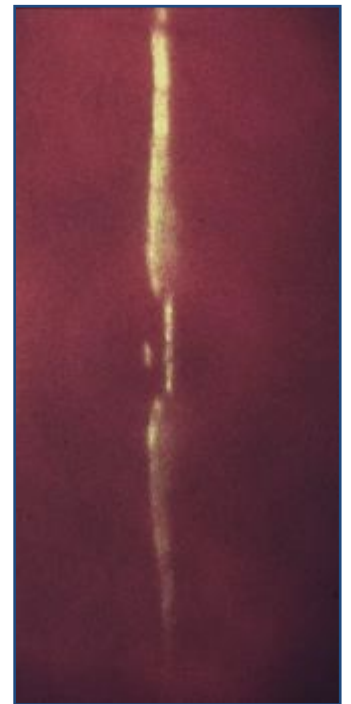
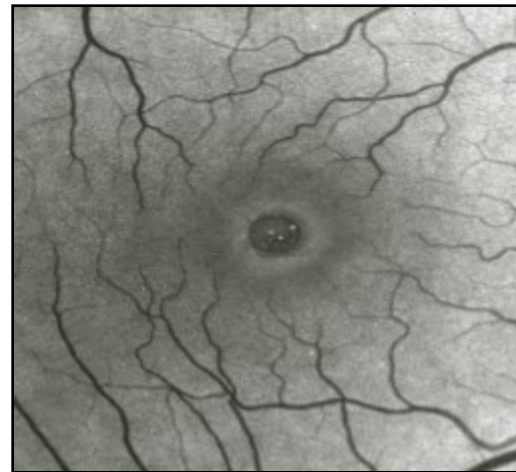
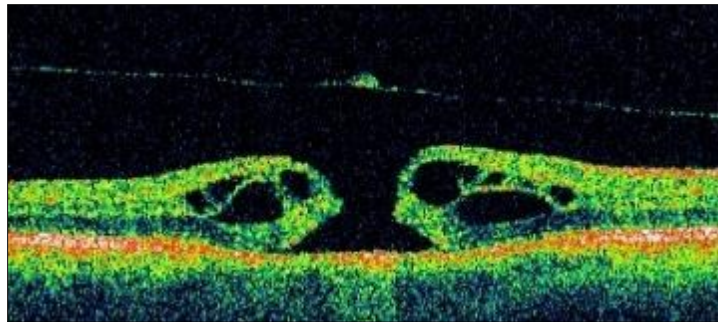


Trous maculaires

Ramin Tadayoni

TM primaire

- Terminologie : Déhiscences rondes centro-fovéolaires primaire
 - + jadis ses stades évolutifs
- Historique :
 - Première description : Knapp 1869
 - Description ophtalmoscopique : Noyes 1871
 - « Trou maculaire » : Ogilvie

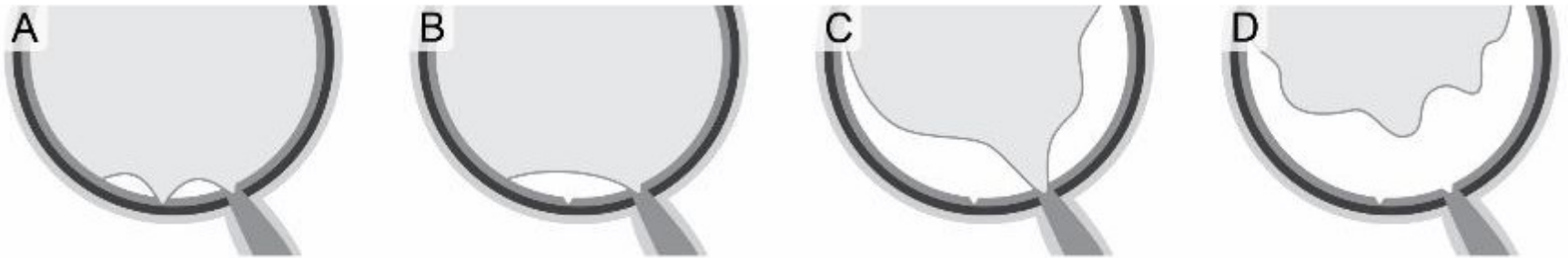
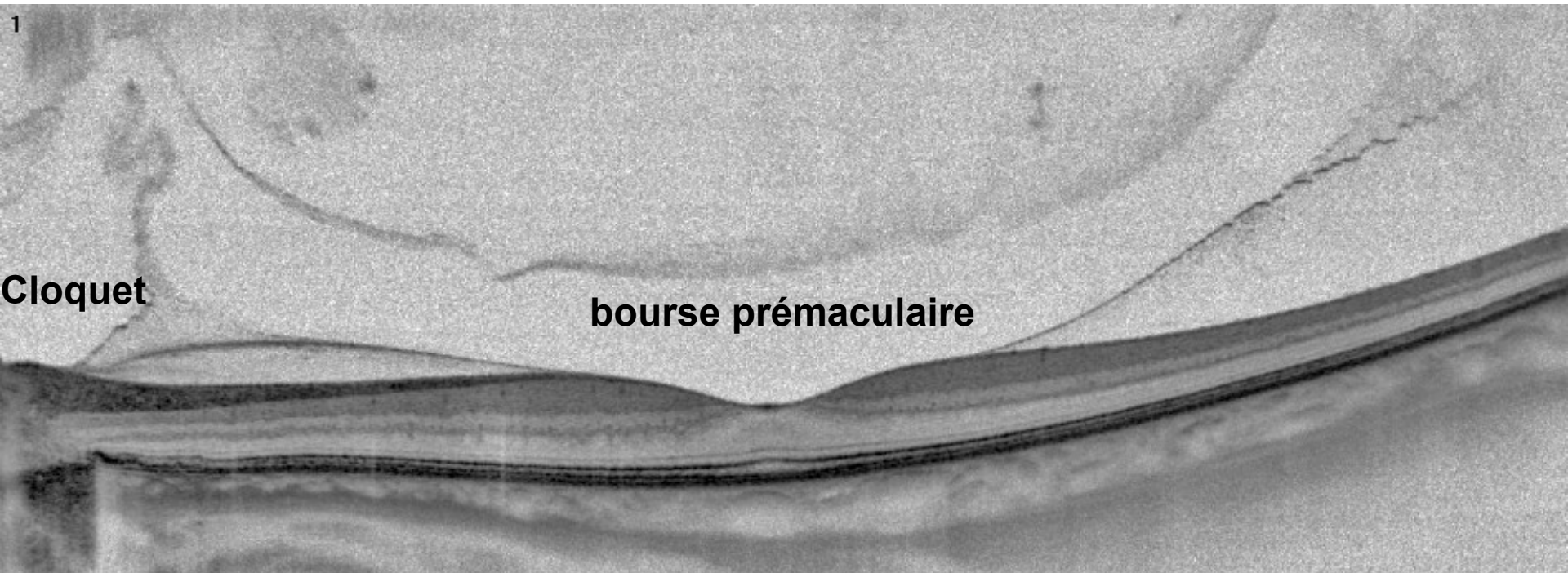


Epidémiologie

- Incidence annuelle : 7.8 /100 000
 - France : environ 5-6000 cas / an
- 2/3 des cas chez la femme
- Souvent après 60 ans
- bilatéraux dans 10 % des cas

PHYSIOPATHOLOGIE

Vitré et DPV normal



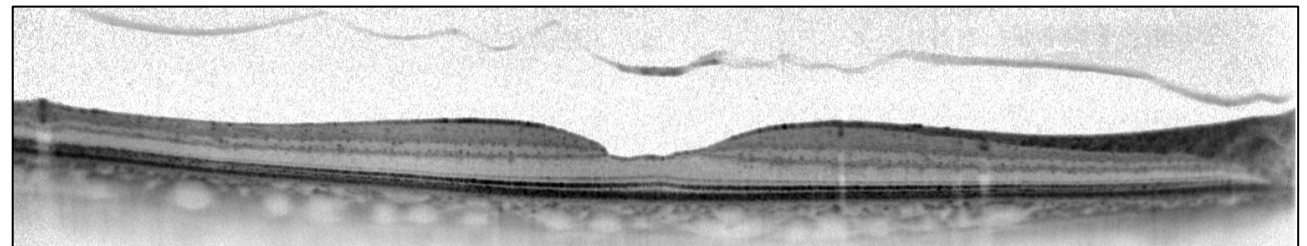
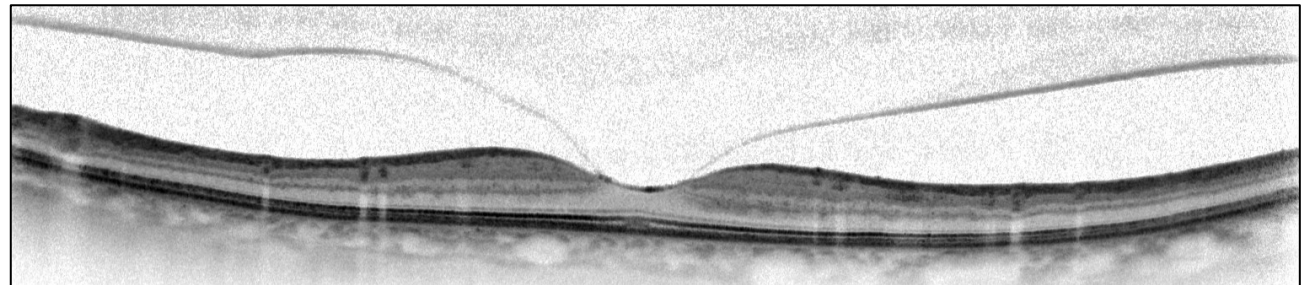
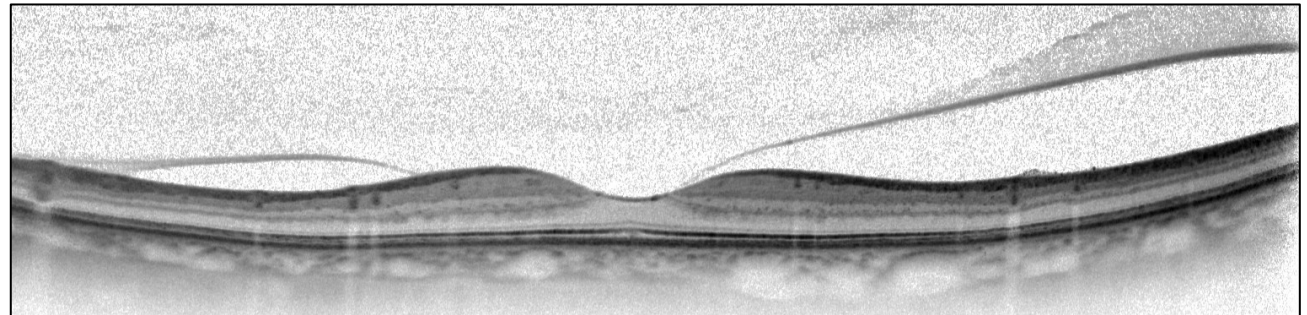
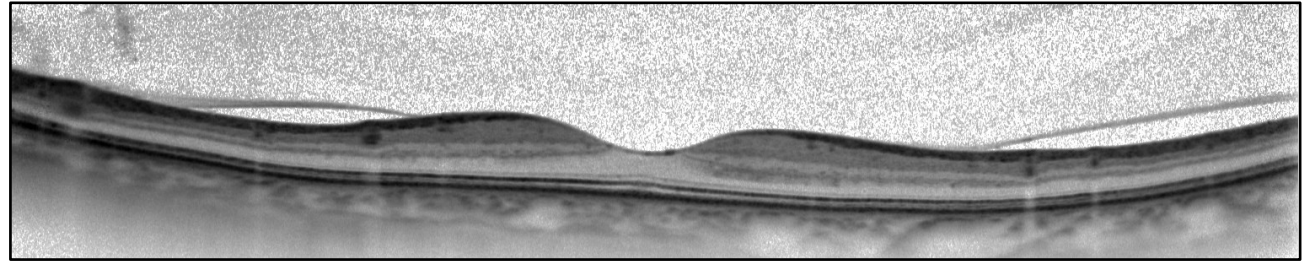
The stages of PVD as described by Johnson, Sebag, Gaudric et al, and Uchino et al.

DPV / OCT

Uchino et al, *Arch Ophthalmol* 2001, showed that :

- PVD begins around the macula
- Before 50 y, 60 % of normal eyes have some degree of partial PVD

No symptom without OCT changes...

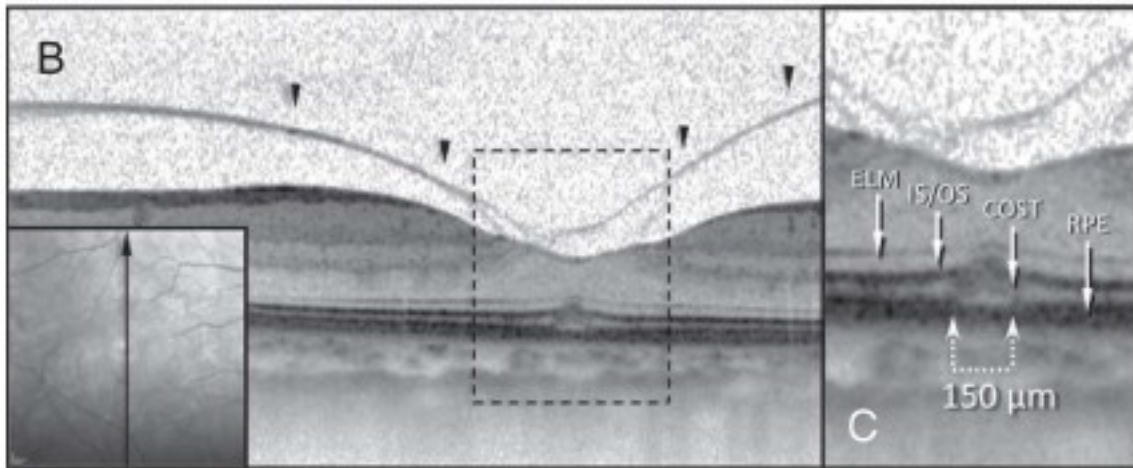


Initial Stages of Posterior Vitreous Detachment in Healthy Eyes of Older Persons Evaluated by Optical Coherence Tomography

Arch Ophthalmol. 2001;119:1475-1479

Macular hole formation

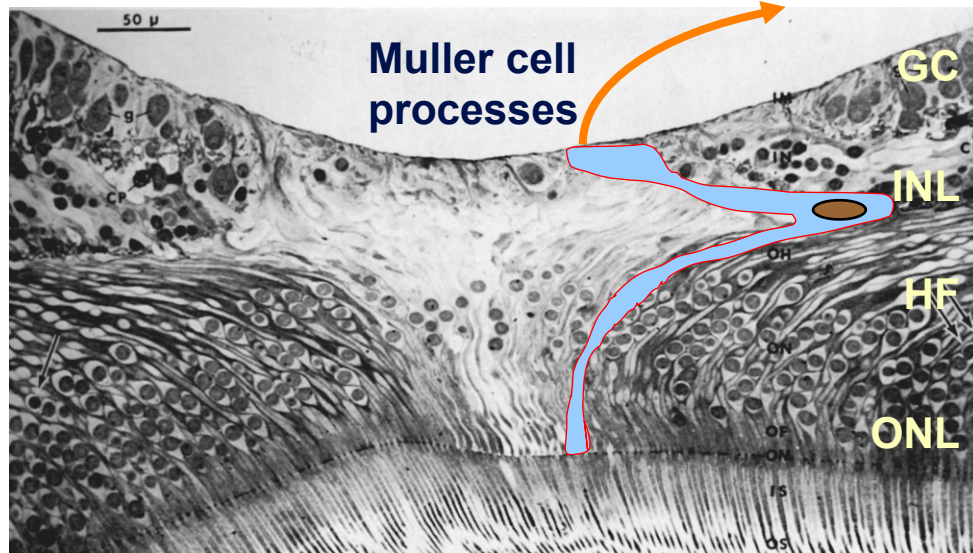
- Now, SD OCT, improved by image summation, have shown very discrete intraretinal foveal anomalies
 - which could be called Stage Zero MH (Chan & Duker 2004)



From Takahashi
et al Retina 2011

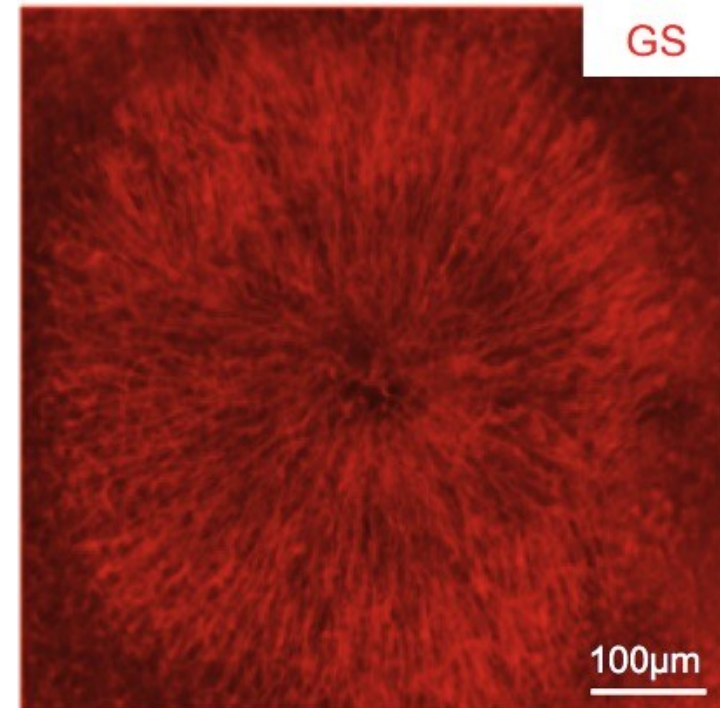
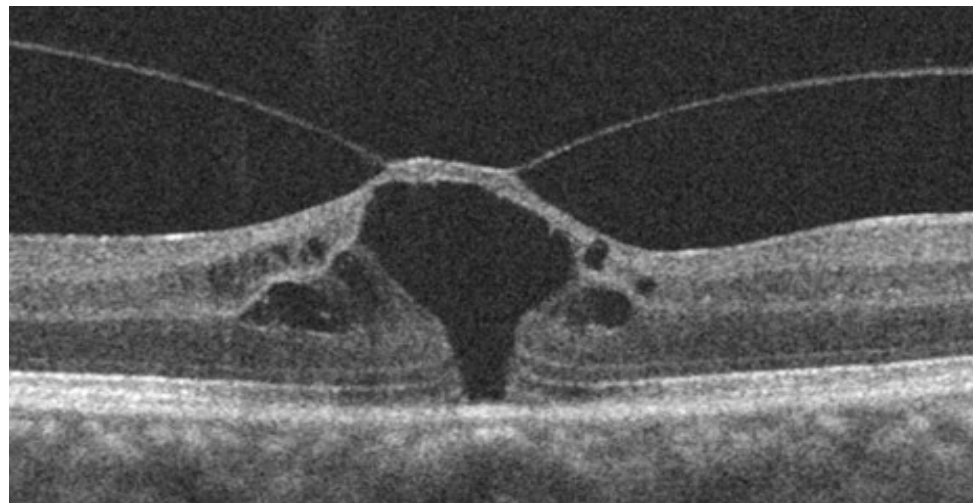
- We have looked at 250 asymptomatic fellow eyes of MH, examined with SD OCT in high resolution mode
 - 23% subtle changes in the foveola

Formation d'un TM : bases anatomiques



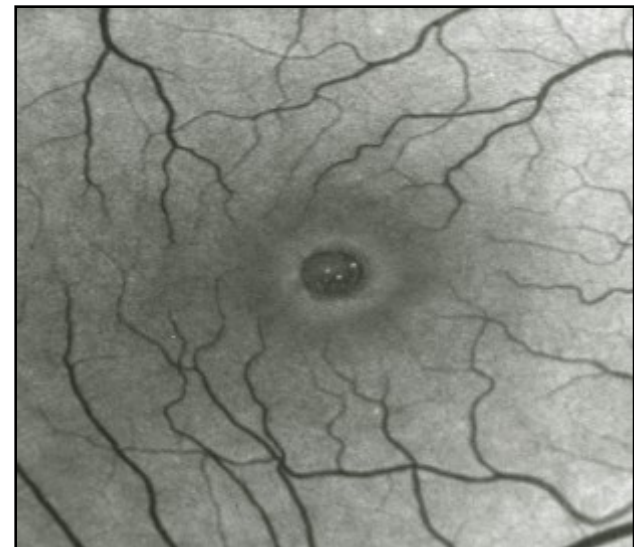
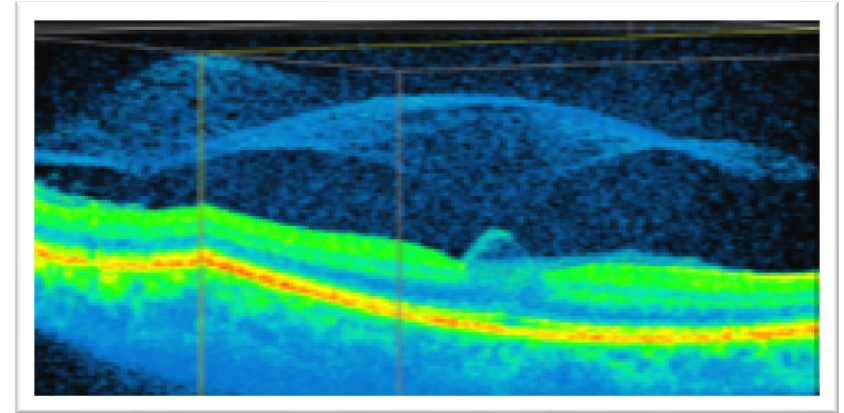
Yamada E. Some structural features of the fovea centralis in the human retina. *Arch Ophthalmol.* 1969;82:151-9.

Matet A, Savastano MC, Rispoli M, Bergin C. En face optical coherence tomography of foveal microstructure in full-thickness macular hole: a model to study perifoveal Müller cells. *Am J Ophthalmol* 2015; 159:1142-1151

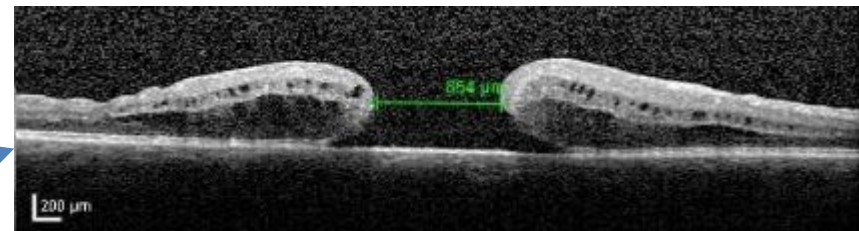
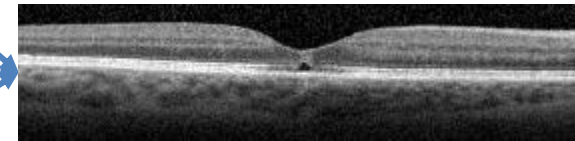
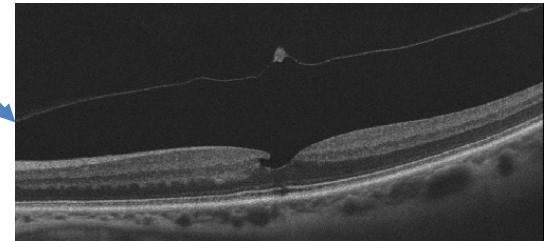
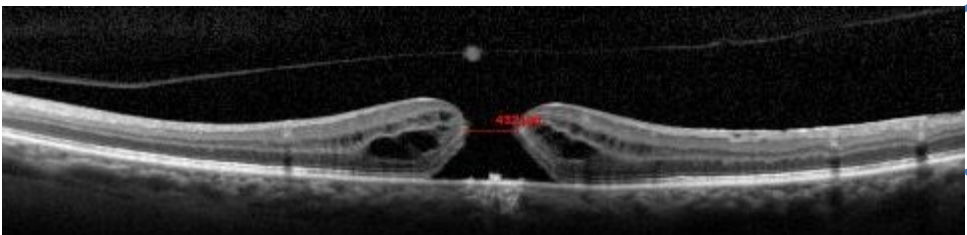
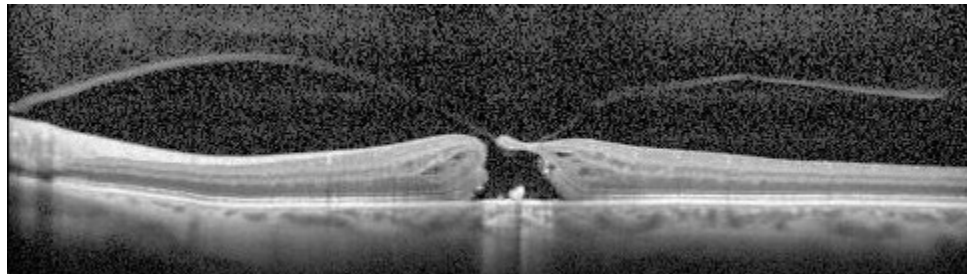
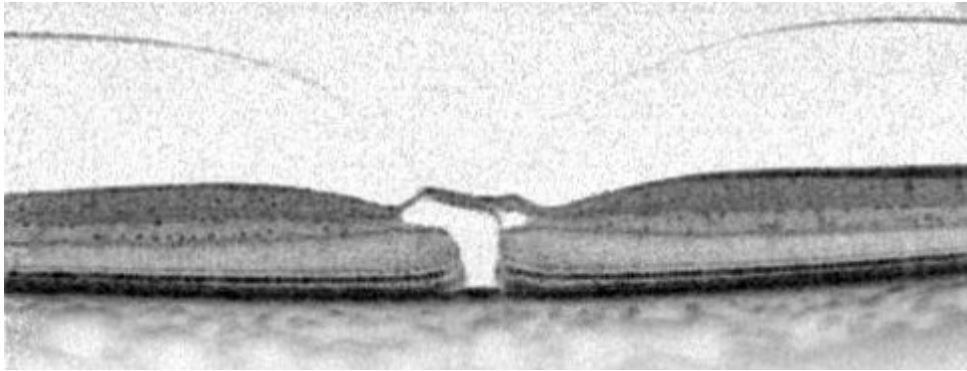
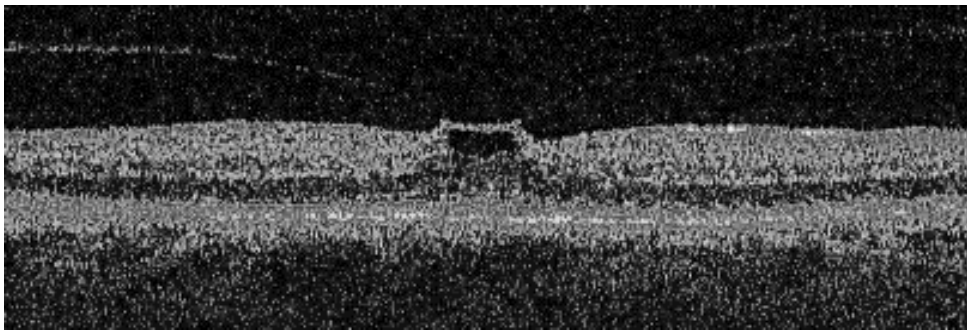


Formation d'un TM

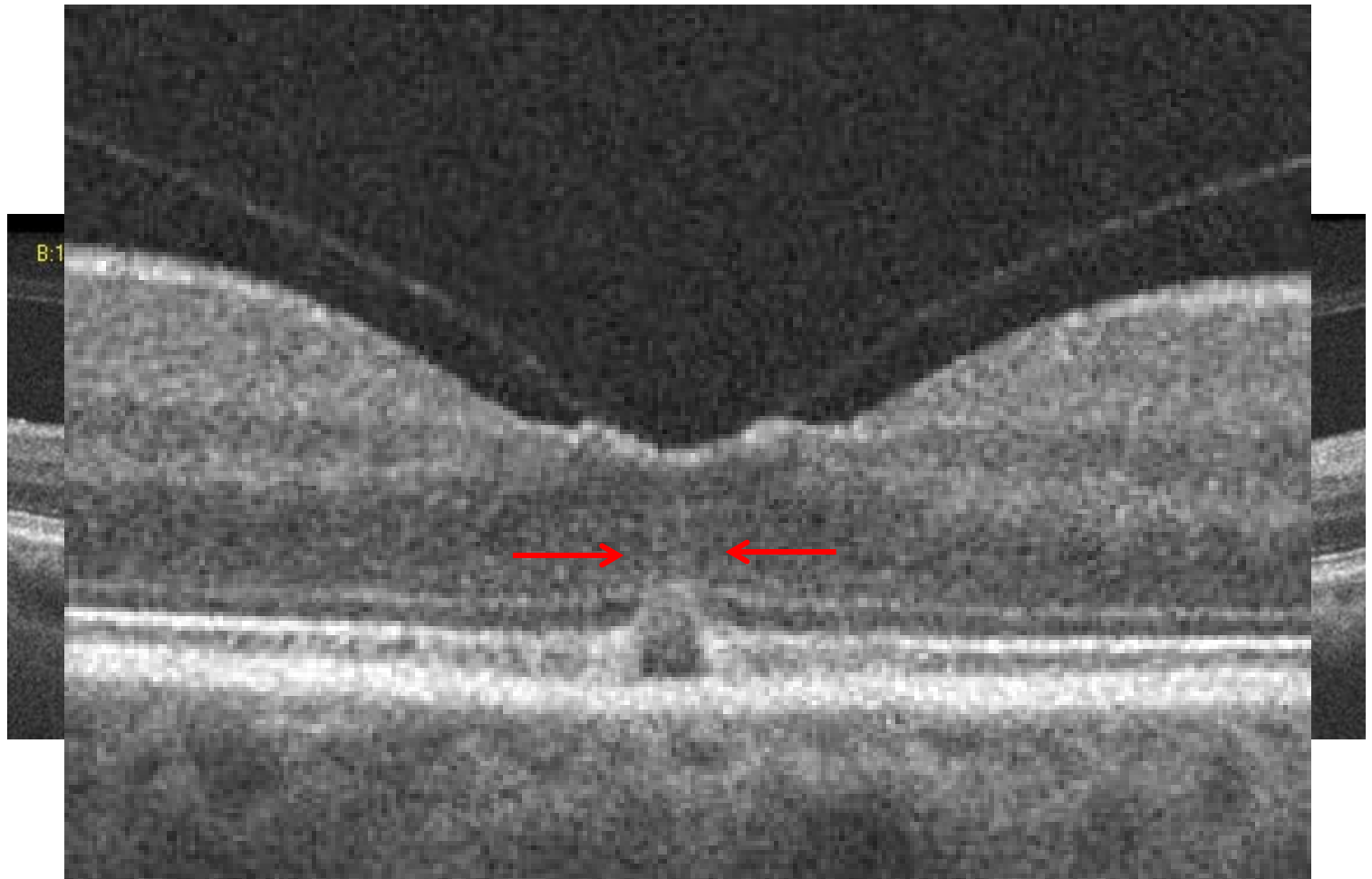
1. DPV anormal du vitré
2. Stades de traction vitreomaculaire (menace de TM ou stade 1) parfois passés inaperçus
3. Trou maculaire (TM) : trou de plein épaisseur dans le centre fovéolaire



