

Imagerie fonctionnelle IRM obstétrique en recherche

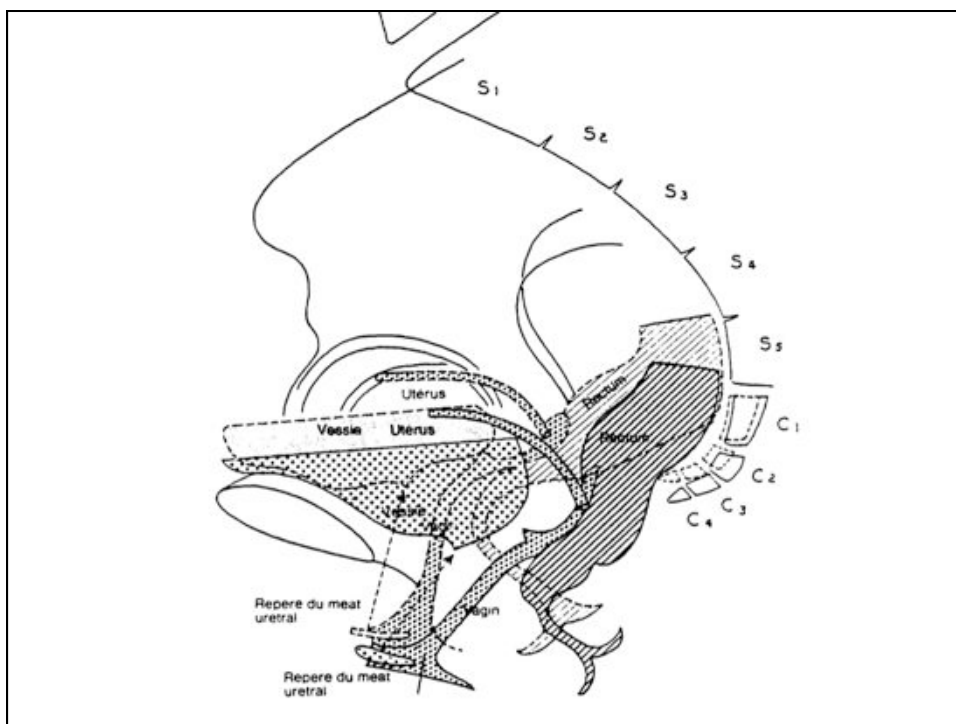
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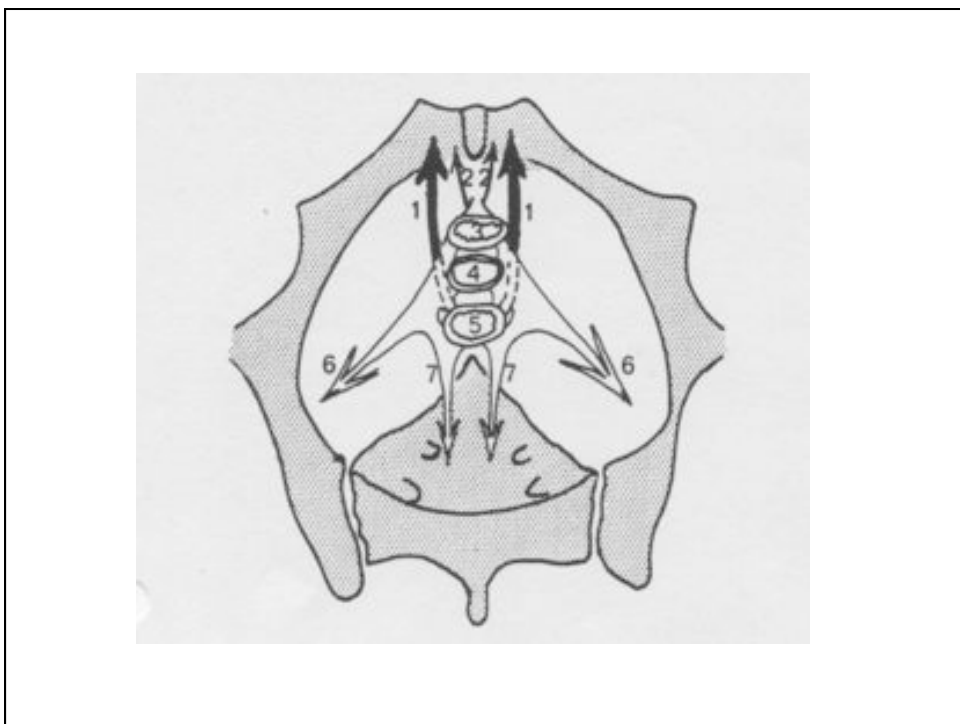
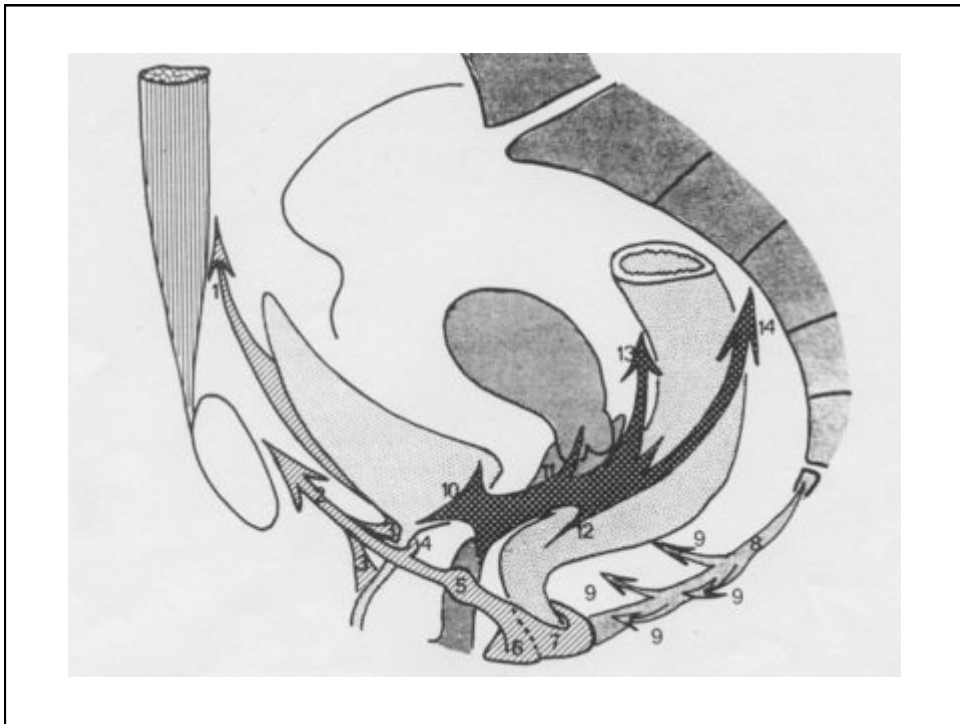
Service de Gynécologie & Obstétrique
CHI Poissy – St-Germain
Université Versailles Saint-Quentin (UVSQ)

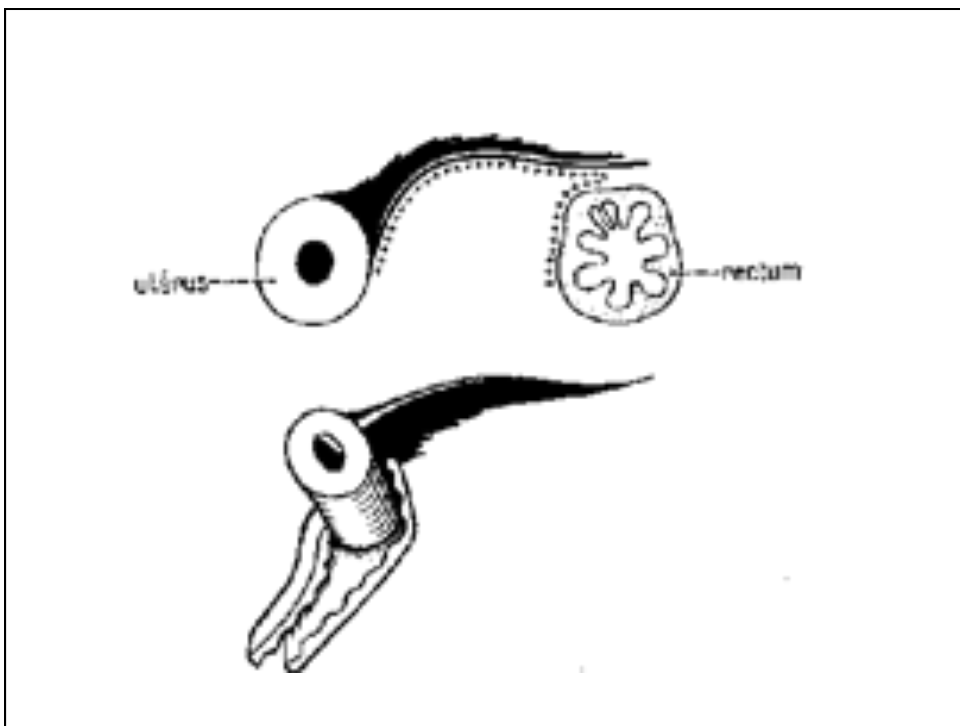
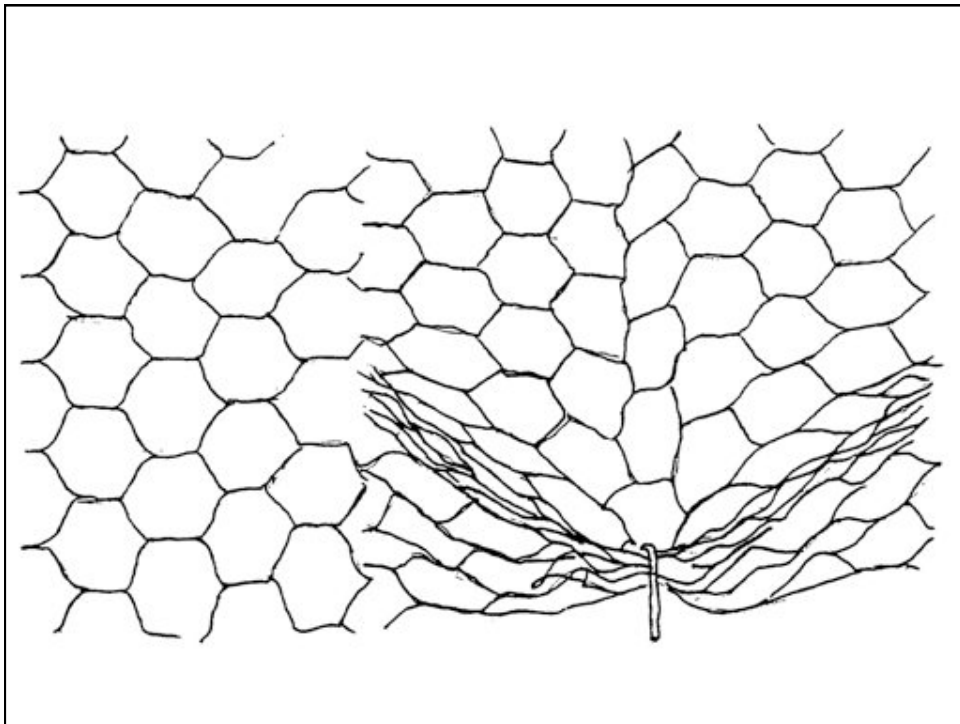
Plan

