Inserm
Institut national
de la santé et de la recherche médicale

Université Claude Bernard Lyon 1

CarMeN LYON

Hospices Civils de Lyon

Bifurcation du tronc commun:

Problématique des gros diamètres

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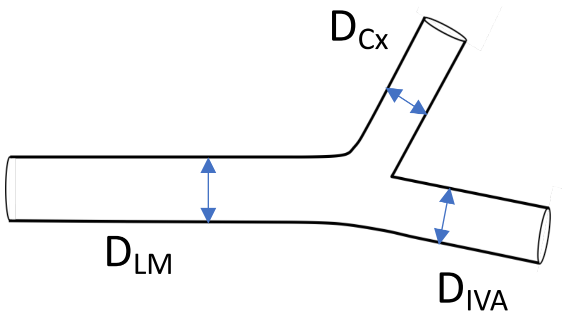
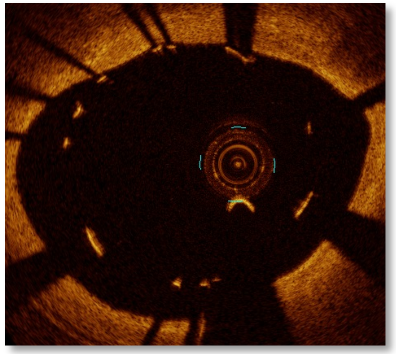
Géométrie fractale physiologique

Formule de Finet



$$D_{LM}=0.678(D_{IVA}+D_{Cx})$$



Small branch	Main branch								
mm	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50
2.50	3.36 Δ=0.86	3.54 Δ=0.79	3.72 Δ=0.72	3.91 Δ=0.66	4.11 Δ=0.61	4.32 Δ=0.57	4.53 Δ=0.53	4.57 Δ=0.33	4.75 Δ=0.25
2.75		3.70 Δ=0.95	3.87 Δ=0.87	4.06 Δ=0.81	4.25 Δ=0.75	4.44 Δ=0.69	4.64 Δ=0.64	4.75 Δ=0.50	4.92 Δ=0.42
3.00			4.04 Δ=1.04	4.21 Δ=0.96	4.39 Δ=0.89	4.58 Δ=0.83	4.77 Δ=0.77	4.92 Δ=0.67	5.09 Δ=0.59
3.25				4.37 Δ=1.12	4.55 Δ=1.05	4.73 Δ=0.98	4.91 Δ=0.91	5.09 Δ=0.84	5.25 Δ=0.75
3.50					4.71 Δ=1.21	4.88 Δ=1.13	5.06 Δ=1.06	5.25 Δ=1.00	5.42 Δ=0.92
3.75						5.05 Δ=1.30	5.22 Δ=1.22	5.42 Δ=1.17	5.59 Δ=1.09
4.00							5.38 Δ=1.38	5.59 Δ=1.34	5.76 Δ=1.26
4.25								5.76 Δ=1.51	5.93 Δ=1.43
4.50									6.00 Δ=1.50

$D_{IVA}=D_{Cx}$ => gros Δ

Finet G et al. EuroIntervention 2008
Huo Y et al. EuroIntervention 2012

Problématiques des gros diamètres

1. Delta diamètres
   - *limites de post dilatation ?*
   - *Impact de la déstructuration du stent*
2. Territoire à risque
   - *gestion de la SB*
3. Technique de post-dilatation
4. Place des stents « dédiés »

→

- Quelle stratégie ?
- Quel matériel ? (ballon/stent)

Quelle stratégie ?

