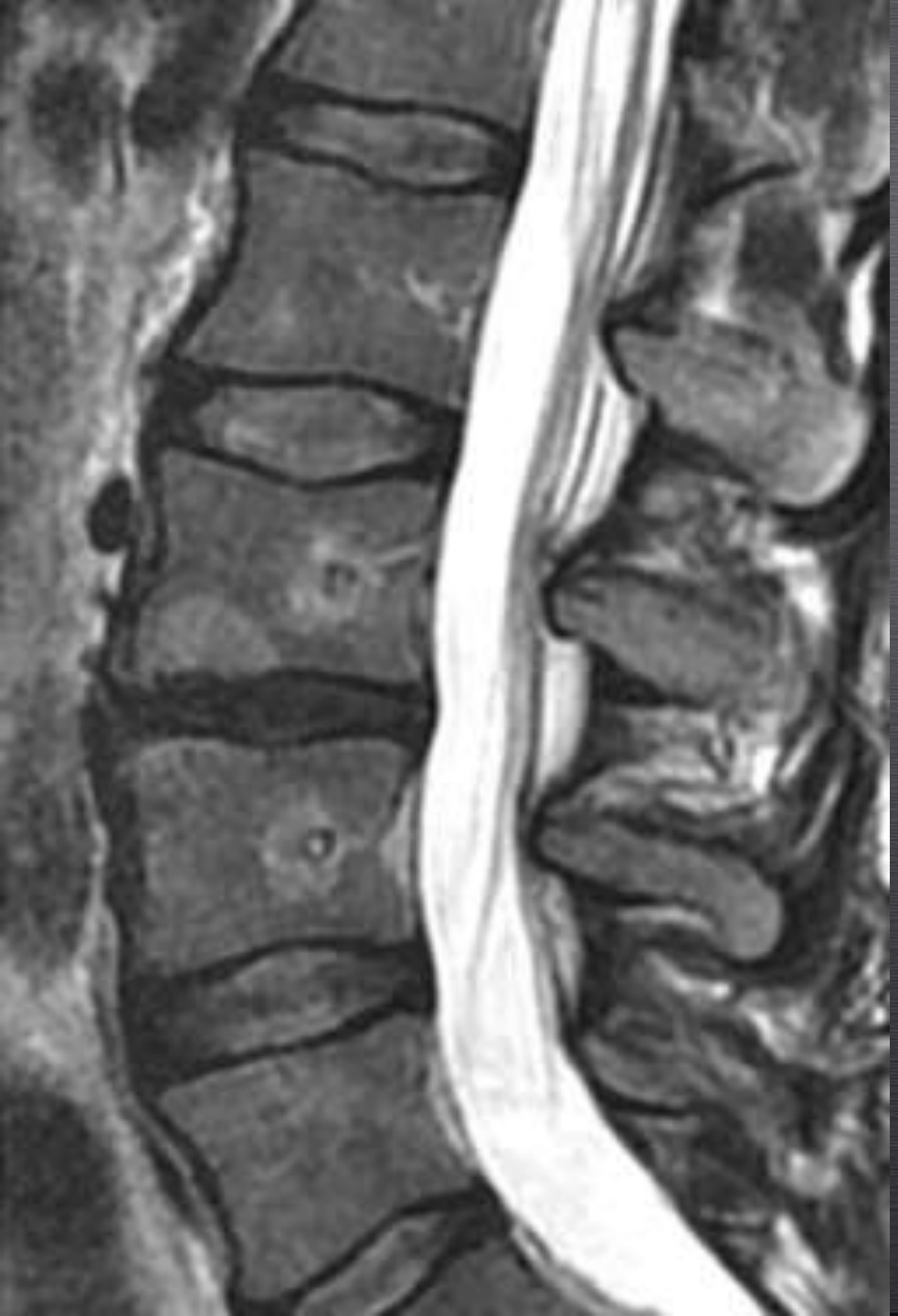
frontiers | Frontiers in Bioengineering and Biotechnology

TYPE Original Research
PUBLISHED 27 February 2023
DOI 10.3389/fbioe.2023.1111356

Intradiscal treatment of the cartilage endplate for improving solute transport and disc

Mohamed Habib[1,2], Shayan Hussien[1], Oju Jeo
Peter I-Kung Wu[1], Eben Alsberg[3] and Aaron

[1]Department of Orthopaedic Surgery, University of California, San Fran
United States, [2]Department of Mechanical Engineering, Al Azhar Universit
Biomedical Engineering, University of Illinois, Chicago, IL, United States



Traitements de la douleur vertébrogénique: Thermolésion nerf vertébrobasilaire (TL NVB)

European Spine Journal (2018) 27:1146–1156
https://doi.org/10.1007/s00586-018-5496-1

ORIGINAL ARTICLE

Étude SMART

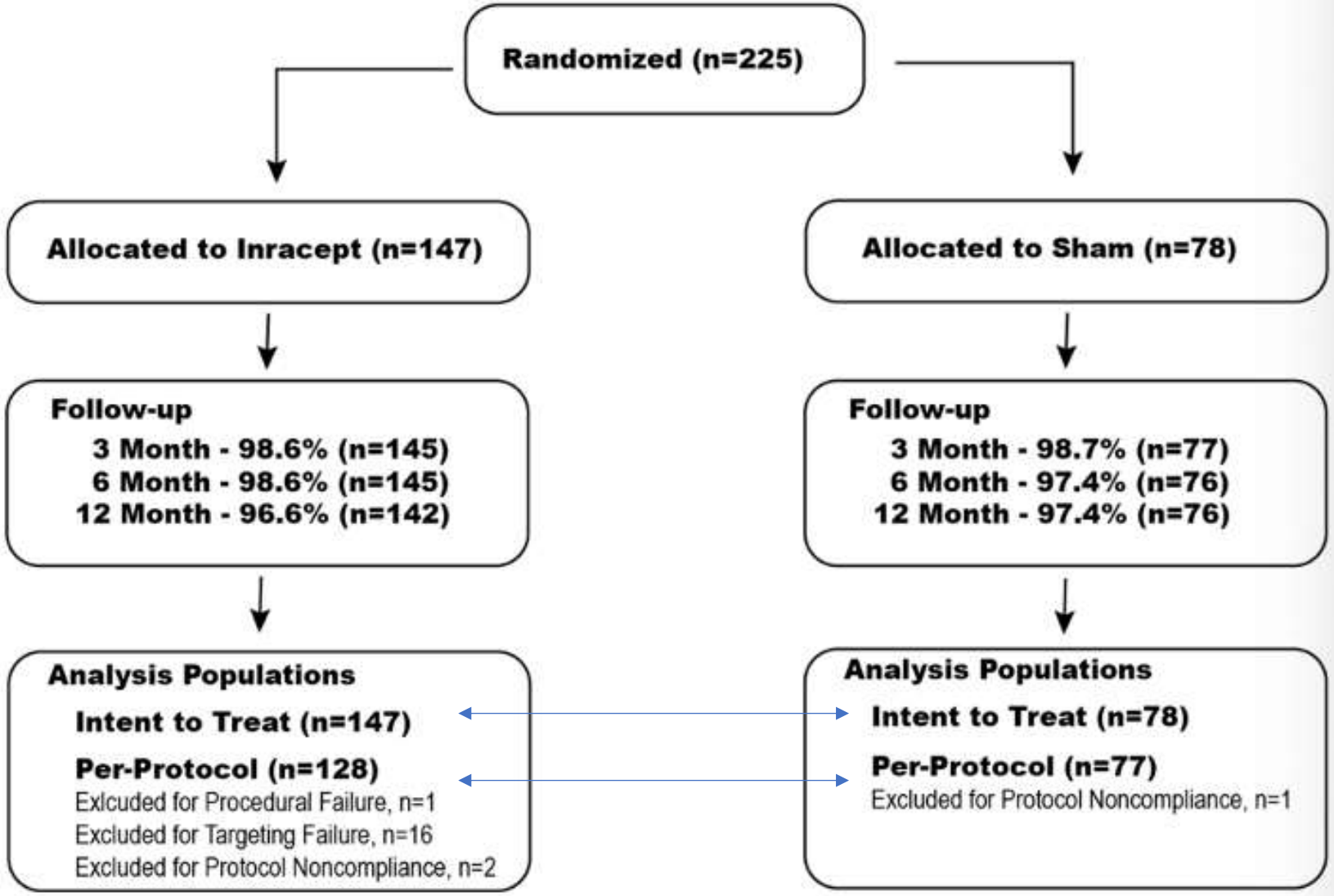
Financé par industrie

Intraosseous basivertebral nerve ablation for the treatment of chronic low back pain: a prospective randomized double-blind sham-controlled multi-center study