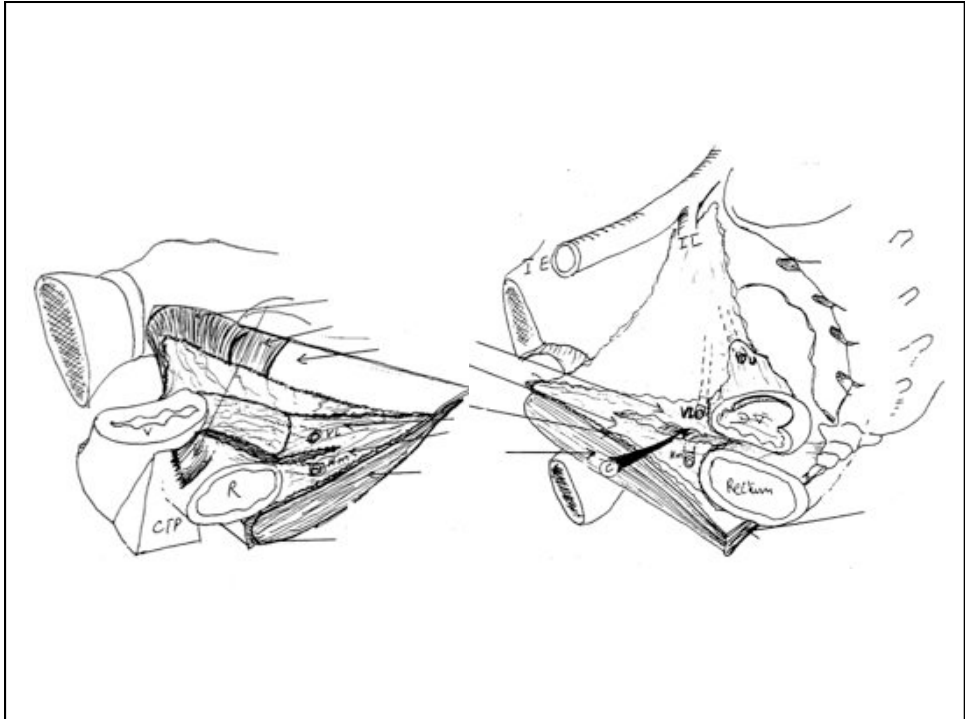
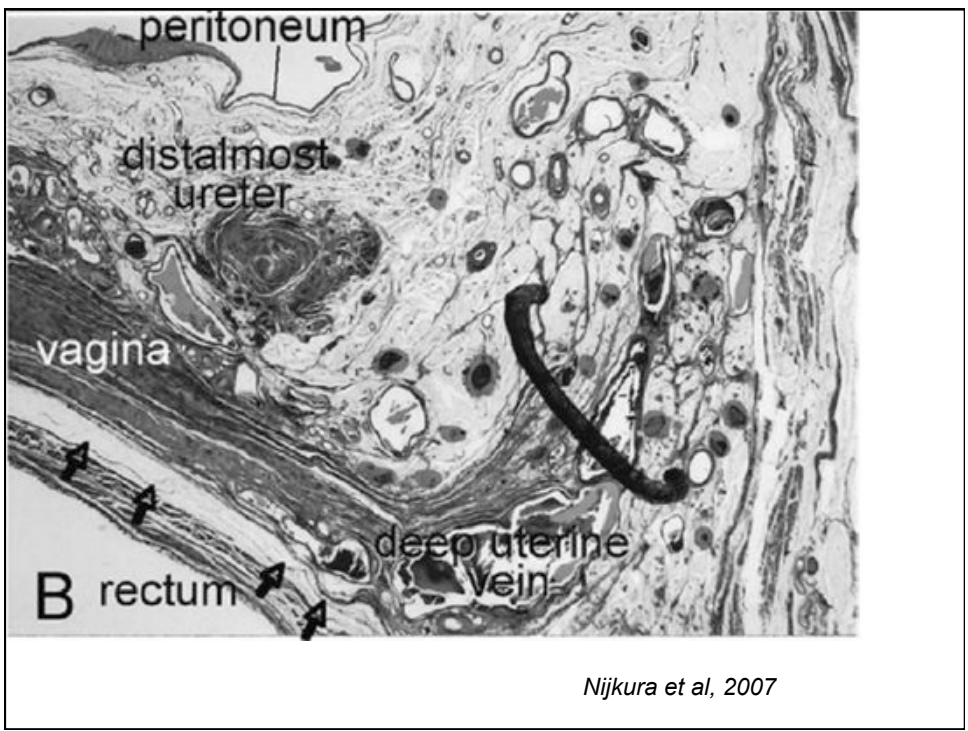
- Rappels anatomiques
- Histoire de l'imagerie fonctionnelle
- Technique d'imagerie fonctionnelle IRM
- Anatomie dynamique de la statique pelvienne
- Mobilité cervico-urétrale et incontinence urinaire d'effort
- Avulsions lévatoriennes et accouchements
- Altérations fonctionnelles des muscles releveurs et troubles de la statique pelvienne à long terme
- Conclusions

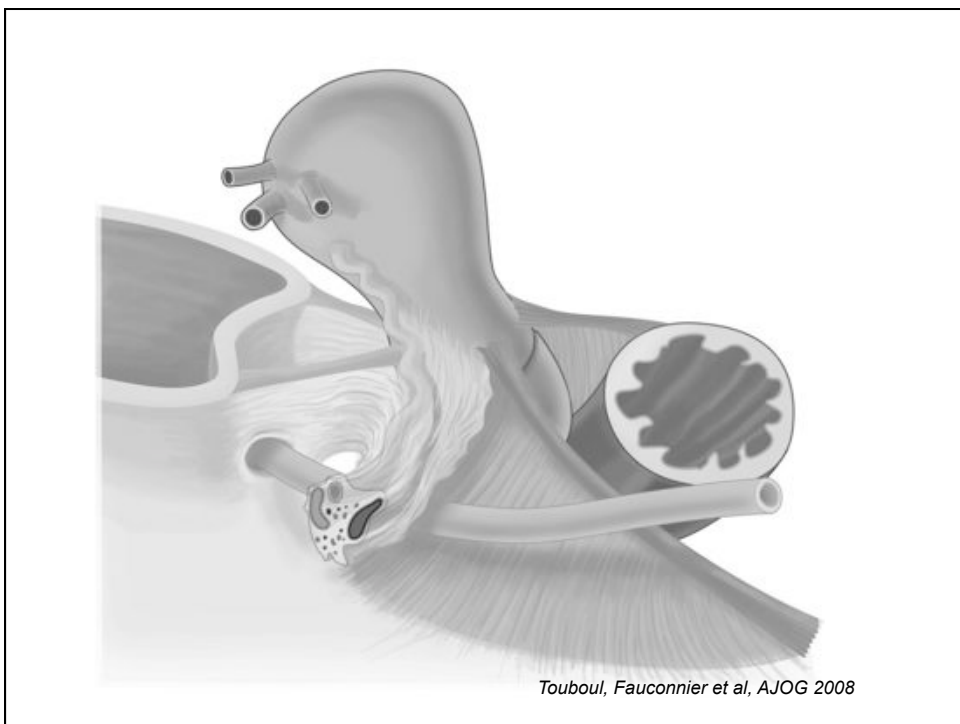
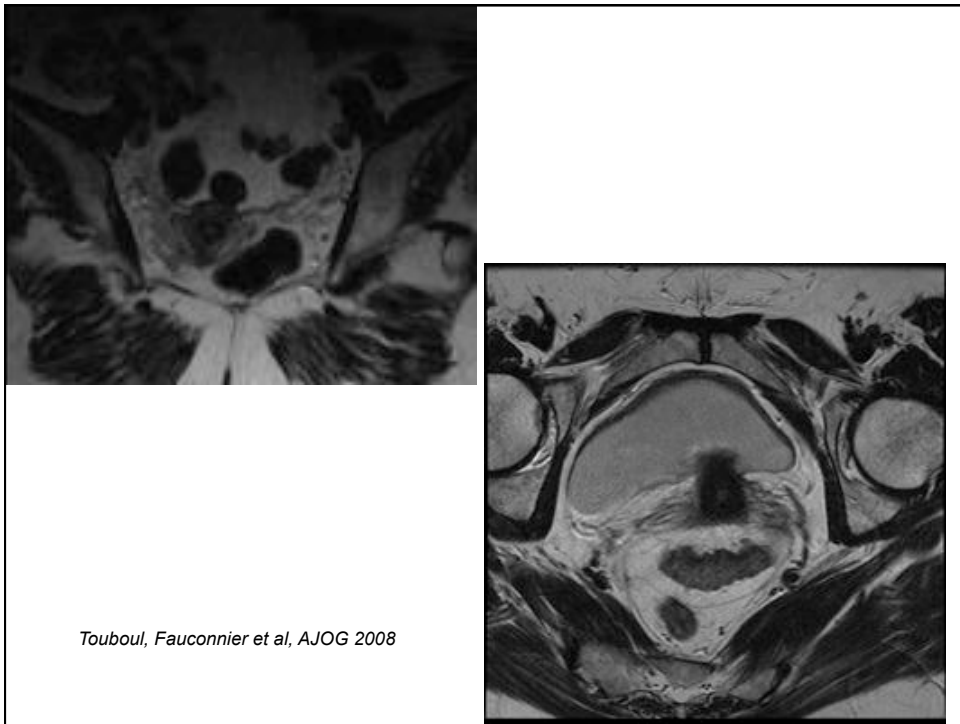
Rappels anatomiques

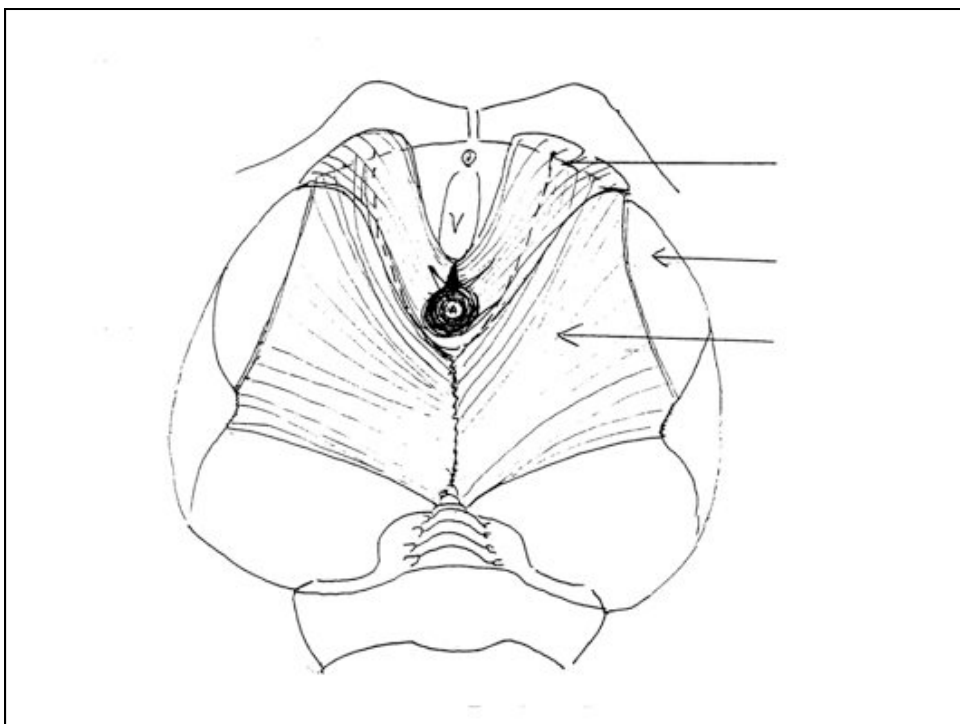
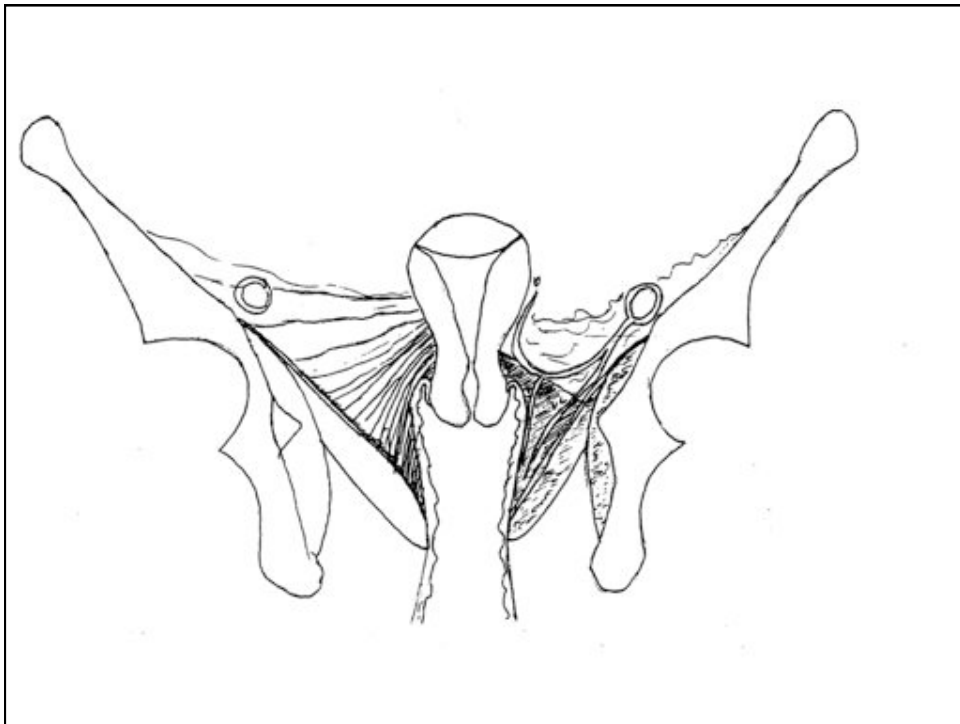