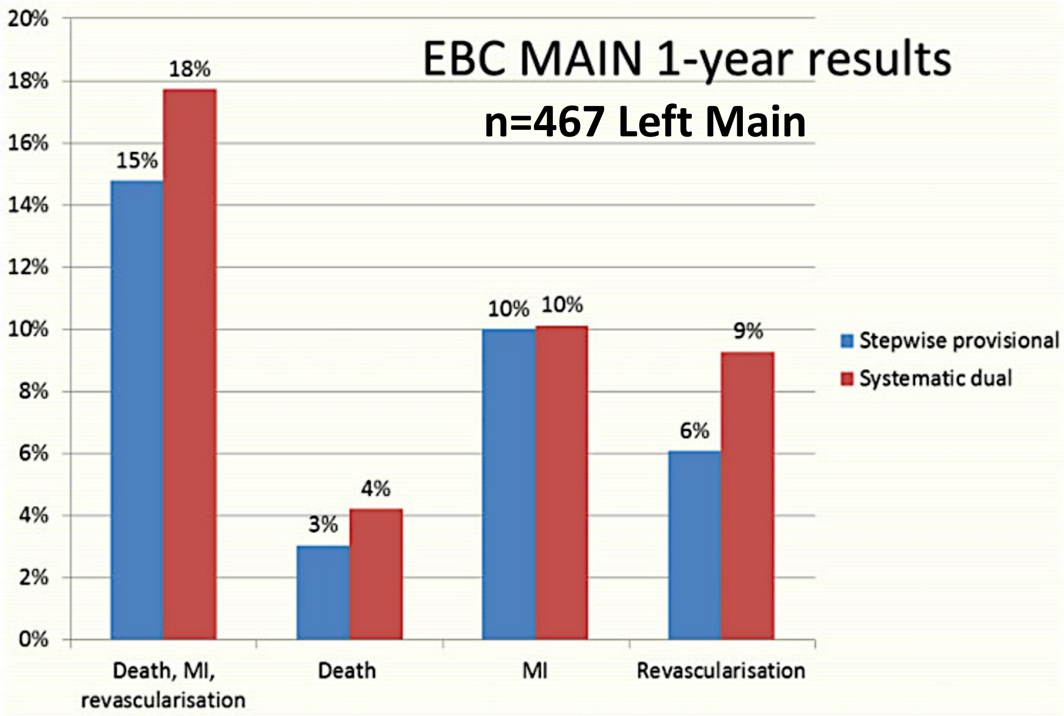


TABLE 1 Quantitative Analysis of the Mechanical Effects of POT

Pooled Results (Promus Premier and Ultimaster Stents)	Before POT (n = 40)	After POT (n = 40)
Mean MoV_{ref} D, mm	4.08 ± 0.03*	4.23 ± 0.08
Proximal mean stent D, mm	3.32 ± 0.08*	4.23 ± 0.08
Expected stepwise difference in diameter between MoV_{ref}-MB_{ref} according to fractal geometry	0.83 ± 0.03	NA
Measured diameter difference between MoV_{ref} and stent, mm	0.76 ± 0.06*	0
Ellipticity ratio of reference MoV	1.03 ± 0.02	1.03 ± 0.01
Ellipticity ratio of stent in MoV	1.04 ± 0.02	1.03 ± 0.02
Stent strut obstruction in SBO, %	34.0 ± 7.4*	26.0 ± 4.2
Distal cell area ratio in SBO, %	22.1 ± 15.9*	28.7 ± 19.6

Values are mean ± SD. *$p < 0.05$ versus after POT.
D = diameter; MB = main branch; MoV = mother vessel; NA = not applicable; POT = proximal optimizing technique; ref = reference; SBO = side-branch ostium.

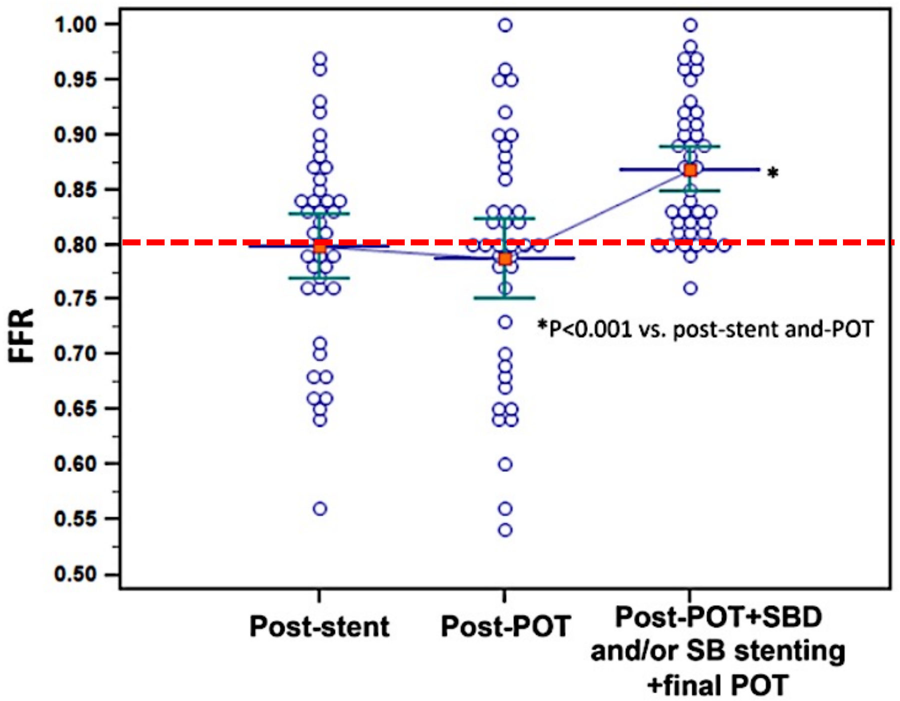
Le tronc commun, une bifurcation comme une autre:

⇒ Provisional stenting en première intention

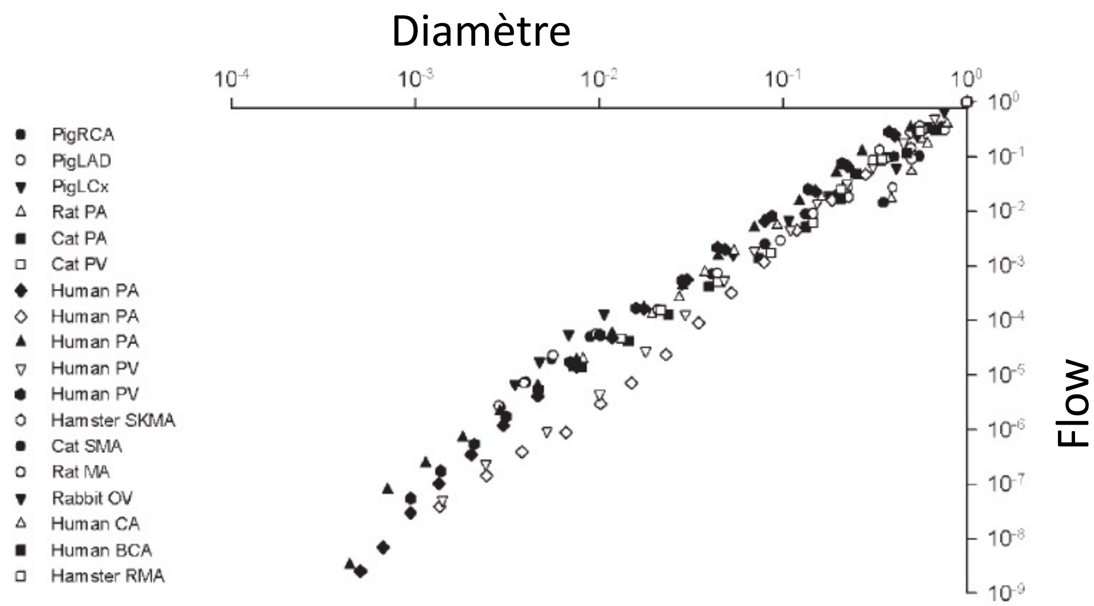
⇒ POT systématique

Hildick-Smith et al. EHJ 2021
Finet et al. JACC inter. 2015

Quelle stratégie ?



Ischémie des mailles résiduelles à l'ostium de la SB



Relation direct entre diamètre natif et le débit coronaire

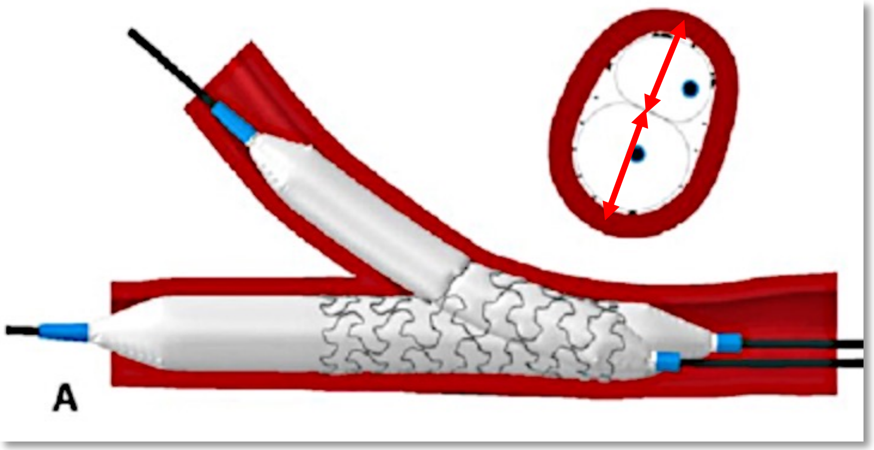
(masse myocardique)

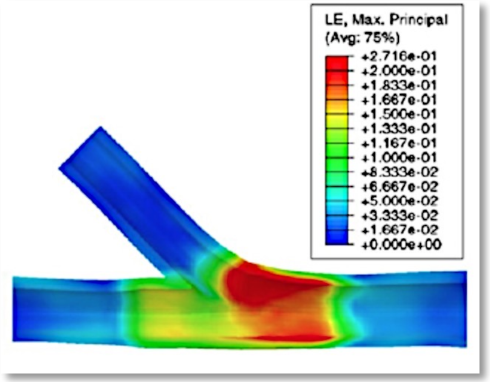
$$Q_{Cx} / Q_{LM} = (D_{Cx}/D_{LM})^{7/3}$$

=> Ouverture systématique de la branche (Circonflexe++)

Kassab et al. Am J Physiol Heart Circ Physiol. 2005
Hakim D et al. Circ Cardiovasc Interv. 2017
Biomechanics and coronary atherosclerotic plaque. Dérimay Ch 24. 2020