Jeffrey S. Fischgrund[1] · A. Rhyne[2] · J. Franke[3] · R. Sasso[4] · S. Kitchel[5] · H. Bae[6] · C. Yeung[7] · E. Truumees[8] · M. Schaufele[9] · P. Yuan[10] · P. Vajkoczy[11] · M. DePalma[12] · D. G. Anderson[13] · L. Thibodeau[14] · B. Meyer[15]

Received: 5 October 2017 / Revised: 11 January 2018 / Accepted: 24 January 2018 / Published online: 8 February 2018

- ÉCR 225 pts, multicentrique, contrôlée avec placebo, à double-insu
- À 1 an, pts placebo pouvait croiser dans le rx actif
- Objectif: Évaluer la sécurité et l'efficacité de la thermolésion nerf vertébrogénique (TL NBV)



- Outcomes:
- Primaire: ODI
- Secondaire:
  - SF-36
  - EVA
  - IRM à 6 sem et 6 mois

Cross-over à 1 an: 73% (57/78); seulement les données de sécurité ont été récoltées à 3 mois

INCLUSION

1. Skeletally mature patients with chronic (≥6 months) isolated lumbar back pain, who had not responded to at least 6 months of nonoperative management
2. Type 1 or Type 2 Modic changes at one or more vertebral body for levels L3–S1
3. Minimum ODI of 30 points (100-point scale)
4. Minimum VAS of 4 cm (10-cm scale) (average low back pain in past 7 days)
5. Ability to provide informed consent, read, and complete questionnaires

EXCLUSION

1. MRI evidence of Modic at levels other than L3–S1
2. Radicular pain (defined as nerve pain following a dermatomal distribution that correlates with nerve compression in imaging)
3. Previous lumbar spine surgery (discectomy/laminectomy allowed if >6 months before baseline and radicular pain resolved)
4. Symptomatic spinal stenosis (defined as the presence of neurogenic claudication and confirmed by imaging)
5. Metabolic bone disease, spine fragility fracture history, or trauma/compression fracture, or spinal cancer
6. Spine infection, active systemic infection, bleeding diathesis
7. Radiographic evidence of other pain etiology
8. Disc extrusion or protrusion >5 mm
9. Spondylolisthesis >2 mm at any level
10. Spondylolysis at any level
11. Facet arthrosis/effusion correlated with facet-mediated LBP
12. BDI >24 or ≥3 Waddell's signs
13. Compensated injury or litigation

Pas de BBM faits

Technique thermolésion nerf vertébrogénique

- 50,2% pts anesthésie générale et 49,8% sédation consciente modérée
- Pt DV, sous fluoro
- 2 groupes
  - TL NVB (Système Intracept- Relievant Medsystem)
  - Placebo (Canule introduite 1-2 mm dar le pédicule et simulation TL)
- Terminus NVB= 40-60% distance AP du CV