DU KYSTE MACULAIRE AU TM

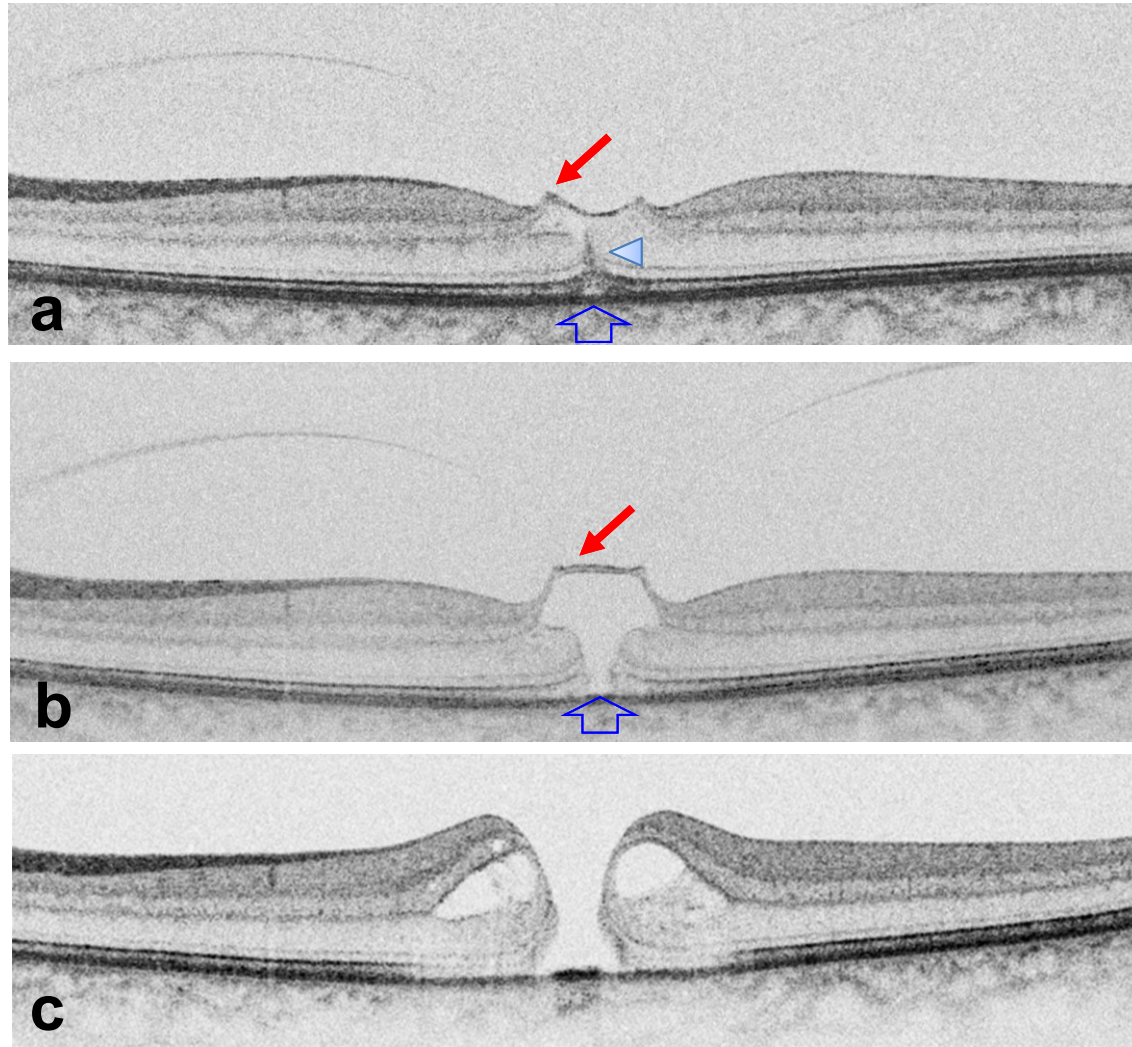


TM St0 (TVM)



TVM évolution. Exemple

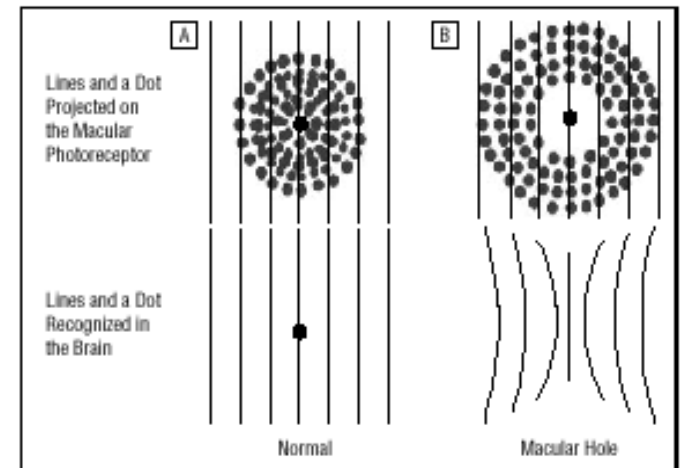
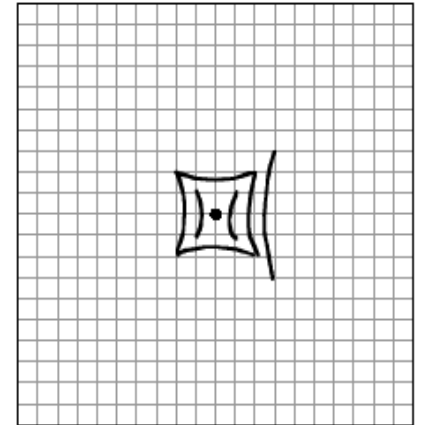
Œil adelphe de TM



DIAGNOSTIC POSITIF

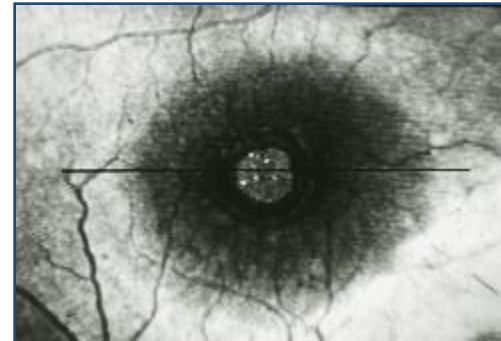
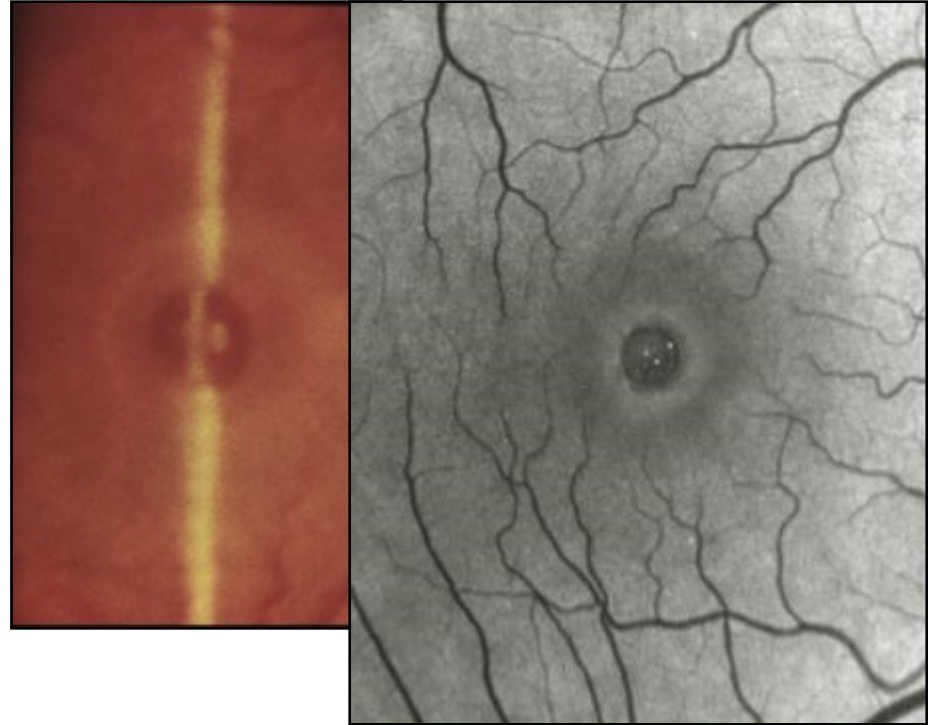
Symptomatologie

- BAV
- Microscotome central (-)
- Métamorphopsies
- Parfois passée inaperçue (œil non dominant)

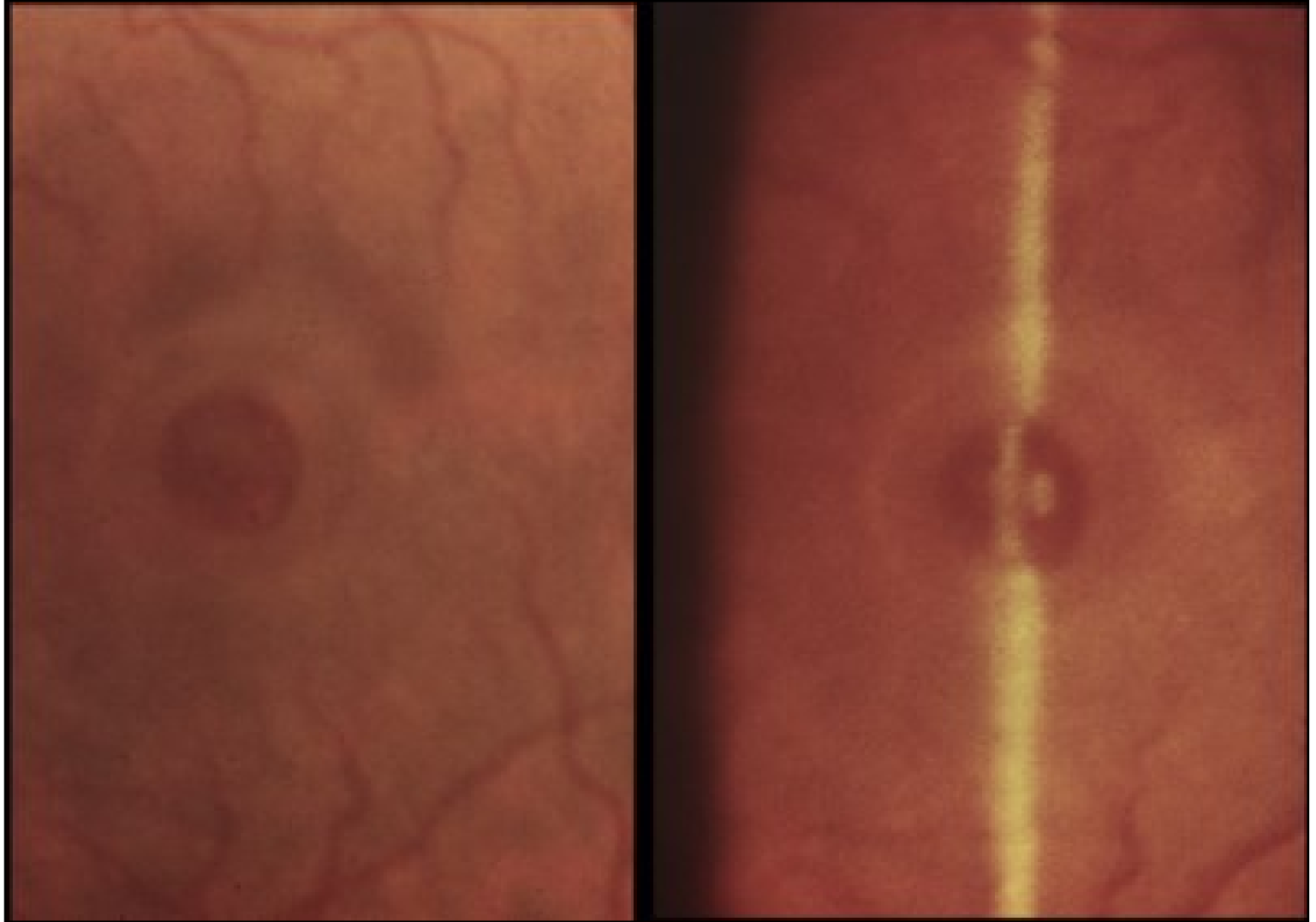


Clinique

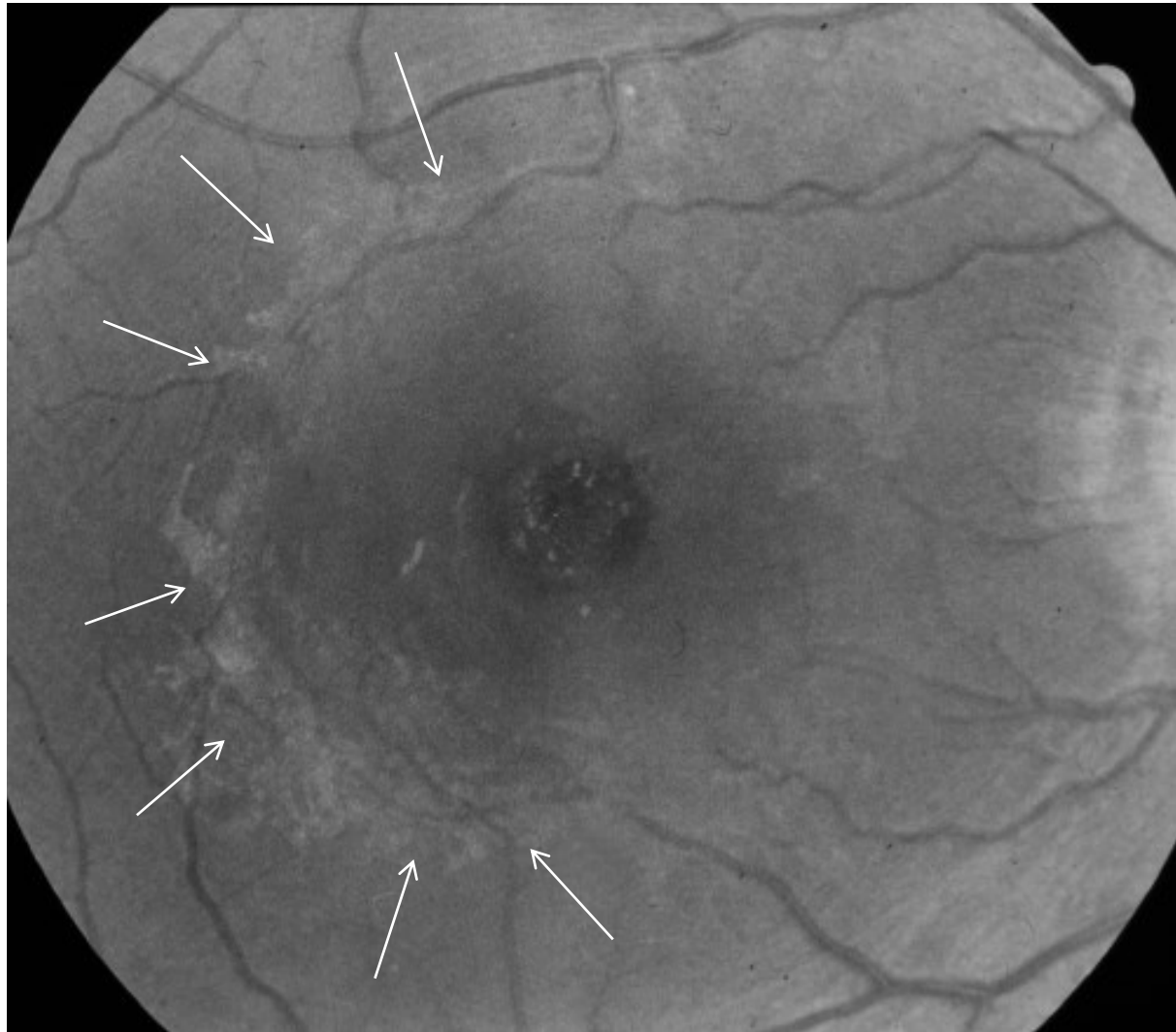
- Mesure AV
- Examen du FO
 - trou typique de pleine épaisseur
 - Dépôts blancs au fond du trou
 - Entouré d' un anneau de soulèvement rétinien
 - Dégénérescence microkystique
 - Stade DPV variable
 - Avec ou sans opercule
 - Parfois MEM (non contractile)
- Test de Watzke (historique?)



Examen FO

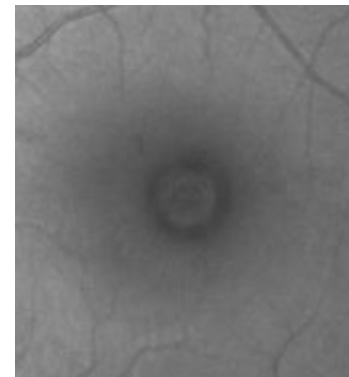
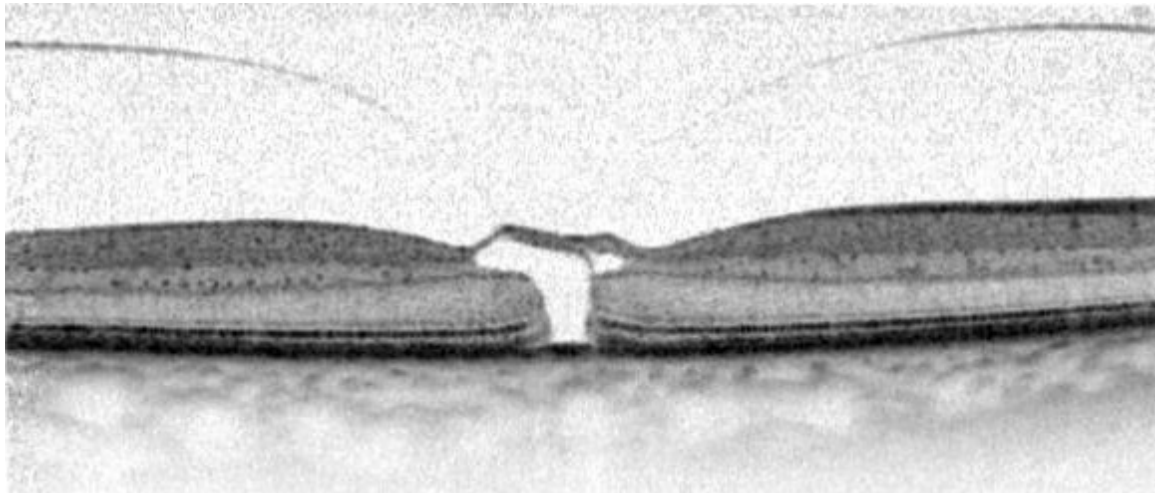
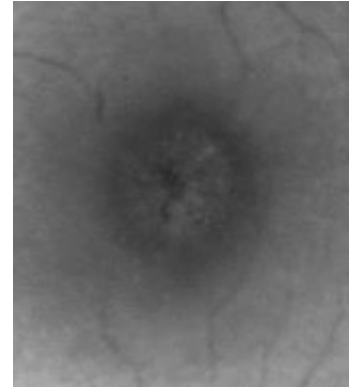
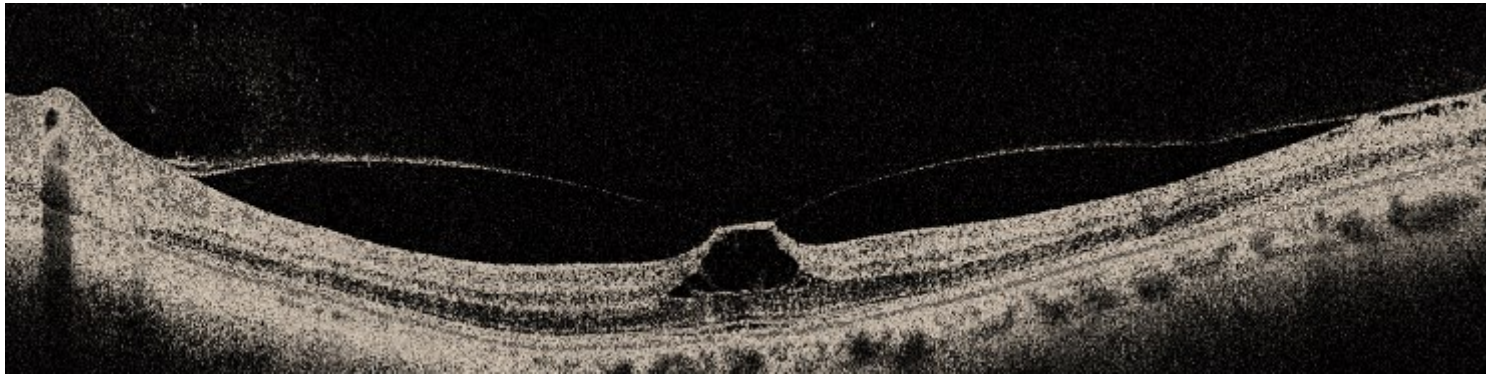


Prolifération peri-TM



HOPITAL LARIBOISIÈRE

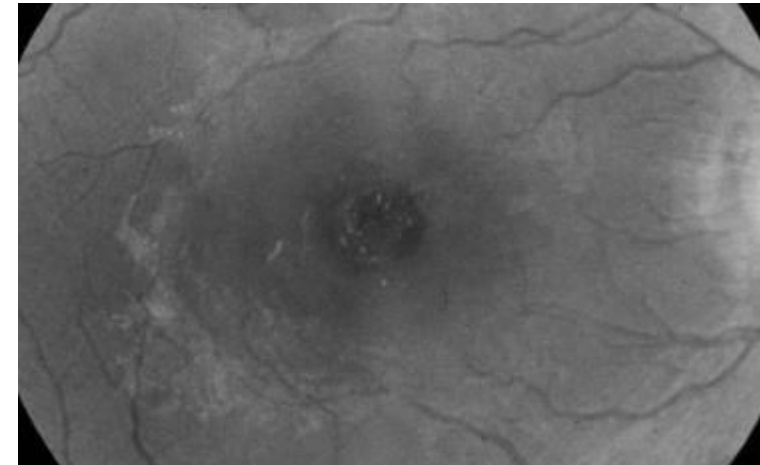
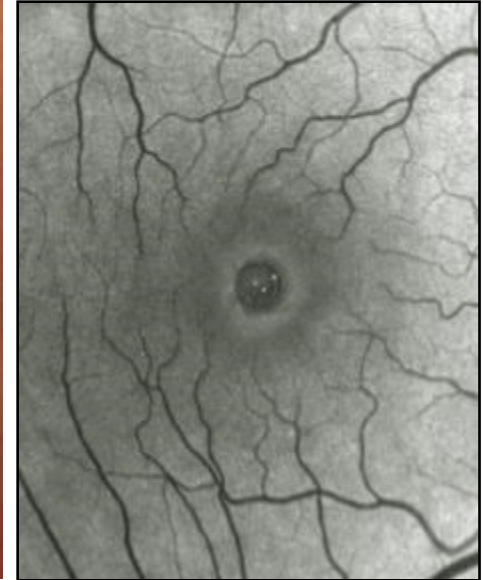
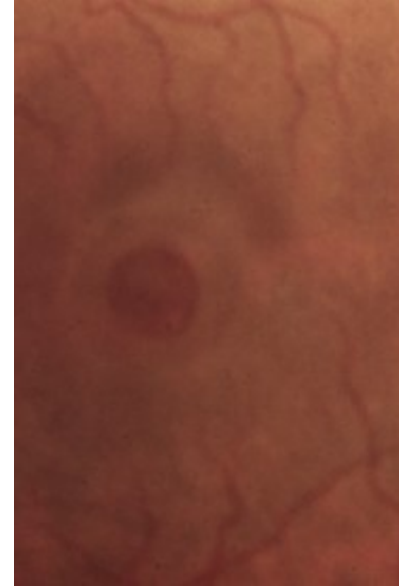
Diagnostics difficiles



EXAMENS COMPLÉMENTAIRES

Photographies du FO

- Photos :
 - Couleur
 - Lumière Verte
 - Bleue
 - Rouge / Autofluo (?)
- Intérêt :
 - Descriptif
 - Anomalies secondaires associées



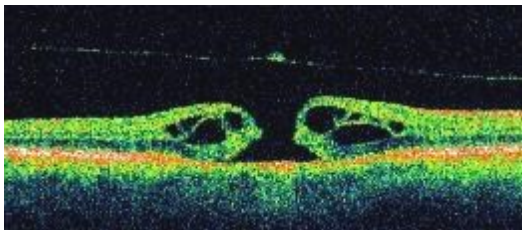
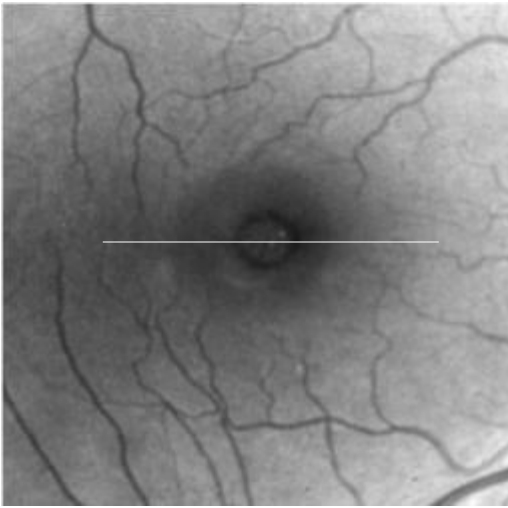
OCT des TM

- Confirmer le diagnostic (3^e D)
 - Cas de diagnostic difficile
 - Diagnostics différentiels
- Etat du DPV
- Taille du TM
- Autres anomalies
 - Prolifération
 - Ligne des photorécepteurs

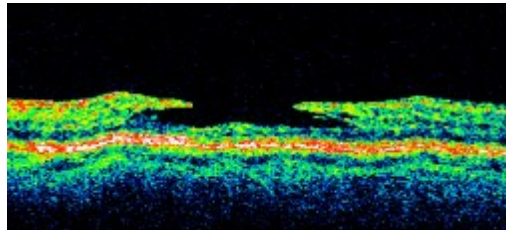
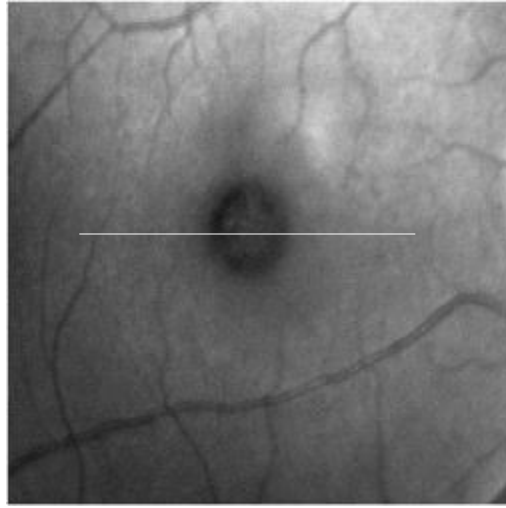


Diagnostic différentiel

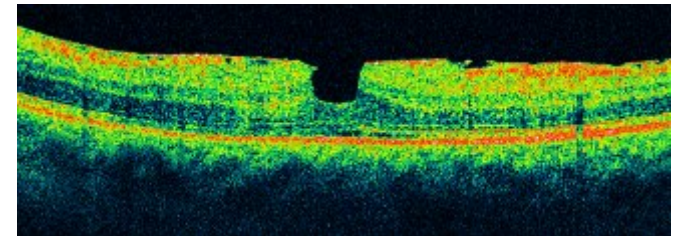
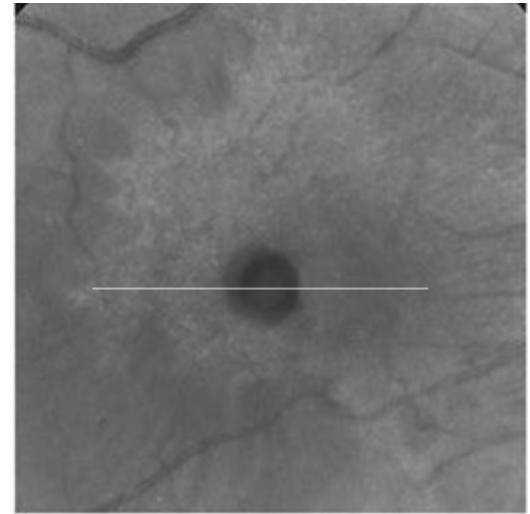
L'OCT permet de faire la différence entre TM, trou lamellaire et pseudo-trou



Trou maculaire



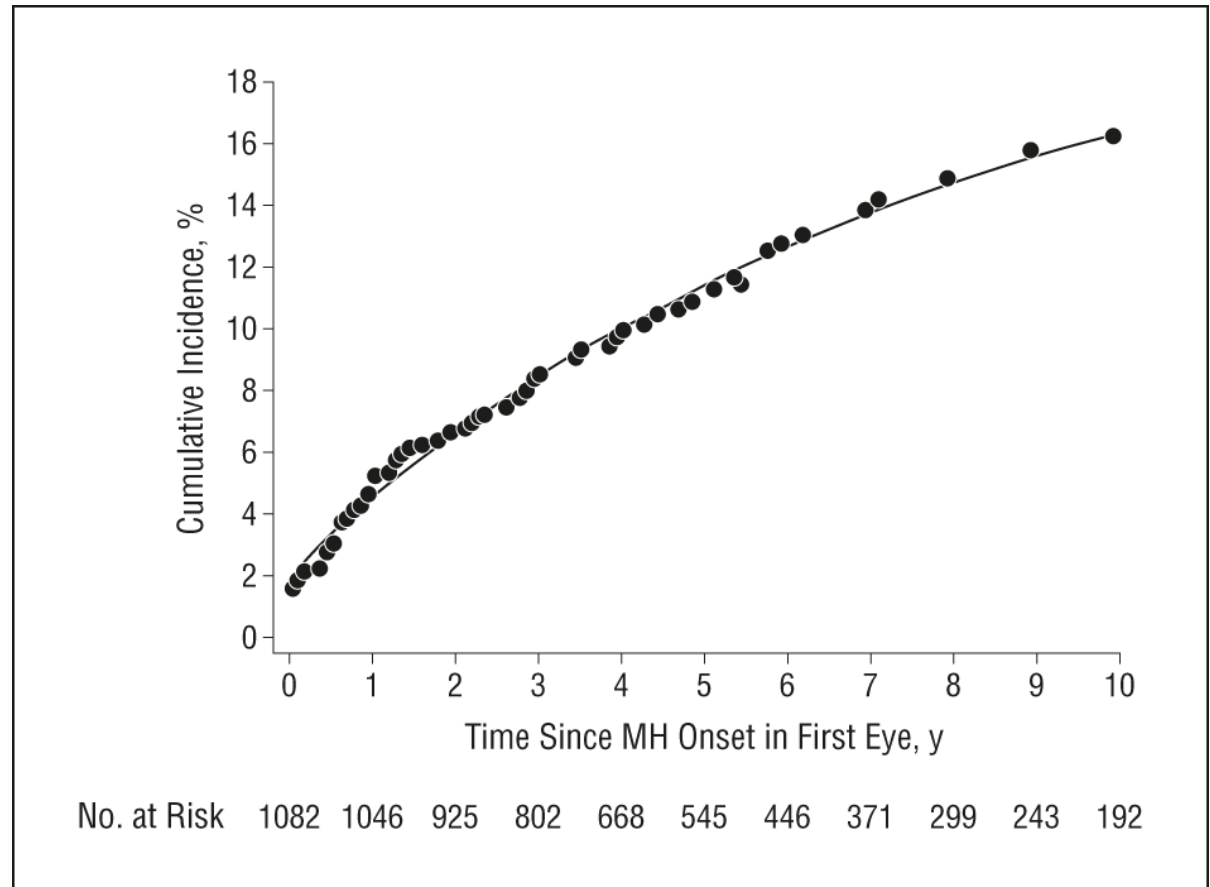
Trou lamellaire



Pseudo-trou

Risque de TM dans l'œil adelphe

- 1082 patients
- 49 mois de suivi
- TM 11,3%
- estimation
 - 11,6% à 5ans
 - 16,7% à 10 ans



Kumagai K, Ogino N, Hangai M, Larson E. Percentage of fellow eyes that develop full-thickness macular hole in patients with unilateral macular hole.