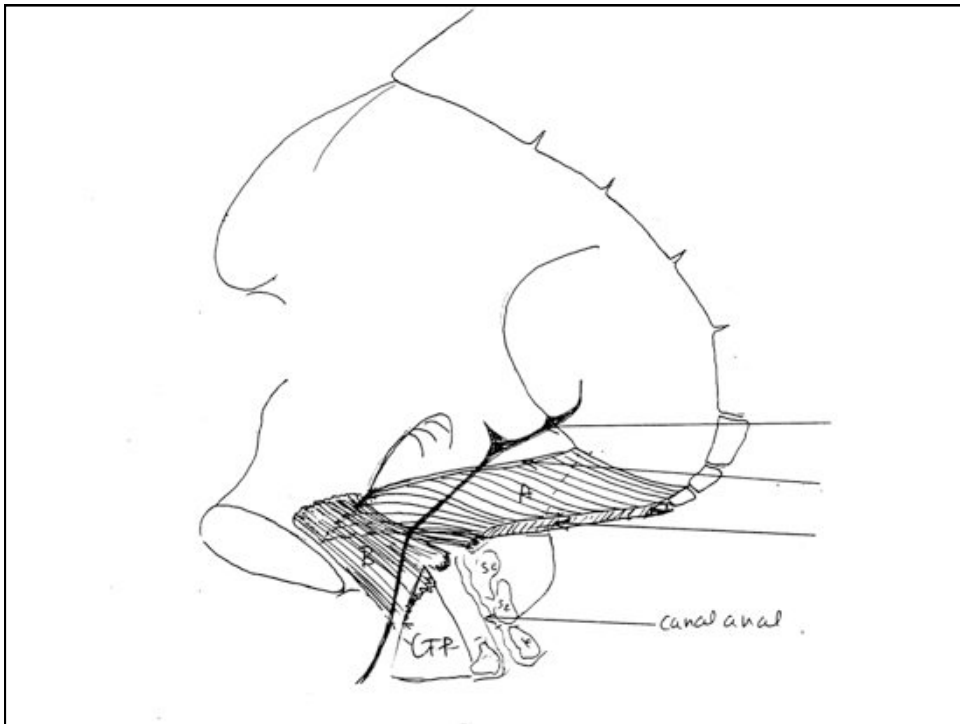




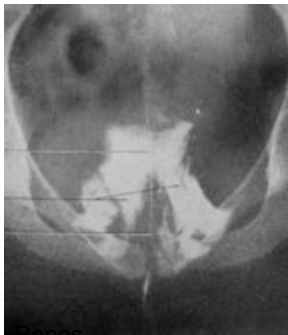




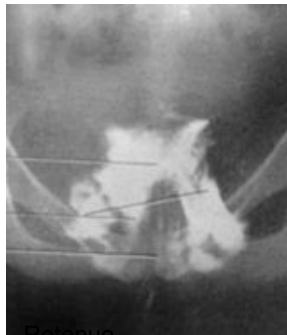




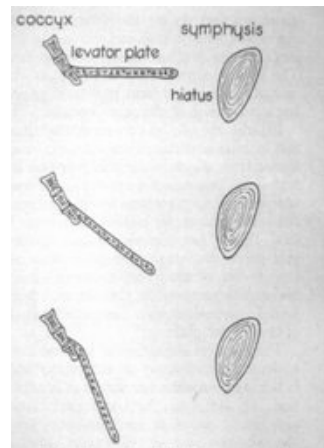
Myographie levatorienne



Repos

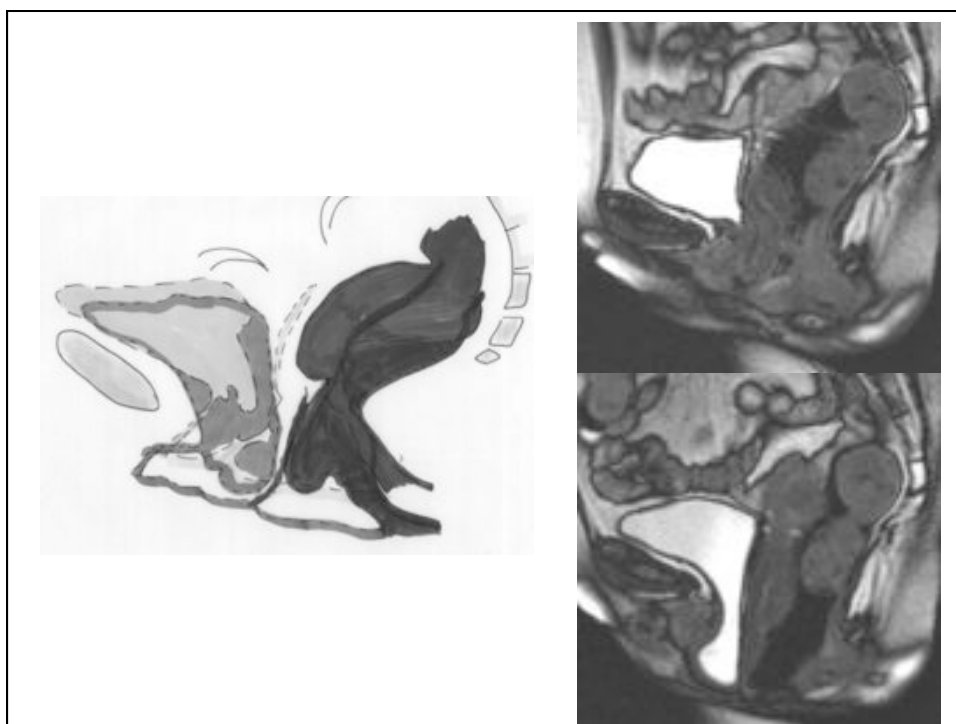
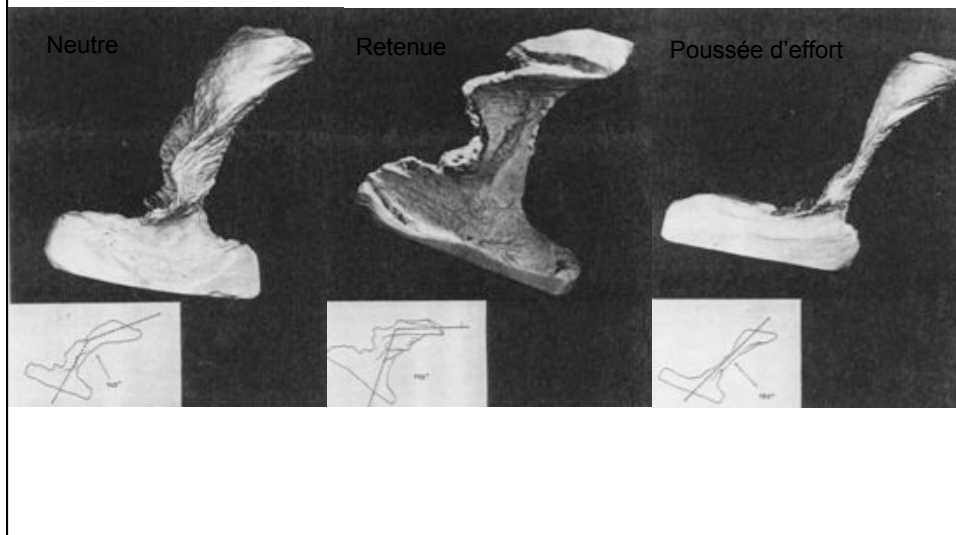


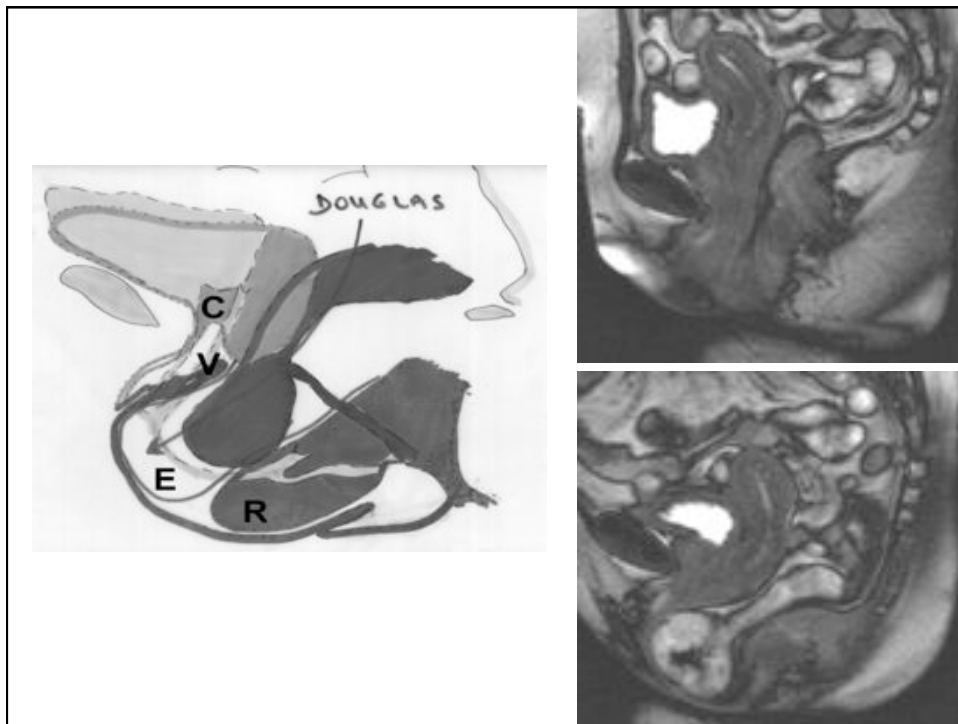
Retenue



Berglas & Rubin Surg
Gynecol Obstet 1954

Moulages vaginaux de Bethoux





Aspects techniques

COMMENT ?

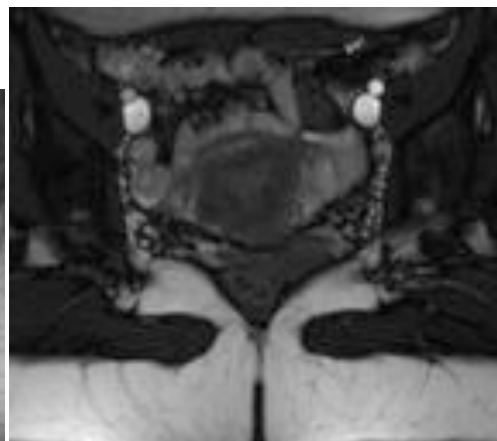
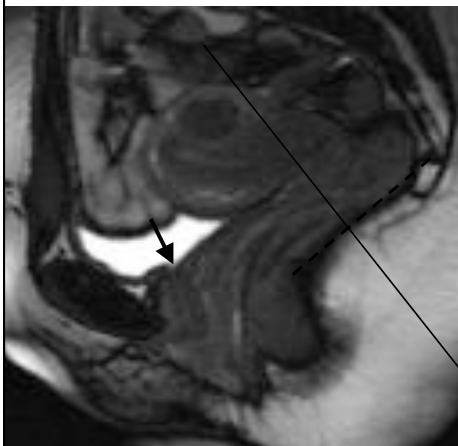
- Sur l'ensemble du pelvis:
 - SAG T2
 - COR T2
- Acquisition dynamique
 - SAG trufispT2
 - En poussée progressive
 - En poussée successive
 - COR trufispT2