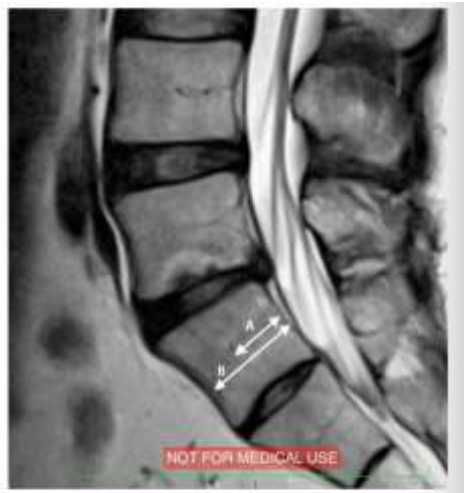
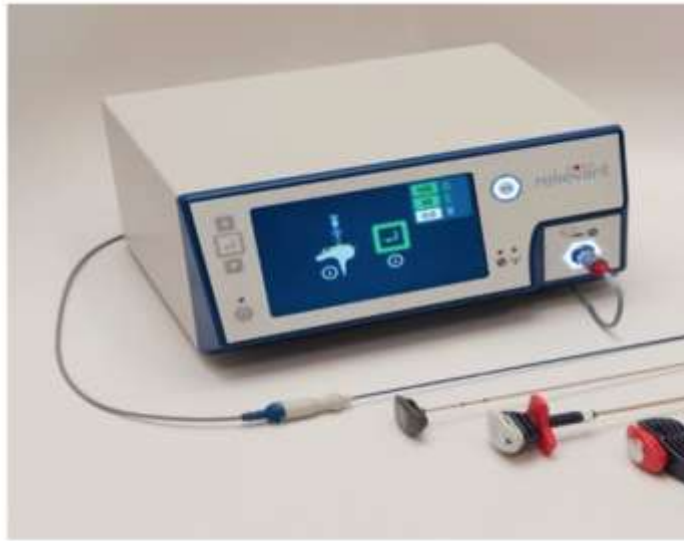
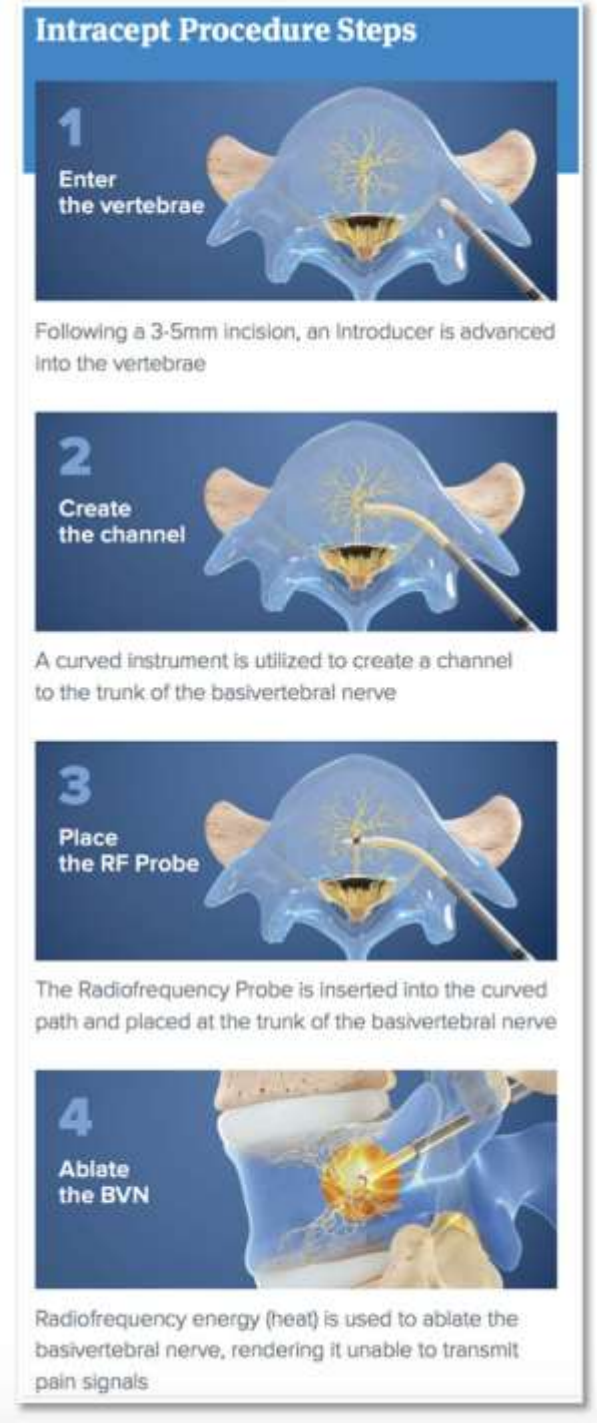
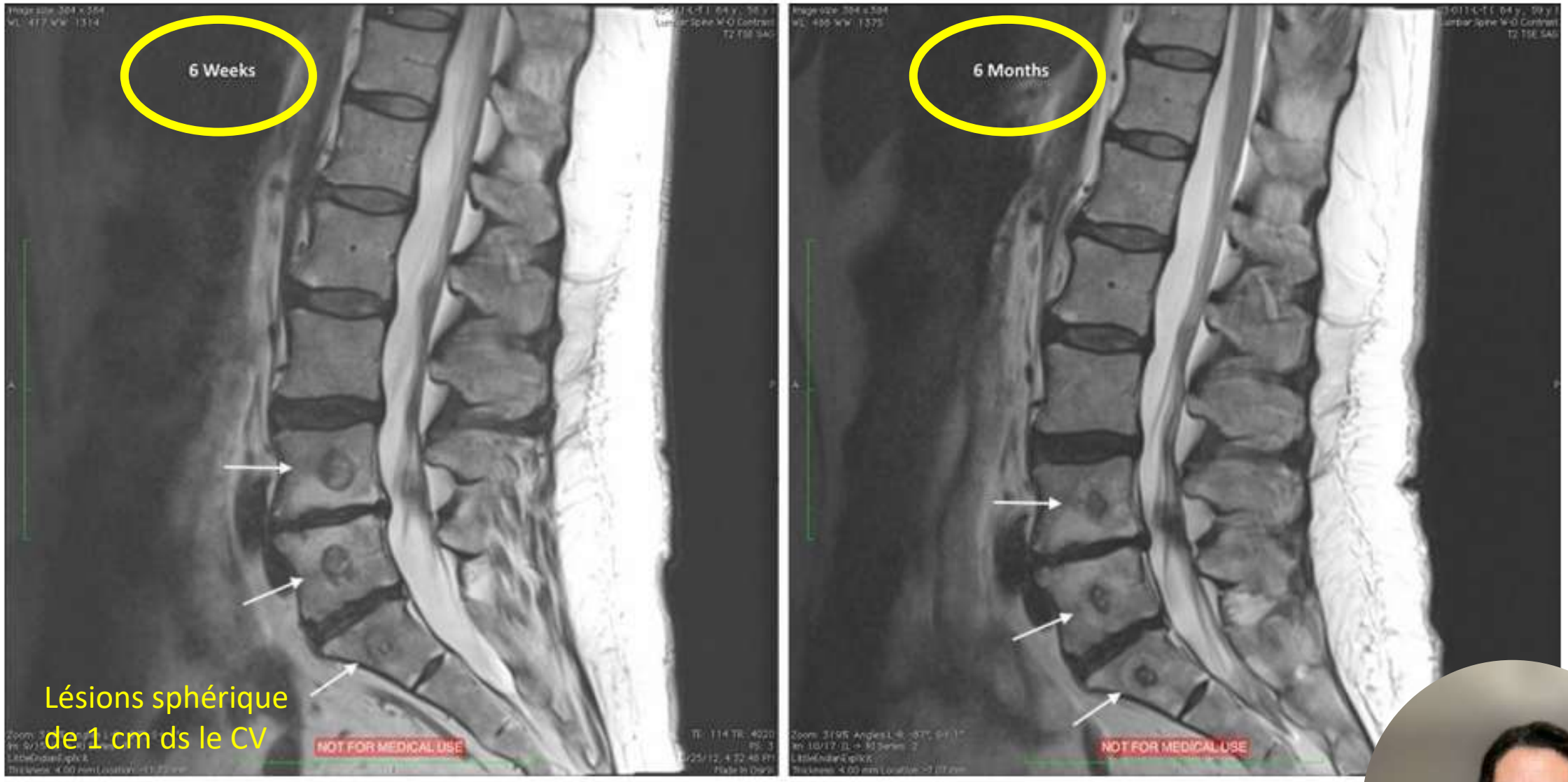


Fig. 1 Targeting of the ablation is performed preoperatively on a sagittal or coronal (not shown) image of the level to be treated. The distance from the posterior wall to the end of the channel with the



Lésion à 85C x 15 min





SMART TRIAL

imaging of patient treated and L4–L5–S1 as seen at 6 weeks (left image) and 6 months (right image).

dle of the vertebral body; bone remodeling and healing is observed by 6 months

Table 1 Patient demographics and baseline characteristics

Characteristic	Intracept system arm ($n = 147$)	Sham control arm ($n = 78$)	p
Age (years), mean (range)	46.9 (26–69)	47.1 (25–69)	0.869[a]
Male, *n* (%)	82 (55.8%)	41 (52.6%)	0.708[b]
BMI (kg/m^2), mean (range)	27.44 (18.9–38.4)	27.16 (19.2–38.0)	0.666[a]
Caucasian, *n* (%)	134 (91.2%)	71 (91.0%)	0.409[b]
Married, *n* (%)	101 (68.7%)	50 (64.1%)	0.142[b]
College degree or higher, *n* (%)	87 (59.2%)	47 (60.3%)	0.535[b]
Working before procedure, *n* (%)	110 (74.8%)	57 (73.1%)	0.328[b]
Current tobacco use, *n* (%)	25 (17.0%)	10 (12.8%)	
Duration low back symptoms, *n* (%)			
≥ 6 months to < 1 year	6 (4.1%)	4 (5.1%)	0.990[c]
≥ 1 year to < 2 years	15 (10.2%)	8 (10.3%)	
≥ 2 years to < 3 years	10 (6.8%)	5 (6.4%)	
≥ 3 years to < 5 years	18 (12.2%)	7 (9.0%)	
≥ 5 years	98 (66.7%)	54 (69.2%)	
Opioid use before procedure, *n* (%)	51 (34.7%)	27 (34.6%)	0.872[b]
Modic changes, *n* (%)			
Type 1	46 (31.3%)	29 (37.2%)	0.578[b]
Type 2	89 (60.5%)	42 (53.8%)	
Type 1 and Type 2	12 (8.2%)	7 (9.0%)	
ODI mean (range)	42.9 (30–76)	41.1 (26–78)	0.277[a]
VAS mean (range)	6.82 (4.0–10.0)	6.63 (4.0–9.1)	0.343[a]
BDI mean (range)	7.7 (0–23)	7.6 (0–24)	0.853[a]
SF-36 PCS mean (range)	33.22 (14.83–48.11)	34.07 (14.01–54.15)	0.407[a]
SF-36 MCS mean (range)	51.97 (23.05–69.06)	52.72 (20.07–73.38)	0.579[a]