Arch Ophthalmol. 2012 Mar;130(3):393–4.

RISQUE POUR L' AUTRE ŒIL

- Séparation vitréo fovéolaire en OCT: Peu de risque
- Séparation vitréo-fovéolaire incomplète : 50% de risque de Trou Maculaire (Chan et Duker 2004)
- Membrane épimaculaire: Peu de risque de trou
- Trou lamellaire : Peu de risque

Author	Year	Nb	F-up (m)	MH%	Comments
Haouchine	2001	22	9	13,6%	All eyes with PPVD and foveal changes
Chan	2004	12	41	42%	With PPVD (12/94) With no vitrofoveal adhesion (67/94) 9%
Niwa	2005	58	24	5,2%	All eyes with PPVD
Takahashi	2011	42	18	12%	With PPVD : 12% With foveal changes : 50%

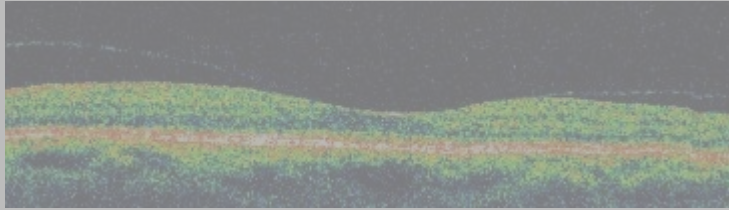
CLASSIFICATIONS

Gass's Classification

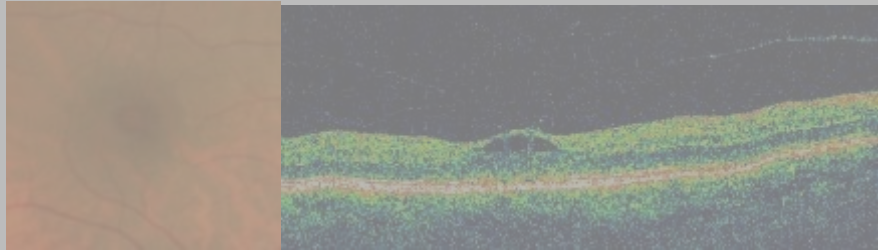
- Stages :
 - Stage 1 A and B
 - Stage 2: $< 400 \mu\text{m}$ + no PVD from the macula
 - Stage 3: $> 400 \mu\text{m}$ +/- pseudo-operculum + no complet PVD
 - Stage 4: complet PVD
- Problems:
 - What about a MH $< 400 \mu\text{m}$ and a pseudo-operculum (PVD from the macula)?
 - What about a MH $< 400 \mu\text{m}$ + complet PVD?

Stade de DPV

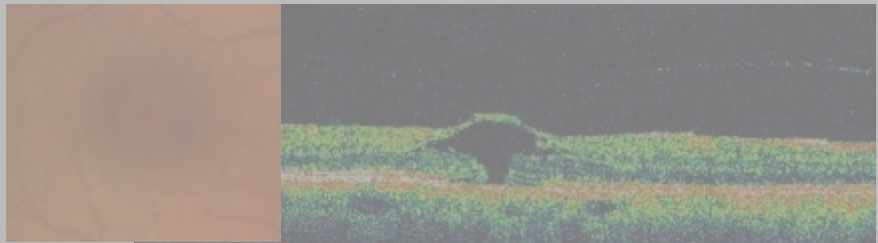
Classification de Gaudric



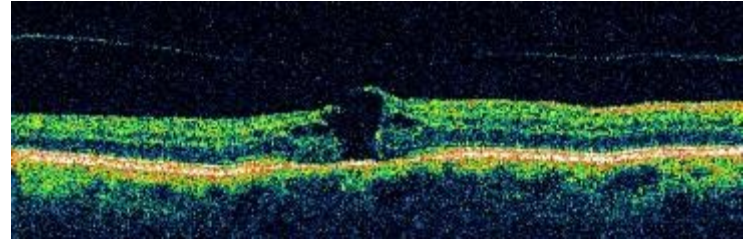
Macula Normale avec DPV partiel



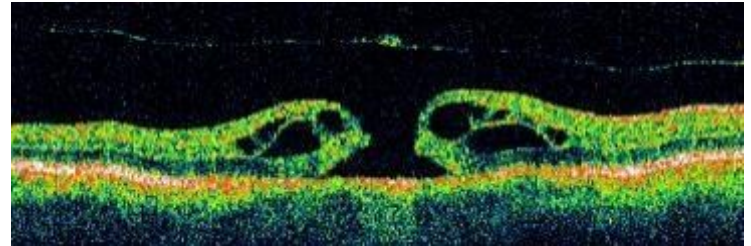
Menace de trou maculaire Stade 1A



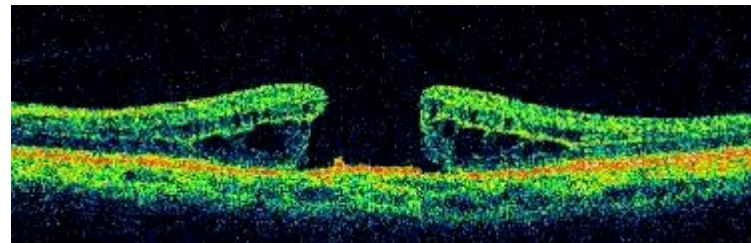
Menace de trou maculaire Stade 1B



Trou maculaire Stade 2

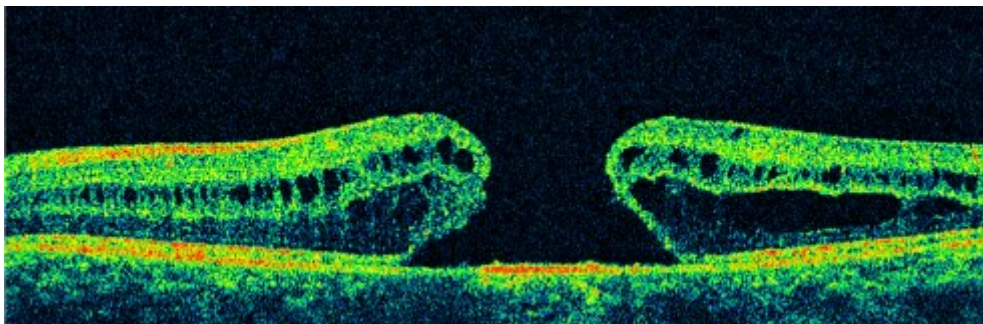
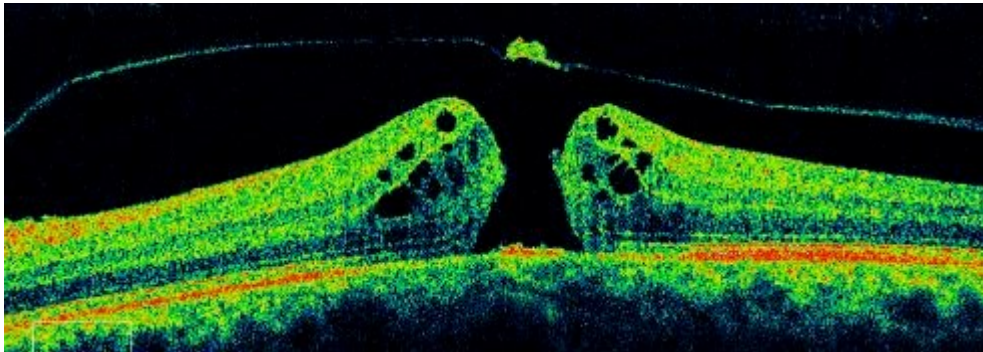
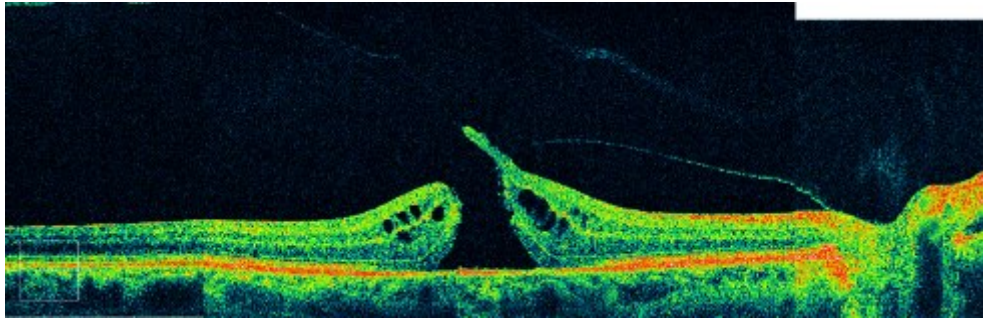


Trou maculaire Stade 3



Trou maculaire Stade 4

Préciser le stade du DPV : utile pour le traitement



MH Measurements

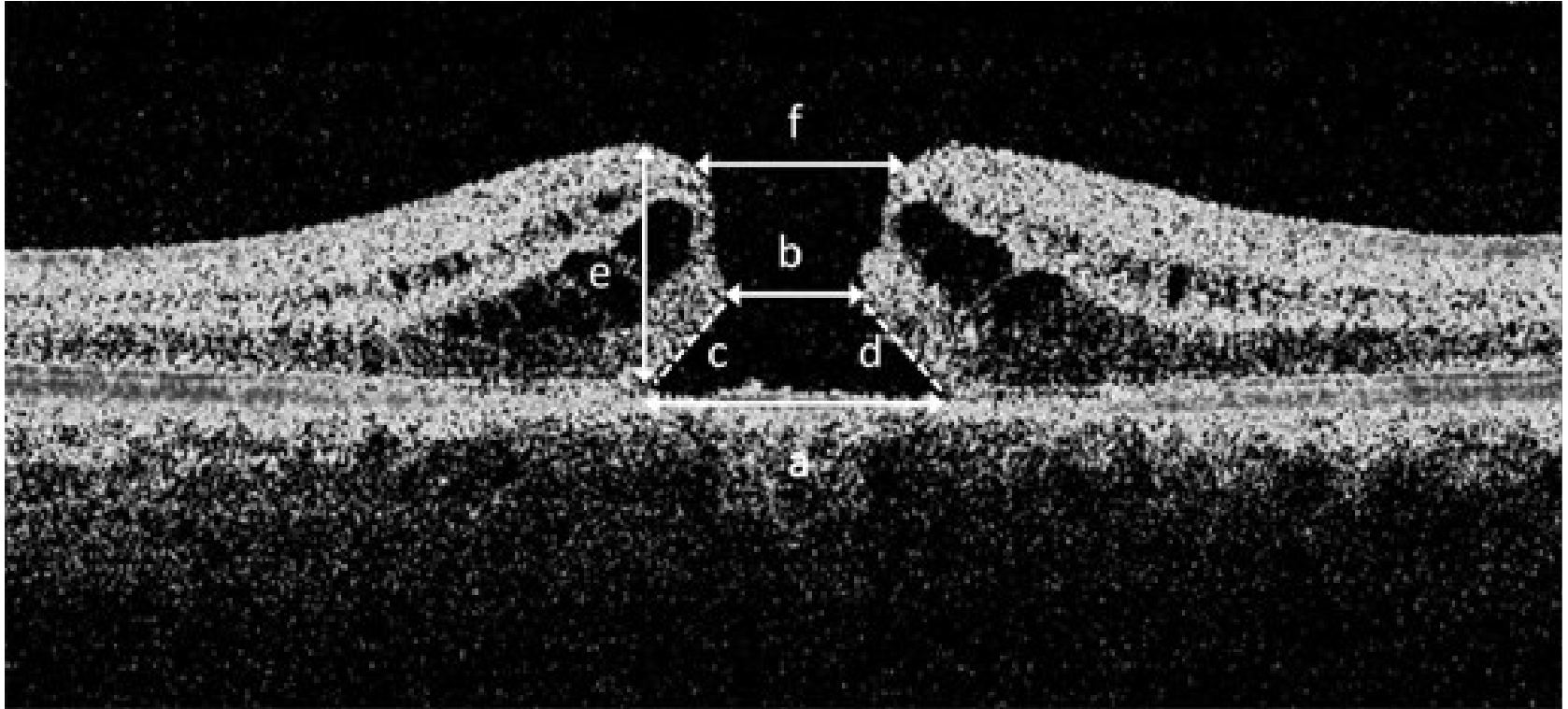
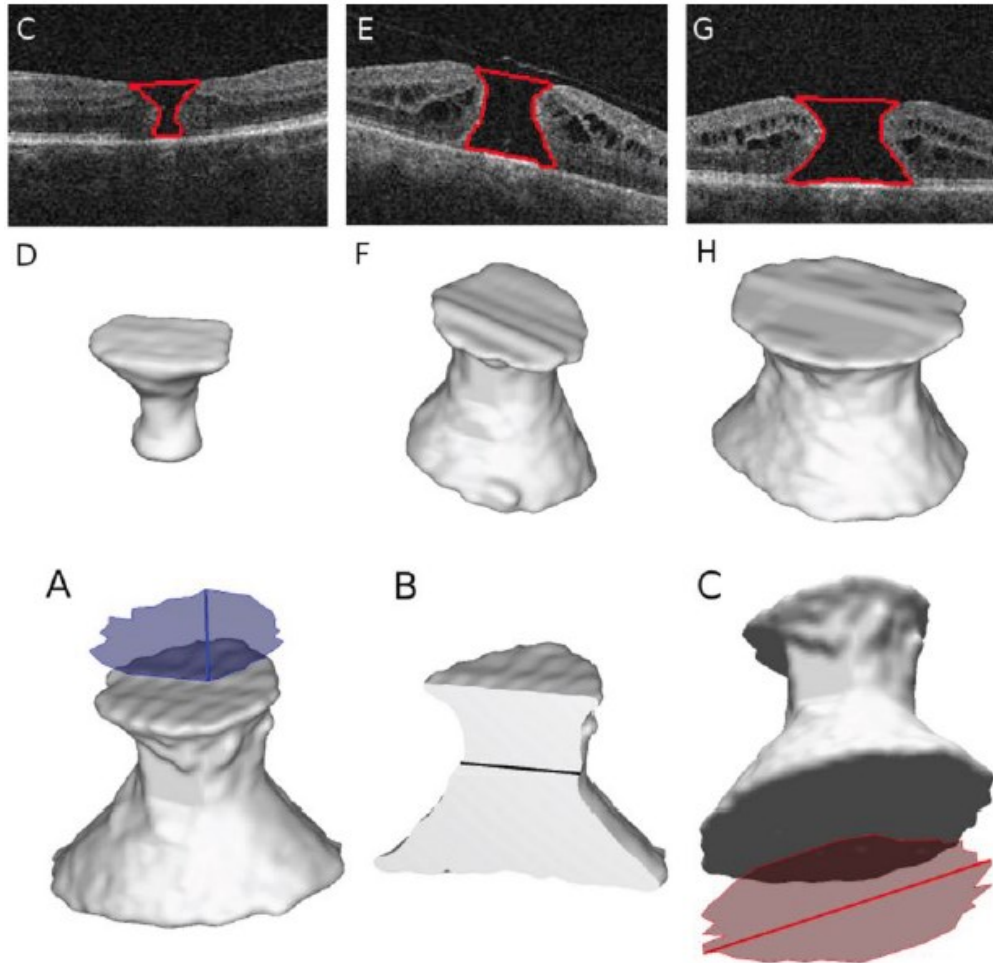


Figure 1 Optical coherence tomography scan measurements: (a) base diameter, (b) minimum linear dimension, (c) and (d) arms for measuring hole form factor, (e) hole height, (f) macular hole inner opening. Hole form factor = $(c+d)/a$; macular hole index = e/a ; tractional hole index

Diamètre des TM

30



- Les TM ont une forme en "diabolo"
- Nombreux paramètres de mesure ont été testés
 - base, collet, rapport base / hauteur
 - consensus : ouverture minimale

Xu D, Yuan A, Kaiser PK, Srivastava SK, Singh RP, Sears JE, et al. A novel segmentation algorithm for volumetric analysis of macular hole boundaries identified with optical coherence tomography. Invest Ophthalmol Vis Sci. 2013;54(1):163-9.

SCIENTIFIC REPORT

Relationship between macular hole size and the potential benefit of internal limiting membrane peeling

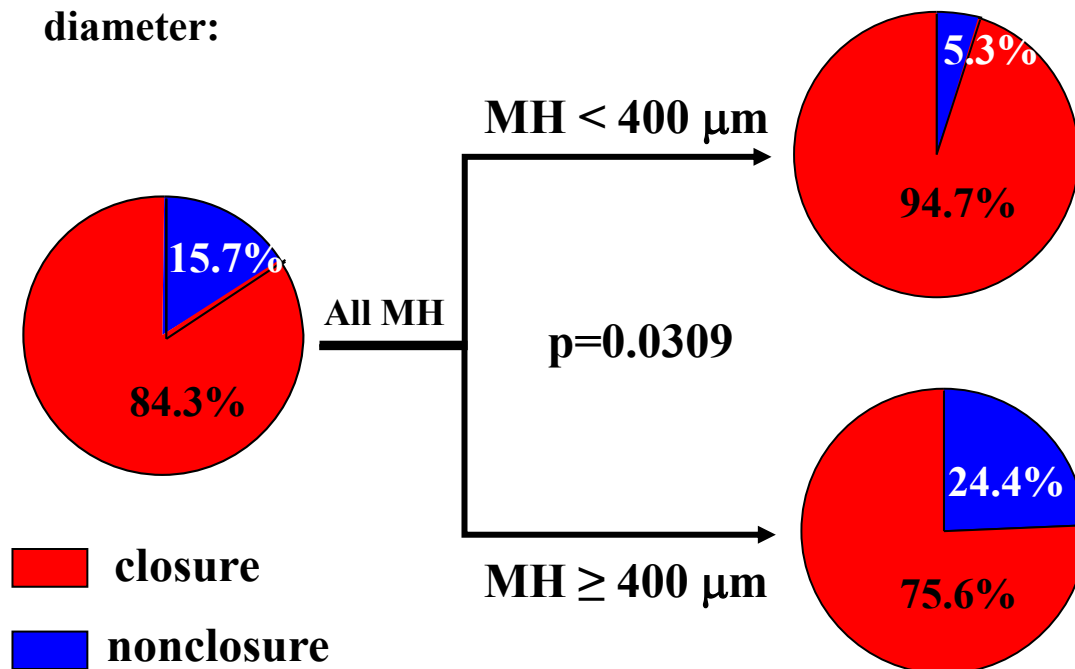
R Tadayoni, A Gaudric, B Haouchine, P Massin



Br J Ophthalmol 2006;**90**:1239–1241. doi: 10.1136/bjo.2006.091777

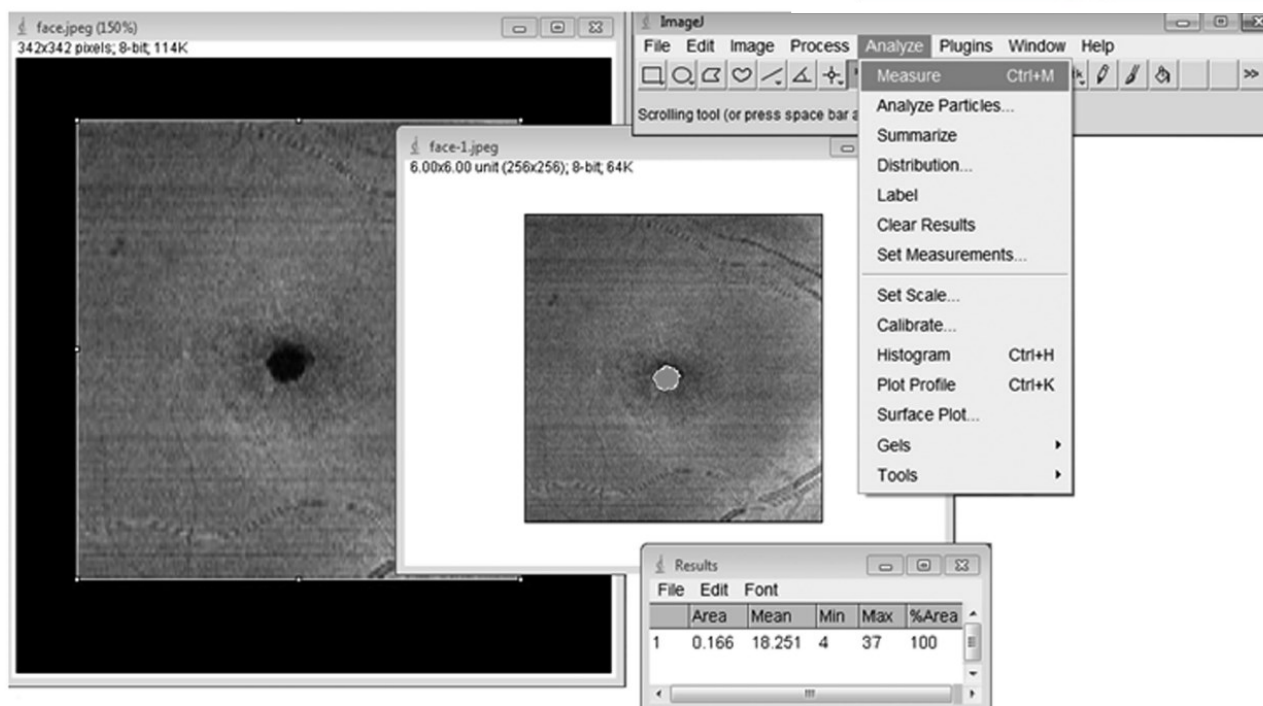
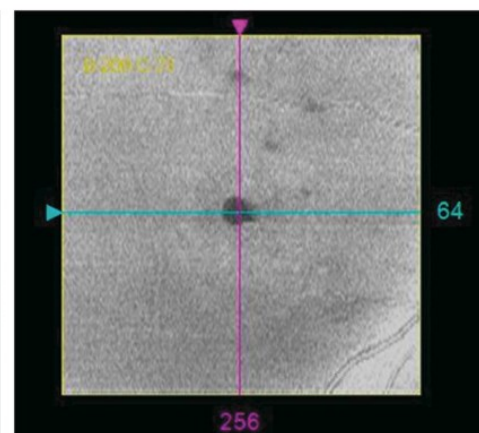
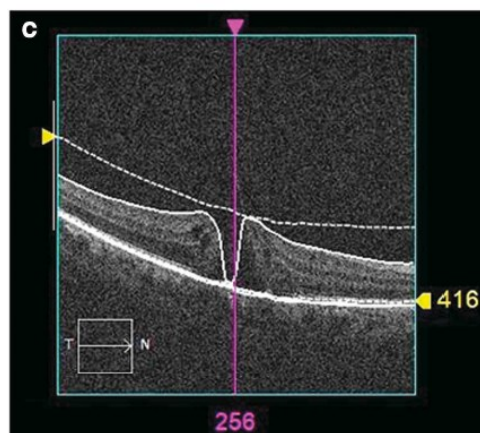


Diagram of postoperative closure rates in the first series of MH (n= 83) showing the predictive value of MH aperture diameter:



Measurement of full-thickness macular hole size using en face optical coherence tomography

E Philippakis, M Legrand, M El Sanharawi, A Erginay, A Couturier and R Tadayoni



A Randomized Controlled Trial of Alleviated Positioning after Small Macular Hole Surgery

Ramin Tadayoni, MD, PhD,¹ Eric Vicaut, MD, PhD,² François Devin, MD,³
Catherine Creuzot-Garcher, MD, PhD,⁴ Jean-Paul Berrod, MD,⁵ Yannick Le Mer, MD,⁶
Jean-François Korobelnik, MD,⁷ Moumir Aout, PhD,² Pascale Massin, MD, PhD,¹ Alain Gaudric, MD¹

Ophthalmology 2011;118:150–155

- MH > 400 μm

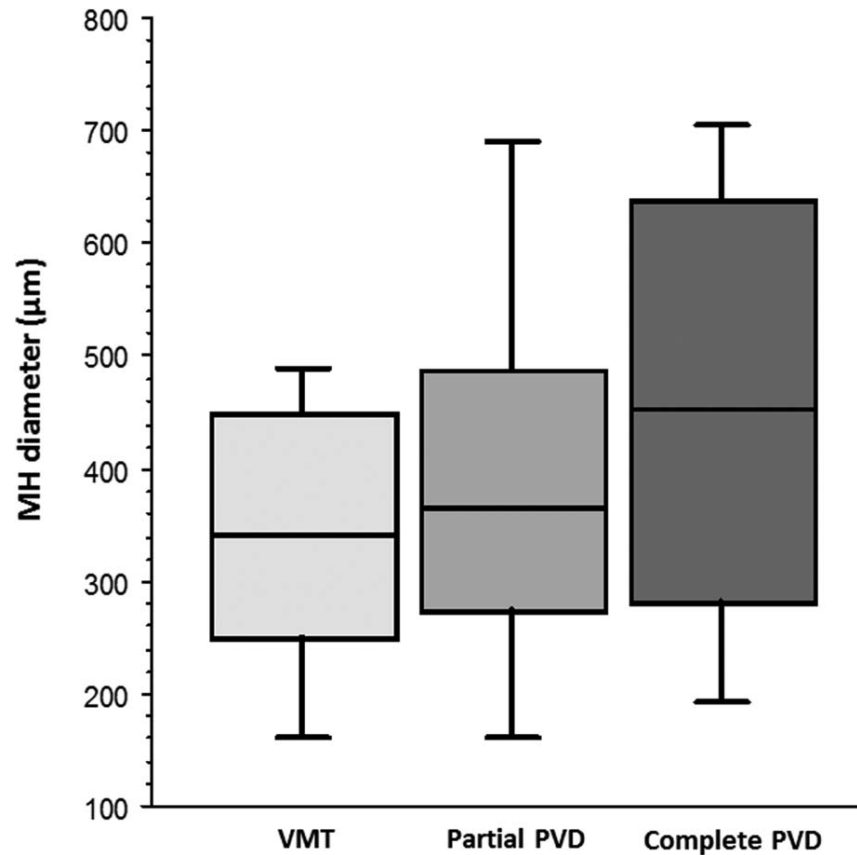
	ILM peeling	No peeling	P
Closure rate	94.9 %	73.2 %	p=0.0085

- MH $\leq$ 400 μm (No ILM Peeling)

	Face-down	Alleviated	95% CI
Closure rate	94.1 %	91.4 %	+9.5 to – 14.88%

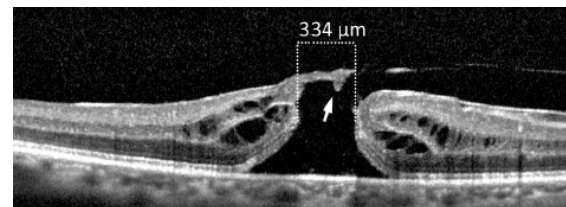
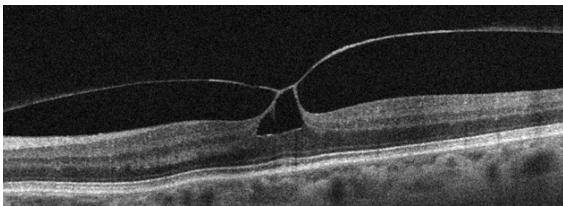
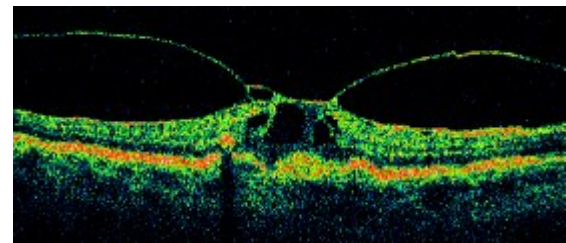
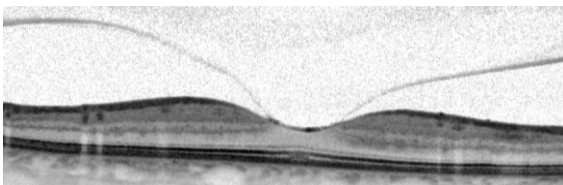
Size and vitreomacular attachment of primary full-thickness macular holes

Elise Philippakis, Franck Amouyal, Aude Couturier, Elise Boulanger-Scemama, Alain Gaudric, Ramin Tadayoni



International Consensus System for Classification of Diseases of the Vitreomacular Interface

<i>Classification</i>	<i>Subclassification</i>
Vitreomacular Adhesion (VMA)	• Size: focal ($\leq 1500 \mu\text{m}$) or broad ($>1500 \mu\text{m}$) • Isolated or concurrent
Vitreomacular Traction (VMT)	• Size: focal ($\leq 1500 \mu\text{m}$) or broad ($>1500 \mu\text{m}$) • Isolated or concurrent
Full-thickness Macular Hole (FTMH)	• Size: small ($\leq 250 \mu\text{m}$), medium ($>250 \mu\text{m}$ to $\leq 400 \mu\text{m}$), or large ($>400 \mu\text{m}$) • Status of vitreous: with or without VMT • Cause: primary or secondary