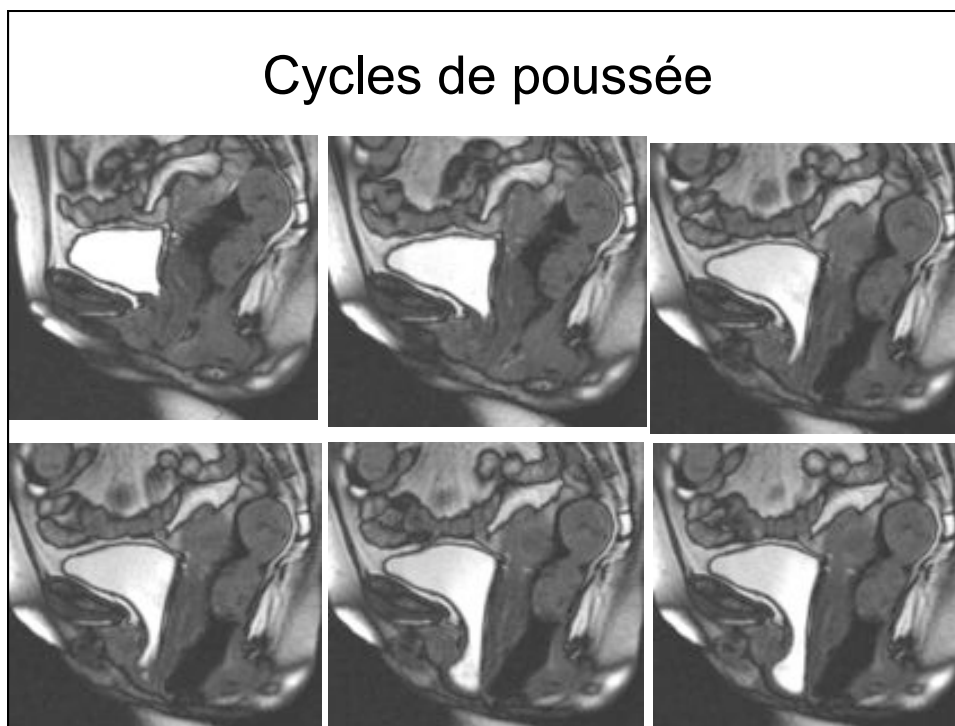
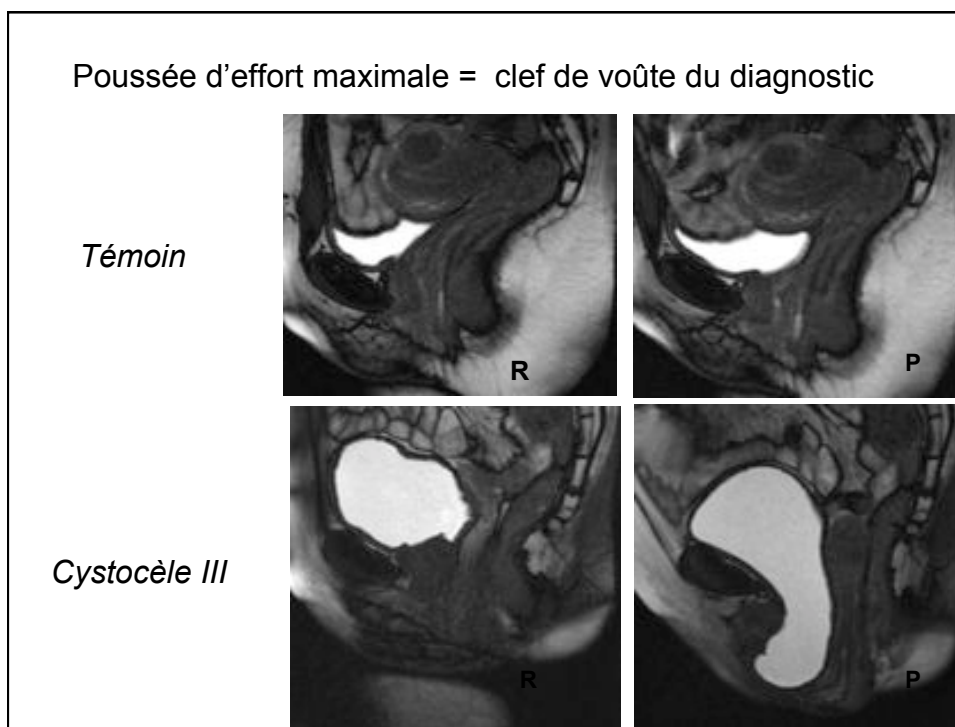


Compromis durée et définition

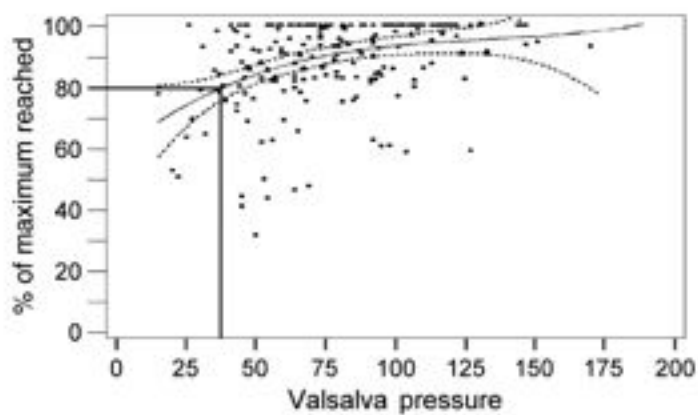
Repérage des coupes :

- sagittale médiane passant par le col vésical
- coronale, passant par le milieu du plancher levatorien





Relation entre poussée d'effort et protrusion maximum



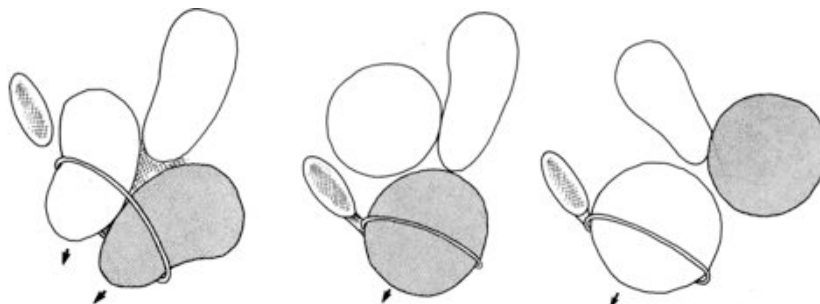
Mulder, ANZOG 2012; 52: 282–285

Opacifier ou pas ?

Compétition

Degré de remplissage

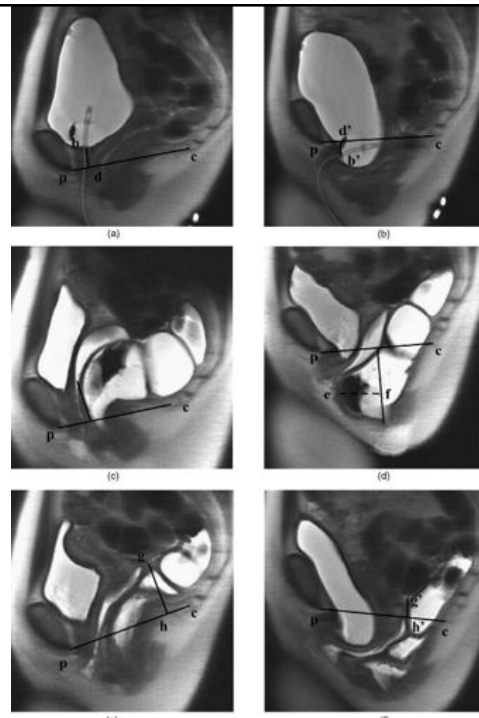
Variabilité de la poussée



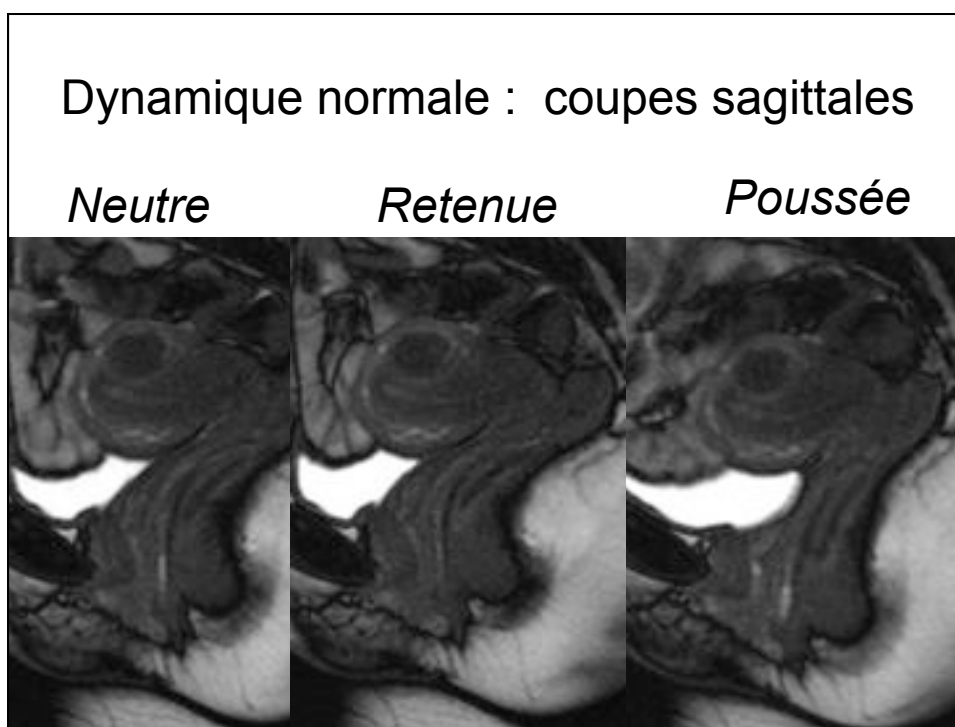
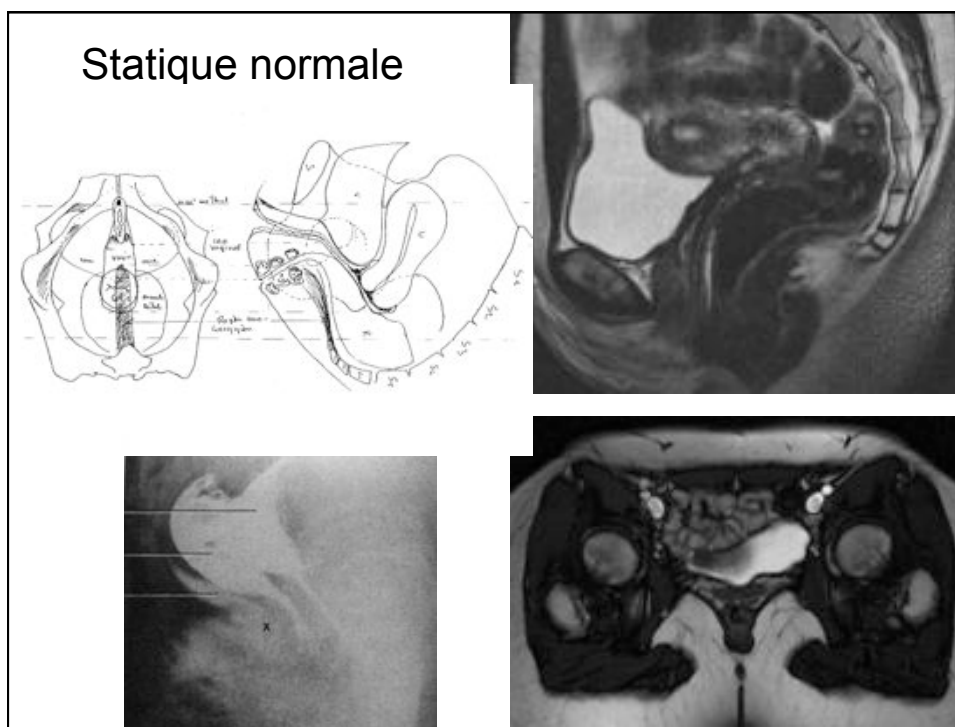
Opacifier ou pas ?

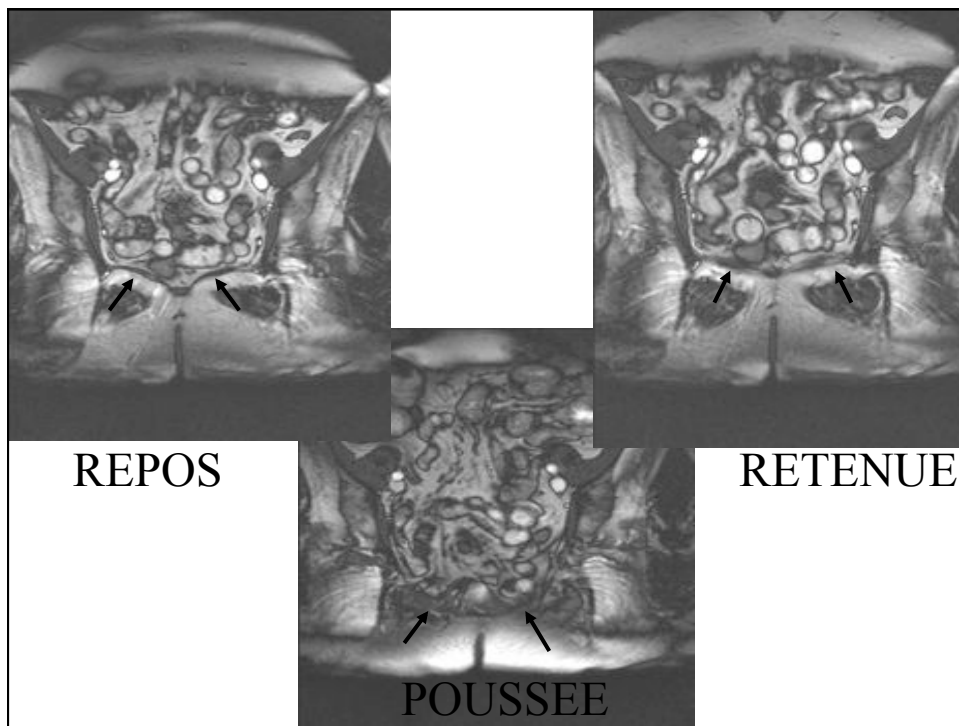
Impact du remplissage
vésical et rectal sur le
résultat de l'IRM
dynamique : Témoin
asymptomatique de 31 ans