Quelle stratégie ? Le *KBI?*





Sur étirement proximal par le FKB selon la géométrie fractal

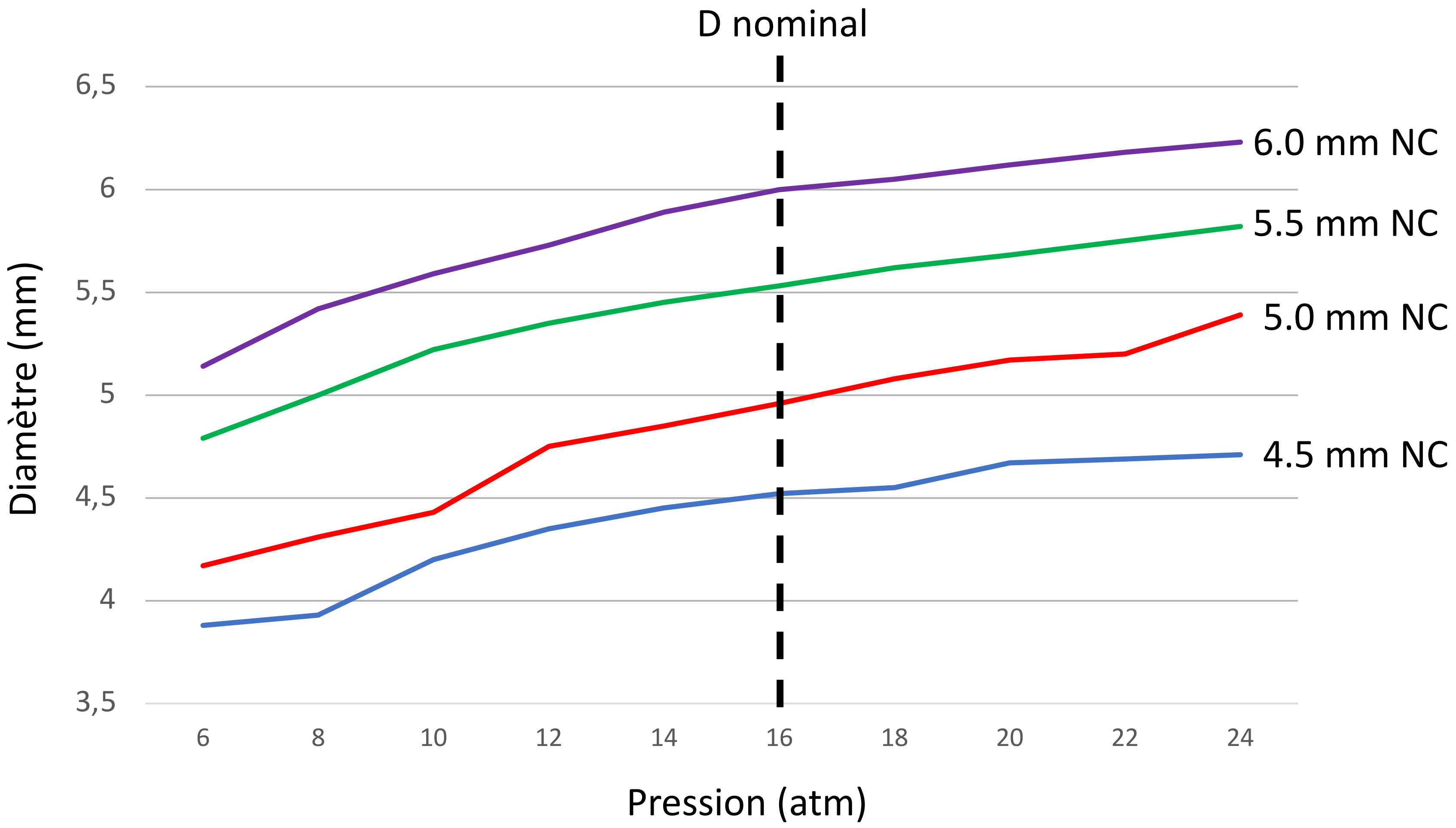
SB	MB						
mm	3.00	3.25	3.50	3.75	4.00	4.25	4.50
3.00	4.04 Δ=1.04 +1.96	4.21 Δ=0.96 +2.04	4.39 Δ=0.89 +2.11	4.58 Δ=0.83 +2.17	4.77 Δ=0.77 +2.23	4.92 Δ=0.67 +2.33	5.09 Δ=0.59 +2.42
3.25		4.37 Δ=1.12 +2.13	4.55 Δ=1.05 +2.20	4.73 Δ=0.98 +2.27	4.91 Δ=0.91 +2.34	5.09 Δ=0.84 +2.41	5.25 Δ=0.75 +2.50
3.50			4.71 Δ=1.21 +2.29	4.88 Δ=1.13 +2.37	5.06 Δ=1.06 +2.44	5.25 Δ=1.00 +2.50	5.42 Δ=0.92 +2.58
3.75				5.05 Δ=1.30 +2.45	5.22 Δ=1.22 +2.53	5.42 Δ=1.17 +2.58	5.59 Δ=1.09 +2.66
4.00					5.38 Δ=1.38 +2.62	5.59 Δ=1.34 +2.66	5.76 Δ=1.26 +2.74
4.25						5.76 Δ=1.51 +2.74	5.93 Δ=1.43 +2.82
4.50							6.00 Δ=1.50 +3.00