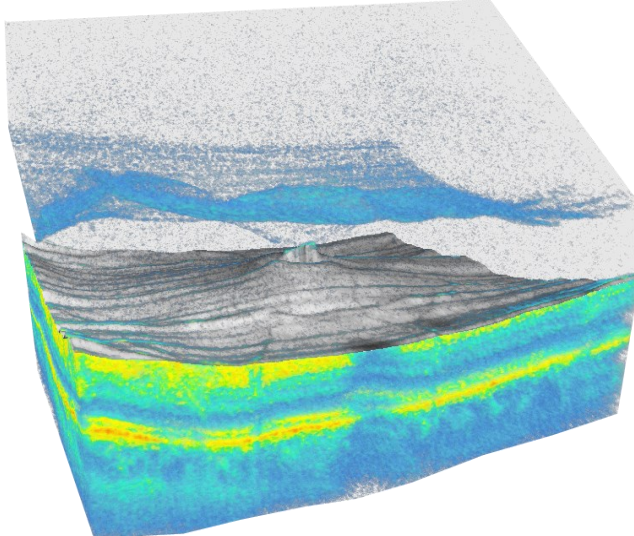
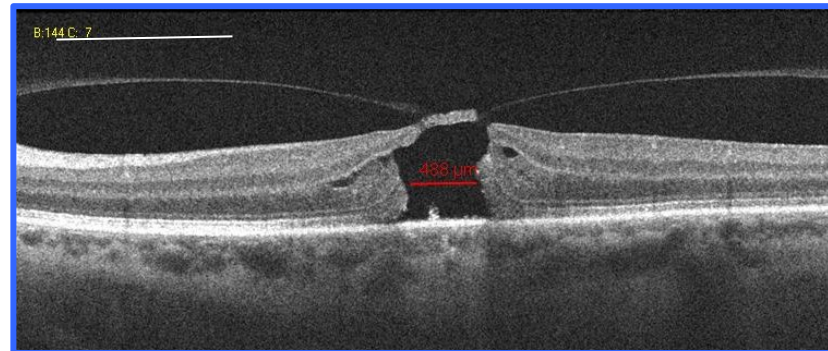
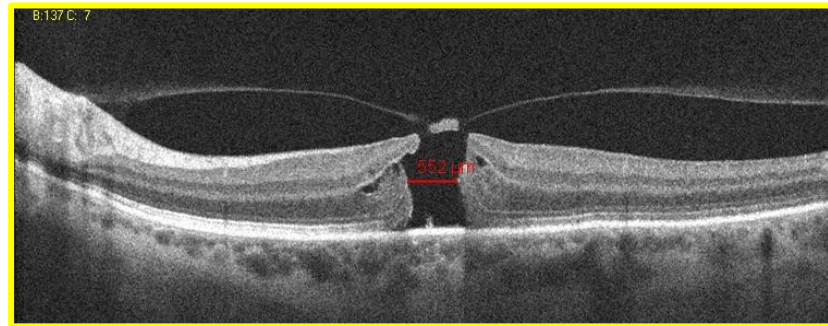
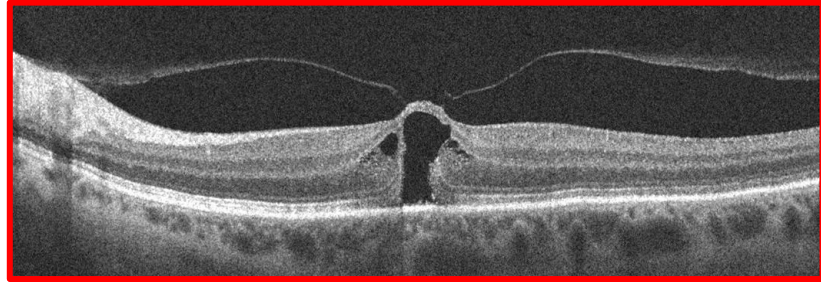
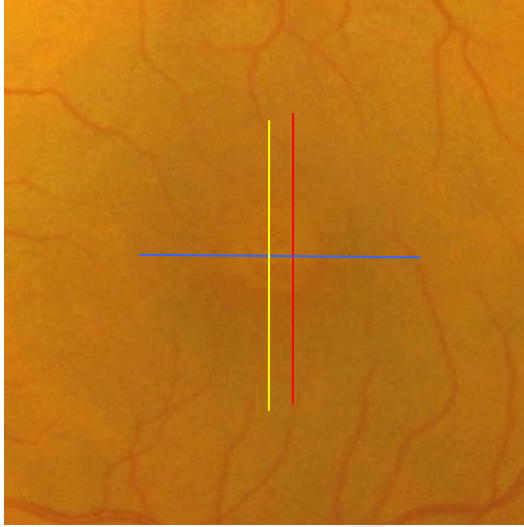
TM primaire / secondaire, petit / moyen / grand, avec ou sans TVM
(en option: $\pm$ DPV complet si sans TVM)

- TM idiopathique	- TM primaire
- TM non idiopathique	- TM secondaire

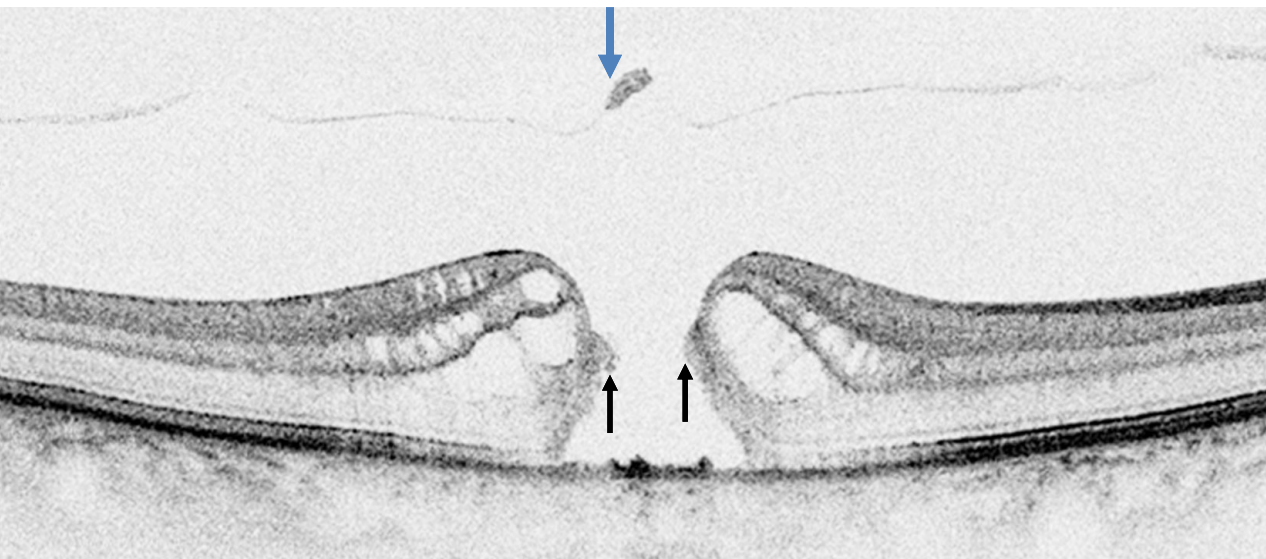
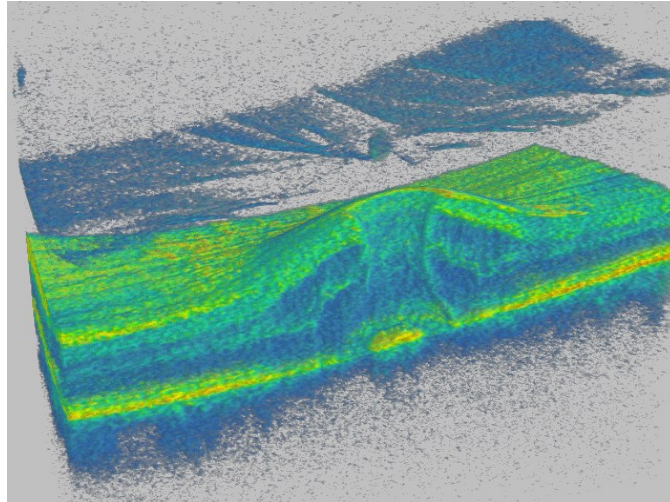
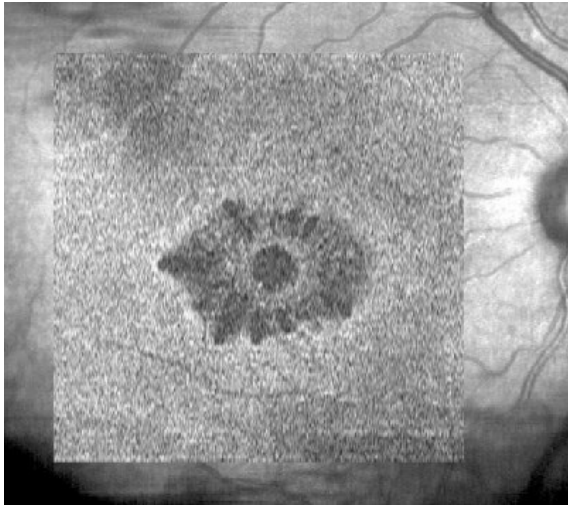
Étiologie du TM:

- dans la plupart des cas, le TM est idiopathique, c'est-à-dire simplement secondaires à une traction fovéolaire anormale. On parle, dans la nouvelle classification, de TM primaires.
- TM secondaire = autres causes : traumatisme à globe fermé, après la rupture de la paroi interne d'un kyste dans les cas d'œdème maculaire cystoïde, myopie forte avec staphylomes (TM sans DPV)...

TM avec TVM

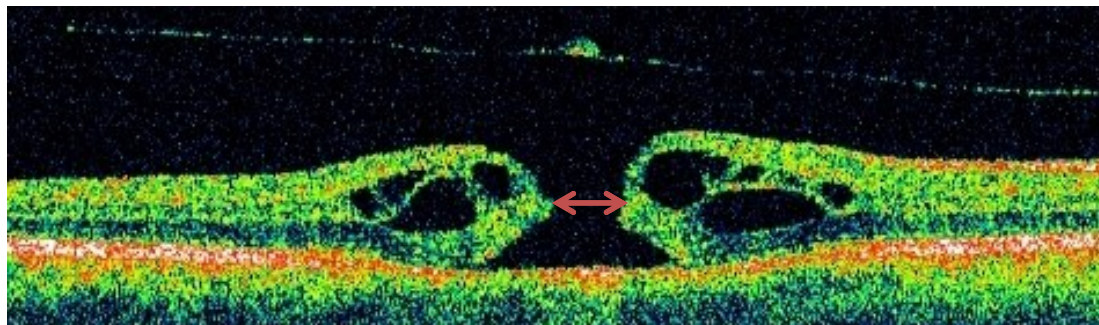


TM de pleine épaisseur, sans TVM



TM primaire / secondaire, petit / moyen / grand, avec ou sans TVM
(en option: $\pm$ DPV complet si sans TVM)

- TM $\leq 250 \mu\text{m}$	- TM petit
- $250 < \text{TM} \leq 400 \mu\text{m}$	- TM moyen
- TM $> 400 \mu\text{m}$	- TM grand



TRAITEMENT

May 1991

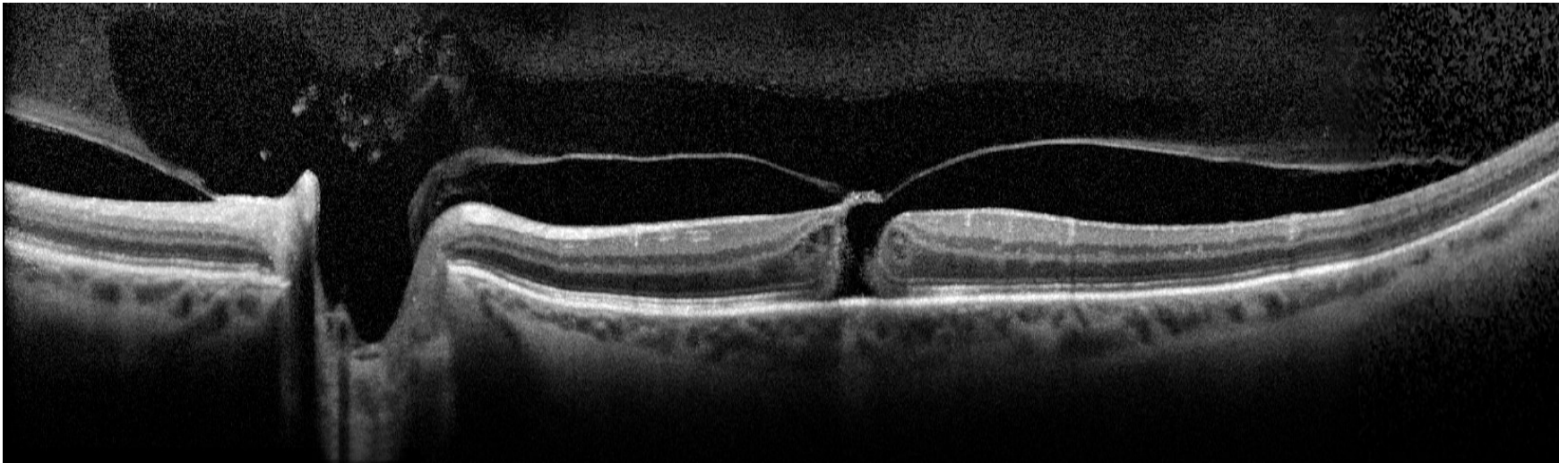
Vitreous Surgery for Idiopathic Macular Holes

Results of a Pilot Study

Neil E. Kelly, MD; Robert T. Wendel, MD

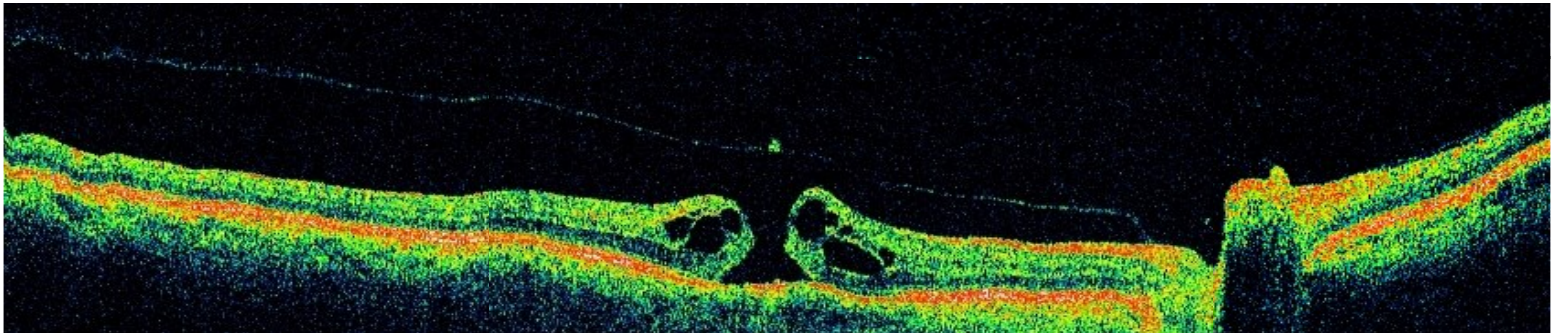
» [Author Affiliations](#)

Arch Ophthalmol. 1991;109(5):654-659. doi:10.1001/archopht.1991.01080050068031

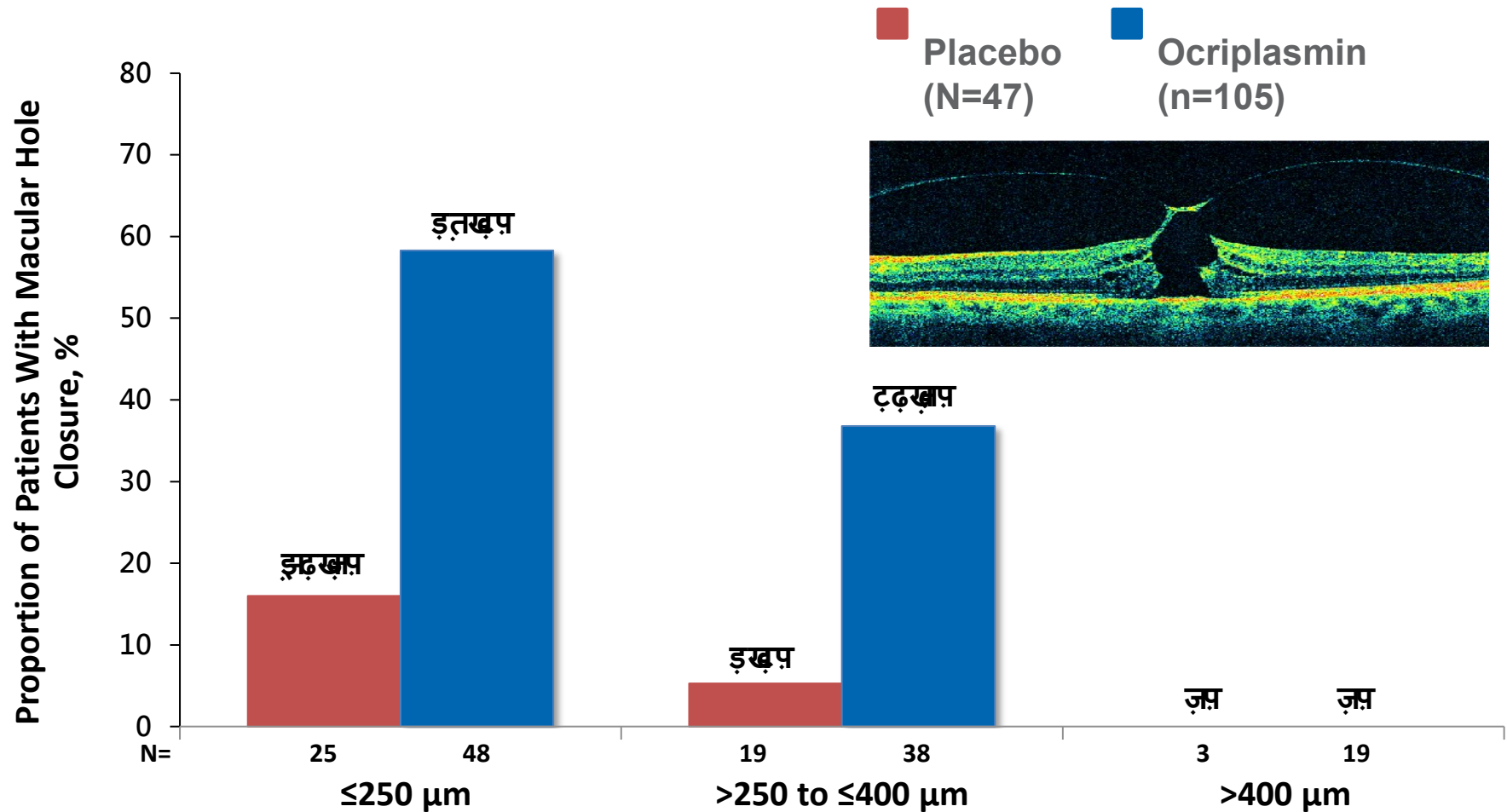


TM < 250 μm

- Peuvent guérir spontanément
 - Presque tous les TM fermés spontanément et publiés sont dans cette catégorie
 - Taux de fermeture d'environ 17-20%
 - Privat E, Tadayoni R, Gaucher D, Haouchine B, Massin P, Gaudric A. AJO 2007
 - Tadayoni R, Massin P, Haouchine B, Cohen D, Erginay A, Gaudric A. Retina 2001
- Fermeture dans les 3 premiers mois
- Eviter élargissement important du TM
- La fermeture peut passer initialement inaperçue par le patient
- => RDV opératoire au 3^e mois avec examen OCT avant pour annuler si fermeture spontanée
- 2 autres alternatives...



Ocriplasmin : fermeture des TM avec vitré attaché

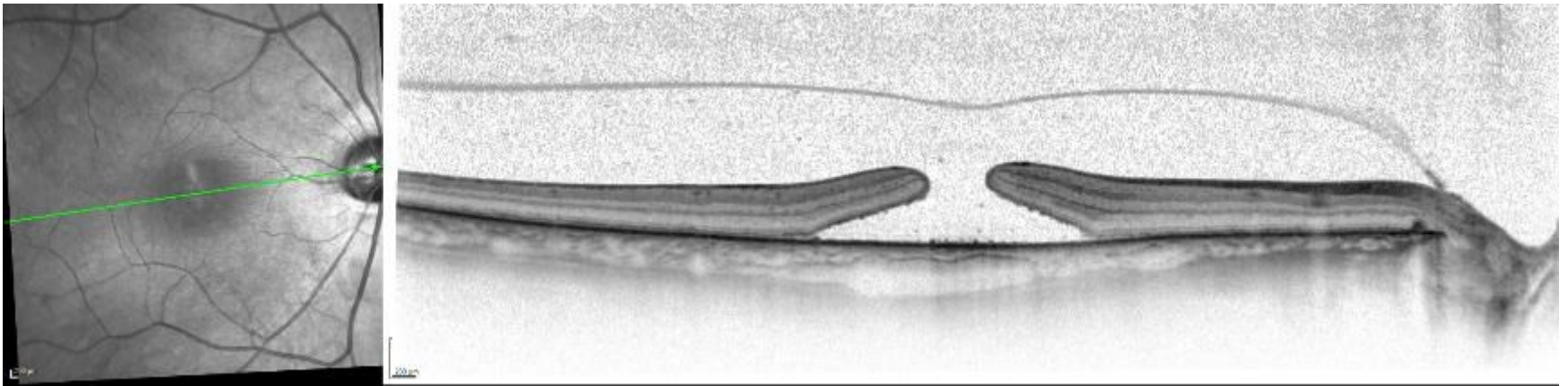
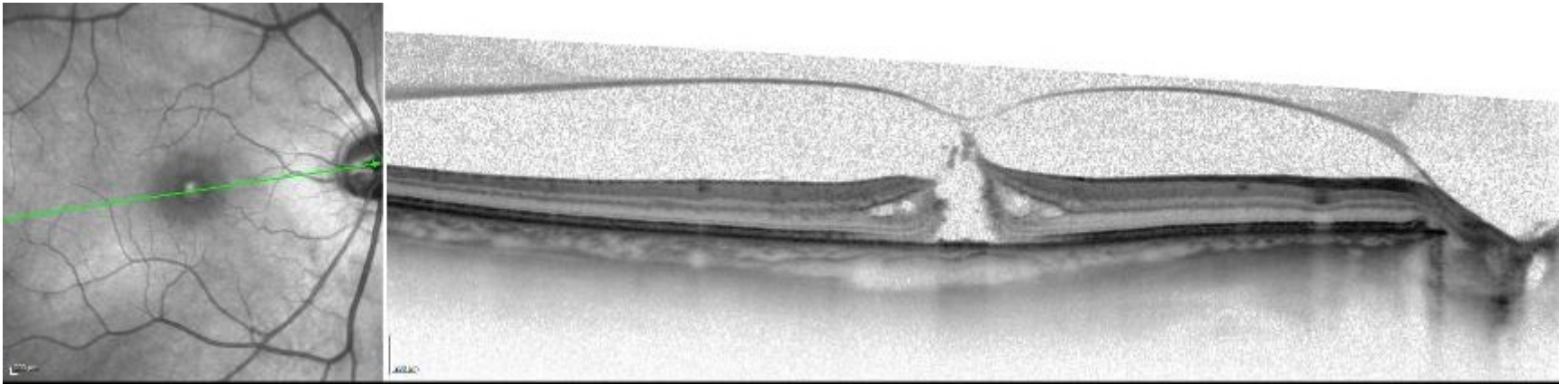


Data on file. ThromboGenics, Inc. 2012.

N=number of patients with macular hole of indicated size randomised to each treatment group

Ocriplasmin Effet II

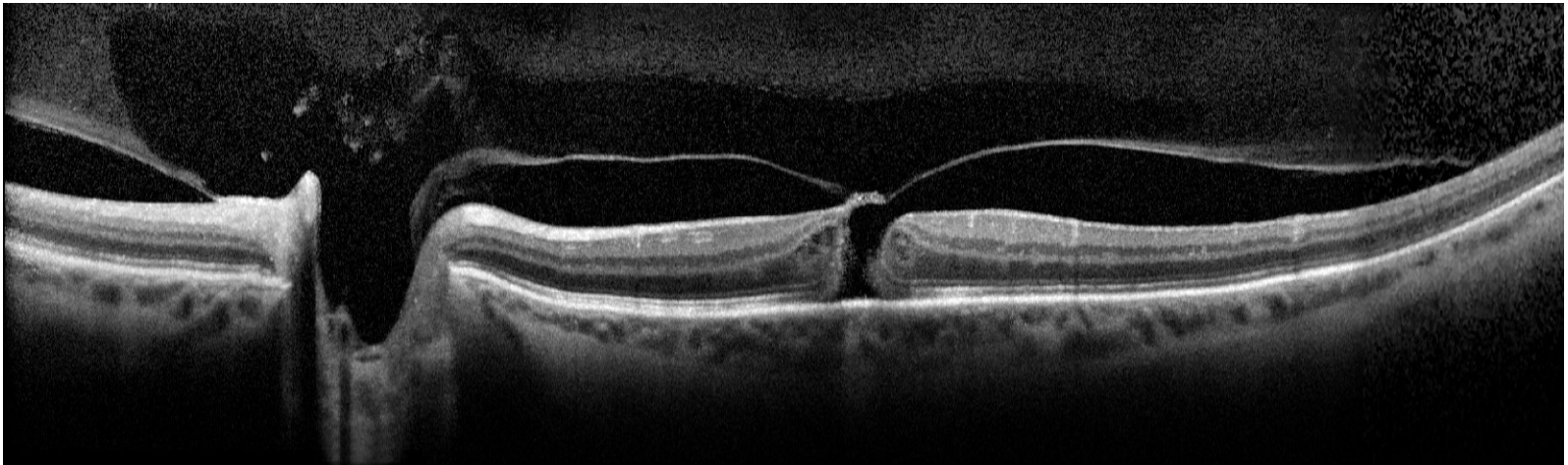
Female patient with recent decrease of VA in her RE....



D10

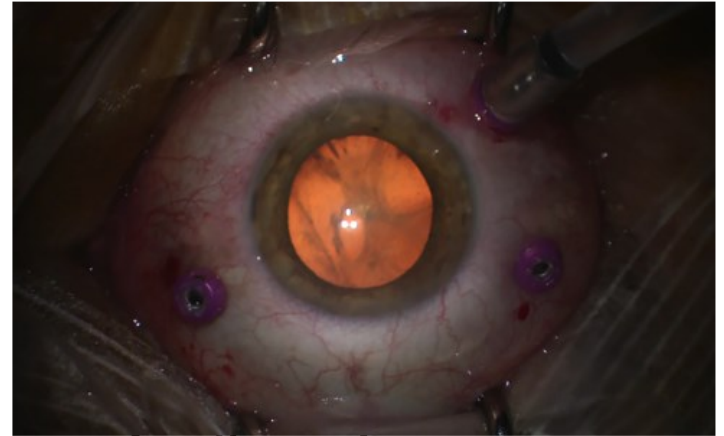
Fermeture pneumatique

- Injection d'une petite bulle de gaz pour libérer la traction et fermer le TM
 - Encore discuté (R/B) pour les TVM
 - Pas suffisamment de preuve pour les TM



La chirurgie

- Ambulatoire
- Anesthésie locorégionale
- Trans conjonctivale
 - Œil souvent blanc et indolore
- Il n'y a que la présence du gaz qui gêne le patient pendant quelque temps : interdiction altitude!



Anesthésie plus légère

RESEARCH ARTICLE

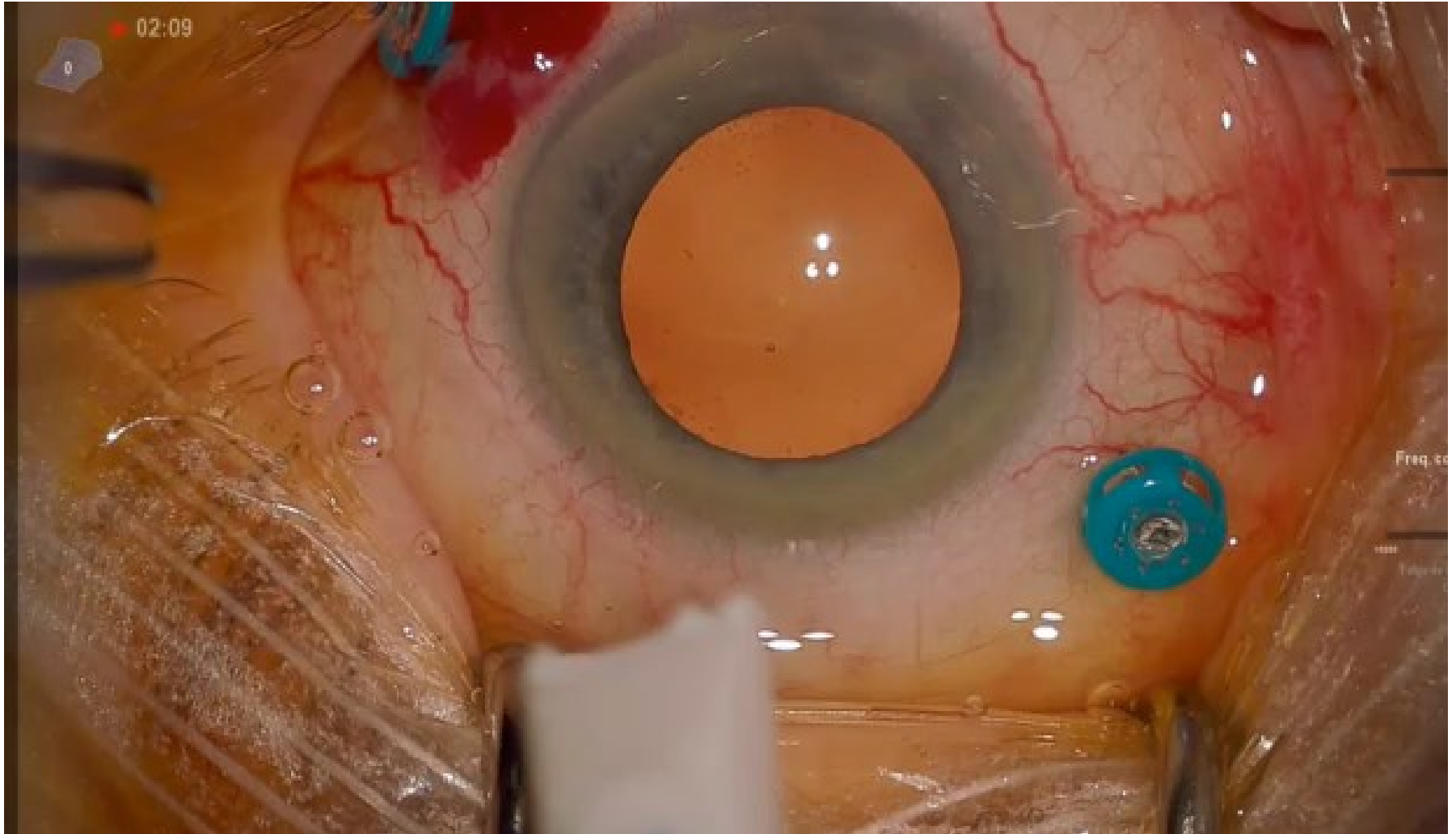
Pain during pars plana vitrectomy following sub-Tenon versus peribulbar anesthesia: A randomized trial

Jefferson A. S. Ribeiro^{1,2}*, Daniel S. Ribeiro², Ingrid U. Scott^{3,4}, João Abrão⁵, Rodrigo Jorge²

Conclusion

In this study of patients who underwent PPV for MH or ERM, topical followed by sub-Tenon anesthesia was more effective in controlling pain during the whole vitrectomy procedure than peribulbar anesthesia. Compared to peribulbar anesthesia which is administered with a sharp needle, sub-Tenon anesthesia administered with a blunt cannula may be associated with a reduced risk of such adverse events as globe perforation, retrobulbar hemorrhage, and inadvertent injection of anesthesia into the optic nerve sheath.