Morren et al, 2005

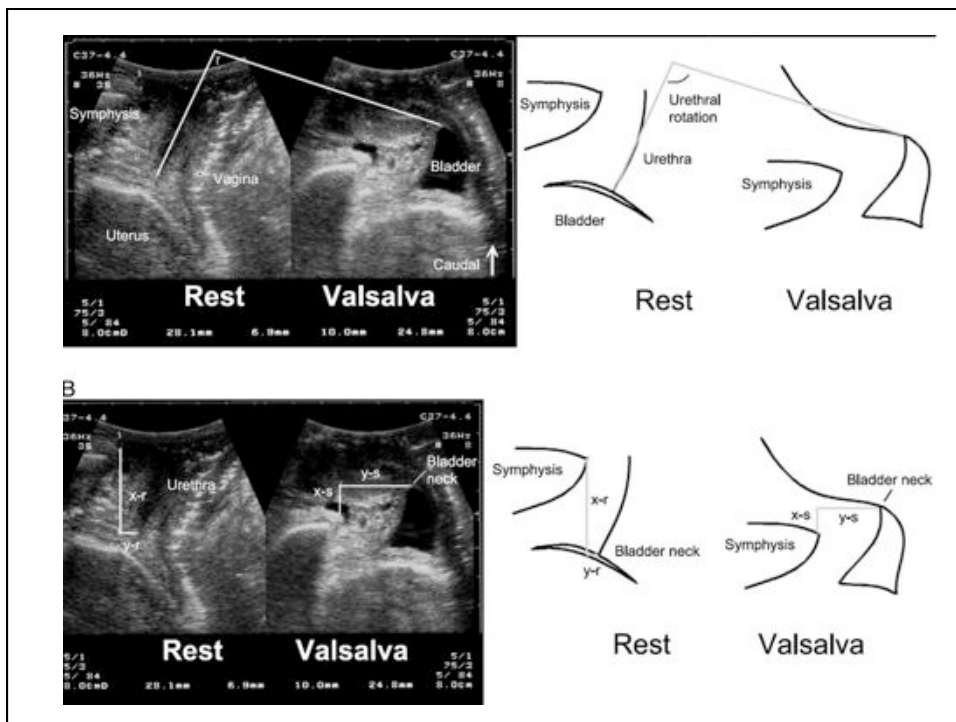
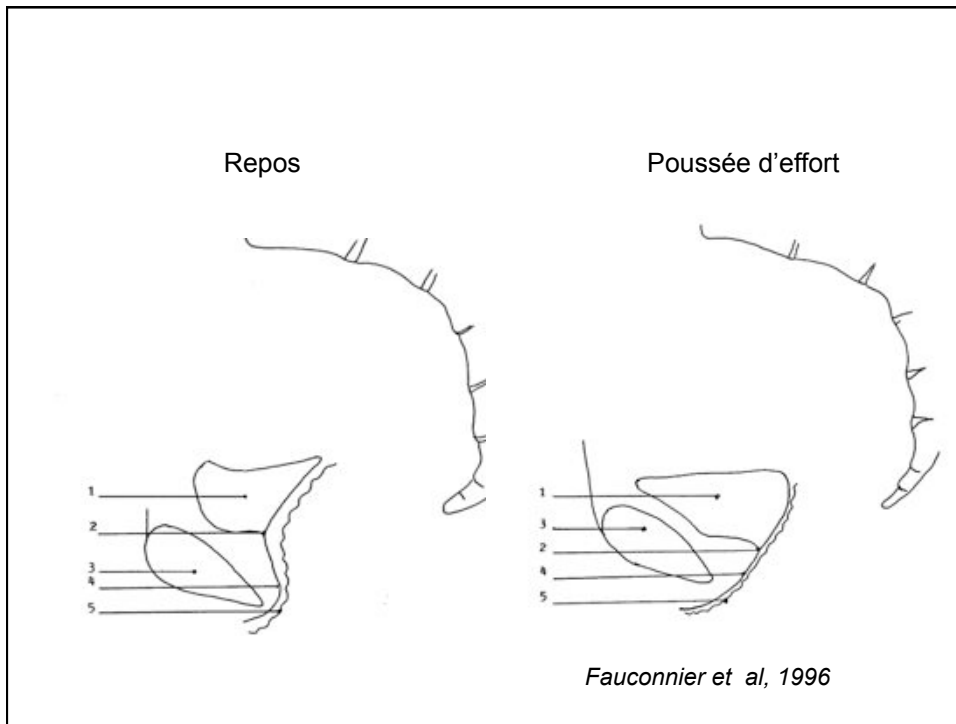


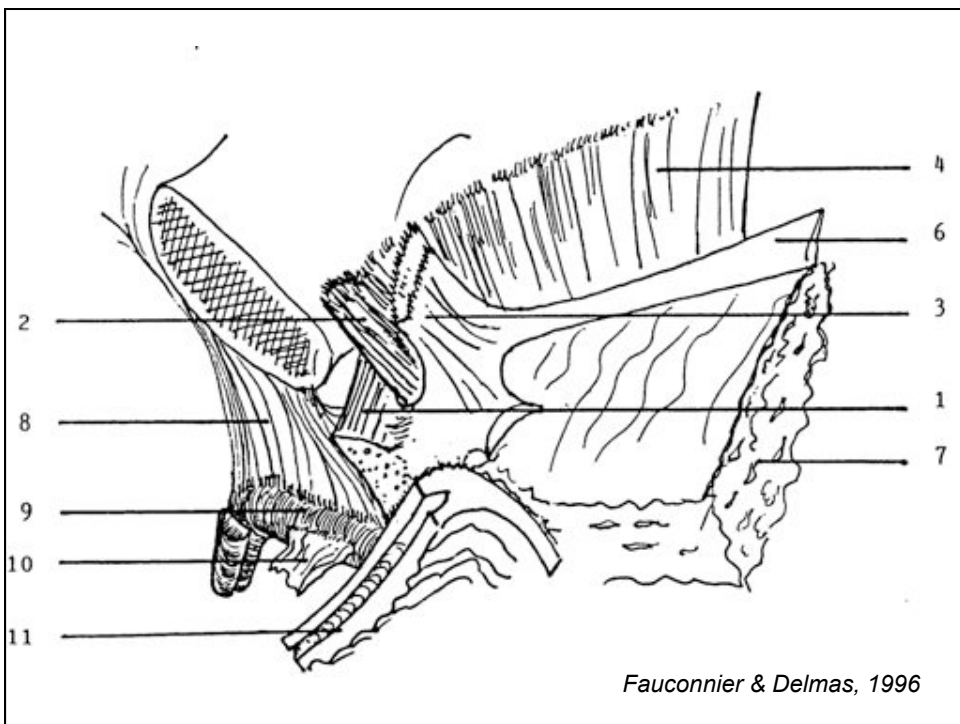
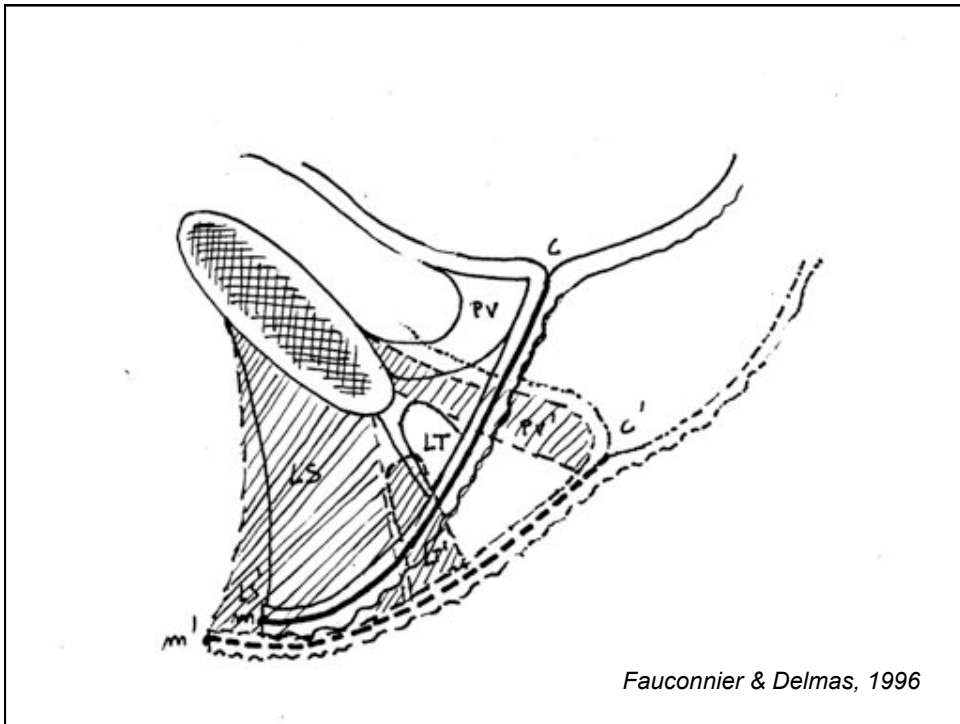
Anatomie dynamique de la statique pelvienne



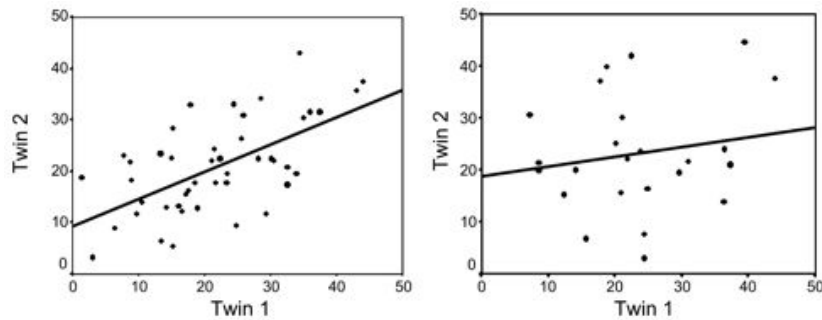


Mobilité cervico-urétrale et
continence à l'effort

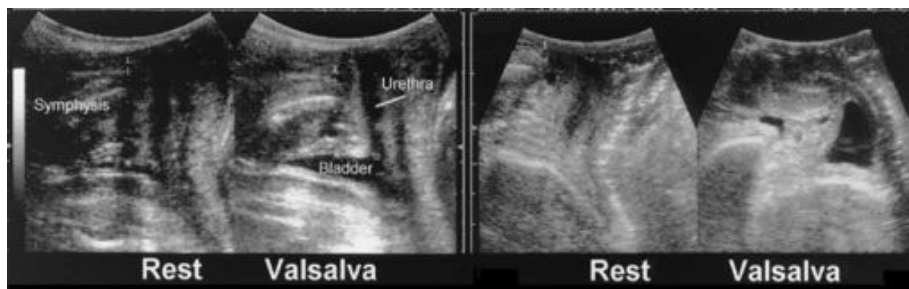




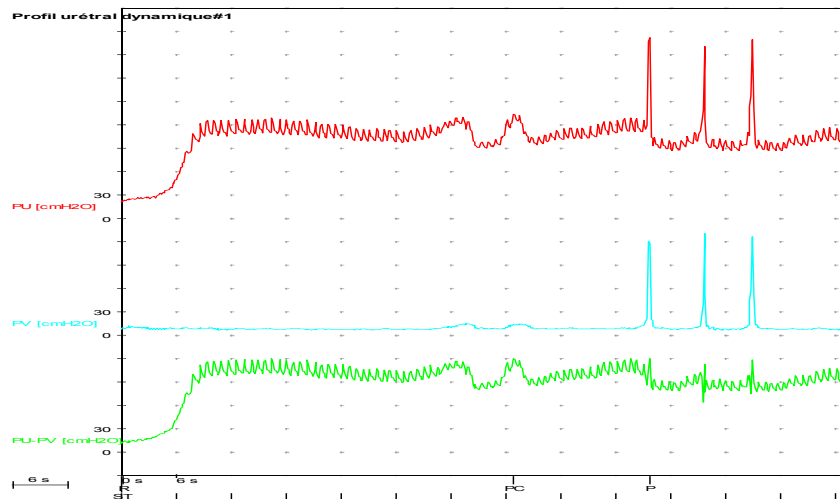
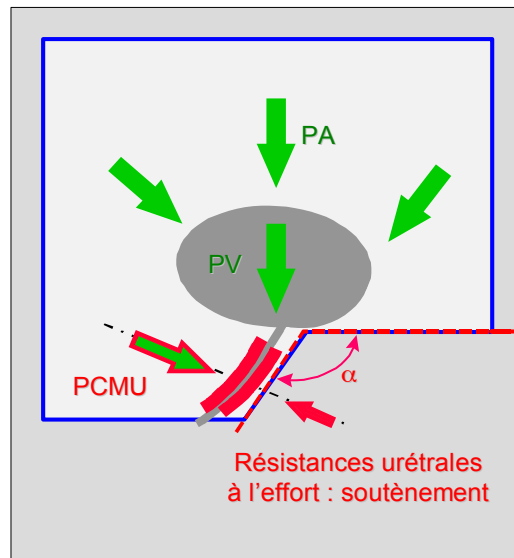
Scatterplots showing greater twin similarity for MZ pairs (left-hand panel, $r = 0.61$) compared with DZ pairs (right-hand panel, $r = 0.15$) Dietz, BJOG 2005