BDI Beck Depression Inventory, *PCS* physical component summary, *MCS* mental component summary

[a]*p* value from a two-way ANOVA with treatment group and analysis center as factors

[b]*p* value from a CMH general association test stratified by analysis center

[c]*p* value from a CMH row mean scores test stratified by analysis center

Résultats SMART TRIAL

ITT: Tous les pts inclus- pertes au suivi sont analysés comme des échecs
PP: Exclusion des non-compliants au rx, procédure pas faite et échec de la TL

3 mois outcome primaire ODI

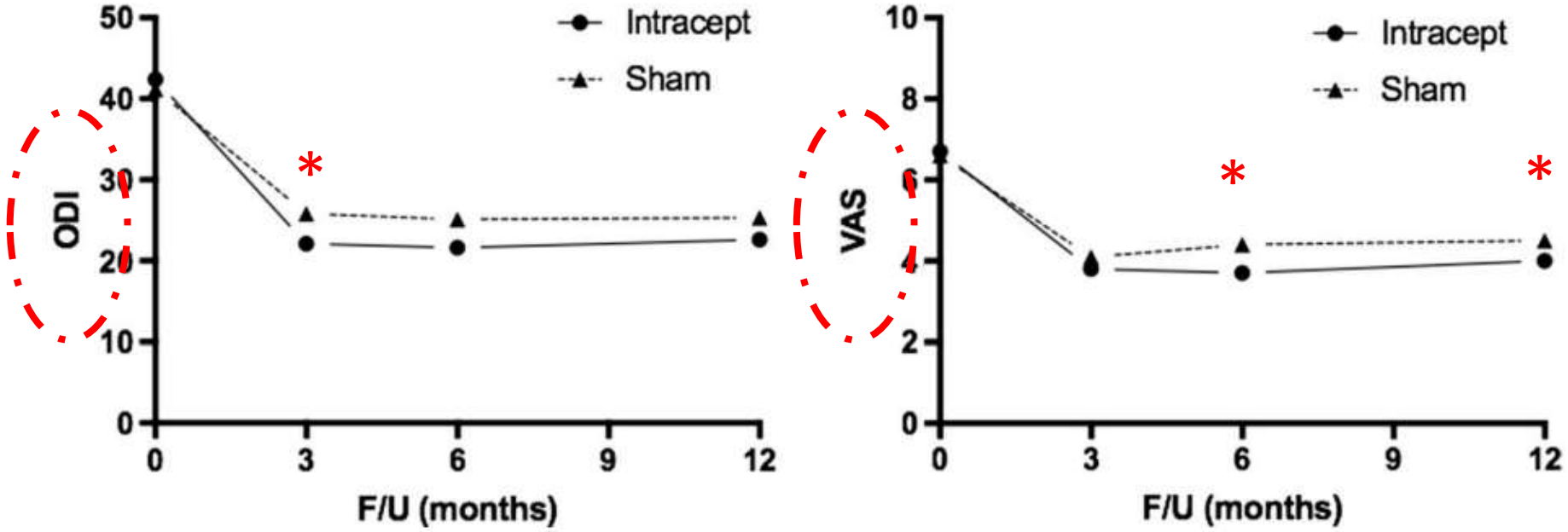
- Population intention-to-treat: ↓19.0 vs 15.4 (placebo) (p=0.107)
- Population per-protocol: ↓ 20.5 vs 15.2 (placebo) (p=0.019)
- MCID de 10 pts= 75.6% vs 55.3% (placebo)

Table 2 Summary of ODI primary end point analyses

ITT population	Intracept system arm ($n = 147$)	Sham control arm ($n = 78$)	p
LS mean ODI change from baseline 95% confidence interval for LS mean	− 19.0 [− 21.6, − 16.5]	− 15.4 [− 18.9, − 11.9]	0.107
PP population	Intracept system arm ($n = 128$)	Sham control arm ($n = 77$)	p
LS mean ODI change from baseline 95% confidence interval for LS mean	− 20.5 [− 23.2, − 17.8]	− 15.2 [− 18.7, − 11.7]	0.019

Valeurs moyennes: pas de données catégoriques

Fig. 4 Mean values of ODI and VAS plotted for all f/u times through 1 year. ODI improvement in treatment arm statistically significant compared to sham arm at 3 months; VAS improvement statistically significant at 6 and 12 months ($p < 0.05$)



<u>IRM à 6 sem et 6 à mois:</u>

Pas d'anomalie moelle épinière, nécrose avasculaire ou DD accélérée

1 pt a eu changement MODIC 1 à 2 entre 6 sem et 6 mois

Etude Intracept

Financé par l'industrie

Contents lists available at ScienceDirect

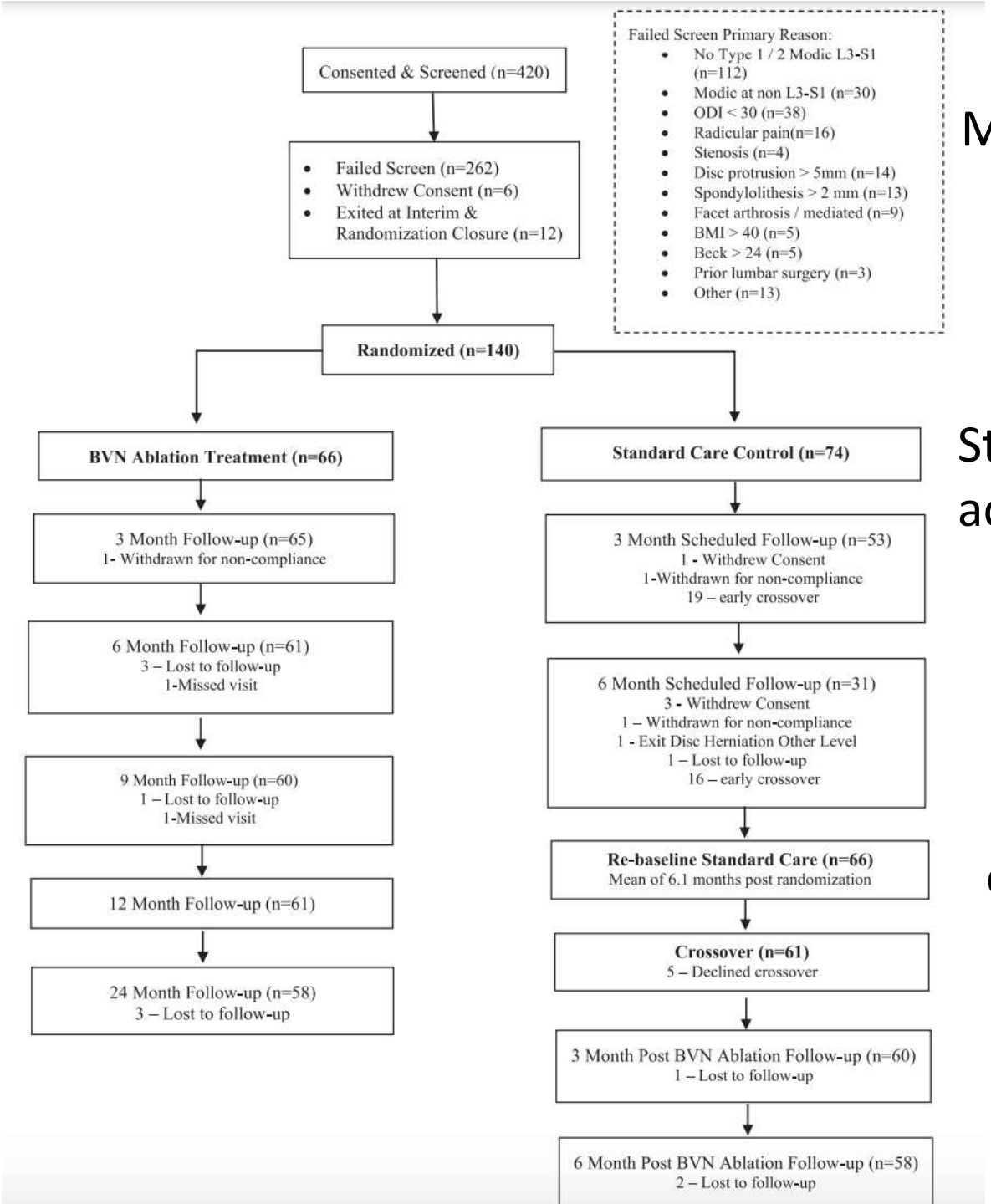
North American Spine Society Journal (NASSJ)

journal homepage: www.elsevier.com/locate/xnsj

Clinical Studies

Prospective, randomized, multicenter study of intraosseous basivertebral nerve ablation for the treatment of chronic low back pain: 24-Month treatment arm results