=> FKB sur TC de gros diamètres ↗ risque d'overstretch (>2mm)

Foin et al. JACCI CI 2012
Hakim D et al. Circ Cardiovasc Interv. 2017.

Quels ballons ?

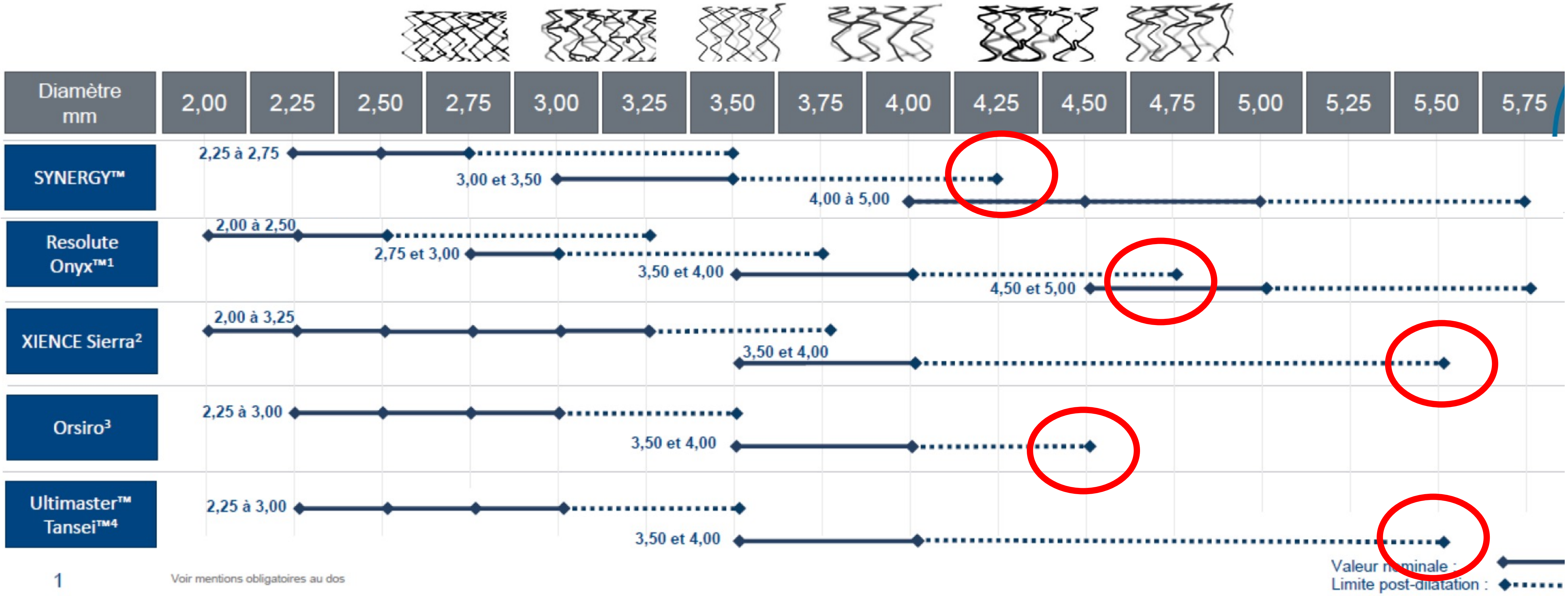
Ballon « à nu »
sans stent ni artère



=>Décalage ++ avec les courbes de compliance des constructeurs (↗ Pression d'inflation)

Quels stents ?