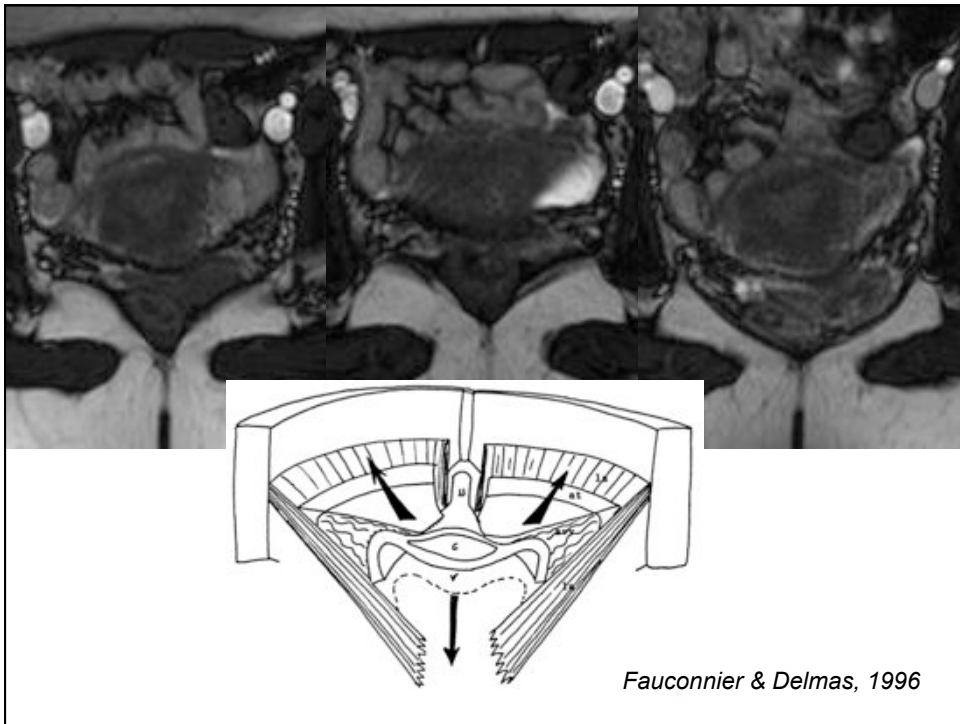
Dietz, 2003 : Antepartum (*left*) and postpartum (*right*) maximal Valsalva maneuvers as imaged by translabial ultrasound. There is a marked increase in pelvic organ mobility in this primiparous woman



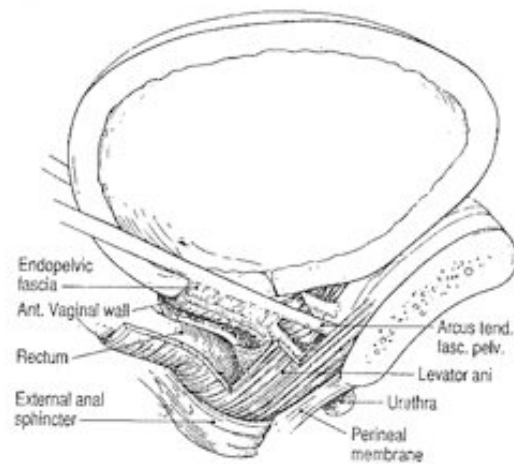
Physiopathologie de l'IUE

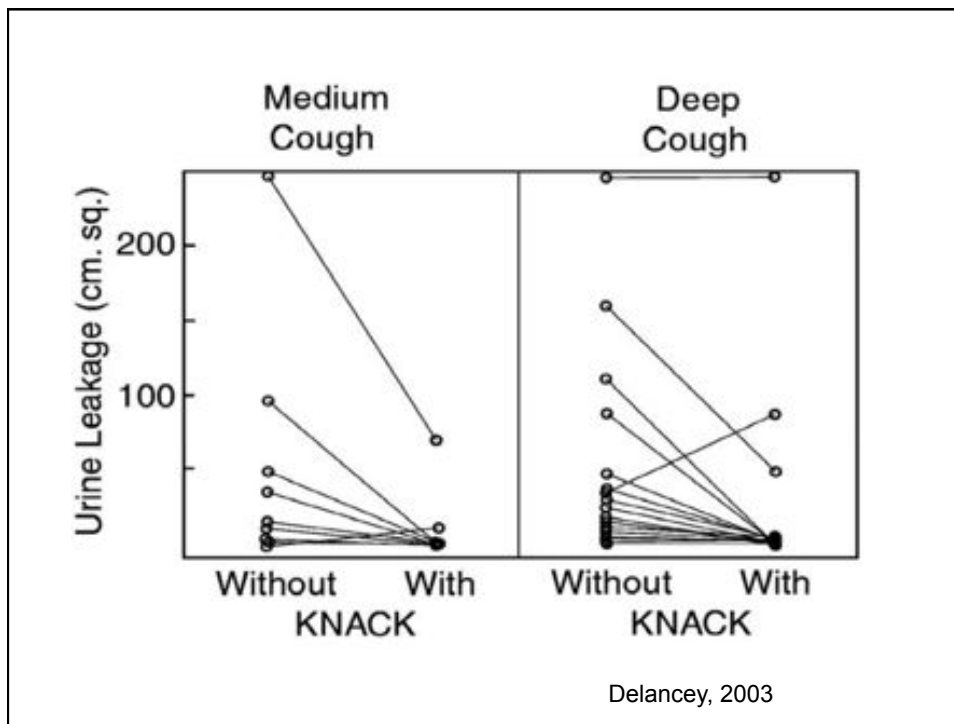


Profil Urétral Dynamique NORMAL



The hammock hypothesis

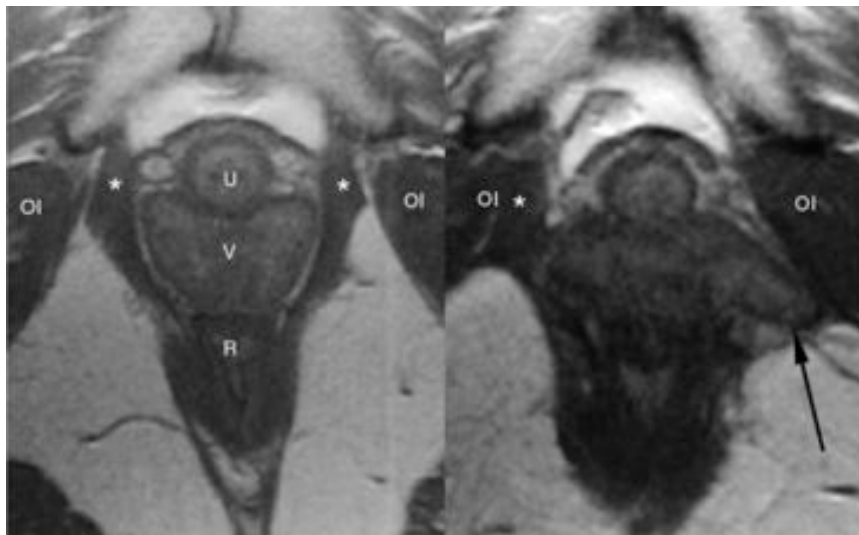
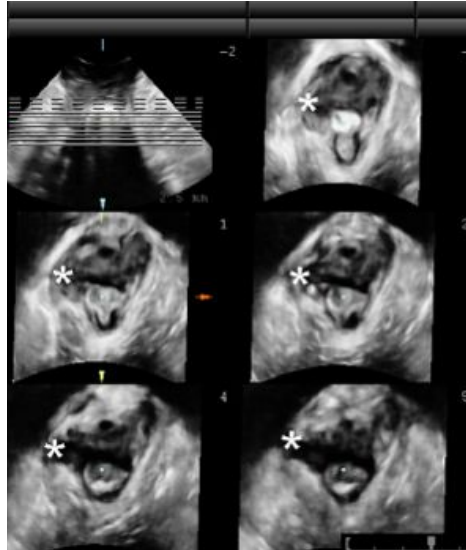
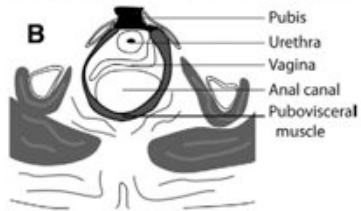
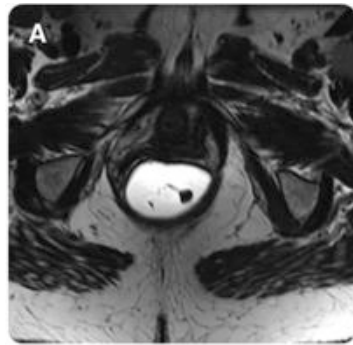




Impact de la grossesse et des accouchements sur les muscles éleveurs

Avulsions post-obstétricales du pubo-coccygéen :

- IRM en axiale T2
- US reconstruction 3D



DeLancey, 2003

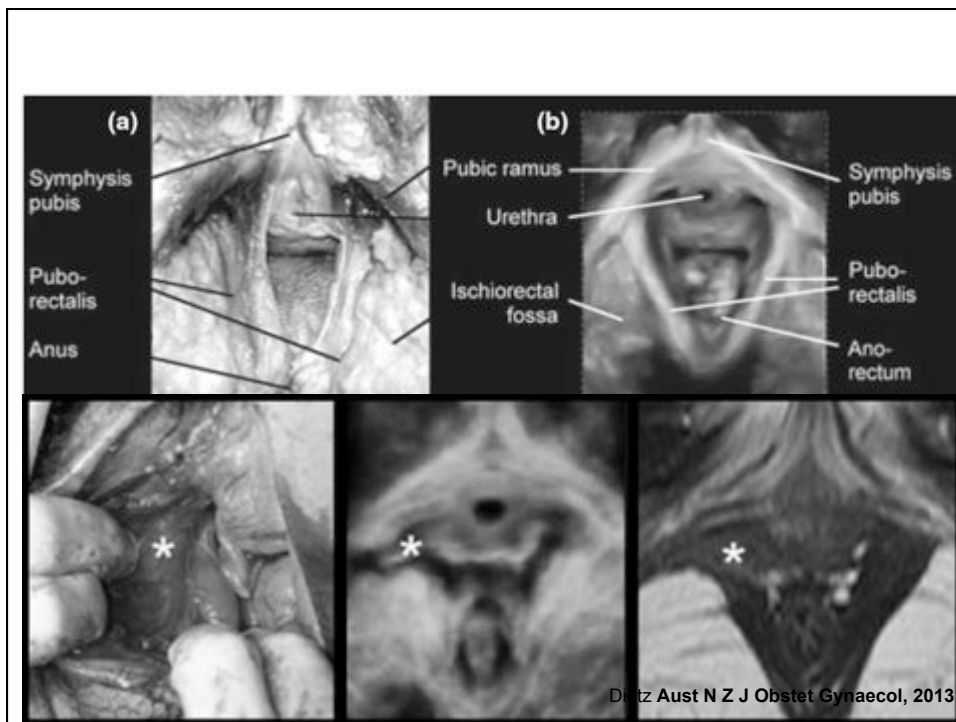
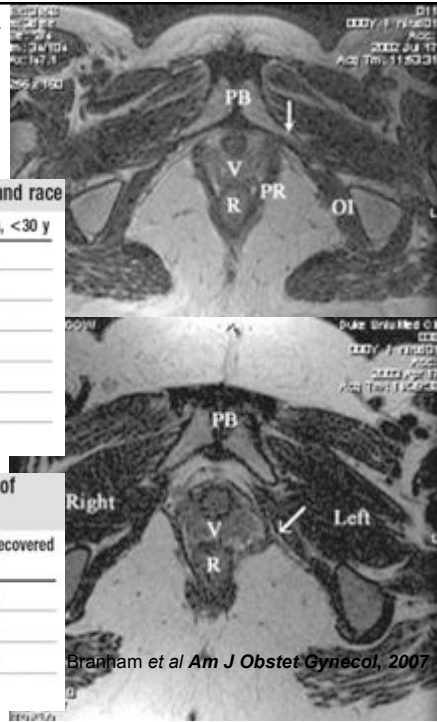
Levator ani abnormality delivery persists at 6 months

