

BERGOFTALMOLOGIA
2024
"La chirurgia della macula"
"La chirurgia della IOL"

BERGOFTALMOLOGICA

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"La chirurgia della macula"
"La chirurgia della IOL dislocata"

SESSIONE 1

"MEMBRANA EPIRETINICA MACULARE IDIOPATICA E FORO MACULARE IDIOPATICO"

MODERATORI: M. Kacerik, P. Radice, S. Zenoni

UPDATE DELLA LETTERATURA

OCT pre/postoperatorio: classificazione, aspetti prognostici e predittivi

Marco Azzolini



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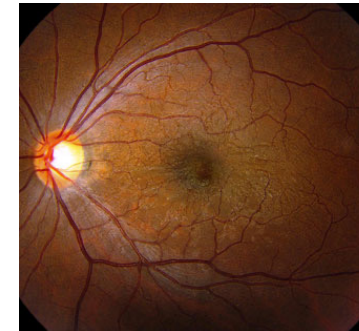
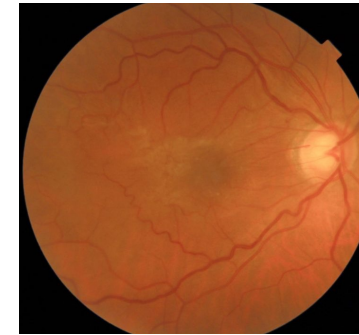
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“La chirurgia della macula”
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Gass, J. Macular dysfunction caused by vitreous and vitreoretinal interface abnormalities: Vitreous traction < maculopathies. In Stereoscopic Atlas of Macular Diseases; Mosby: St. Louis, MO, USA, 1987; pp. 910–937

- ❖ Grade 0 cellophane maculopathy, which is a translucent membrane without distortion of the inner retina with no symptoms.
- ❖ Grade 1 crinkled cellophane maculopathy, characterized by fine retinal folds, wrinkling of the inner retina, and symptoms of metamorphopsia.
- ❖ Grade 2 macular pucker of thick opaque membranes with full-thickness retinal distortion.



Hwang JU, Sohn J, Moon BG, et al. Assessment of macular function for idiopathic epiretinal membranes classified by spectral-domain optical coherence tomography. *Invest Ophthalmol Vis Sci.* 2012;53(7): 3562–3569.

Group 1: fovea-involving ERM

1A Outer retinal thickening and minimal inner retinal change

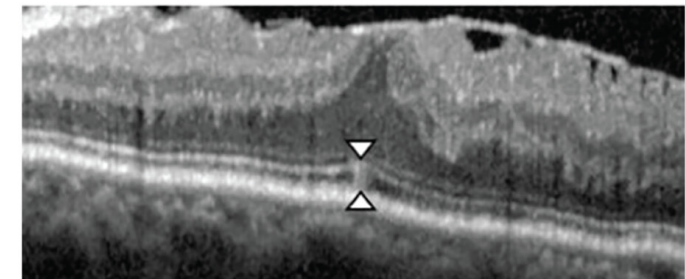
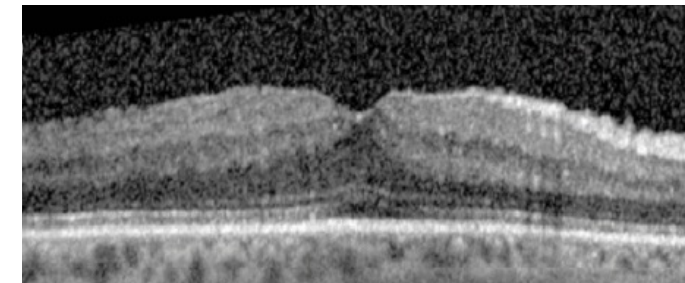
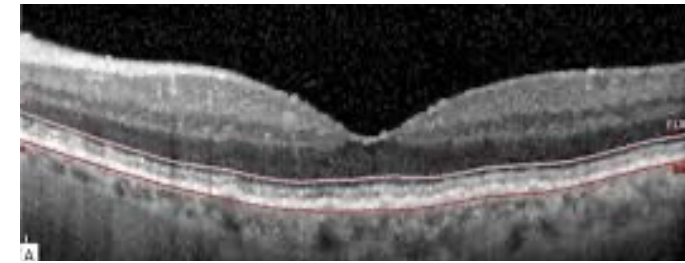
1B Outer retinal inward projection and inner retinal thickening