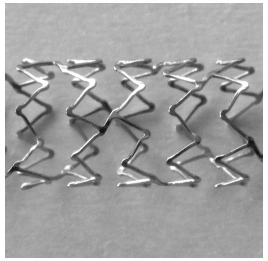
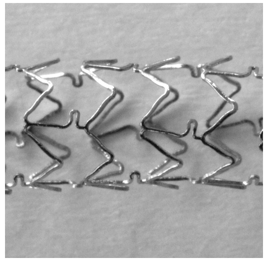
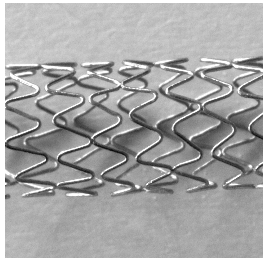
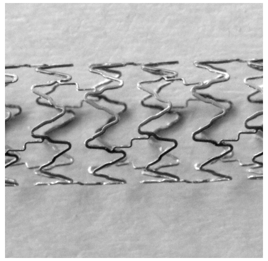
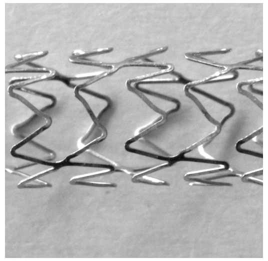
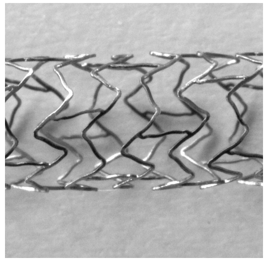
New DES workhorse and model designs



=> Quelles limites de post dilatation? (POT++)

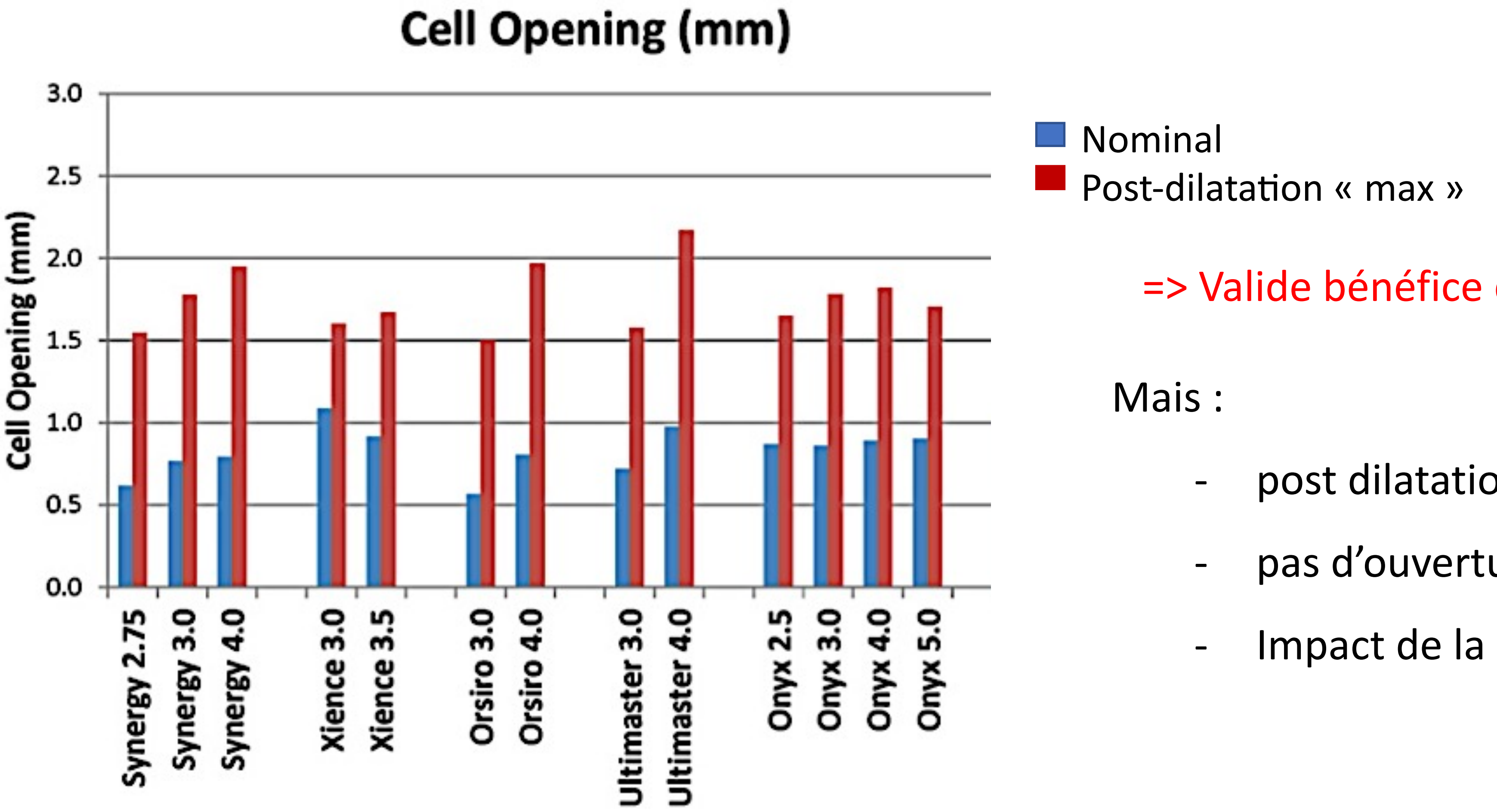
Ng et al. Int J cardiol 2016.