Comparison of incidence of levator injury for subjects, by age and race

Subjects	White, <30 y	White, ≥30 y	African American, <30 y
Nulliparous			
Normal	9 (82%)	6 (100%)	7 (88%)
Injured	2 (18%)	0 (0%)	1 (12%)
Primiparous			
Normal	7 (44%)	12 (52%)	4 (66%)
Injury, persistent	2 (12%)	5 (22%)	1 (17%)
Injury, recovered	7 (44%)	6 (26%)	1 (17%)

Relationship of mode of delivery to frequency and persistence of levator injury

Delivery type	n	No injury	Injured-persistent at 6 mo	Injured-recovered by 6 mo
Vaginal; push <30 min	6	4 (67%)	0 (0%)	2 (33%)
Vaginal; push ≥30 min	29	15 (52%)	4 (14%)	10 (35%)
CS in labor	6	2 (33%)	2 (33%)	2 (33%)
EC	4	2 (50%)	2 (50%)	0 (0%)

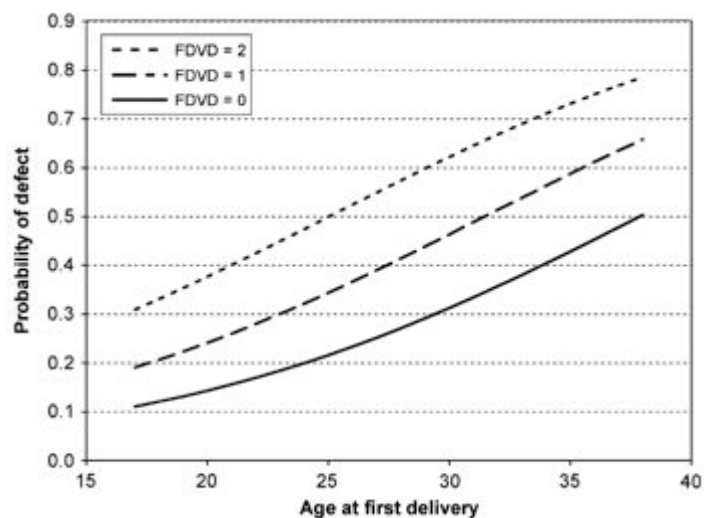


Avulsion et mode d'accouchement

Consensus reading	Treatment group			Total
	Sphincter tear	Vaginal control	Cesarean control	
MRI negative (no/minor LAM injury)	72	85	29	186
MRI positive (major LAM injury)	17	3	0	20
Total, n (%)	89 (19.1)	88 (3.5)	29 (0)	206 (9.7)

Heilbrun *et al Am J Obstet Gynecol*, 2010

Relation entre âge au premier accouchement et risque d'avulsion



Dietz *Aust N Z J Obstet Gynaecol*, 2013

Conséquences de l'avulsion sur la statique pelvienne

Variable	Crude OR (95% CI)	Adjusted OR (95% CI)	P value
Obstetric history			
Episiotomy	3.24 (1.76–5.97)	3.77 (1.80–7.89)	< .001
Pelvic reconstructive surgery			
Anterior compartment	4.15 (2.34–7.34)	3.29 (1.60–6.77)	.001
POP-Q measurement			
C	1.20 (1.08–1.33)	1.18 (1.04–1.34)	.01
UDI			
Genital prolapse	1.02 (1.007–1.023)	1.01 (1.002–1.023)	.02
DDI			
Obstructive defecation	0.98 (0.97–0.99)	0.97 (0.96–0.99)	< .001

Lammers et al. Correlating signs and symptoms with pubovisceral muscle avulsions on MRI
AMJOG 2013

Avulsion et symptômes pelvi-périnéaux

Questionnaires	No defect (n = 57)		Minor pubovisceral avulsion (n = 48)		Major pubovisceral avulsion (n = 83)		P value
	n	Median (range)	n	Median (range)	n	Median (range)	
UDI							
Overactive bladder	55	33.3 (0–100)	45	22.2 (0–100)	78	33.3 (0–88.9)	.35
Urinary incontinence ^a	55	33.3 (0–100)	47	16.7 (0–100)	79	33.3 (0–100)	.25
Obstructive micturition	56	25.0 (0–100)	48	25.0 (0–100)	80	16.7 (0–100)	.49
Discomfort/pain	55	33.3 (0–100)	48	33.3 (0–100)	83	33.3 (0–100)	.32
Genital prolapse ^a	55	16.7 (0–100)	47	33.3 (0–100)	82	33.3 (0–100)	.001 ^b
DDI							
Constipation ^a	56	33.3 (0–100)	48	0 (0–100)	83	16.7 (0–100)	.02 ^{b,c}
Obstructive defecation ^a	55	33.3 (0–100)	48	16.7 (0–83.3)	83	16.7 (0–75)	< .001 ^{b,d}
Pain ^a	56	33.3 (0–100)	48	0 (0–100)	83	0 (0–100)	< .01 ^{b,d}
Fecal incontinence ^a	55	16.7 (0–100)	49	16.7 (0–100)	82	0 (0–100)	.27
Flatus incontinence	55	33.3 (0–100)	49	33.3 (0–100)	83	33.3 (0–100)	.66
Physical functioning							
Physical functioning	55	33.3 (0–100)	47	33.3 (0–83.3)	78	33.3 (0–100)	.37
Mobility	54	33.3 (0–100)	48	44.4 (0–100)	81	33.3 (0–100)	.67
Social functioning	53	22.2 (0–88.9)	44	16.7 (0–100)	79	22.2 (0–100)	.84
Embarrassment	52	25.0 (0–100)	46	16.7 (0–100)	78	16.7 (0–100)	.44
Emotional health	57	55.6 (0–100)	48	33.3 (0–100)	80	33.3 (0–100)	.13 ^e

Lammers et al. Correlating signs and symptoms with pubovisceral muscle avulsions on MRI
AMJOG 2013

Troubles urinaires et avulsions

First author	n with levator avulsion	Percentage of women of study population with levator avulsion		Conclusion
DeLancey [15]	Cases:	23	29 %	Primiparous women with SUI were twice as likely to have a muscle abnormality than primiparae without SUI. No avulsions were identified in nulliparous women
	Control groups:			
	Non-SUI primiparae	9	11 %	
	Nulliparae	0	0 %	
Dietz [17]	Complete	46	14 %	No association was found between complete avulsion and urodynamic findings or symptoms of bladder dysfunction except for frequency ($p=0.02$)
Dietz [31]	Complete	50	19 %	Sixty-two percent of women with complete avulsions complained of SUI. Defect score was significantly higher in women with symptoms of urinary frequency ($p=0.05$)
Dietz [33]	Complete	104	25 %	Women with complete avulsions were less likely to suffer from SUI ($p<0.001$) and USI ($p=0.065$), but more likely to show signs of voiding dysfunction ($p=0.005$)
Heilbrun [24]	Major	20	10 %	There was no relation between major avulsion and (S)UI based on MESA compared to women with minor or no avulsion
Morgan [26]	Major	83	55 %	SUI symptoms were least present in women with major avulsions and most frequently reported by women with minor avulsions
	Minor	24	16 %	

Lammers et al 2012
Int Urogynecol J
 Diagnosing Pubovisceral Avulsions: A Systematic Review

Troubles ano-rectaux et avulsions

First author	n with levator avulsion	Percentage of women of study population with levator avulsion		Conclusion
Chantarasorn [30]	Complete bilateral	38	10 %	Both unilateral and bilateral complete avulsions were not associated with FI, fecal urgency, or flatus incontinence
	Complete unilateral	39	10 %	
Heilbrun [24]	Major	20	10 %	Women with major avulsions had a higher prevalence of FI based on FIS1 questionnaire ($p=0.006$) compared to women with no or minor avulsions
Lewicky-Gaupp [25]	OI	6	75 %	Older women with FI were more likely to have avulsions than women without FI
	OC	2	22 %	
	YC	1	11 %	
	Overall	9	35 %	
Morgan [27]	Cases:			There was no relation between levator ani defect status and symptom severity of anal incontinence and difficult defecation among women with POP
	Major	83	55 %	
	Minor	24	16 %	
	Controls:			
	Major	21	16 %	
	Minor	30	22 %	
Rodrigo [36]	Complete	209	22 %	Levator ani avulsion was more common among women with FI ($p=0.003$). On multivariable analysis, there was no independent effect of avulsion

Lammers et al 2012
Int Urogynecol J
 Diagnosing Pubovisceral Avulsions: A Systematic Review

Prolapsus et avulsions

Lammers et al 2012
Int Urogynecol J
Diagnosing Pubovisceral Avulsions: A Systematic Review

First author	n with levator avulsion	Percentage of women of study population with levator avulsion	Conclusion
Abdool [29]	Bilateral 31 Unilateral 45	9 % 12 %	Cystocele and rectocele (on POP-Q) were associated with both unilateral and bilateral avulsion. Uterine prolapse was only related to bilateral avulsion
Adekanmi [23]	Cases: Partial 18 Complete 21 Controls 0	26 % 30 % 0 %	Women with symptomatic POP (stage II) showed in 56 % of the cases a partial or complete avulsion. No avulsions were identified in nulliparous women
DeLancey [13]	Cases: Major 83 Minor 24 Controls: Major 21 Minor 30	55 % 16 % 16 % 22 %	Major avulsions were statistically significant related to POP status ($p < 0.001$) and associated with an adjusted OR of 7.3 (95 % CI 3.9–13.6)
Dietz [14]	Complete 181	23 %	Women with complete avulsions were twice as likely to have significant POP, especially cystocele and uterine prolapse
Dietz [38]	Complete 21	20 %	Women with a palpated avulsion showed more cystocele descent both on ultrasound and on POP-Q
Dietz [17]	Complete 46	14 %	Women with complete avulsions had higher grades of POP of the anterior and central compartment. There was no association between complete avulsion and POP symptoms
Dietz [31]	Complete 50	19 %	Defect score was associated with cystocele and uterine prolapse and POP symptoms
Dietz [33]	Complete 104	25 %	Women with a complete avulsion were more likely to have POP of the anterior compartment ($p < 0.001$)
Dietz [22]	Complete 226	30 %	A complete avulsion was strongly associated with symptoms of POP, significant POP on clinical assessment, and bladder descent on perineal ultrasonography (all $p < 0.001$)
Heilbrun [24]	Major 20	10 %	POP-Q points Ba and Bp were more often at or below the hymen in women with major avulsions compared to women with no or minor avulsions
Morgan [28]	Major 46	55 %	There was no difference in preoperative anterior, apical, and posterior POP-Q data between women with and without a major avulsion

Récidive de prolapsus après chirurgie en fonction des avulsions visualisées par IRM ou US

Lammers et al 2012
Int Urogynecol J
Diagnosing Pubovisceral Avulsions: A Systematic Review

First author	n with levator avulsion	Percentage of women of study population with levator avulsion	Follow-up duration ^a	Conclusion
Dietz [32]	Complete 29	35 %	4.5 years [3–6.4]	Complete avulsion was associated with an RR of 3 to 4 for cystocele recurrence
Model [34]	Complete 156	21 %	NR	Complete avulsion was associated with an increased prevalence of significant POP and symptoms of POP after previous POP or anti-incontinence surgery
Morgan [28]	Major 46	55 %	42.3 days (12.0)	Women with major avulsions were less likely to have anterior compartment support at least 2 cm above the hymen after surgery compared to women with no or minor avulsions
Weemhoff [35]	Partial 59 Complete 63	39 % 41 %	31 months [14–50]	Fifty-two percent of women with anatomical recurrence of cystocele had a complete avulsion compared to 31 % of women without anatomical recurrence. There was no difference in anatomical recurrence in relation to partial avulsion
Wong ^b [37]	Complete 83	38 %	2.1 years [6 weeks–5.6 years]	Complete avulsion was associated with an OR of 2.27 (95 % CI 1.23–4.21) for significant cystocele recurrence on ultrasound. This effect was significant for women after a specific type of mesh operation

Altération fonctionnelles des muscles releveurs et troubles de la statique pelvienne à long terme