1C Prominent thickening of the inner retinal layer

Group 2: fovea-sparing ERM

2A Formation of a macular pseudohole

2B Schisis-like intraretinal splitting



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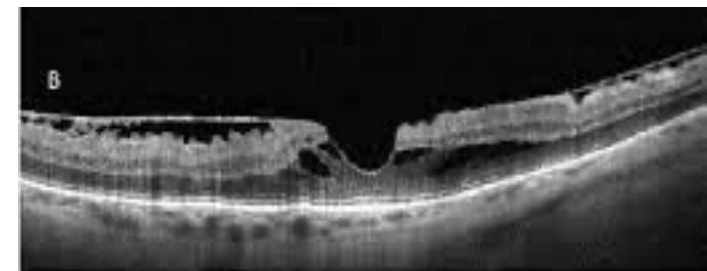
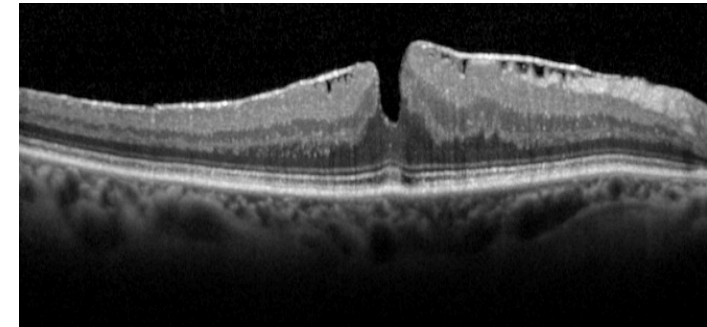
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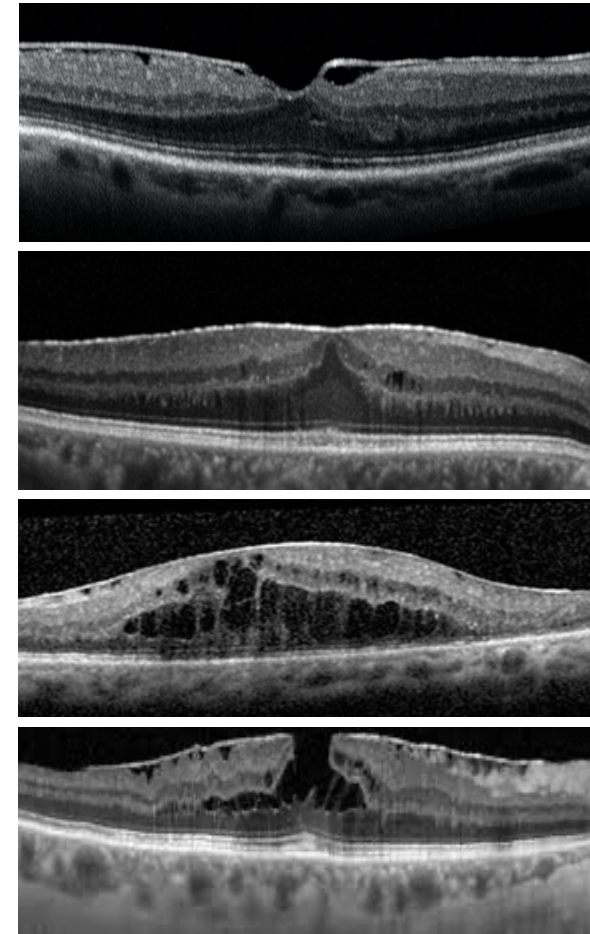
Konidaris V, Androudi S, Alexandridis A, Dastiridou A, Brazitikos P.
Optical coherence tomography-guided classification of epiretinal membranes. *Int Ophthalmol.* 2015;35(4):495–501.

Group A: with posterior vitreous detachment

- ❖ A1 no contraction
- ❖ A2 contraction
 - ❖ A2.1 with retinal folding
 - ❖ A2.2 with edema
 - ❖ A2.3 with cystoid macular edema
 - ❖ A2.4 with lamellar macular hole

Group B: with vitreous attachment

- ❖ B1 no traction
- ❖ B2 vitreomacular traction
 - ❖ B2.1 with edema
 - ❖ B2.2 with retinal detachment
 - ❖ B2.3 with schisis



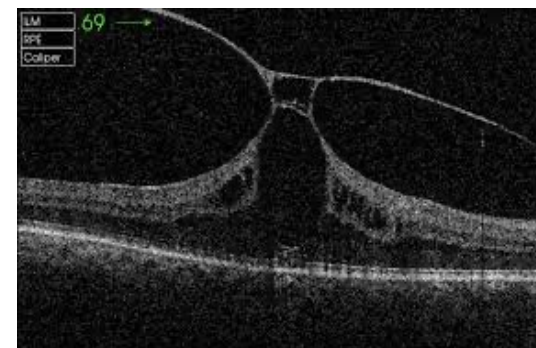
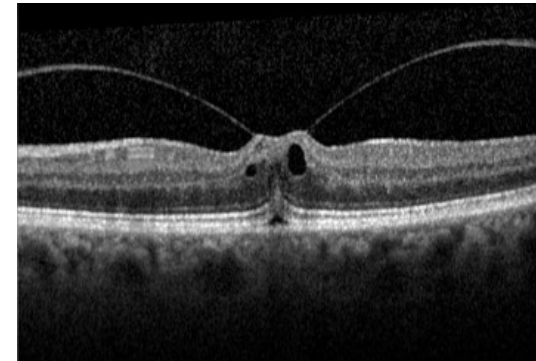
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Group B: with vitreous attachment

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 - ❖ B2.3 with schisis



Stevenson W, Prospero Ponce CM, Agarwal DR, Gelman R, Christoforidis JB. Epiretinal membrane: optical coherence tomography-based diagnosis and classification. Clin Ophthalmol. 2016;10:527-534.