Quels stents ?

Plateforme 3.5mm	Synergy™	Xience Xpedition™	Resolute Integrity™	Coroflex Isar™	Ultimaster™	Orsiro™
Ballon 6.0mm 24b						
Alliage	PtCr	CoCr	CoCr	CoCr	Cocr	CoCr
Connectors	2	3	2	3	2	3
Connector type	Peak to peak	Peak to valley	Peak to peak	Peak to valley	Peak to peak	Valley to valley
Strut thickness (µm)	86	89	95	64	95	60
D « max » Ng et al(mm)	4.2	5.6	5.6	-	5.8	5.3
Dmax (mm)	5.1	6.0	5.9	5.9	6.0	5.8
% ΔL à Dmax	+4.2%	+5.0%	-14.2%	+5.8%	-31.4%	-9.3%

En fait capacité de post dilatation > à celles annoncées => déstructuration++

Quels stents ?



=> Valide bénéfice du POT

Mais :

- post dilatation sous maximale
- pas d'ouverture de la SB
- Impact de la place du connecteur?

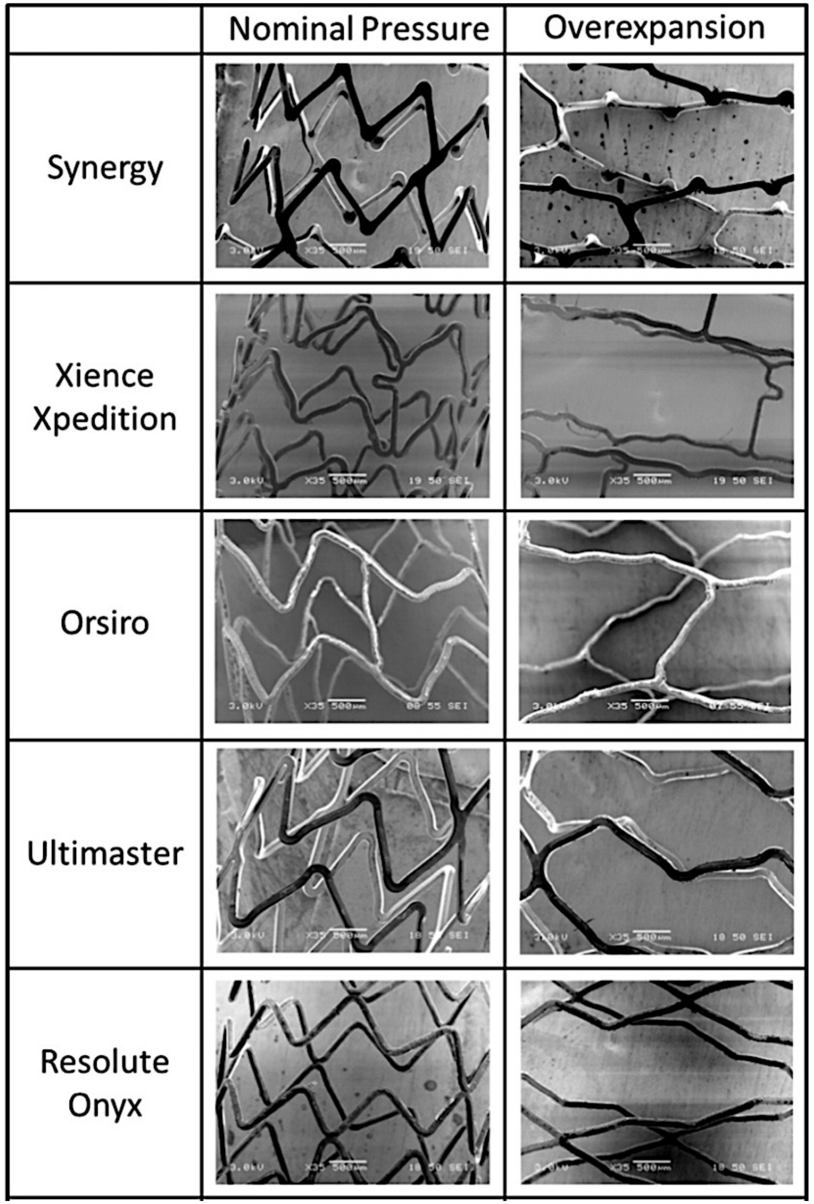
Ng et al. Int J cardiol 2016.

Quels stents ?

Over expansion = « déstructuration » du stent

- Effet « string » (protrusion de matériel, résistance à la compression)
- ↘ surface de couverture métallique
  - ↗ S artérielle 43% 3.5 à 5.0 mm
  - ↗ S artérielle 71% 3.5 à 6.0 mm
- Altération du coating
- Raccourcissement ?