Absence d'Akinésie : TM sous topique



MH Surgery Principles

1. Relieve any resistance to closure

- 3 Peelings

1. To reduce its size: “dry” the MH

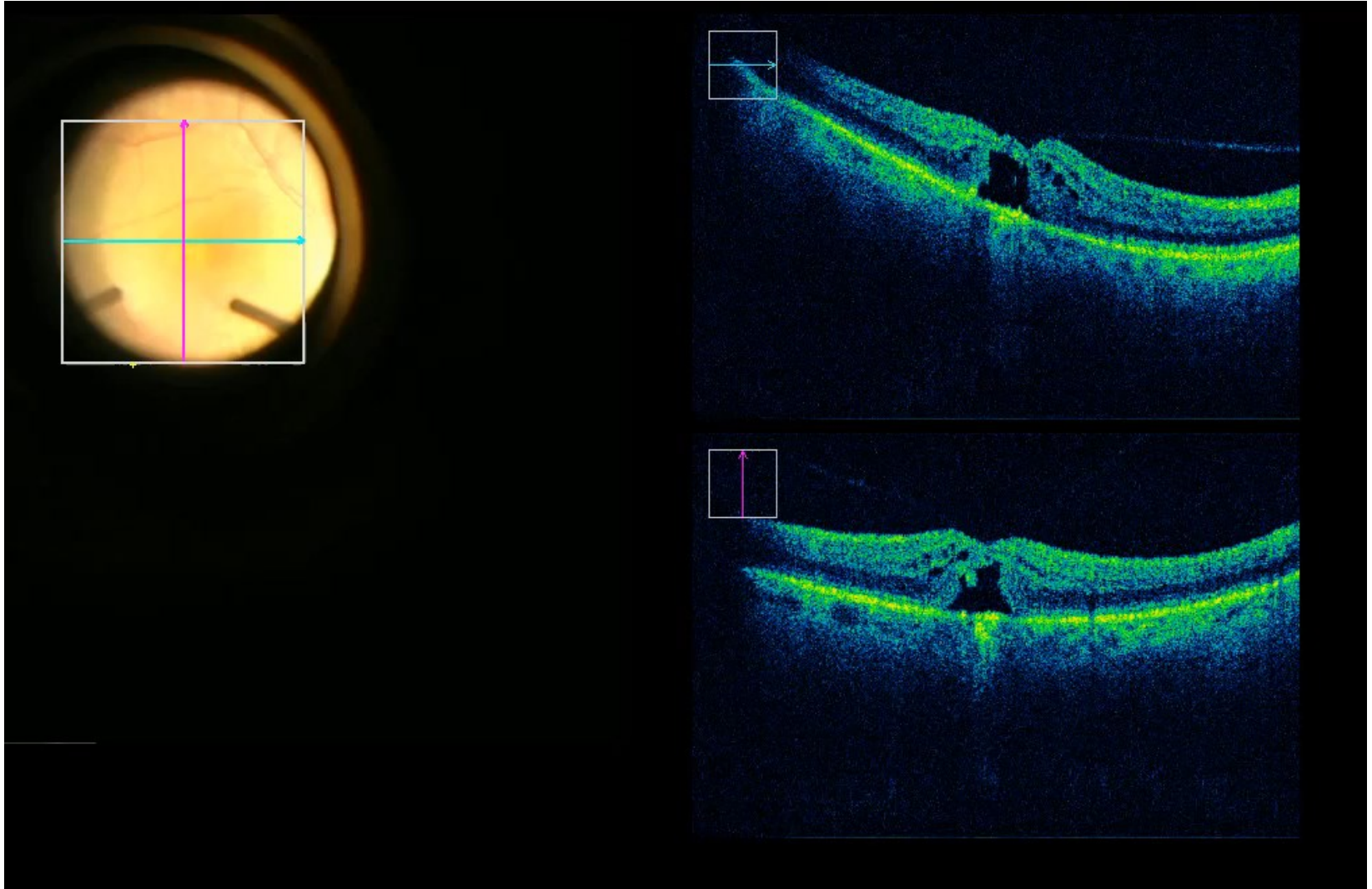
- FAX

1. Help scar formation: tamponade

- Gas

- Face-down positioning

Chirurgie d'un TM en OCT per-op



Position face vers le sol

«No one shall be subjected to torture or to inhuman or degrading treatment or punishment.»

The European convention on human rights. Article 3.



The process of closure of experimental retinal holes in rabbit eyes

T Yamana ¹, M Kita, S Ozaki, A Negi, Y Honda

- In the gas-injected eyes, the retinal holes were ophthalmoscopically closed by 7 days after the surgery.
 - area of retinal defect was covered with cells which were positive for cytokeratin 18 and GFAP: glial and RPE cells might play an important role
- In the eyes without gas tamponade, the retinal holes did not close during the observation period.

Intraocular Tamponade Choice with Vitrectomy and Internal Limiting Membrane Peeling for Idiopathic Macular Hole

A Systematic Review and Meta-analysis

Nikolaos Dervenis, MD, PhD,^{1,2} Panagiotis Dervenis, MD, MSc,⁴ Teresa Sandinha, MD, FRCSEd (Ophth),^{3,5}
Declan C. Murphy, MBBS, MRes,^{6,7} David H. Steel, MD, FRCOphth^{5,6,7}

Conclusion: The current evidence base for tamponade selection with vitrectomy and ILM peeling for full-thickness macular hole has several major limitations. Further appropriately designed studies are needed to guide tamponade selection. *Ophthalmology Retina* 2022;6:457-468 © 2022 by the American Academy of

Pars plana vitrectomy with silicone oil tamponade for primary and secondary macular hole closure: Is it still a useful procedure?

Janusz Pieczynski ^{1 2}, Patrycja Kuklo ^{1 2}, Andrzej Grzybowski ^{1 3}

Conclusion: There are reports on good efficacy of silicone oil tamponade for primary and recurrent macular hole closure. Anatomical closure and visual acuity rates in pars plana vitrectomy with silicone oil and with gas filling are comparable. Gas tamponade seems to be safer and needs no more surgery. Postoperative complications in both methods are similar, but all patients with silicone oil filling need to undergo a reoperation to have the silicone removed. There are also other surgical techniques for

GAS-FOVEAL CONTACT

A New Approach to Evaluating Positioning Regimens in Macular Hole Surgery

MARK ALBERTI, MD, MORTEN LA COUR, MD, DMS

GAS-FOVEAL CONTACT • ALBERTI AND LA COUR

919

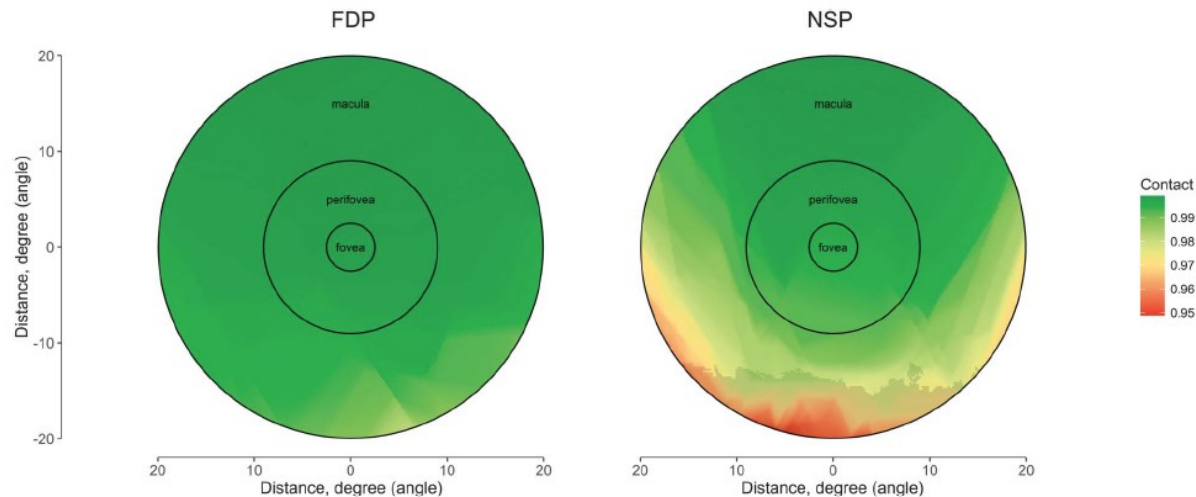


Fig. 4. Gas-macular contact in a 20° radius from the fovea is visualized above in a heatmap visualization by aggregating median values for 31,417 different macular locations. Gas-macular contact in the inferior macular area of the NSP group is significantly worse than in the FDP group (visualized in gray shading). The difference is significant at 13.2° from the fovea. The selected radii for the fovea, perifovea, and macular areas are 2.5°, 9°, and 20°, respectively.

Facedown Positioning Following Surgery for Large Full-Thickness Macular Hole

A Multicenter Randomized Clinical Trial

[Saruban Pasu](#), MBBS, MD,^{1,2,3} [Lauren Bell](#), BSc,^{4,5} [Zohra Zenasni](#), MSquize,^{4,5} [Doris Lanz](#), MSc,^{4,5} [Irene A Simmonds](#), BA, MA, BSc,^{4,5} [Ann Thompson](#), MSc,^{4,5} [David Yorston](#), MBChB,⁶ [D. Alistair H. Laidlaw](#), MBBS,⁷ [Catey Bunce](#), MSc, DSc,^{1,2,8} [Richard Hooper](#), PhD,^{4,5} and [James W. B. Bainbridge](#), MA, MBBChir^{1,2,3},
for the Positioning In Macular Hole Surgery (PIMS) Study Group

- A total of 185 participants
- MH of at least 400 μm and a duration of fewer than 12 months.
- Peeling of the internal limiting membrane
- Macular hole closure was observed in 90 (85.6%) who were advised to position face forward
- 88 (95.5%) advised to position facedown (adjusted odds ratio, 3.15; 95% CI, 0.87-11.41; $P = .08$)
- ...

Conclusions and Relevance

The results do not prove that facedown positioning following surgery is more likely to close large macular holes compared with facing forward but do support the possibility that visual acuity outcomes may be superior.



Review

Face-Down Posture versus Non-Face-Down Posture following Large Idiopathic Macular Hole Surgery: A Systemic Review and Meta-Analysis

Hou-Ren Tsai ^{1,2}, Tai-Li Chen ^{1,2,3}, Chun-Yu Chang ^{2,4} , Huei-Kai Huang ^{2,5,6,7} and Yuan-Chieh Lee ^{8,9,*}

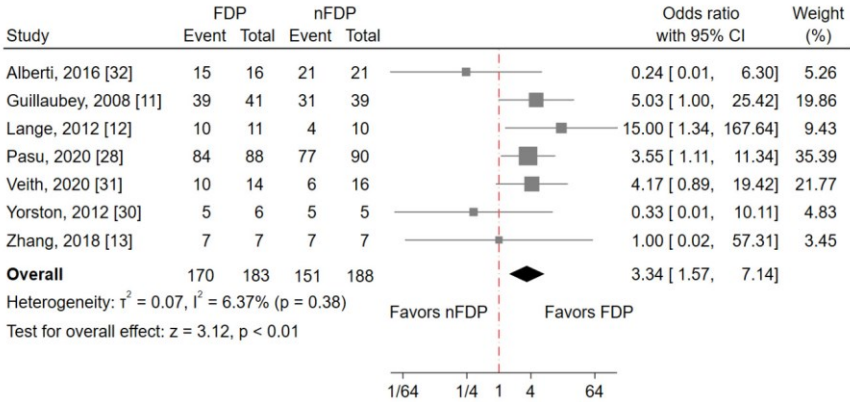


Figure 2. Forest plot of large idiopathic macular hole closure rate.

Table 2. Subgroup analyses of large IMH closure rate.

Large IMH Closure Rate				
Subgroups	No. of Trials	Pooled OR (95% CI)	p-Value	I ² (%)
Posturing periods				
≤3 days	3	1.76 (0.32 to 9.70)	0.52	22.21
≥5 days	4	4.05 (1.60 to 10.22)	<0.01 *	9.30
Follow-up periods				
≤3 months	4	2.91 (0.71 to 11.98)	0.14	30.73
≥6 months	3	3.51 (1.18 to 10.39)	0.02 *	3.22

* $p < 0.05$; IMH, idiopathic macular hole.

A Randomized Controlled Trial of Alleviated Positioning after Small Macular Hole Surgery

Ramin Tadayoni, MD, PhD,¹ Eric Vicaut, MD, PhD,² François Devin, MD,³
Catherine Creuzot-Garcher, MD, PhD,⁴ Jean-Paul Berrod, MD,⁵ Yannick Le Mer, MD,⁶
Jean-François Korobelnik, MD,⁷ Moumir Aout, PhD,² Pascale Massin, MD, PhD,¹ Alain Gaudric, MD¹

Ophthalmology 2011;118:150–155

- MH > 400 μm

	ILM peeling	No peeling	P
Closure rate	94.9 %	73.2 %	p=0.0085

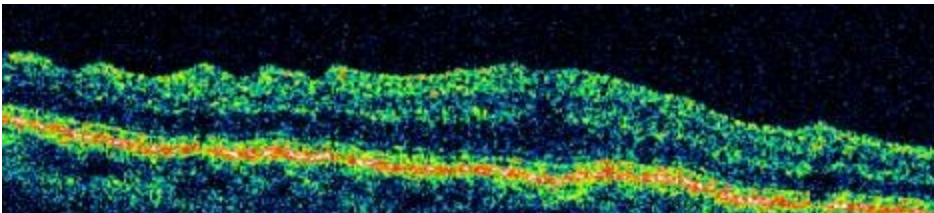
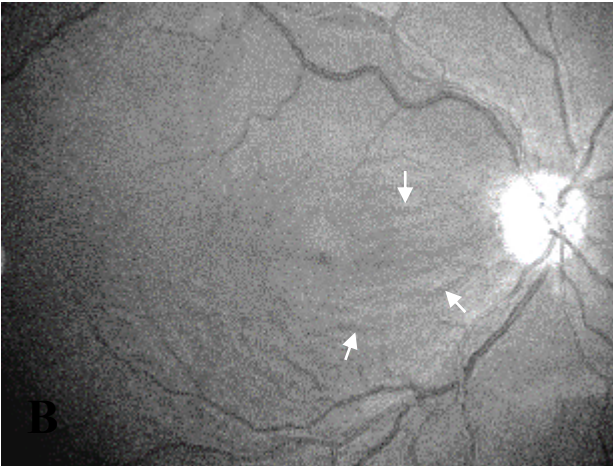
- MH $\leq$ 400 μm (No ILM Peeling)

	Face-down	Alleviated	95% CI
Closure rate	94.1 %	91.4 %	+9.5 to – 14.88%

Effets secondaires de la dissection de la MLI

Dissociated Optic Nerve Fiber Layer Appearance of the Fundus after Idiopathic Epiretinal Membrane Removal

Ramin Tadayoni, MD,¹ Michel Paques, MD,¹ Pascale Massin, MD,¹ Soraya Mouki-Benani, MD,¹
Jacqueline Mikol, MD,² Alain Gaudric, MD¹



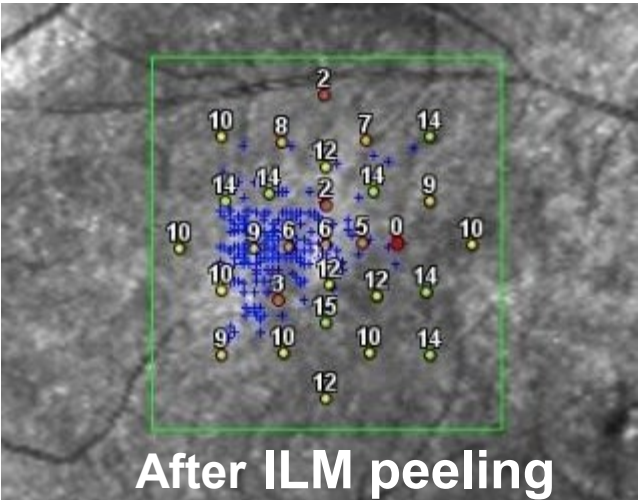
Ophthalmology 2001

BJO Online First, published on October 17, 2012 as 10.1136/bjophthalmol-2012-302035
Clinical science

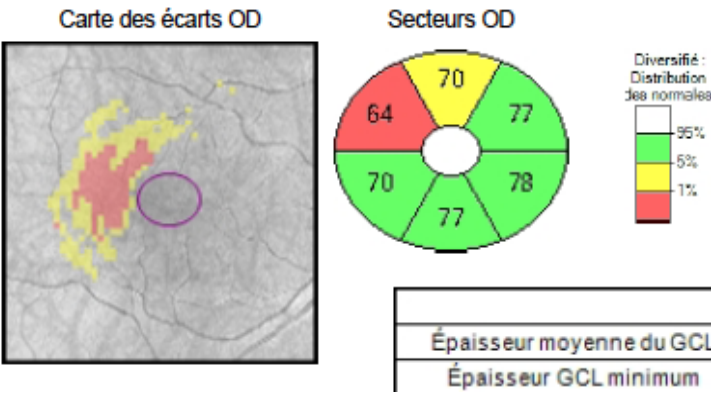


Decreased retinal sensitivity after internal limiting membrane peeling for macular hole surgery

Ramin Tadayoni, Ivana Svorenova, Ali Erginay, Alain Gaudric, Pascale Massin



Br J Ophthalmol. 2012



May 1991

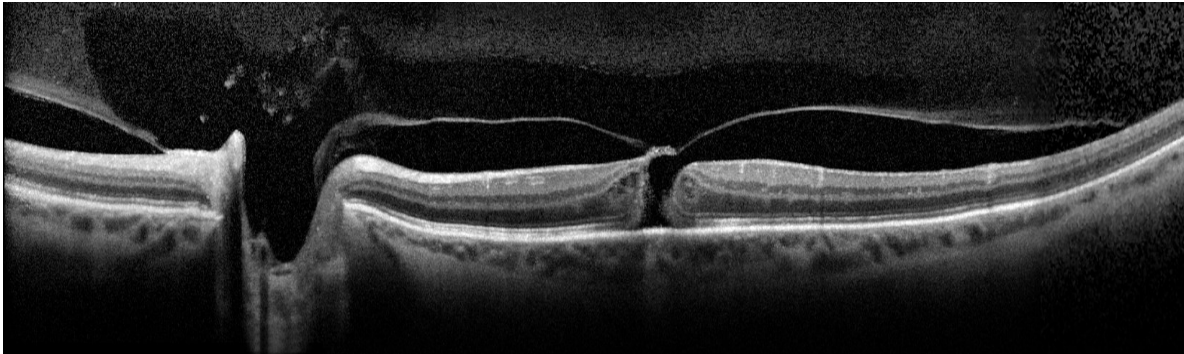
Vitreous Surgery for Idiopathic Macular Holes

Results of a Pilot Study

Neil E. Kelly, MD; Robert T. Wendel, MD

» [Author Affiliations](#)

Arch Ophthalmol. 1991;109(5):654-659. doi:10.1001/archopht.1991.01080050068031



Today excellent prognosis:

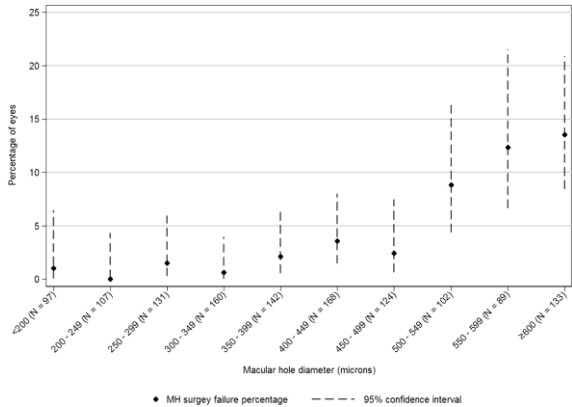
- Hole closure > 95%
 - D. H. Stell et al. Eye 2021
- VA > 0.5 at 3 month in ½ eye
- Average 0.8 at 2 y!



Factors affecting anatomical and visual outcome after macular hole surgery: findings from a large prospective UK cohort

D. H. Steel^{1,2} · P. H. J. Donachie³ · G. W. Aylward⁴ · D. A. Laidlaw⁵ · T. H. Williamson⁵ · D. Yorston⁶ · the BEAVRS Macular hole outcome group

Fig. 2 Macular hole surgery failed closure rates, 95% confidence intervals shown for 50 micron increments of the hole diameter in microns; $N = 1,253$ primary macular hole operations with a known surgical outcome.



At the multivariate level, the factors predicting visual success were better pre-operative VA, smaller hole size, shorter duration of symptoms and the absence of AMD.

The Manchester Large Macular Hole Study: Is it Time to Reclassify Large Macular Holes?



SOON WAI CH'NG, NIAL PATTON, MAHMOUD AHMED, TSVETA IVANOVA, CARMEN BAUMANN, STEPHEN CHARLES, AND ASSAD JALIL

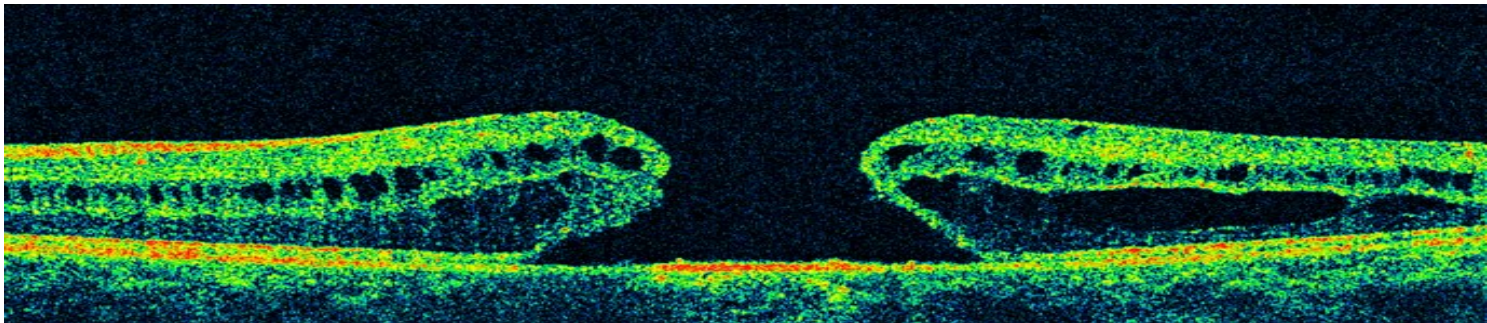
- ILM peel with Brilliant Blue G + 20% C2F6 or 14% C3F8

TABLE. Patient Demographic Profiles and Preoperative/Postoperative Functional and Anatomic Outcomes					P Value
	Quartile 1 (N = 65) 400–477 μ m	Quartile 2 (N = 65) 478–558 μ m	Quartile 3 (N = 64) 559–649 μ m	Quartile 4 (N = 64) 650–1416 μ m	
Anatomic hole closure, n (%)	64 (98)	59 (91)	60 (94)	48 (76)	$P < .001$
Postoperative BCVA (logMAR) Mean	0.53	0.58	0.67	0.70	$P = .002$

Am J Ophthalmol 2018;195:36–42.

$$TM > 800 \mu\text{m}$$

- Cas sélectionnés bénéficie de la chirurgie
 - Original study:
 - Closure rate for XL-MH (mean: 942 μm [810-1501]): 72.2%.
 - The mean VA increased by -0.565 LogMAR in closed XL-MH and remained unchanged in others.
 - Outcomes not significantly different from those of L-MH
 - AAO 2007 (R. Tadayoni, M. Bennani, A. Gaudric)

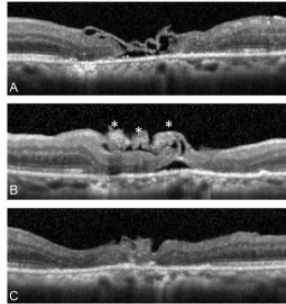


ILM flap

FOVEAL MICROSTRUCTURE IN MACULAR HOLES SURGICALLY CLOSED BY INVERTED INTERNAL LIMITING MEMBRANE FLAP TECHNIQUE

TERAKO DAYANIL, MD, SHIH KENTYANA, MD RETINA 34:2444-2450, 2014

- ...Idiopathic MH (diameter >500 µm) ... high myopia (axial length > 26.5 mm with or without RD)...
- Twenty eyes of 19 patients with MH closed surgically by the inverted ILM flap technique...

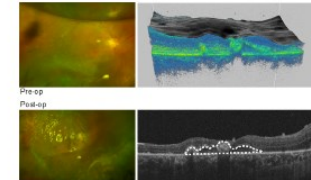


Retinal Transplant

SUBRETINAL TRANSPLANTATION OF AN AUTOLOGOUS RETINAL FREE FLAP FOR CHRONIC RETINAL DETACHMENT WITH PROLIFERATIVE VITREORETINOPATHY WITH AND WITHOUT MACULAR HOLE

ABDELKAYE E. THERIAULT, MD, MSc, TAREK H. MABROUK, MD, PhD

RETINA 38:S121-S124, 2018



R. Tadayoni own case

Blood products

► Eur J Ophthalmol, 2020 Sep 28;1120672120960340. doi: 10.1177/1120672120960340.
Online ahead of print.

Long-term results of autologous plasma as adjuvant to pars plana vitrectomy in the treatment of high myopic full-thickness macular holes

Marta S Figueras ^{1,2,3}, Anna Mora Cantallops ¹, Gianni Virgili ⁴, Andrea Govetto ^{5,6}

Effect of Autologous Platelet Concentrate in Surgery for Idiopathic Macular Hole

Results of a Multicenter, Double-masked, Randomized Trial

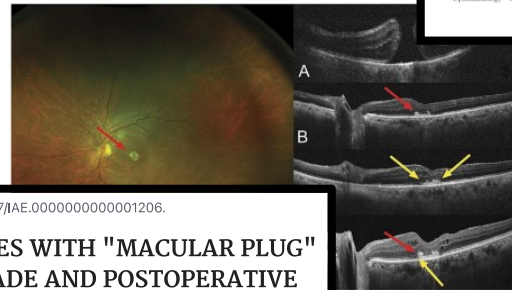
Michel Pajon, MD,¹ Claude Chassang, MD, PhD,² André Mathis, MD,³ Jaf Sahel, MD,⁴ Pascal Marnin, MD,⁵ Christine Lissac, MD,⁶ Jean-François Baudouin, MD,⁷ Jean-François Gargano, MD, PhD,⁸ Alain Gaudin, MD,⁹ for the Platelet in Macular Hole Surgery Group[†]

Ophthalmology Volume 126, Number 5, May 2019

Anatomic Success Rate

The success rate at 1 month after surgery was 52 of 53 (98%; 95% exact confidence interval, 0.90–1.00) in the platelet group and 47 of 57 (82%; 95% exact confidence interval, 0.70–0.91) in the control group ($P = 0.009$, Fisher's exact test; relative risk, 1.19; 95% confidence interval, 1.05–1.35). When adjusting for baseline covariates (e.g., age, hole duration, and visual acuity) by a logistic model, the two treatment groups remained significantly different ($P = 0.02$). Before the 6-month visit, these responses (ORs) of the macular hole occurred: first in the platelet group and then in the

Membrane amiotique



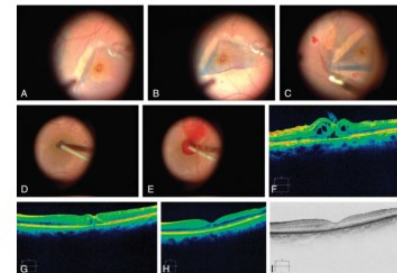
RETINA39:S95-S103, October 2019

Retina. 2017 Mar;37(3):451-459. doi: 10.1097/JAE.0000000000001206.

CLOSING MACULAR HOLES WITH "MACULAR PLUG" WITHOUT GAS TAMPONADE AND POSTOPERATIVE POSTURING

Meena Chakrabarti ¹, Preethi Benjamin, Keya Chakrabarti, Arup Chakrabarti

"MACULAR PLUG"



The autologous gluconated blood clumps (AGBC) solution was prepared immediately before starting the surgery by adding 1 mL of 5% glucose to 2 mL of autologous blood drawn from the patients' antecubital vein in the cubital fossa with strict attention to aseptic precautions during blood withdrawal.