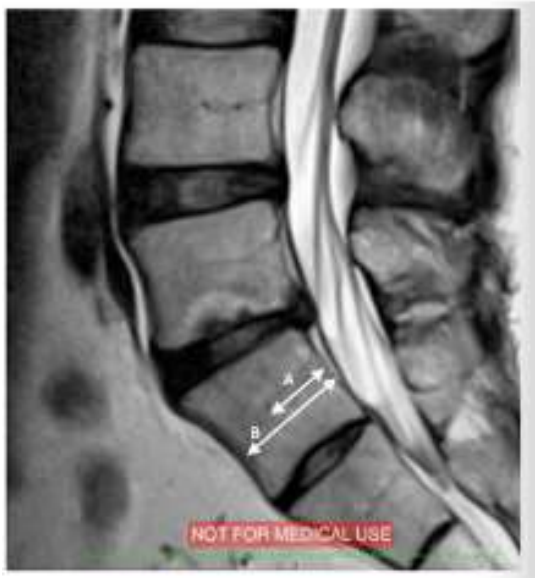
Theodore Koreckij[a,*], Scott Kreiner[b], Jad G. Khalil[c], M. Smuck[d], J. Markman[e], Steven Garfin[f], on behalf of the INTRACEPT Trial Investigators



Même critères inclusion et exclusion que SMART

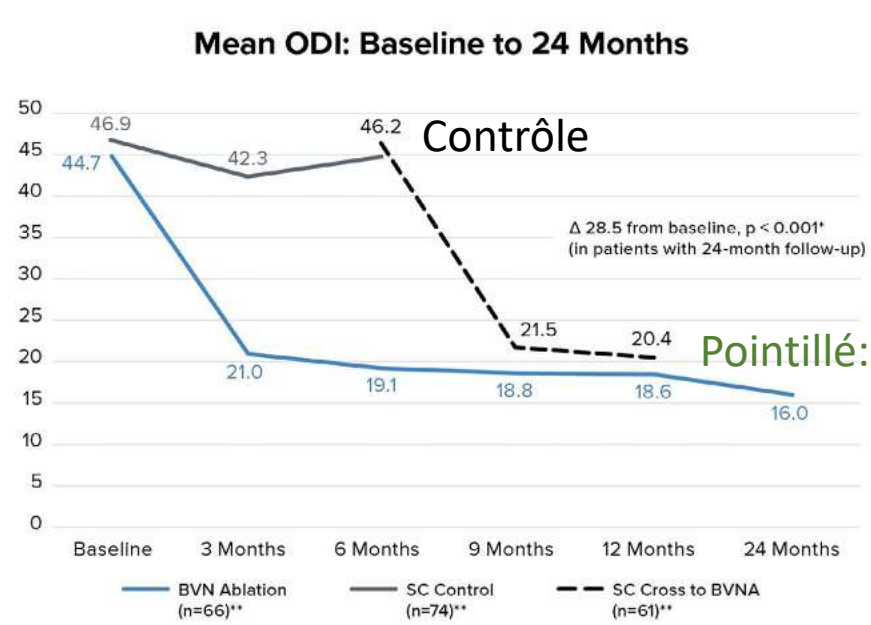
Standard care= physiotx, exs, chiropracie, acupuncture, médications, injections spinales

Cross-over à 6 mois= 61 pts



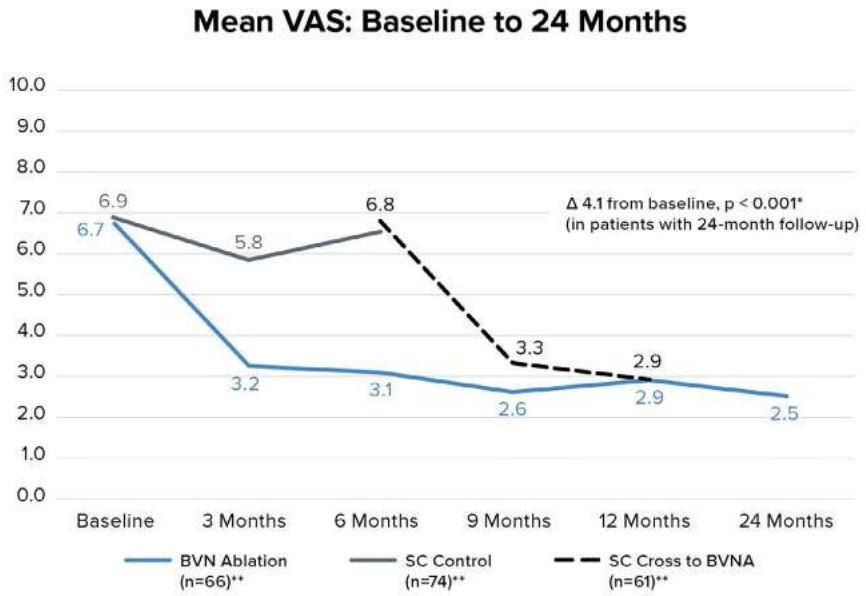
Étude INTRACEPT: Cible 30-50% AP

Intracept



* P-value from a paired t-test on the basivertebral nerve ablation treatment arm.
**Multiple imputations for 3 Month ODI missing values. All other measurements as observed, no imputations for missing data.

Fig. 2. Mean oswestry disability index (ODI) over time. This graph depicts the mean ODI at each study follow-up for each arm of the RCT through the longer-term follow-up of the BVNA arm. A statistically significant and clinically meaningful difference in mean ODI was observed from baseline/re-baseline for each timepoint in patients treated with BVN ablation, including in control patients that crossed to active treatment. Abbreviations: ODI, Oswestry Disability Index; BVNA, basivertebral nerve ablation.



* P-value from a paired t-test on the basivertebral nerve ablation treatment arm.
**As observed, no imputations for missing data.

Fig. 3. Mean visual analog scale (VAS) over time. This graph depicts the mean VAS at each study follow-up for each arm of the RCT through the longer-term follow-up of the BVNA arm. A statistically significant and clinically meaningful difference in mean VAS was observed from baseline/re-baseline for each timepoint in patients treated with BVN ablation, including in control patients that crossed to active treatment. Abbreviations: VAS, visual analogue scale; BVNA, basivertebral nerve ablation.

Table 4

Responder rates. Responder rates were defined as ≥15-point reduction in Oswestry Disability Index (ODI) and ≥2 cm reduction in Visual Analog Scale (VAS). Individual measurement responder rates and combined responder rates were significant at all timepoints for BVNA arm patients.