Physiopathologie

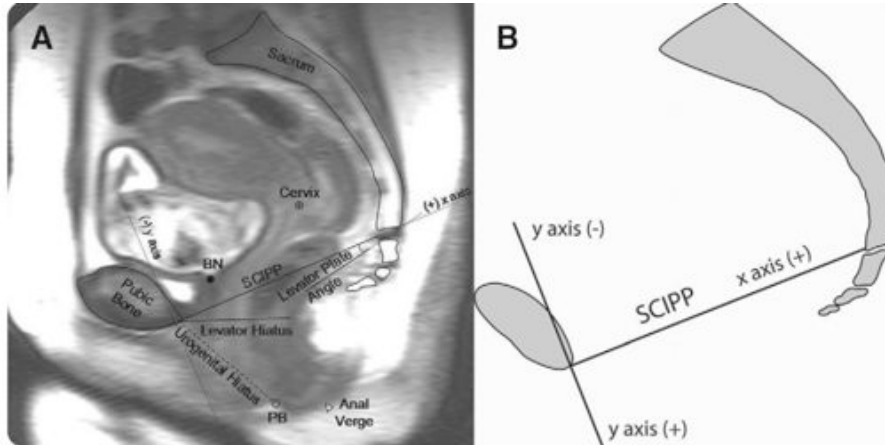
Hiatus des releveurs

- 6 à 36 cm² chez la nullipare
- la tête fœtale à terme entre 70 et 100 cm²

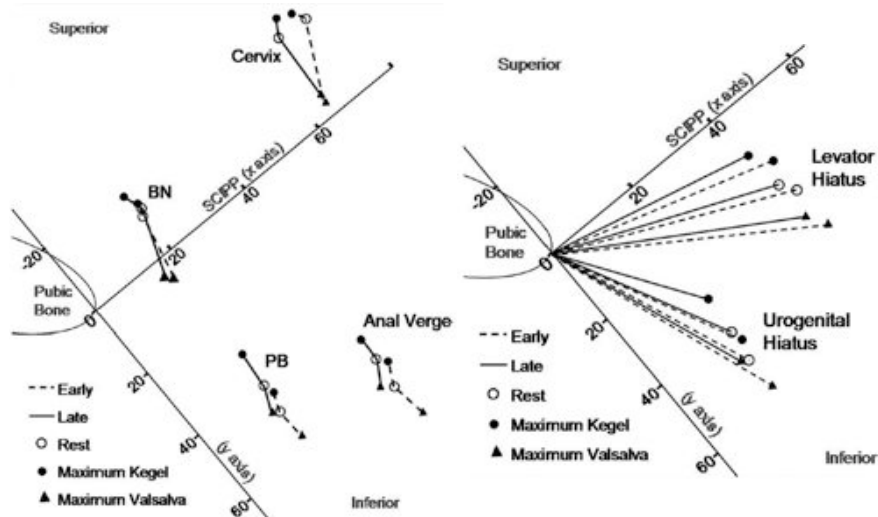
Table 1. Area of the levator hiatus at rest versus parity in a series of 189 symptomatic women (series unrelated to those given in Tables 2 and 3).

Vaginal delivery	N	Mean	Standard deviation	
0	21	11.421	2.941	(-----*-----)
1	24	12.945	2.732	(-----*-----)
2	58	14.621	3.375	(-----*-----)
3	47	14.513	3.005	(-----*-----)
4	39	14.319	3.584	(-----*-----)
				10.5 12.0 13.5 15.0

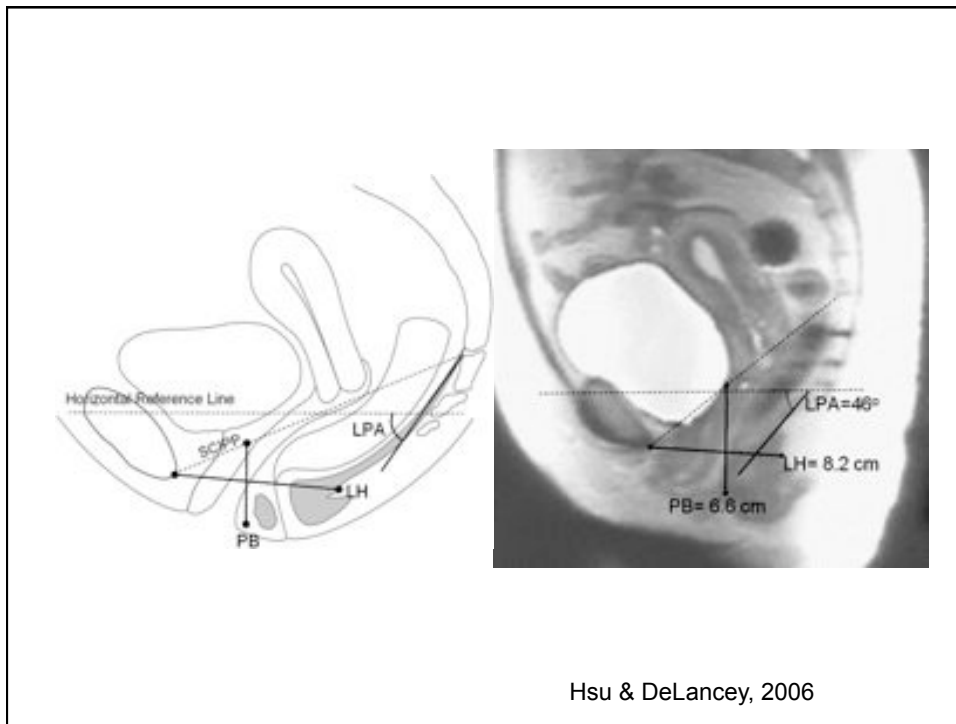
Mesures dynamiques de la physiologie des releveurs dans le post-partum



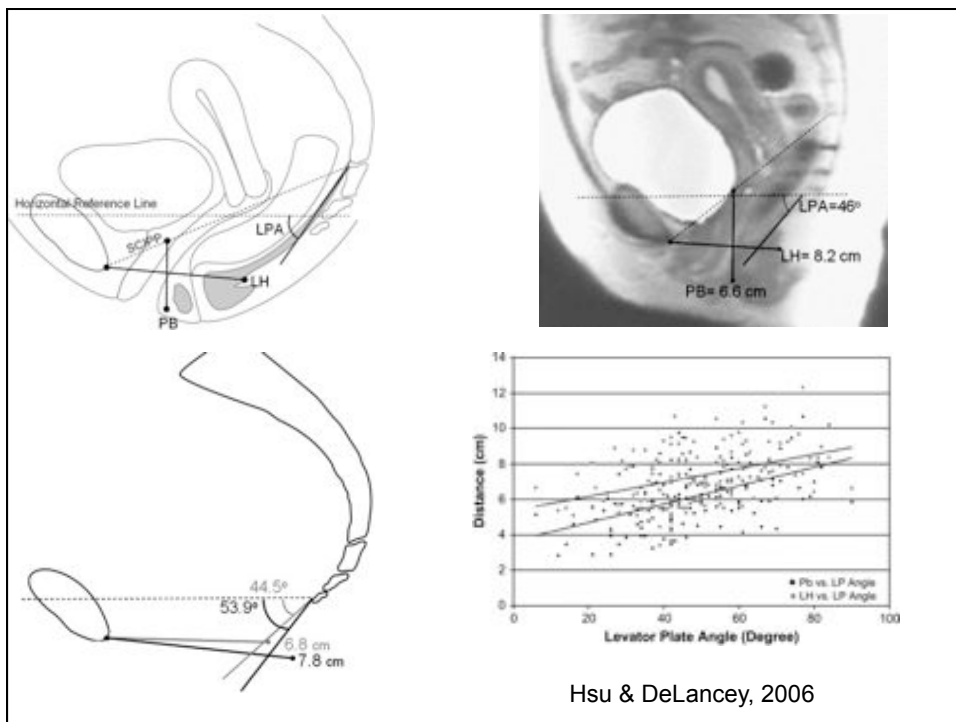
Yousuf et al., *Pelvic structure and function at 1 month compared to 7 months by dynamic magnetic resonance after vaginal birth.* Am J Obstet Gynecol, 2009.



Yousuf et al., *Pelvic structure and function at 1 month compared to 7 months by dynamic magnetic resonance after vaginal birth.* Am J Obstet Gynecol, 2009.

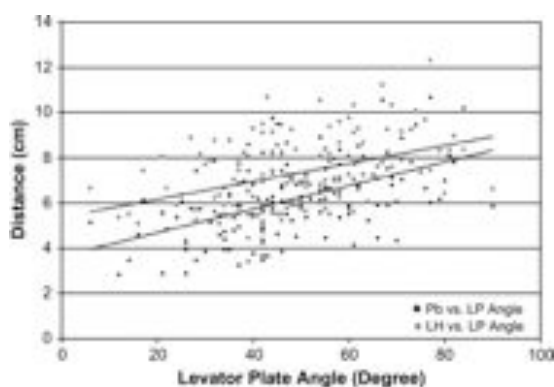
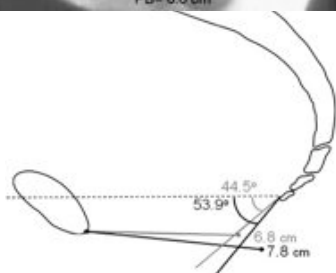
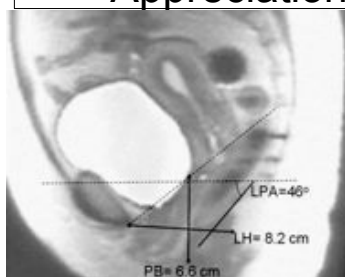


Hsu & DeLancey, 2006



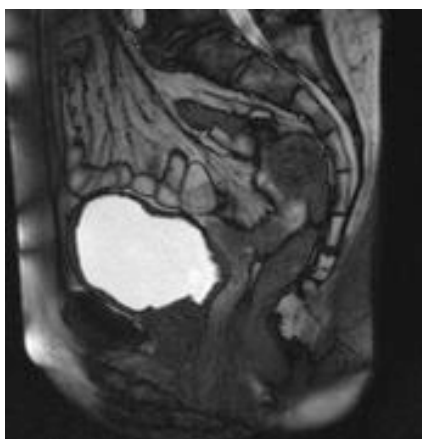
Hsu & DeLancey, 2006

Aspects quantitatifs :
Appréciation des muscles élévateurs

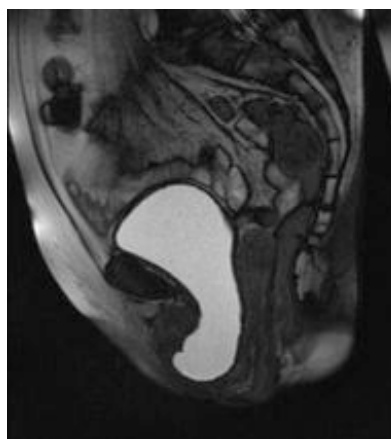


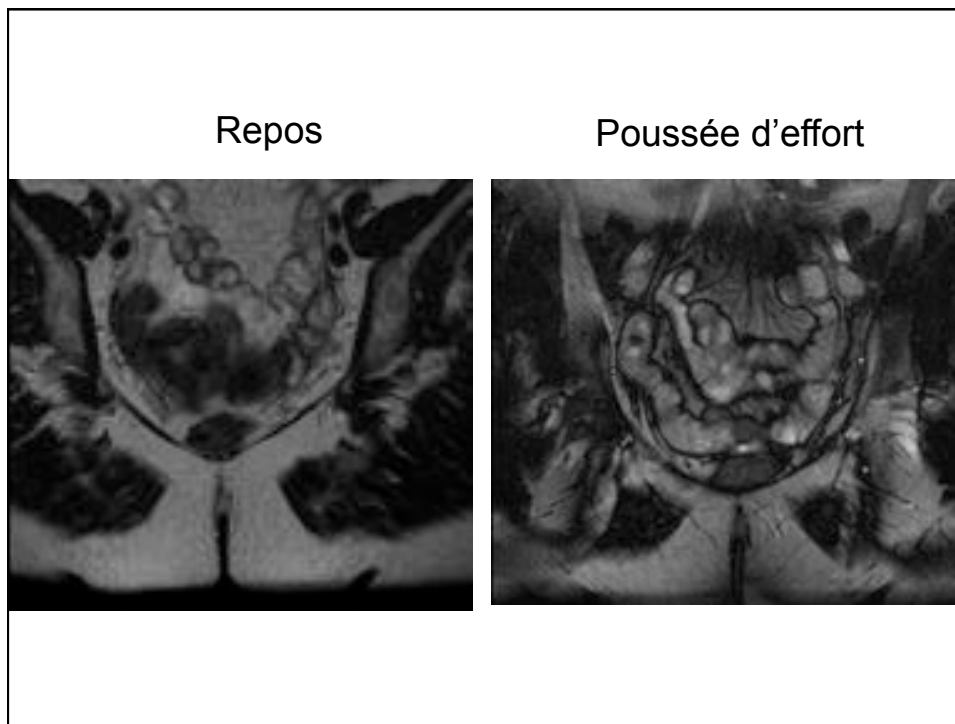
Hsu & DeLancey, 2006

Repos



Poussée d'effort





L'IRM constitue un excellent outil d'investigation de l'ensemble des conséquences pelvi-périnéale des grossesses et des accouchements

Exploration anatomique et physiologique des muscles releveurs

Exploration physiologique de la statique pelvienne

Exploration de la continence urinaire d'effort

➤ Applications en recherche en pelvi-périnéologie

*Les applications cliniques de
l'IRM restent limitées*

Pas ou peu d'implication thérapeutique des
lésions observées

Autres moyens d'investigation disponibles

- Clinique
- Echographique

Intérêt pédagogique