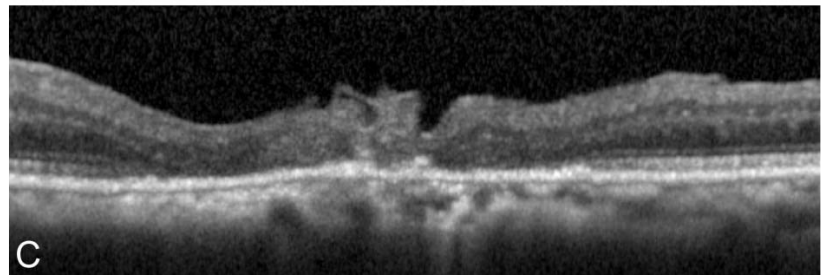
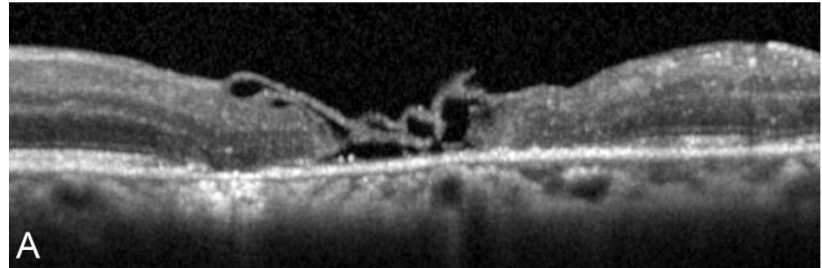
MODIFICATIONS OF MACULAR HOLE SURGERY • CHAKRABARTI ET AL
RETINA, THE JOURNAL OF RETINAL AND VITREOUS DISEASES • 2017 • VOLUME 37 • NUMBER 3

ILM flap

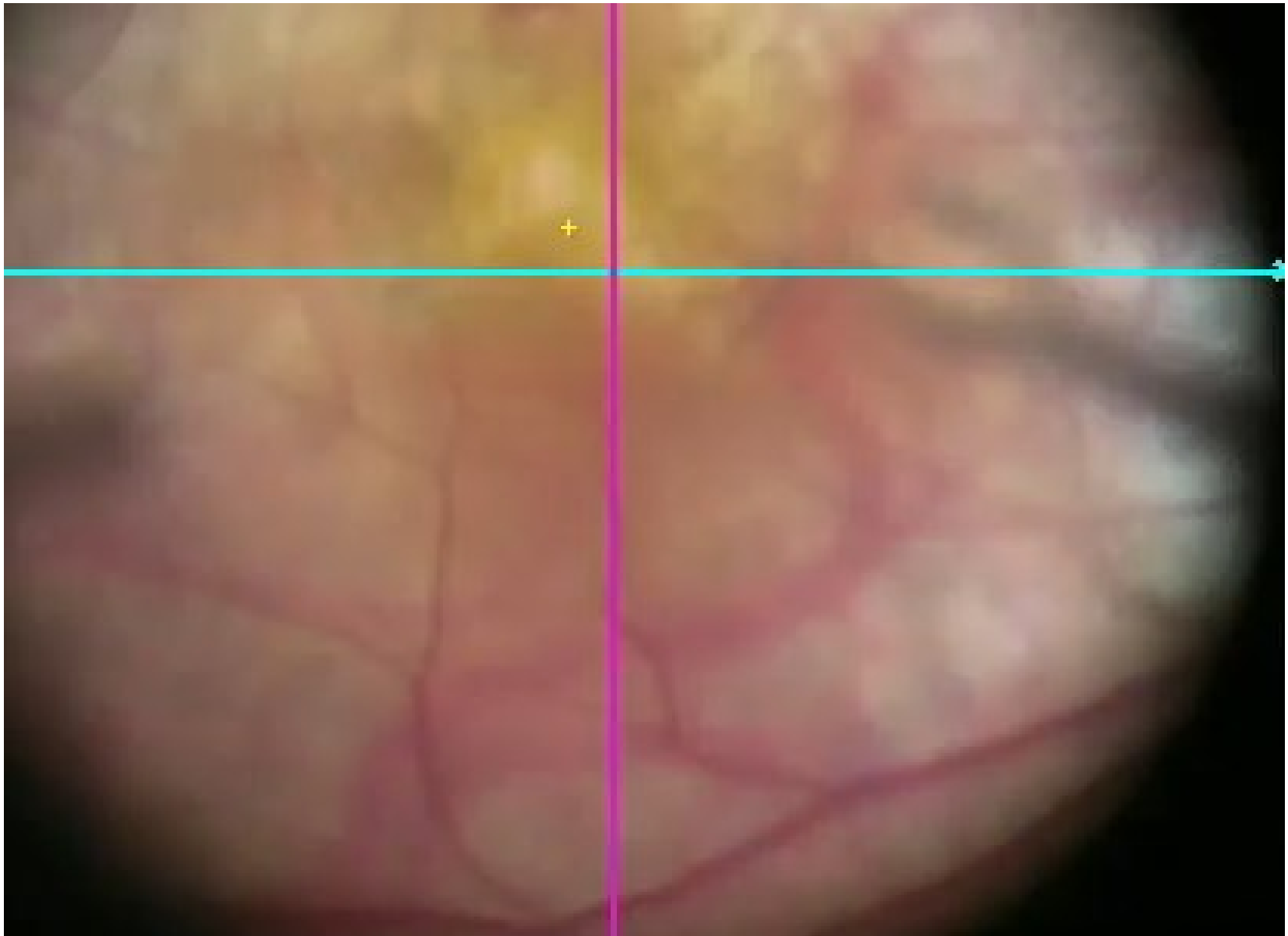
FOVEAL MICROSTRUCTURE IN MACULAR HOLES SURGICALLY CLOSED BY INVERTED INTERNAL LIMITING MEMBRANE FLAP TECHNIQUE

HISAKO HAYASHI, MD, SHOJI KURIYAMA, MD *RETINA 34:2444–2450, 2014*

- ...idiopathic MH (diameter $>500\ \mu\text{m}$) ... high myopia (axial length $> 26.5\ \text{mm}$ with or without RD)...
- Twenty eyes of 19 patients with MH closed surgically by the inverted ILM flap technique...



Inverted ILM Flap



DIFFERENCES IN ANATOMICAL AND VISUAL OUTCOMES AMONG THREE INTERNAL LIMITING MEMBRANE TECHNIQUES TREATING EXTRA- LARGE IDIOPATHIC MACULAR HOLES

Lingzi Liu ^{1 2}, Yanping Yu ^{1 2}, Xiaohan Yang ^{1 2}, Zengyi Wang ^{1 2}, Biying Qi ^{1 2}, Ke Zhang ^{1 2}, Xijin Wu ^{1 2}, Xinbo Wang ^{1 2}, Wu Liu ^{1 2}

Methods: Patients with idiopathic macular holes (minimum linear diameter $\geq 650 \mu\text{m}$) were divided into peeling group, insertion group, and cover group. The initial closure rate, final length of external limiting membrane and ellipsoid zone recovery, and best-corrected visual acuity were evaluated.

Conclusion: For extra-large idiopathic macular holes, cover technique surpasses internal limiting membrane peeling technique in closure rate and outperforms insertion technique in anatomical and functional recovery, whereas insertion technique may adversely affect the recovery of foveal microstructure and best-corrected visual acuity.

Sci Rep. 2022 Jan 14;12(1):731. doi: 10.1038/s41598-021-04739-x.

Effect of inverted internal limiting membrane flap technique on small- medium size macular holes

Kanako Yamada ¹, Akio Oishi ², Mao Kusano ¹, Hirofumi Kinoshita ¹, Eiko Tsuiki ¹,
Takashi Kitaoka ¹

- The result suggested that inverted ILM flap technique does not have additional benefits for small- medium size MHs and may delay recovery of retinal integrity.

At least to use MH size to decide...

- Excellent prognosis:
 - Up to 400 without posturing or peeling
 - Up to 650 microns with ILM peeling
- Our data even suggest up to 800 microns with ILM peeling + posturing
- More invasive technics should show benefit before being used...

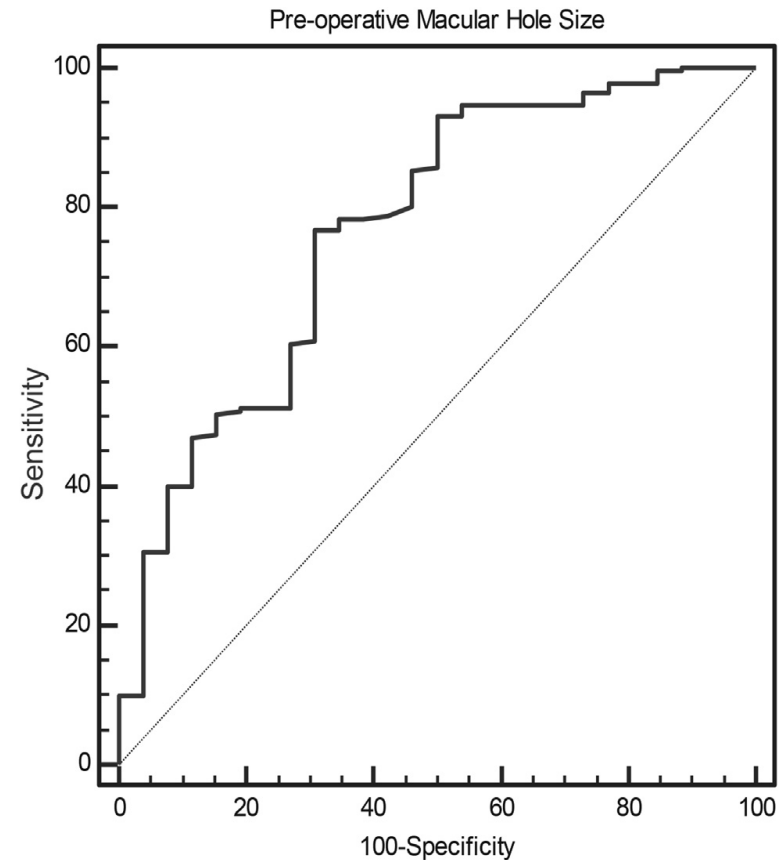


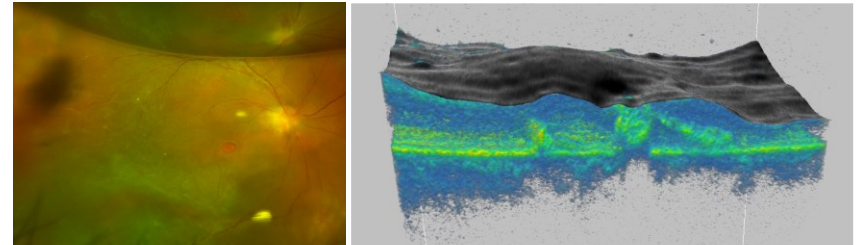
FIGURE 3. Receiver operating curve (ROC) analysis using area under curve (AUC) to determine the macular hole size as a predictor of success.

Retinal Transplant

SUBRETINAL TRANSPLANTATION OF AN AUTOLOGOUS RETINAL FREE FLAP FOR CHRONIC RETINAL DETACHMENT WITH PROLIFERATIVE VITREORETINOPATHY WITH AND WITHOUT MACULAR HOLE

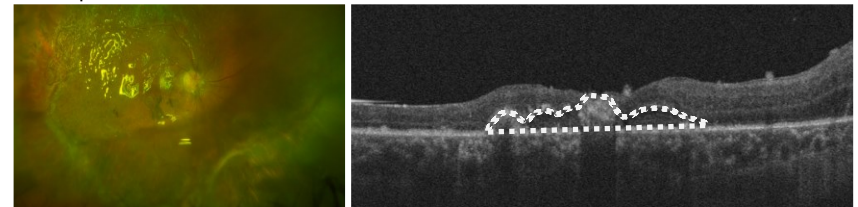
AKSHAY S. THOMAS, MD, MS,* TAMER H. MAHMOUD, MD, PhD†

RETINA 38:S121–S124, 2018

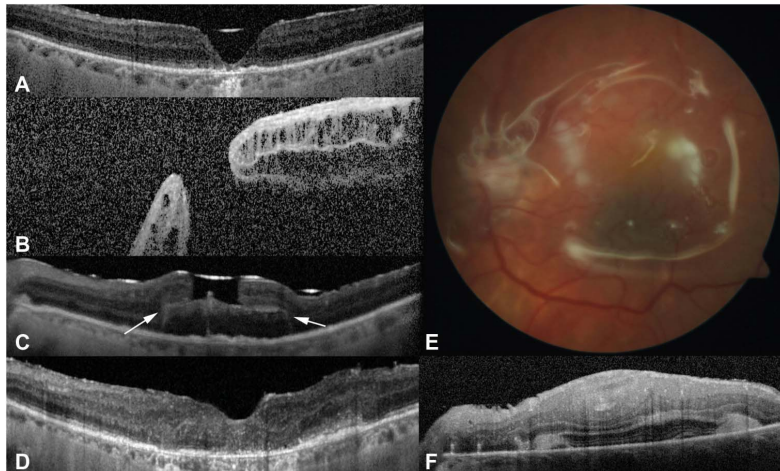


Pre-op

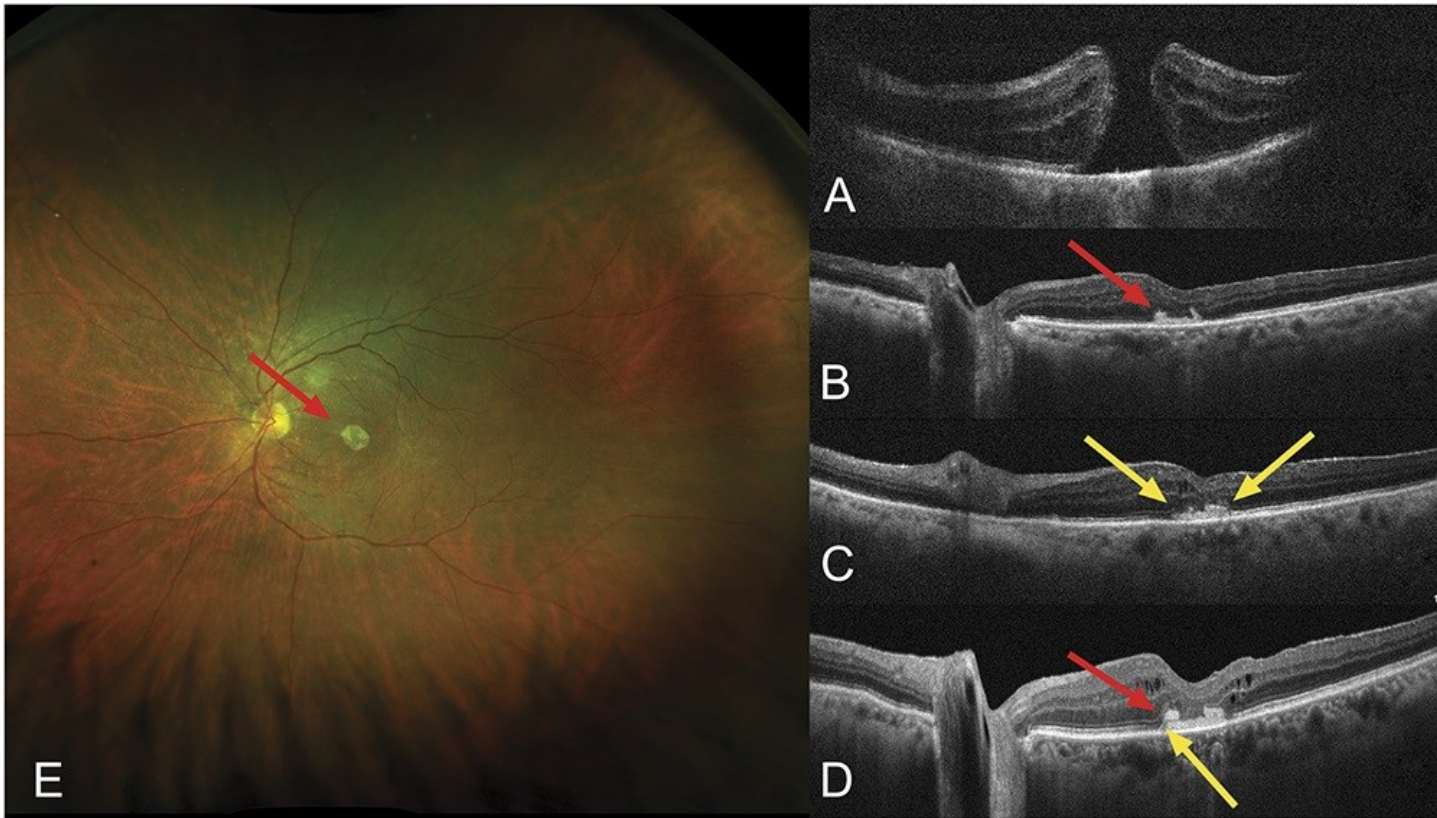
Post-op



R. Tadayoni own case



Membrane amniotique



RETINA39:S95-S103, October 2019

Produits sanguins

► [Eur J Ophthalmol](#). 2020 Sep 28;1120672120960340. doi: 10.1177/1120672120960340.

Online ahead of print.

Long-term results of autologous plasma as adjuvant to pars plana vitrectomy in the treatment of high myopic full-thickness macular holes

Marta S Figueroa ^{1 2 3}, Arnau Mora Cantallops ¹, Gianni Virgili ⁴, Andrea Govetto ^{5 6}

Effect of Autologous Platelet Concentrate in Surgery for Idiopathic Macular Hole

Results of a Multicenter, Double-masked, Randomized Trial

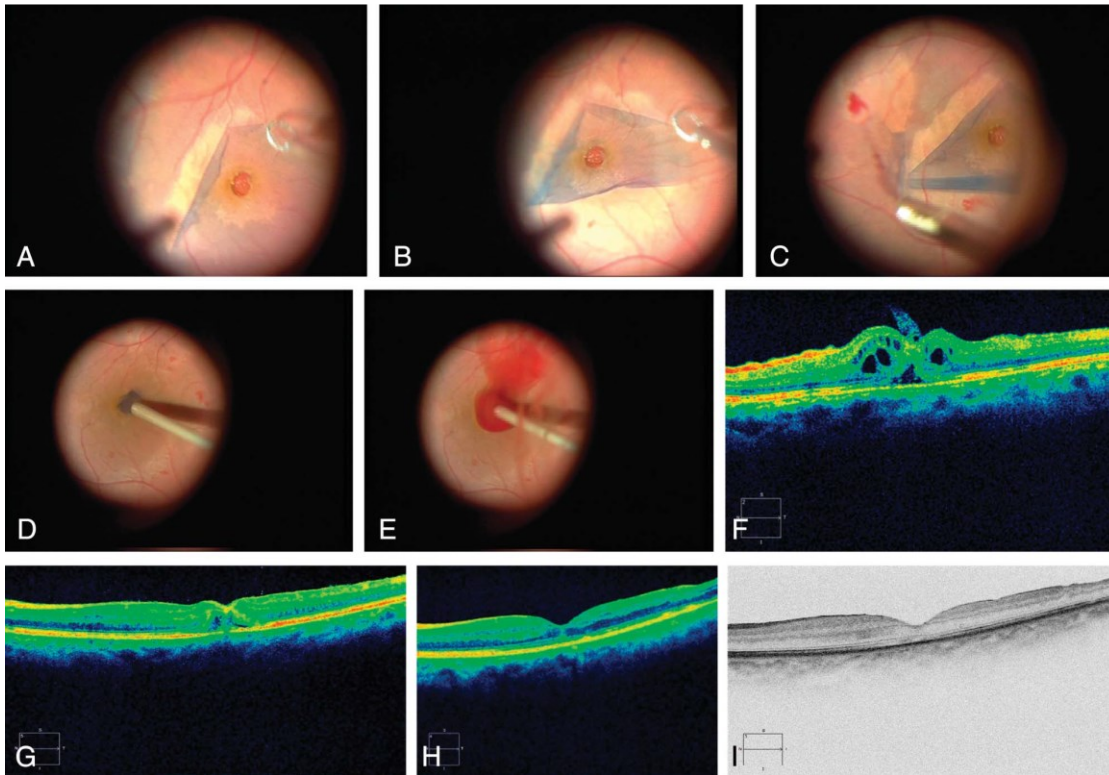
Michel Paques, MD,¹ Claude Chastang, MD, PhD,² André Mathis, MD,³ José Sahel, MD,⁴
Pascale Massin, MD,¹ Christine Dosquet, MD,⁵ Jean-François Korobelnik, MD,⁶
Jean-François Le Gargasson, MD, PhD,⁷ Alain Gaudric, MD,¹ for the Platelets in Macular Hole Surgery Group*

Ophthalmology Volume 106, Number 5, May 1999

Anatomic Success Rate

The success rate at 1 month after surgery was 52 of 53 (98%; 95% exact confidence interval, 0.90–1.00) in the platelet group and 47 of 57 (82%; 95% exact confidence interval, 0.70–0.91) in the control group ($P = 0.009$, Fisher's exact test; relative risk, 1.19; 95% confidence interval, 1.05–1.35). When adjusting for baseline covariates (e.g., age, hole duration, and visual acuity) by a logistic model, the two treatment groups remained significantly different ($P = 0.02$). Before the 6-month visit, three reopenings (3%) of the macular hole occurred: two in the platelet group and one in the control group. Therefore, the success rate at 6 months was 50 (94%) of 53 in the platelet group and 46 (81%) of 57 in the control group ($P = 0.04$, Fisher's exact test).

“MACULAR PLUG”



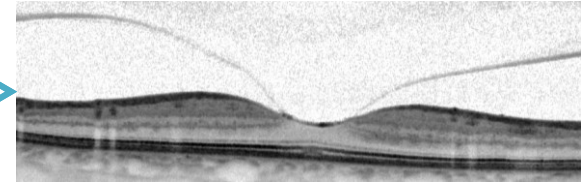
The autologous gluconated blood clumps (AGBC) solution was prepared immediately before starting the surgery by adding 1 mL of 5% glucose to 2 mL of autologous blood drawn from the patients' antecubital vein in the cubital fossa with strict attention to aseptic precautions during blood withdrawal.

MODIFICATIONS OF MACULAR HOLE SURGERY • CHAKRABARTI ET AL

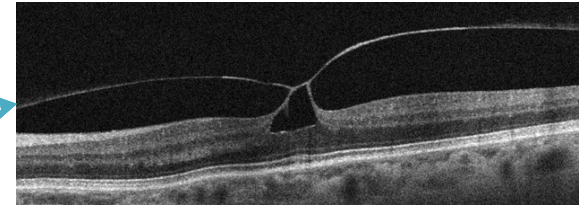
RETINA, THE JOURNAL OF RETINAL AND VITREOUS DISEASES • 2017 • VOLUME 37 • NUMBER 3

Indication TM et « menaces »

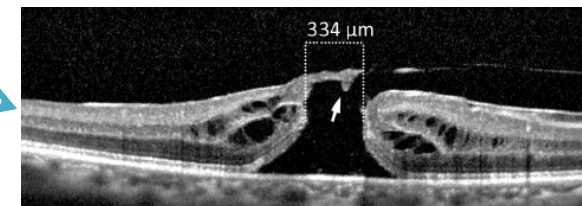
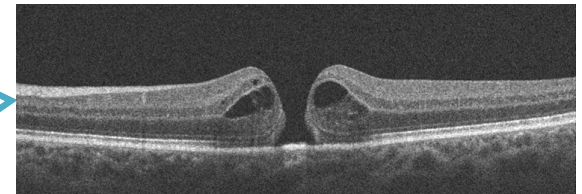
- DPV normal : pas de traitement.....>



- TVM symptomatique sans MEM et petite taille (menace TM) : (ocriplasmine ou gaz?)
 - surveillance / chirurgie discutés fonction AV etc



- TM :
 - Vitré détaché
 - < 250 μm : chir. au 3^e mois
 - Autres : chir.
 - Vitré attaché
 - < 400 μm : (ocriplasmine ou gaz?) chir.
 - > 400 μm : chirurgie ILM + position
 - > (650) 800 : ILM flap et autres



Conclusion

- Trou maculaire : une maladie rare mais un exemple de succès de la chirurgie vitréorétinienne
- Reste un model/laboratoire d'innovation
- Avec une armurerie de techniques pour personnaliser
 - La chirurgie des cas de bon pronostic est simplifiée
 - La chirurgie des cas de mauvais pronostic est consolidée
- Stade ultime une chirurgie simple et efficace rendant la personnalisation inutile....

FORMES CLINIQUES

SECONDARY MH

- TRAUMA

- ✓ Blunt Trauma
- ✓ Laser injury
- ✓ Retrobulbar needle perforation
- ✓ Electrical trauma
- ✓ Refractive surgery

- HIGH MYOPIA

- CATARACT

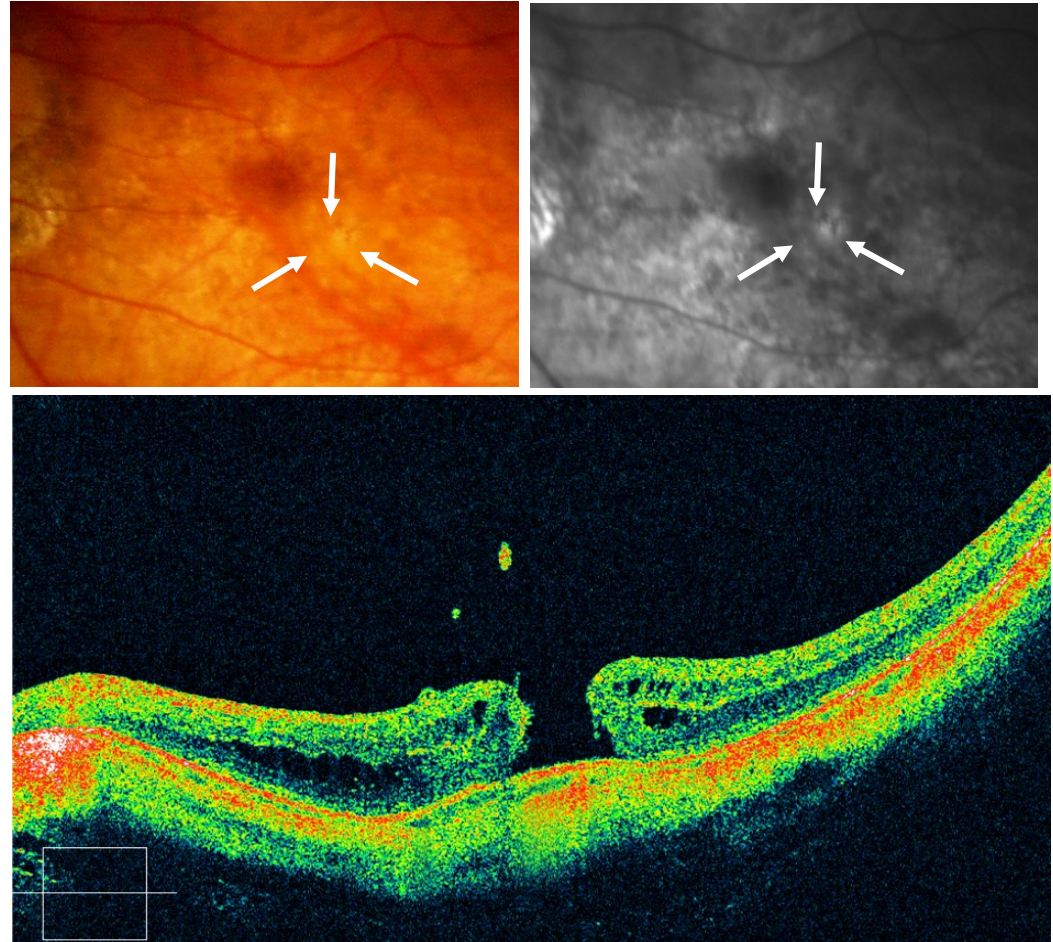
- ✓ cataract surgery
- ✓ Nd YAG capsulotomy

- MISCELLANEOUS

- ✓ Diabetic retinopathy
- ✓ Macular drusen
- ✓ Degenerative maculopathies
 - Adult vitelliform macular degeneration
 - Best's disease
 - Bull's eye maculopathy
 - Bietti's crystalline dystrophy
 - Alport's syndrome
- ✓ macular choroidal melanoma
- ✓ Submacular surgery

TM du myope fort

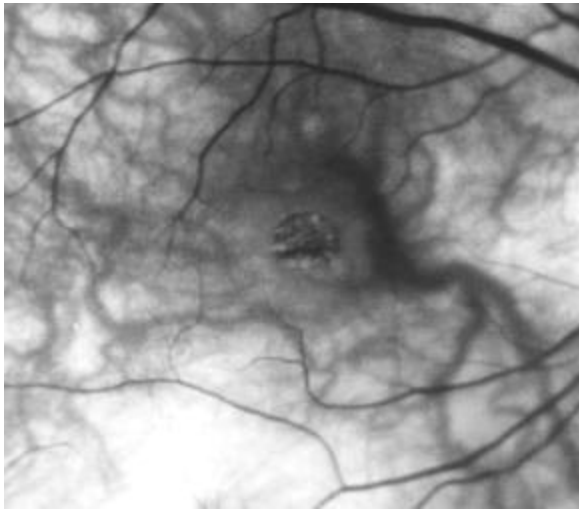
- Parfois asymptomatique et découvert seulement à l'OCT (6%des cas) ¹
- Fréquemment conséquence d'un foveoschisis ²



1. Coppe A et al. Prevalence of asymptomatic macular holes in highly myopic eyes. *Ophthalmology* 2005; 112(12):2103-9.
2. Shimada N,. *Br J Ophthalmol.* 2008;92(6):762-4.