Responder rates (≥ 15-point ODI and ≥ 2 cm VAS reduction)	Basivertebral nerve ablation arm ($N = 66$)	p-Value
3 Month	$N = 65$[a]	<0.001[b]
ODI ≥ 15-point reduction – *n* (%)	45 (69.2%)	
VAS ≥ 2 cm reduction – *n* (%)	48 (72.7%)	
Combined (reductions in ODI ≥ 15 and VAS ≥ 2) – *n* (%)	41 (63.1%)	
6 Month	$N = 60$[a]	<0.001[b]
ODI ≥ 15-point reduction – *n* (%)	41 (67.2%)	
VAS ≥ 2 cm reduction – *n* (%)	45 (75.0%)	
Combined (reductions in ODI ≥ 15 and VAS ≥ 2) – *n* (%)	35 (58.3%)	
9 Month	$N = 60$[a]	<0.001[b]
ODI ≥ 15-point reduction – *n* (%)	40 (66.7%)	
VAS ≥ 2 cm reduction – *n* (%)	45 (75.0%)	
Combined (reductions in ODI ≥ 15 and VAS ≥ 2) – *n* (%)	37 (61.7%)	
12 Month	$N = 61$[a]	<0.001[b]
ODI ≥ 15-point reduction – *n* (%)	42 (68.9%)	
VAS ≥ 2 cm reduction – *n* (%)	48 (78.7%)	
Combined (reductions in ODI ≥ 15 and VAS ≥ 2) – *n* (%)	40 (65.6%)	
24 Month	$N = 57$[a,c]	<0.001[b]
ODI ≥ 15-point reduction – *n* (%)	44 (77.2%)	
VAS ≥ 2 cm reduction – *n* (%)	46 (79.3%)	
Combined (reductions in ODI ≥ 15 and VAS ≥ 2) – *n* (%)	42 (73.7%)	

Abbreviations: ODI, Oswestry Disability Index; VAS, visual analogue scale; cm, centimeters

[a] As observed, with no imputation for missing data.

[bPbp] -value from a Binomial test.

[c] 57 patients with ODI and 58 patients with VAS at 24 months.

Pain Med. 2022 Aug; 23(Suppl 2): S50–S62. Published online 2022 Jul 20.
doi: 10.1093/pm/pnac070

PMCID: PMC9297160 | PMID: 35856331

The Effectiveness of Intraosseous Basivertebral Nerve Radiofrequency Ablation for the Treatment of Vertebrogenic Low Back Pain: An Updated Systematic Review with Single-Arm Meta-analysis

Aaron Conger, DO, Taylor R Burnham, DO, MS, Tyler Clark, MD, Masaru Teramoto, PhD, MPH, PStat®, and Zachary L McCormick, MD

Revue systématique avec méta-analyse à un bras

- 2 ECR: TL NVB vs 1- placebo (1,2,5 ans) et 2- tx conservateur (3,6,12,24 mois)
- 4 études de cohorte (3-12 mois)

Financé par Relievant MedSystems!!!

1. Skeletally mature patients with chronic (≥6 months) isolated lumbar back pain, who had not responded to at least 6 months of nonoperative management

2. Type 1 or Type 2 Modic changes at one or more vertebral body for levels L3–S1

3. Minimum ODI of 30 points (100-point scale)

4. Minimum VAS of 4 cm (10-cm scale) (average low back pain in past 7 days)

5. Ability to provide informed consent, read, and complete questionnaires

1. MRI evidence of Modic at levels other than L3–S1

2. Radicular pain (defined as nerve pain following a dermatomal distribution that correlates with nerve compression in imaging)

3. Previous lumbar spine surgery (discectomy/laminectomy allowed if >6 months before baseline and radicular pain resolved)

4. Symptomatic spinal stenosis (defined as the presence of neurogenic claudication and confirmed by imaging)

5. Metabolic bone disease, spine fragility fracture history, or trauma/compression fracture, or spinal cancer

6. Spine infection, active systemic infection, bleeding diathesis

7. Radiographic evidence of other pain etiology

8. Disc extrusion or protrusion >5 mm

9. Spondylolisthesis >2 mm at any level

10. Spondylolysis at any level

11. Facet arthrosis/effusion correlated with facet-med

12. BDI >24 or ≥3 Waddell's signs

13. Compensated injury or litigation

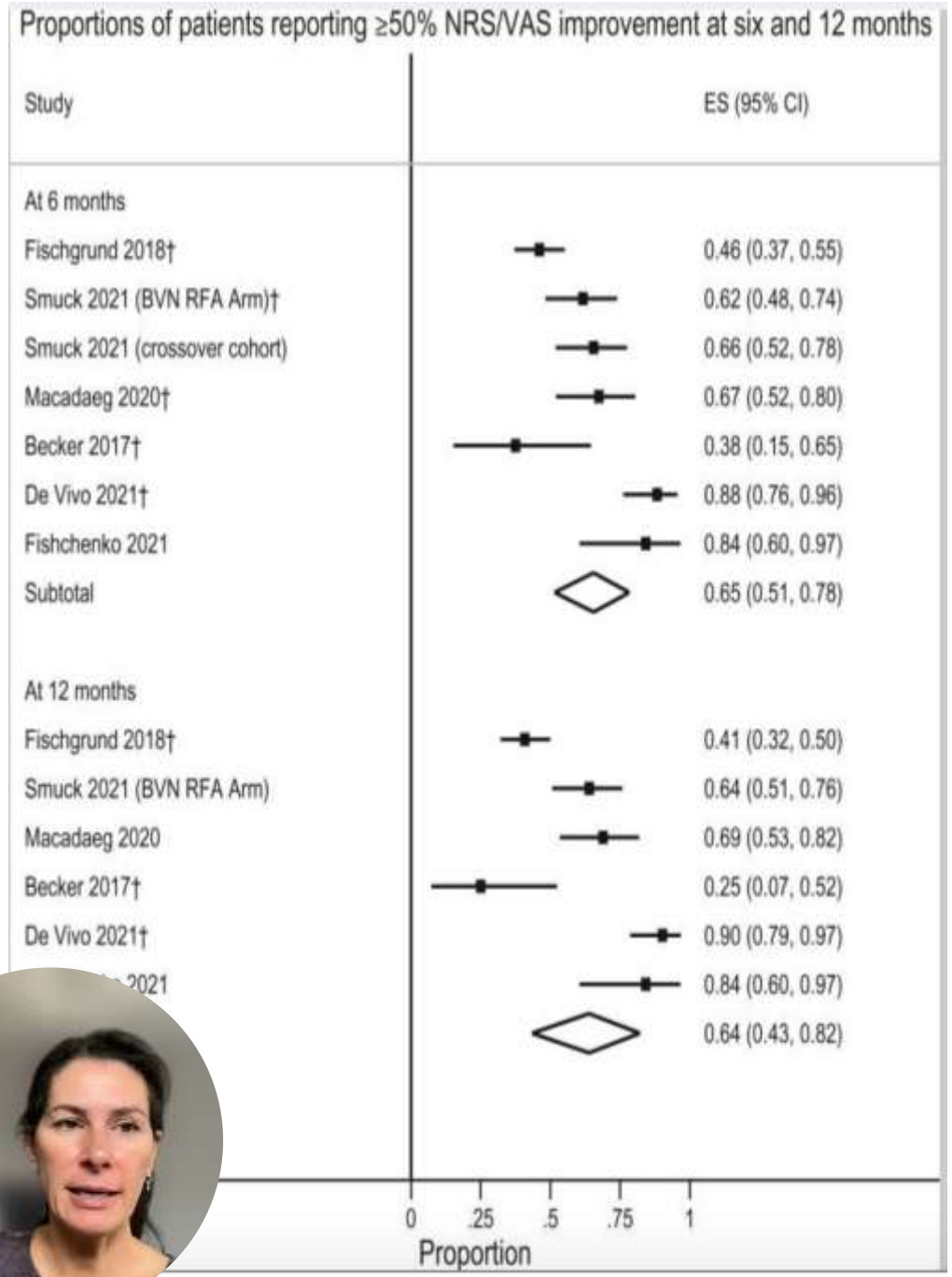
- Méta-analyse à un bras:

  basée données PerProtocol…

Outcomes (414 participants):