=> Place des stents dédiés? (aux bif? aux troncs?)



Ng et al. int J cardiol 2016
Guérin et al. Circ Cardiovasc Inter. 2010

Quels stents ?

Compromis « idéal » d'un stent pour les troncs de grand diamètre:

- Post-dilatation possible (jusqu'à 6.0mm)
- Accès à la branche accessoire possible
- Sans altérer:
  - Résistance à la compression radiale
  - Résistance à la compression longitudinale (post-dilatation/concertina effect)
  - Conserver une bonne couverture métallique (drug delivery, plaque protrusion)

Quels stents ?

MEGATRON™ *Boston Scientific*

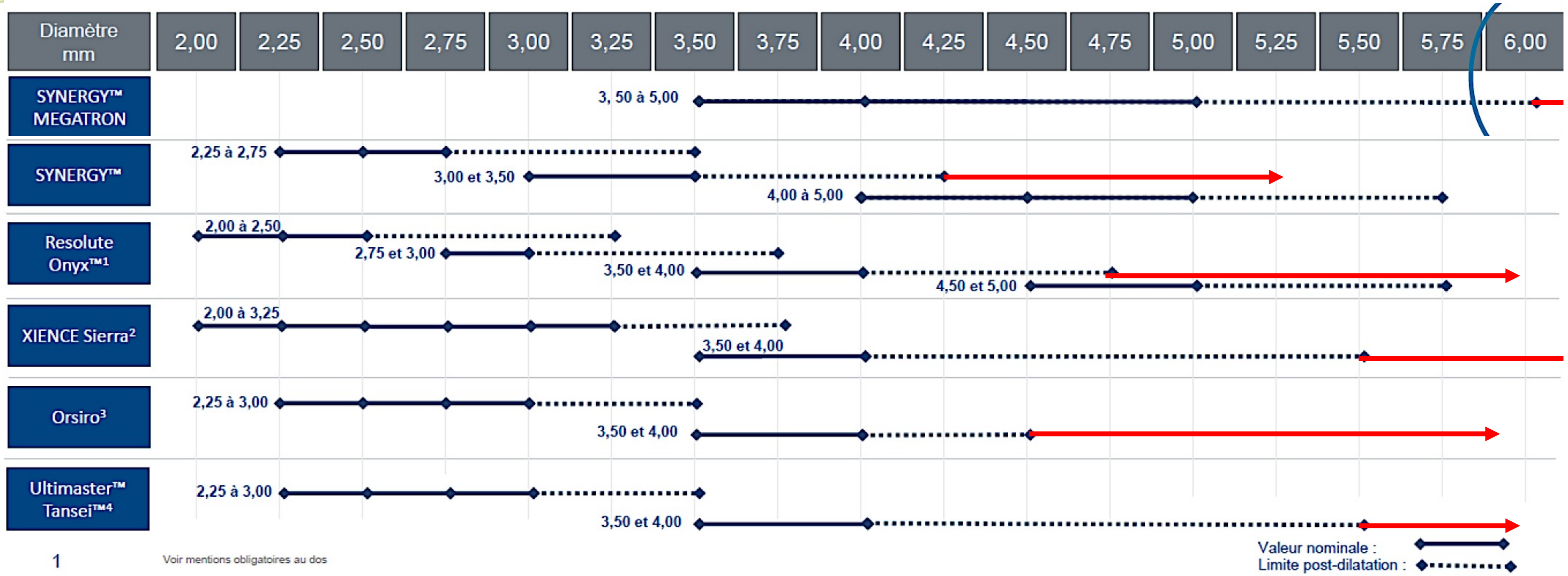
	Faciliter la post dilatation	Accessibilité de la SB	R compression radiale	R compression longitudinale	Couverture métallique
6 sinusoides	**+**	**?**			**+**
3 connecteurs		**?**	**+**	**+**	
4 connecteurs prox				**+**	
Peak « optimisé »	**+**				

Plateforme 3.5mm	Synergy™	Xience Xpedition™	Resolute Integrity™	Coroflex Isar™	Ultimaster™	Orsiro™	Megatron™
D max	5.2	6.0	5.9	5.9	6.0	5.8	6.0
% Δ L	+4.2%	+5.0%	-14.2%	+5.8%	-31.4%	-9.3%	-1.4%

Conclusions

- Gros tronc commun = stratégie habituelle mais:
  - Anticiper comportement du matériel
  - Anticiper éventuel bail out (side branch++)
- Stents modernes compatibles avec les post dilatations attendues (déstructuration++)
- Intéret de stents dédiés ?
- Nécessité d'up date du comportement mécanique des stents

Conclusions



Merci de votre attention