TM / myopie forte

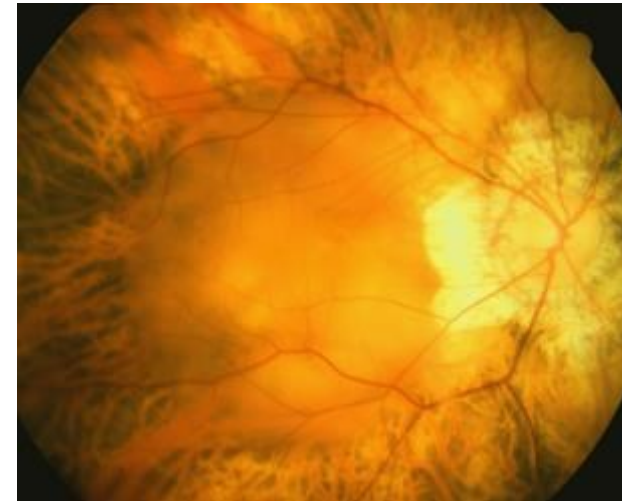
- L'apparition d'un TM est une complication fréquente de la myopie forte
- 3 formes cliniques



TM à plat



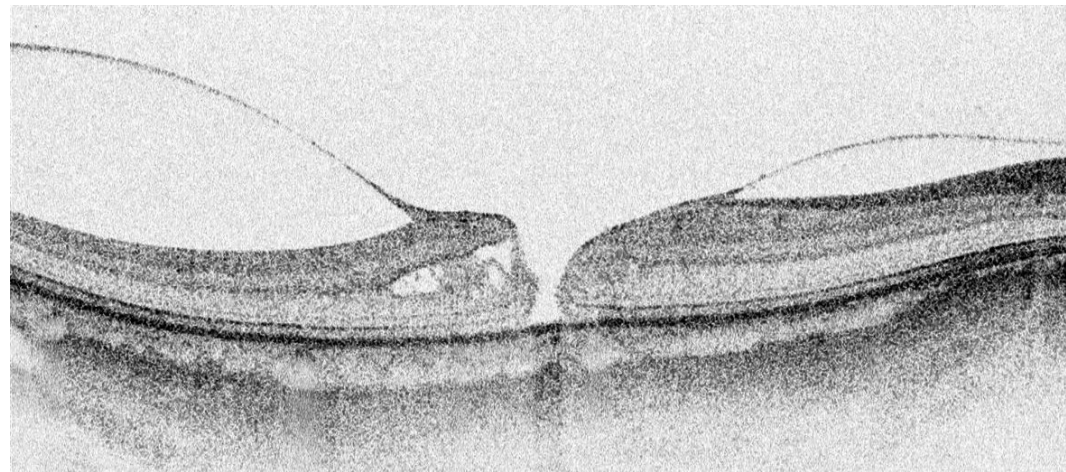
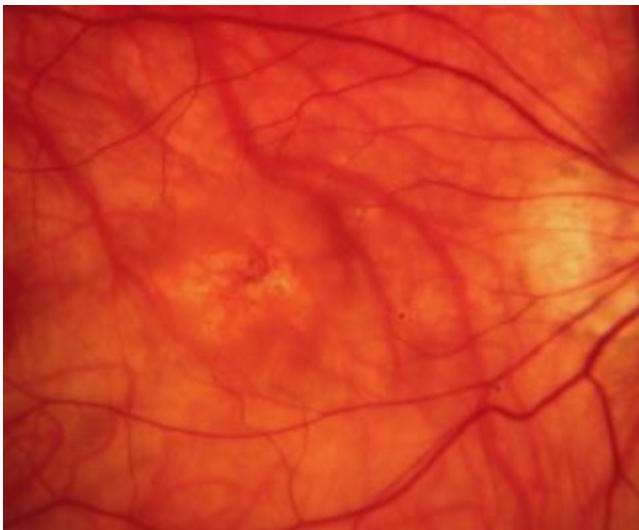
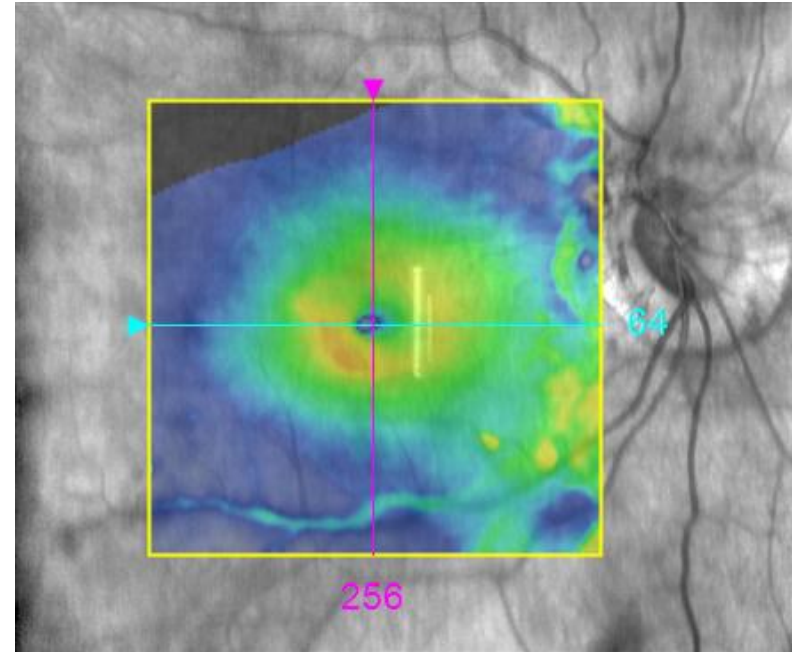
TM/Fovéoschisis



DR/TM

TM à plat du myope fort

- Parfois baisse visuelle
 - surtout sensible de près
 - Typiquement modérée
- diagnostic FO malaisé :
 - peu de contraste
 - Bon examen / verre de contact
- OCT

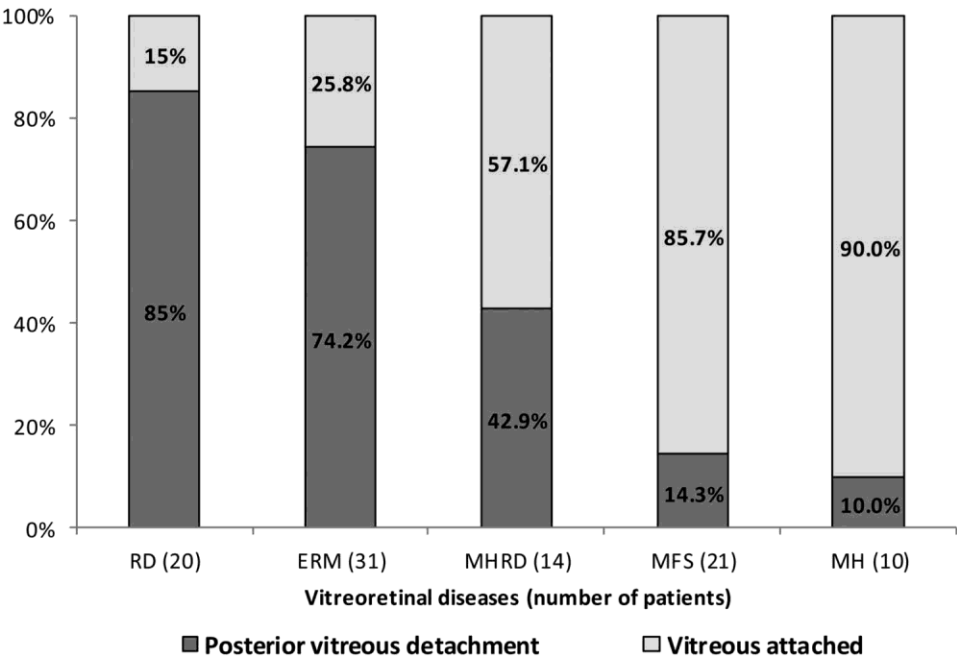


POSTERIOR VITREOUS DETACHMENT IN HIGHLY MYOPIC EYES UNDERGOING VITRECTOMY

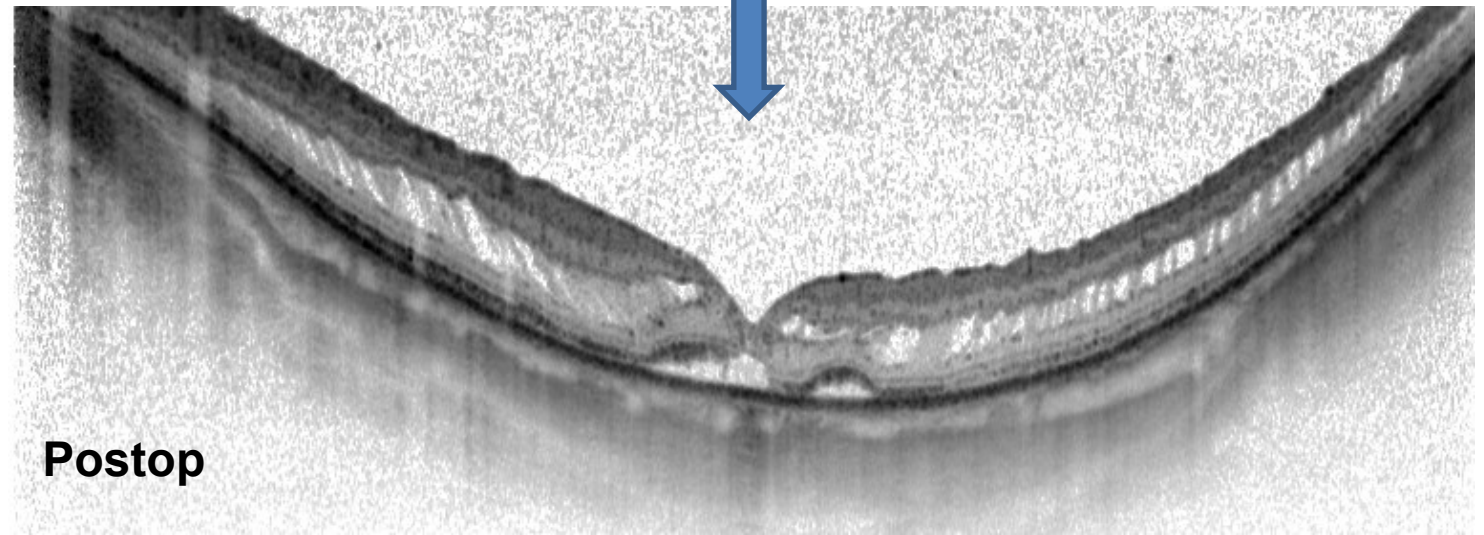
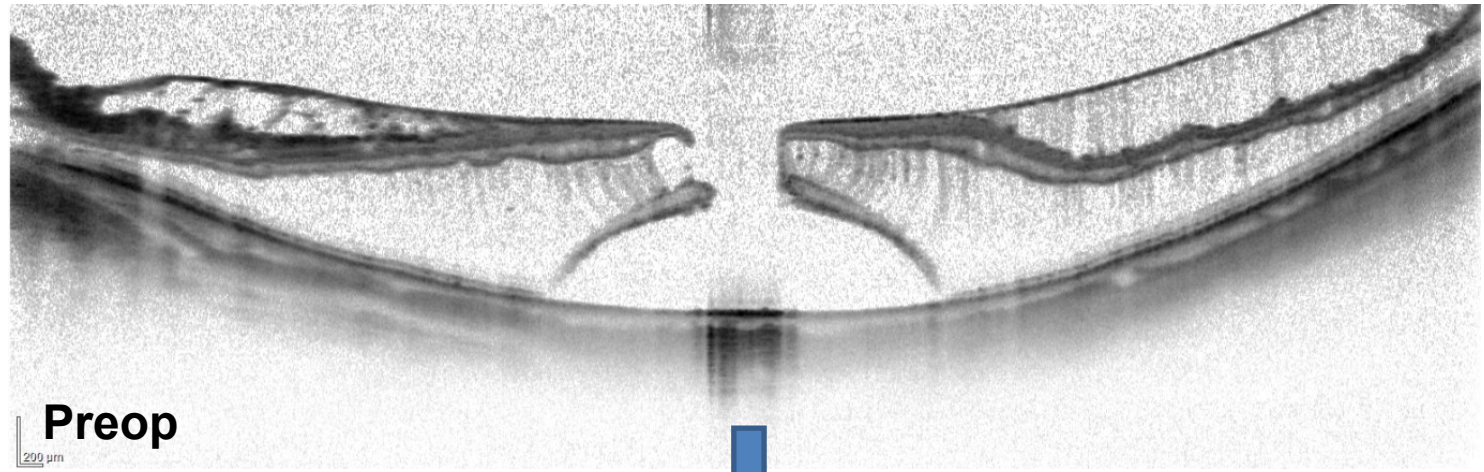
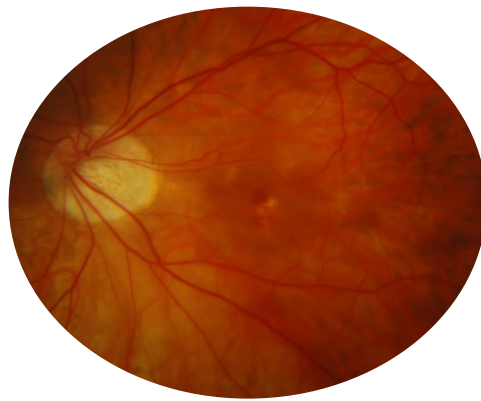
ELISE PHILIPPAKIS, MD,* AUDE COUTURIER, MD,* DAVID GAUCHER, MD, PhD,†
VINCENT GUALINO, MD,* PASCALE MASSIN, MD, PhD,* ALAIN GAUDRIC, MD,*
RAMIN TADAYONI, MD, PhD*

1074 RETINA, THE JOURNAL OF RETINAL AND VITREOUS DISEASES • 2016 • VOLUME 36 • NUMBER 6

Fig. 2. Complete posterior vitreous detachment rates in highly myopic eyes, which underwent vitrectomy, by vitreoretinal disease. ERM, epiretinal membrane; MFS, myopic foveoschisis; MH, myopic macular hole; MHRD, macular hole retinal detachment; RD, rhegmatogenous retinal detachment.

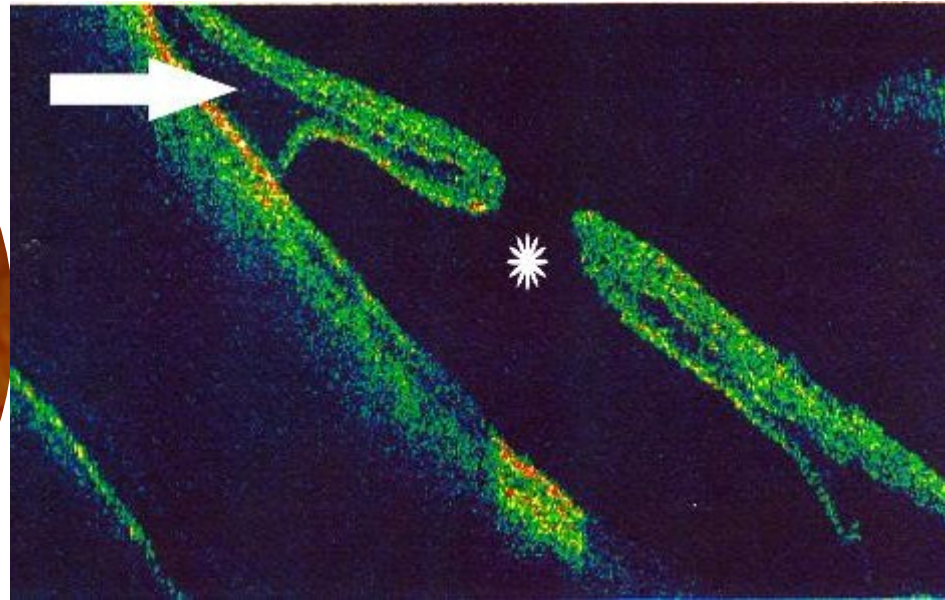


Jonction vitrénne anormale



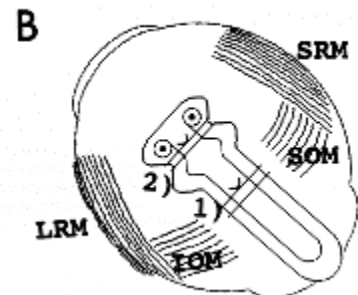
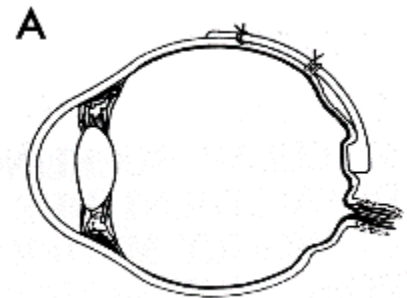
DR / TM

- DR du pôle postérieur TM
- N'existe que chez le myope fort (staphylome postérieur)
- Rare parmi les DR
 - 0,5 à 1% de tous les DR
 - mais jusqu'à 10% en Asie



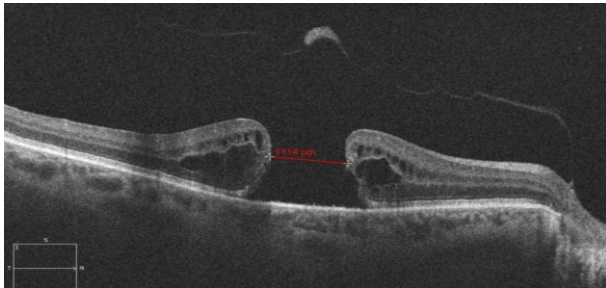
Chirurgie DR / TM / myopie forte

- Est une indication opératoire
- Vitrectomie dissection gaz sans laser
 - En utilisant des « agents de visualisation »
 - Double pelage (triamcinolone + TB) : succès 70%
 - Li KK et al. Clin Experiment Ophthalmol. 2010
- Si échec/récidive :
 - Laser maculaire
 - 96,2 % de succès avec pelage MLI et laser
 - Yu J et al. OSLI 2010
 - Au besoin avec silicone à long terme
- Parfois indentation maculaire +/- gaz
 - SASOH, MITAMURA 2000
 - RIPANDELLI STIRPE 2001,
 - THEODOSSIADIS 2005

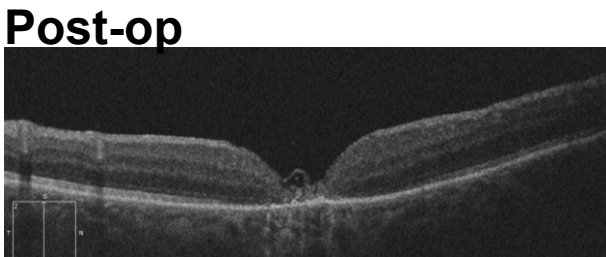


ILM flap

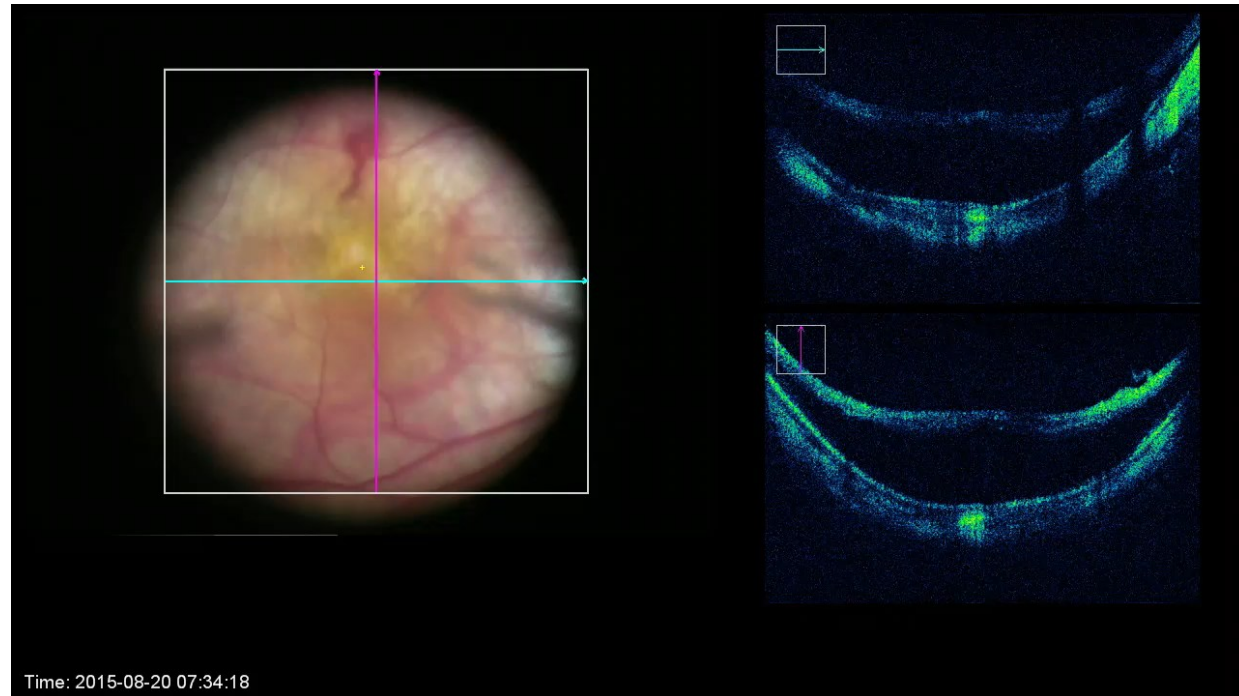
- **Synonyme : Lambeaux de MLI (transposition ou libre)**



Pré-op



Post-op



Résultats ILM flap / TM / Myopie forte

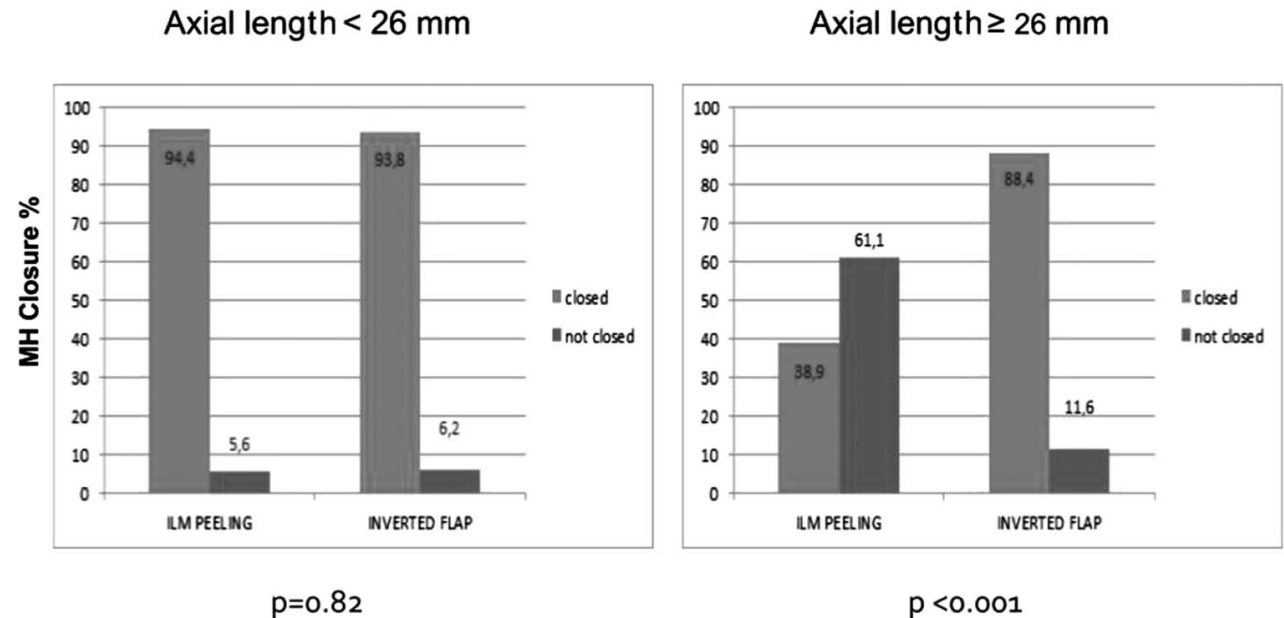
INTERNAL LIMITING MEMBRANE PEELING VERSUS INVERTED FLAP TECHNIQUE FOR TREATMENT OF FULL-THICKNESS MACULAR HOLES

A COMPARATIVE STUDY IN A LARGE SERIES OF PATIENTS

STANISLAO RIZZO, MD, RUGGERO TARTARO, MD, FRANCESCO BARCA, MD,
TOMASO CAPOROSI, MD, DANIELA BACHERINI, MD, FABRIZIO GIANSAITI, MD

RETINA 0:1-6, 2017

Fig. 2. Comparison of MH closure rates between ILM peeling and IF. Patients split according to AL.

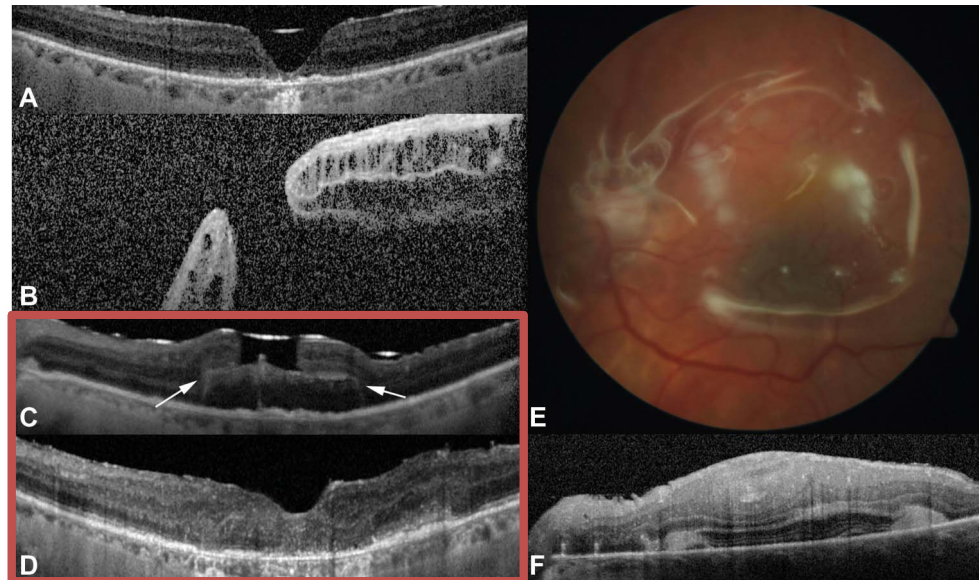
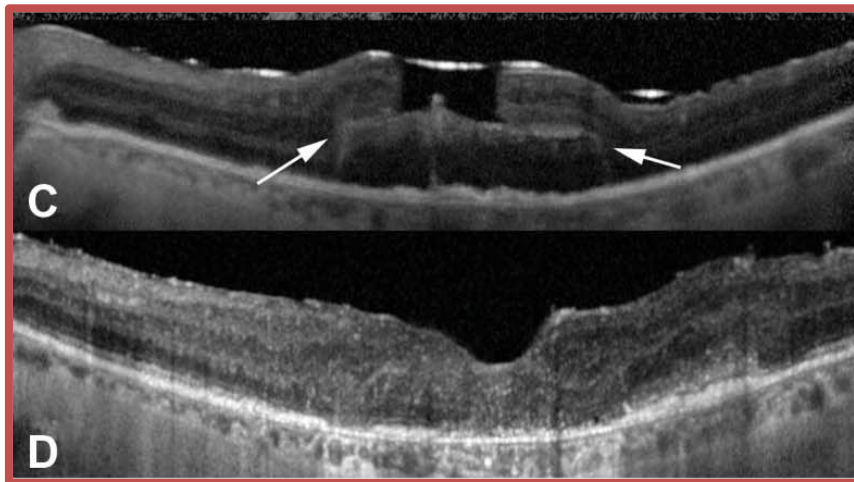


Autogreffe de rétine

- Synonymes : Lambeau libre de rétine, autologous retinal free flap

SUBRETINAL TRANSPLANTATION OF AN AUTOLOGOUS RETINAL FREE FLAP FOR CHRONIC RETINAL DETACHMENT WITH PROLIFERATIVE VITREORETINOPATHY WITH AND WITHOUT MACULAR HOLE

AKSHAY S. THOMAS, MD, MS,* TAMER H. MAHMOUD, MD, PhD† **RETINA** 0:1–4, 2017



Autogreffe de rétine

- Variantes : Lambeau libre de rétine + EP et choroïde

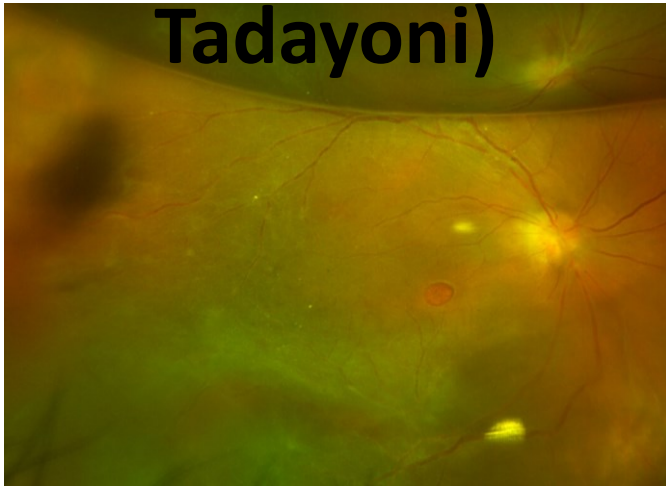
COMBINED AUTOLOGOUS TRANSPLANTATION OF NEUROSENSORY RETINA, RETINAL PIGMENT EPITHELIUM, AND CHOROID FREE GRAFTS

BARBARA PAROLINI, MD,* DILRAJ S. GREWAL, MD,† SAJISH J. PINACKATT, MD,*
ANDREA BALDI, MD,* ATTILIO DI SALVATORE, MD,* GIANLUCA BESOZZI, MD,*
ALESSANDRO FINZI, MD,* DANIELE CARDILLO, MD,* TAMER H. MAHMOUD, MD, PhD† **RETINA** 0:1–11, 2017

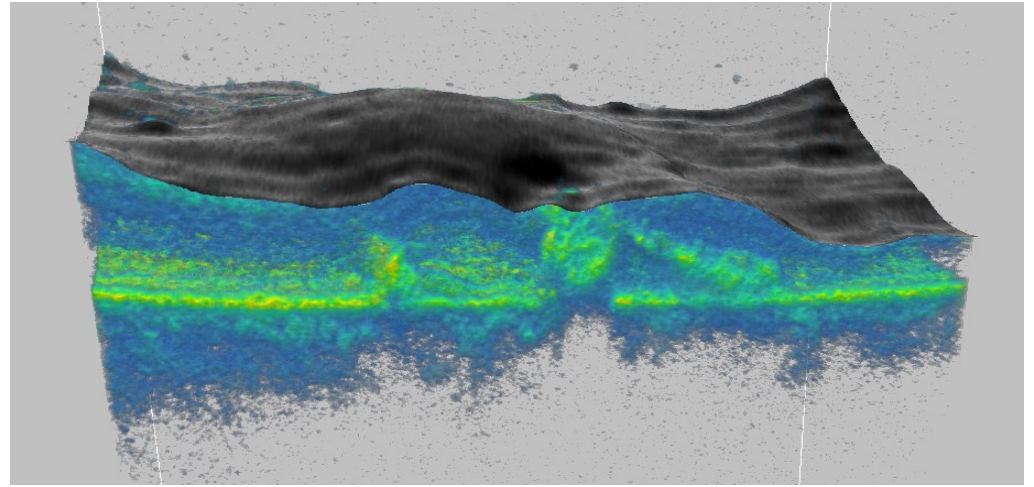


Autogreffe de rétine

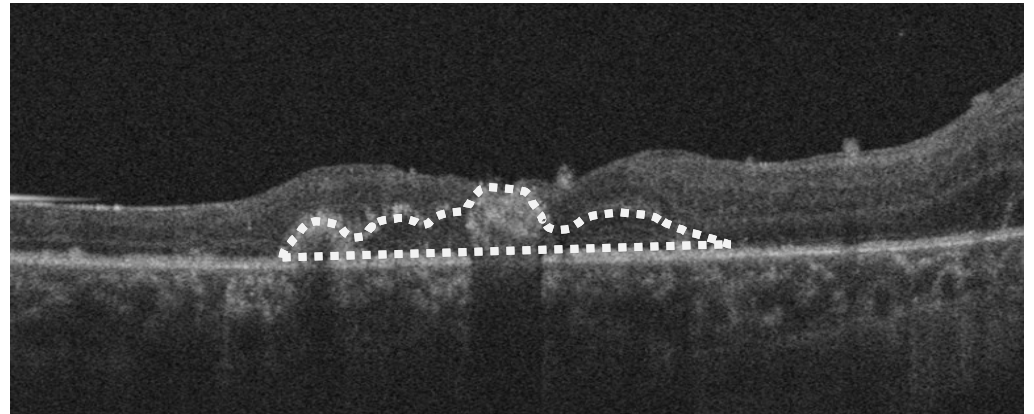
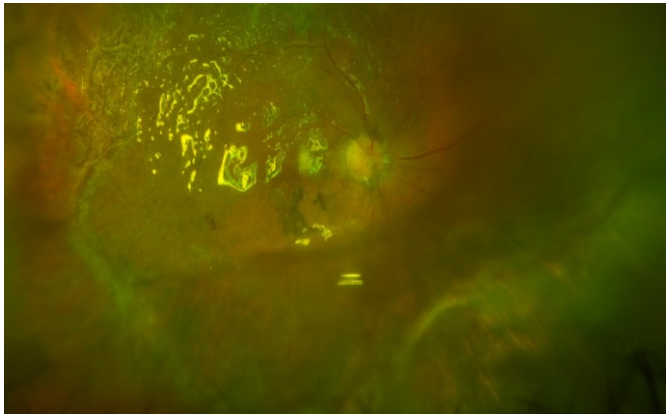
- 1^e cas avec couverture vitréenne (R. Tadayoni)