- EVA: Succès ↓ dlr ≥50%:
  - 6 mois: 65% (IC95% 51-78%)
  - 12 mois 64% (IC95% 43-82%)

- ODI: Succès ↓ ≥15-point
  - 6 mois: 75% (IC95% 63–86%)
  - 12 mois 75% (IC95% 63–85%)



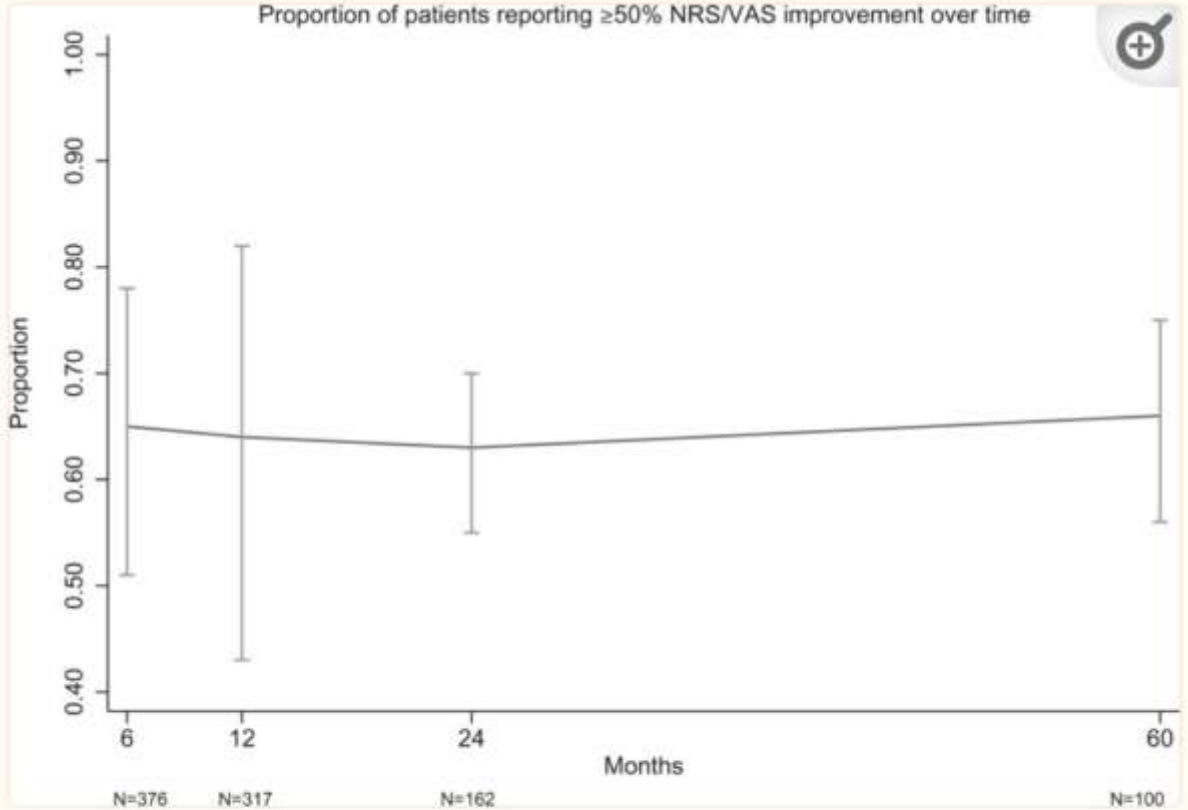


Figure 4.

Proportion of patients reporting ≥50% NRS/VAS improvement over time.

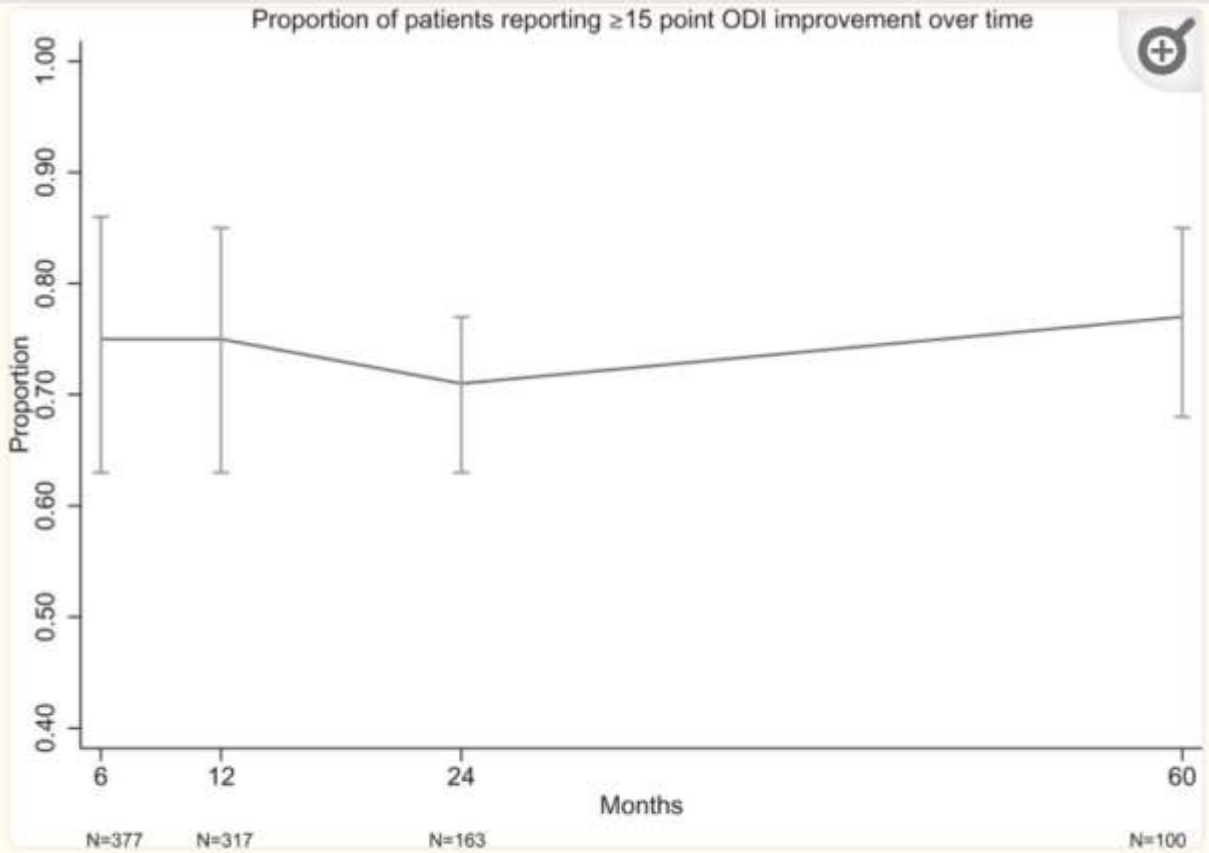


Figure 5.