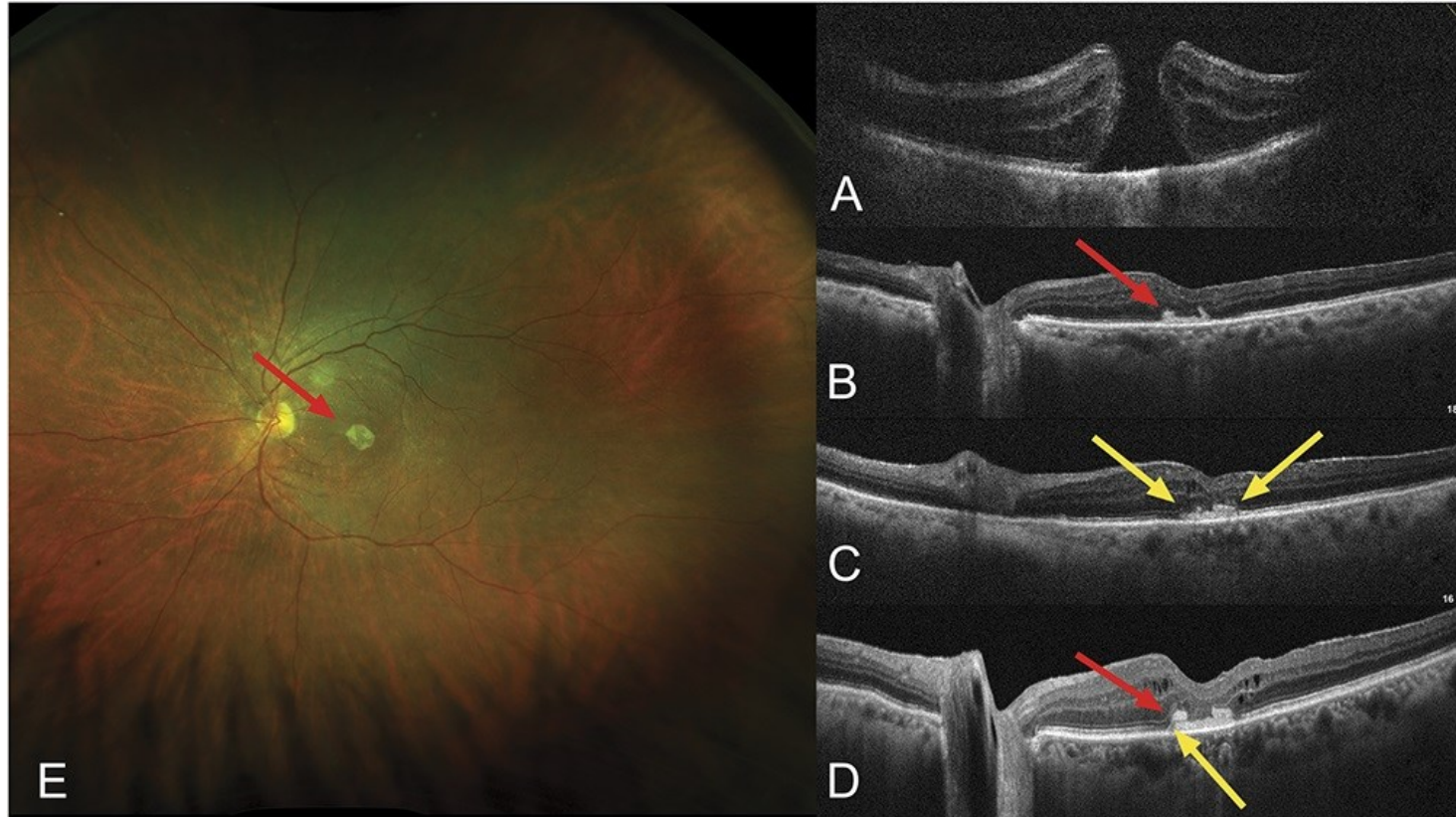
Pré-op



Post-op



Remplir les TM « à la mode »: membrane amniotique



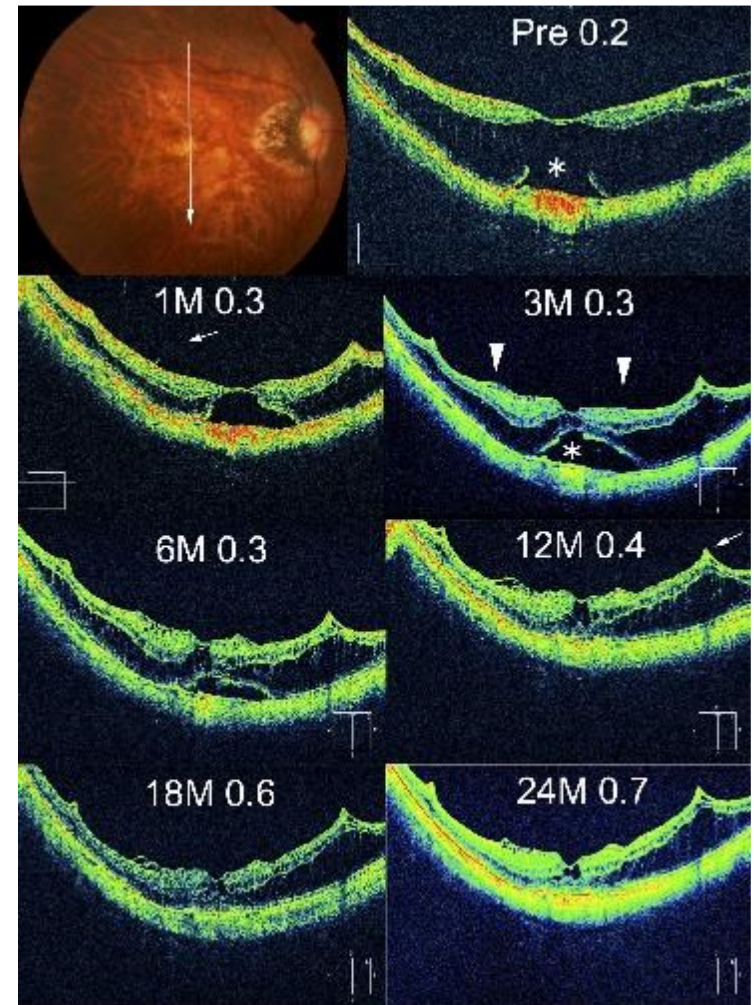
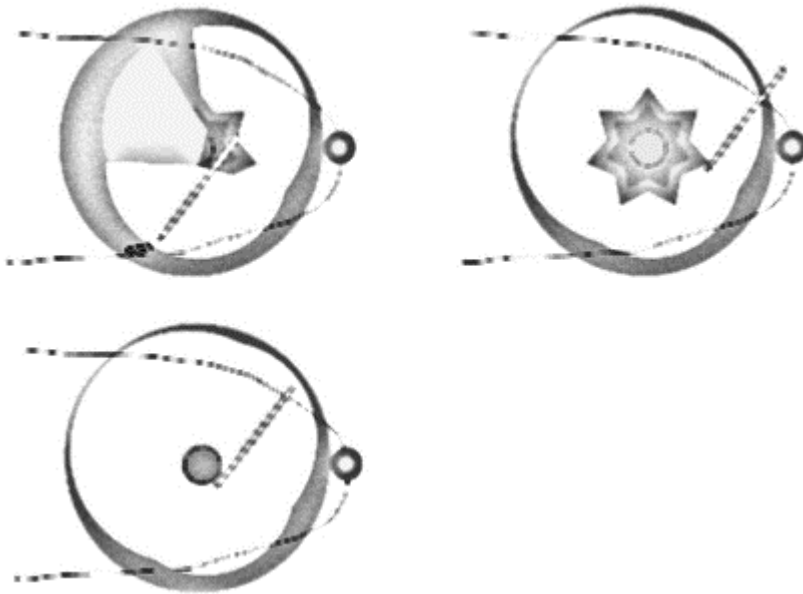
Prévention par Fovea-Sparing

- Synonymes : épargne fovéolaire

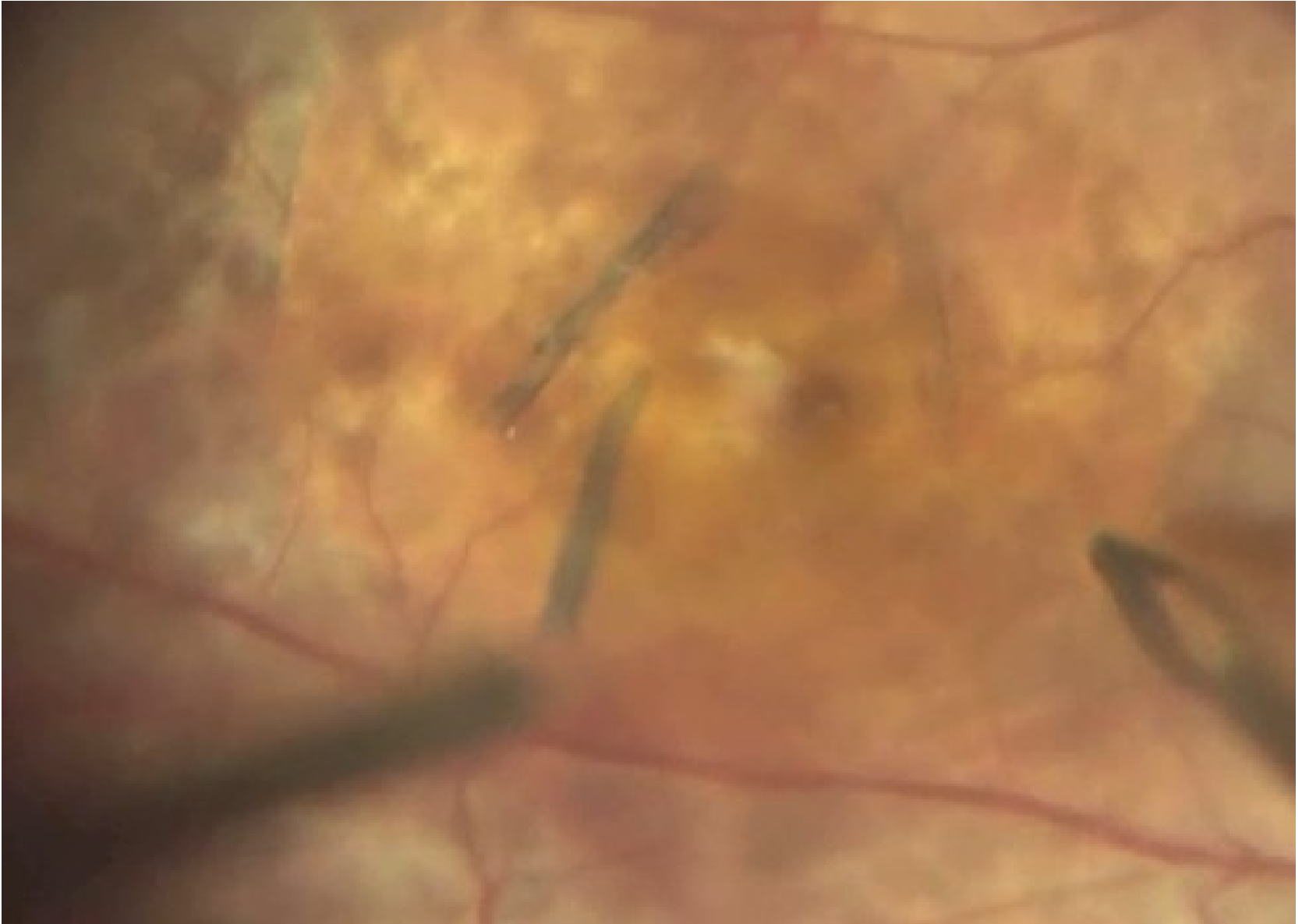
Fovea-Sparing Internal Limiting Membrane Peeling for
Myopic Traction Maculopathy

Am J Ophthalmol 2012

NORIAKI SHIMADA, YOSHIHARU SUGAMOTO, MANABU OGAWA, HIROSHI TAKASE, AND
KYOKO OHNO-MATSUI



Fovea-sparing surgery

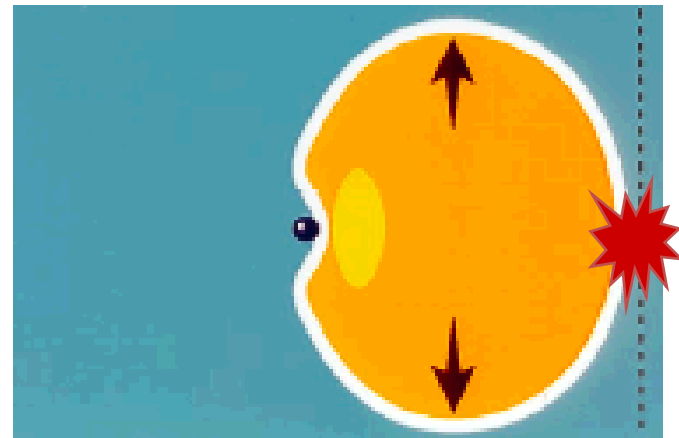


Conclusion : TM/Myopie forte

- La myopie forte est assez fréquemment compliquée d'un TM
- Il faut opérer les TM/ myopie forte si le TM est responsable
 - Baisse d'acuité visuelle
 - Décollement de rétine
- Principal facteur pronostic pour l'œil opéré : La longueur axiale
 - ROBERT F. LAM *et al.* AJO 2006
 - NAKANISHI H. *et al.* AJO 2008
- Probabilité de DR/TM de l'œil adelphe : $\approx 8\%$ à 5-7 ans

Traumatic MH

- usually in young males: *industrial accidents, ball games...*
- no Posterior Vitreous Detachment
- mechanism: deformation of the eyeball
 - flattening of the posterior pole
 - stretching of the macula
 - opening of the fovea

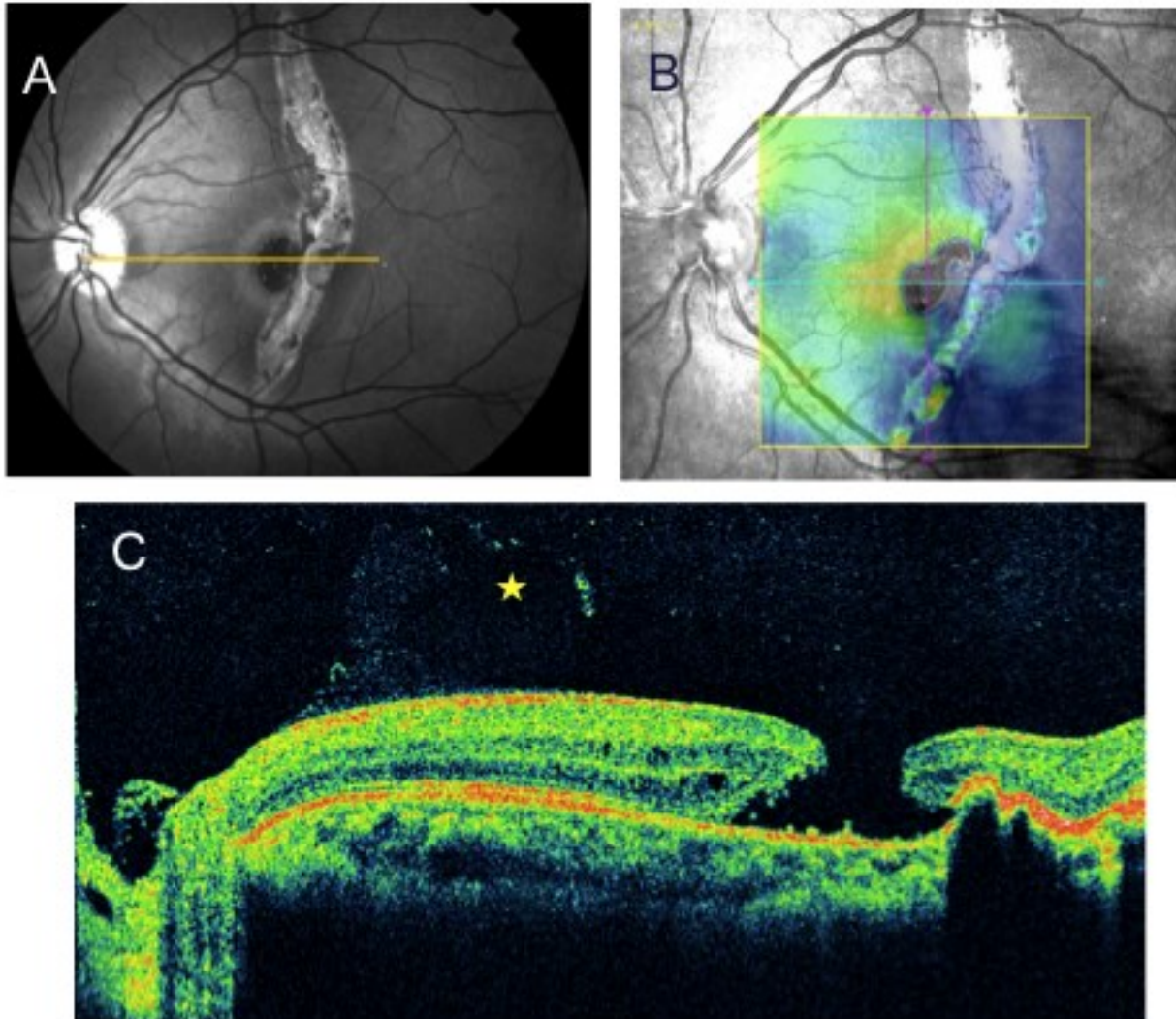


Traumatic MH

- The prognosis depends on the associated lesions
 - RPE atrophy
 - Choroidal rupture

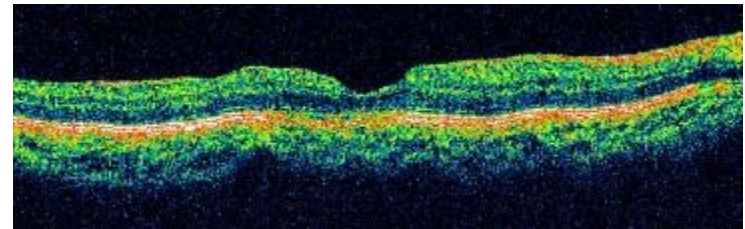
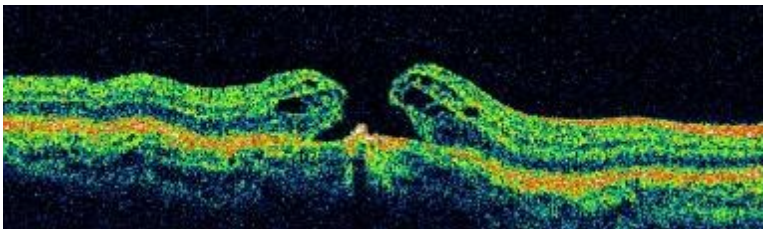
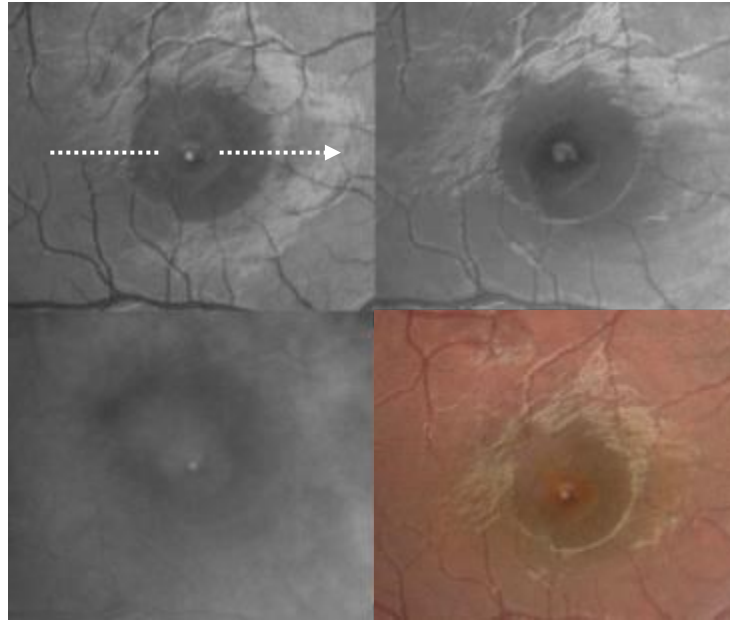


Traumatic MH



Trou maculaire post contusif

- pré et post opératoire



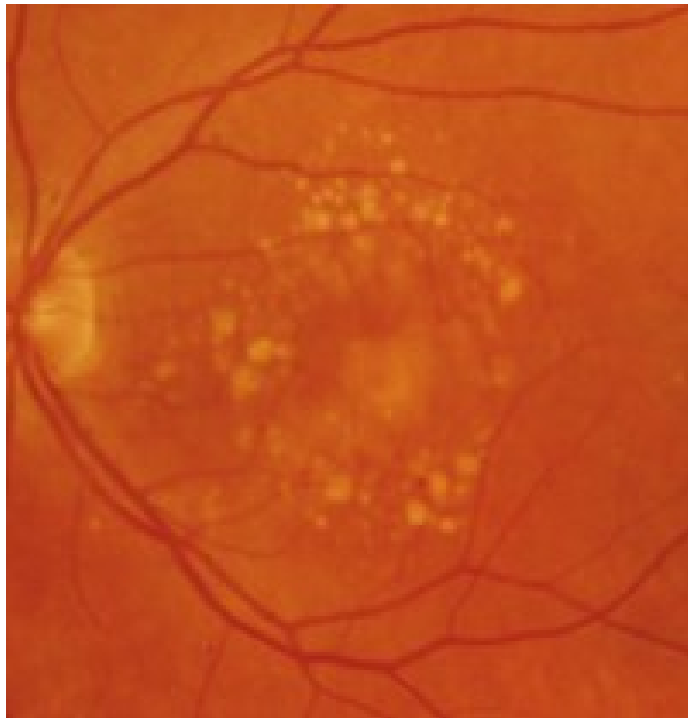
MACULAR HOLE BY LASER INJURY

- Accidents during adjustment and alignment of the laser beam of industrial or research lasers (Nd:YAG)
- May close spontaneously
- Successful surgery reported in 2 cases



MACULAR HOLE and DRUSEN

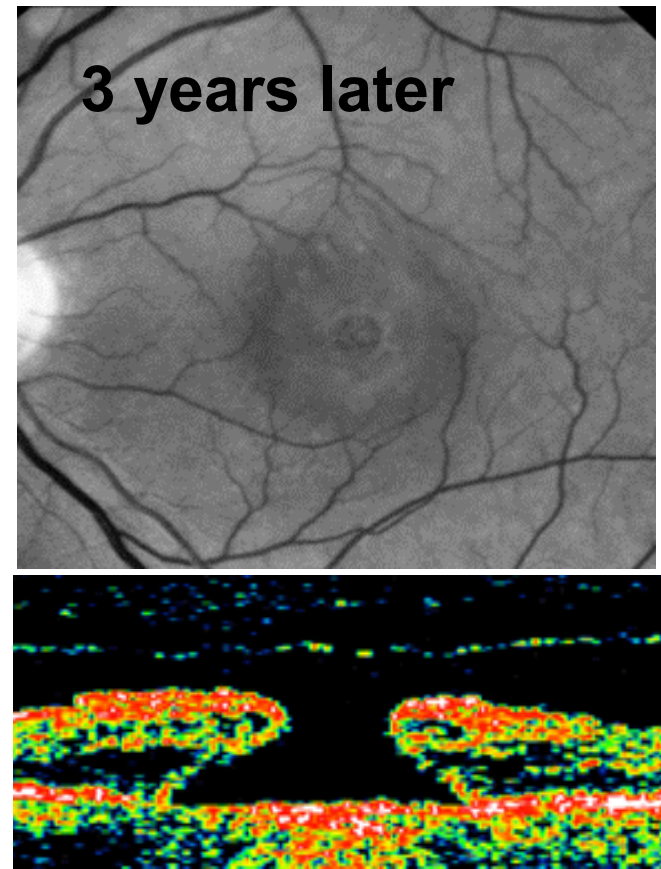
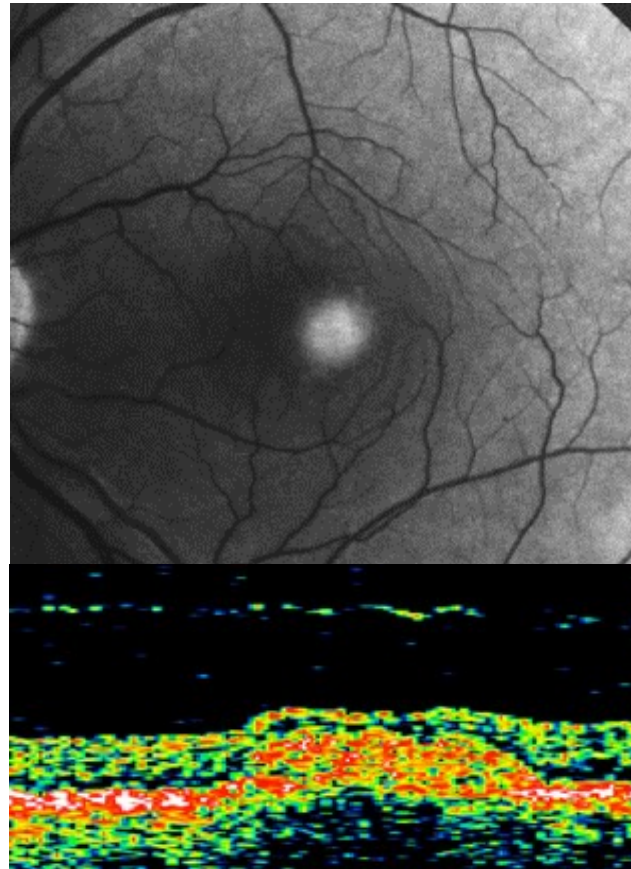
- Macular drusens are not rare in the range of age for MH
- Berinstein, *Ophthalmology* 2000:
 - 32 eyes, 76 % success - good visual recovery



MACULAR HOLE & HEREDITARY MACULOPATHIES

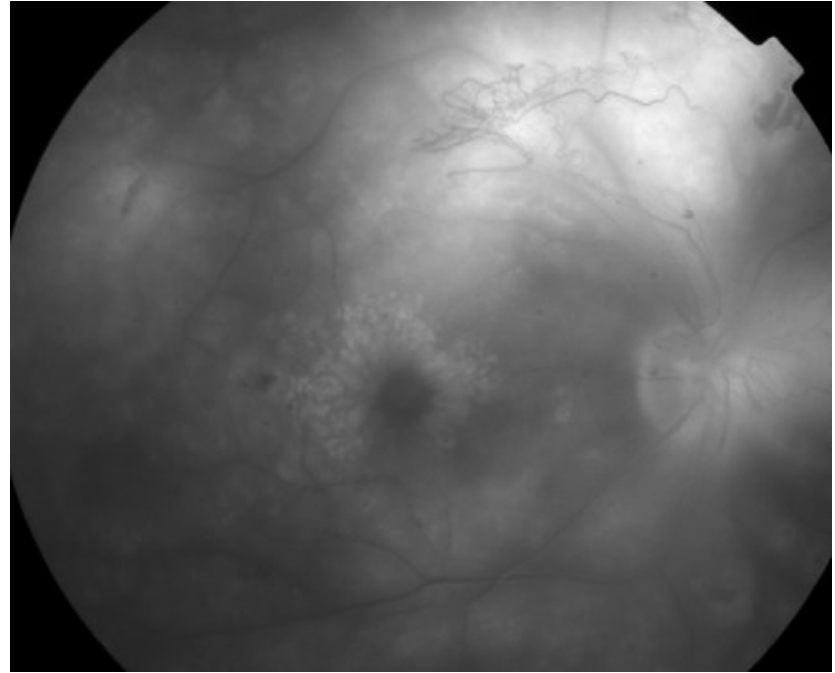
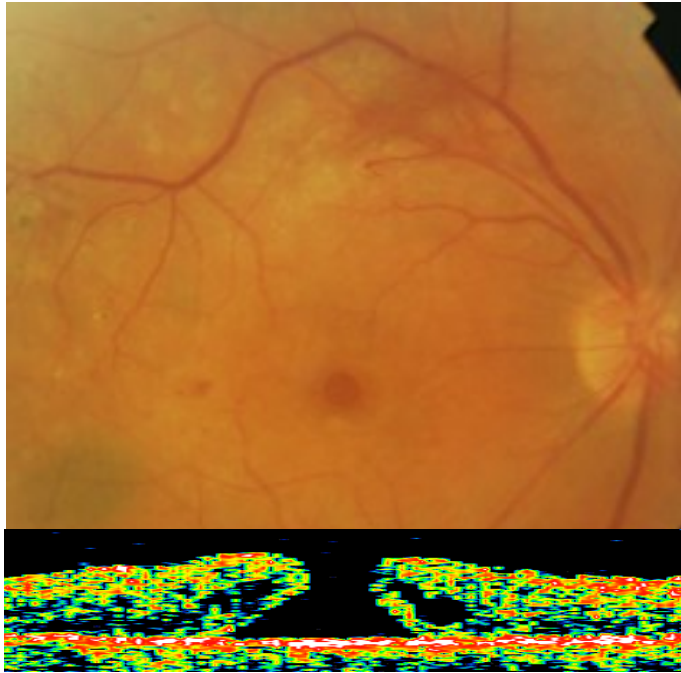
- MH may occur in Best's disease, adult onset vitelliform degeneration, Bietti's crystalline dystrophy , etc..

- In adult onset vitelliform degeneration, OCT shows foveal thinning over the subretinal deposit



MH in diabetic retinopathy

- MH is a rare complication of DR
 - It may be the consequence of tractional cystoid macular edema





Université
de Paris

ASSISTANCE
PUBLIQUE  HÔPITAUX
DE PARIS
AP-HP.Nord : Lariboisière & Saint Louis



HÔPITAL FONDATION
Adolphe de ROTHSCHILD
LA RÉFÉRENCE TÊTE ET COU

Merci

ramin.tadayoni@aphp.fr



Hôpital Lariboisière
Hôpital Saint Louis
AP-HP.Nord



Université
de Paris



HÔPITAL FONDATION
Adolphe de ROTHCHILD
LA RÉFÉRENCE TÊTE ET COU



MERCI

ramin.tadayoni@aphp.fr

rtadayoni@for.paris