Proportion of patients reporting ≥15-point ODI improvem

Amélioration durable à 2 et 5 ans

NVG contient plusieurs fibres nonmyélinisées=

TL peut produire amélioration durable des sx

Complications: seulement temporaires

- Douleur transitoire jambe (2^{o} pénétration pédicule)
  - 11% (14/127 dans INTRACEPT)
  - Résolution en 48,5 jours

- Hémorrhagies rétropéritonéale (2 cas)
  - 2^{o} positionnement trop latéral

Évaluation qualité GRADE

- Seulement 2 ECR [1-2]
- Incapacité que les pts du groupe placebo soit aveugle au rx de façon efficace
- Biais de publication – plusieurs études financées par l'industrie
  - 2 études indépendantes en 2021

Évidence de qualité modérée que TL NVB fonctionne pour améliorer la douleur et fonction chez pt avec lombalgie d'origine VG vs TL placebo[1] et rx conservateur[2]

1- Fischgrund JS, Rhyne A, Franke J, et al. Intraosseous basivertebral nerve ablation for the treatment of chronic low back pain: A prospective randomized double-blind sham-controlled multicenter study. Eur Spine J 2018;27(5):1146–56.
2-Khalil JG, Smuck M, Koreckij T, et al. A prospective, randomized, multicenter study of intraosseous basivertebral nerve ablation for the treatment of chronic low back pain. Spine J 2019;19 (10):1620–32.

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Scoping Review

Basivertebral Nerve Ablation for the Treatment of Chronic Low Back Pain: A Scoping Review of the Literature

William Schnapp, MD[1], Kenneth Martiatu, CRA[1], and Gaëtan J.-R. Delcroix, PhD[2,3]

Limitations: The limitations found were:

- A very specific chronic pain population is typically utilized for this intervention. The inclusion criteria leave many who experience chronic low back pain ineligible for the procedure.
- Study demographics need to be more diversified to truly represent the chronic low back pain population.
- There is a lack of true control groups due to high crossover rates in published studies.
- Very few high-level or long-term studies have been published.
- Funding for many of the studies published on the subject is industry-led (Table 6). With an already limited amount of published research, a need for out-of-industry funding is required to avoid any possibility of bias.

À qui s’adresse les injections intradiscales?

- Pt <50 ans qui présente x >5 ans une douleur lombaire centrale avec possibilité d'une douleur somatique référée (pas de dlr neuropathique). Blocages lombaires intermittents. Pas chx.
- E\P: Neuro N. MMT N. Peu dlr facettaire lombaire.
- Pt qui a tenté la médication (AINS, ISRN, relax musc) et tx conservateur (chiro, ostéo, acupuncture, physio) sans succès

IRM:

L4-L5: N

L5-S1: Dégénérescence discale ++ avec HD large rayon de courbure postéromédiane de 8mm. Arthrose facettaire.

Essais thérapeutiques

- EXERCICES DE STABILIATION LOMBAIRE

- Épidurale caudale- 12-15 cc (↓ inflammation épidurale rétrodiscal en bloquant les NSV)
- Blocs facettaires L4-S1 D et G et si pas amélioration: BBM L3, L4, L5 D/G
- +/- épidurales TF L5 bilatérales (5cc /côté)

Provocation discale?

Si échec: Ozone L5-S1 (pas PRP…)?

<u>Et si IRM:</u>

L4-L5: Déchirure annulaire/ MODIC 1-2

L5-S1: N

Si échec: Corticostéroïde L4-L5 vs ozone?

L4-L5: Déchirure annulaire et changement MODIC 1 plateau inférieur gauche
L5-S1: Dégénérenscence discale modérée. HD large rayon de courbure postéromédiane 8 mm. Arthrose facettaire droite.

1. **PRP- régénératif/anti-inflammatoire:**
   - IRM: déchirure annulaire, protrusion ≤5mm

À 18 mois:
Amélioration dlr 50% ou dim 2 pts: 25%
ODI: 25%

1 RCT et 4 études de cohorte
À 6 mois: Soulagement >50% dlr lombaire:
54.8% (IC95%: 40-70%) (23/42 pts)
Évidence de qualité très basse

2. **Ozone- AI/analgésique/momification:**
   - IRM: Dégénérescence discale HD de petite taille (+/- déchirure annulaire)

À 24 mois: (28 pts)
Amélioration dlr 50% ou dim 2 pts: 40%
ODI: 47%

MODIC 1 et 2: Cortico? Thermolésion nerf vertébrobasilaire?

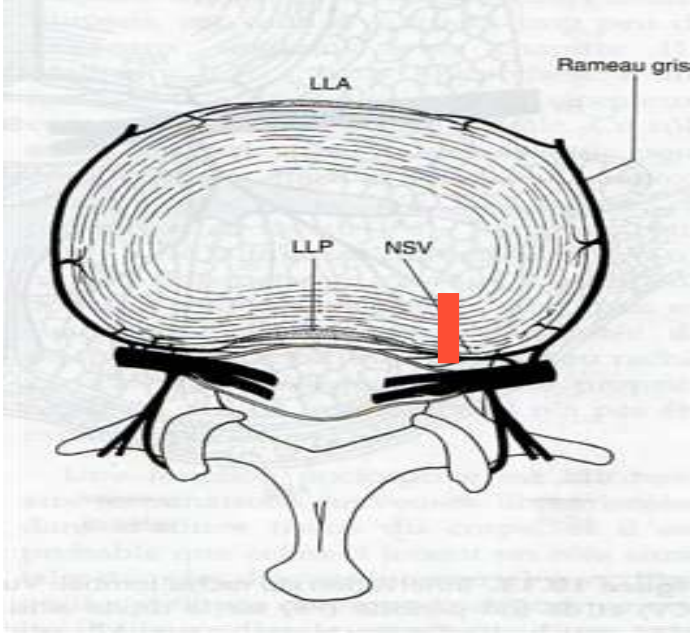
Conclusion

Tableau de douleur discovertébrogénique (éléments antérieurs)

- Pt <50 ans
- Dlr lombaire centrale de longue date +/- DSR, possibles blocages lombaires, échec rx conservateur (méds, exs)
- Examen neuro/MMT: Négatif
- IRM lombaire: Combinaison:
  - DDD, déchirure annulaire, HD (pas dlr radiculaire), MODIC 1-2

Avant de conclure à douleur discovertébrale…

Exs stabilisation lombaires



Infiltrations à tenter pour éliminer autres sources de douleur

1. Épidurale caudale/épidurales TF bilatérales
   - ↓ inflammation épidurale rétrodiscal en bloquant les NSV
2. Blocs facettaires et/ou BBM
   - Éliminer dlr origine facettaire
3. Infiltration sacro-iliaques et/ou BBL

+/- Provocation discale avec manométrie (scan post-provocation)

Longue discussion avec le patient concernant attentes réalistes: PRP vs Ozone intradiscal

	Dlr discogénique	Dlr discogénique	Dlr vertébrogénique
Symptômes	Dlr lombaire centrale +/- référée Hx de blocages lombaires	Dlr lombaire centrale +/- référée	Dlr lombaire centrale
Signes	Neuro N MMT – (occ +)	Neuro N MMT-	Neuro N MMT-
IRM	Déchirure annulaire HD ≤5mm	Dégénérescence discale HD ≥ 5 mm ou ≤5mm	MODIC 1 et 2
Traitements	PRP CSM (déchirure)	Ozone CSM (DD, HD)	Corticostéroïde? TL NVB CSM (M1 et M2)
Évidences	PRP: ↓50% dlr 55% (6 mois); 25% (18 mois) (IPQ)	Ozone: ↓50% dlr ou ↓2 pts EVA 29% (12 mois) (IPQ) 40% (24 mois) (IPQ)	TL NVB: ↓50% dlr 65% (6 mois) 64% (12 mois)