Kinoshita T, Kovacs KD, Wagley S, Arroyo JG. Morphologic differences in epiretinal membranes on ocular coherence tomography as a predictive factor for surgical outcome. Retina. 2011;31(8):1692-1698.

Uji A, Murakami T, Unoki N, et al. Parallelism as a novel marker for structural integrity of retinal layers in optical coherence tomographic images in eyes with epiretinal membrane. Am J Ophthalmol. 2014;157(1):227-236.

Joe SG, Lee KS, Lee JY, Hwang JU, Kim JG, Yoon YH. Inner retinal layer thickness is the major determinant of visual acuity in patients with idiopathic epiretinal membrane. Acta Ophthalmol. 2013;91(3):242-243.

Classificazioni dal valore descrittivo basate sulle caratteristiche del quadro tomografico

Mancanza di consenso circa la loro reale validità clinica



Govetto A, Lalane RA, Sarraf D, Figueroa MS, Hubschman JP. Insights Into Epiretinal Membranes: Presence of Ectopic Inner Foveal Layers and a New Optical Coherence Tomography Staging Scheme. Am J Ophthalmol. 2017 Mar;175:99-113.

- ❖ Stage 1: ERMs were mild and thin. Foveal depression is present.
- ❖ Stage 2: ERMs with a widening of the outer nuclear layer and loss of the foveal depression.
- ❖ Stage 3: ERMs with continuous ectopic inner foveal layers crossing the entire foveal area.
- ❖ Stage 4: ERMs were thick with continuous ectopic inner foveal layers and disrupted retinal layers.

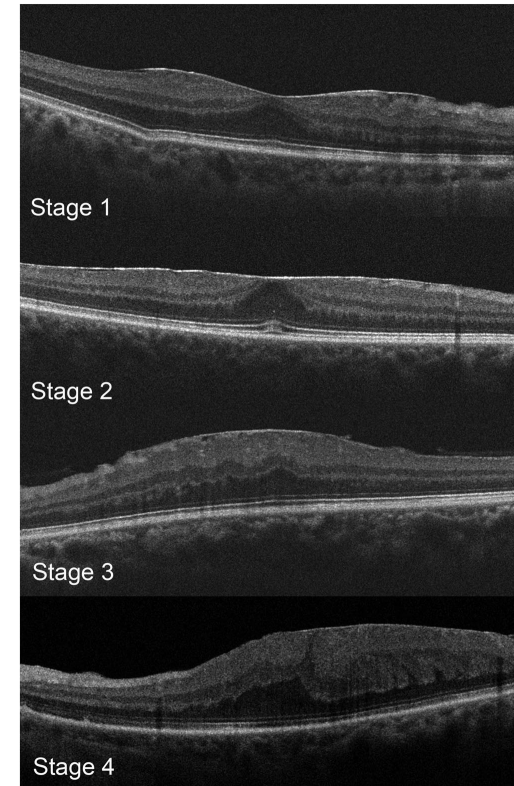


FIGURE 5 Govetto et al⁸⁴ optical coherence tomography classification of epiretinal membrane. Stage 1: the foveal pit is present and there are well-defined retinal layers. Stage 2: the foveal pit is absent but there are well-defined retinal layers. Stage 3: the foveal pit is absent, there is the addition of a continuous ectopic inner foveal layer (EIFL) but the retinal layers are still well defined. Stage 4: the foveal pit is absent, there is an EIFL and the retinal layers are disrupted



- ❖ «A higher ERM stage using this classification system correlated with poorer VA, greater central foveal thickness (CFT), an increased prevalence of CMO, ellipsoid zone (EZ) disruption, and a reduction in the size of the foveal avascular zone (FAZ).»

Altri autori hanno confermato la validità clinica di questa classificazione

Doguizi S, Sekeroglu MA, Ozkoyuncu D, Omay AE, Yilmazbas P. Clinical significance of ectopic inner foveal layers in patients with idiopathic epiretinal membranes. Eye (Lond). 2018;32:1652-1660.

- ❖ «VA was found to decrease in an inverse linear relationship the higher the ERM stage. Furthermore, significant predictors of VA included the presence and thickness of the EIFL, as well as greater CFT.»

Alkabes M, Fogagnolo P, Vujosevic S, Rossetti L, Casini G, De Cilla S. Correlation between new OCT parameters and metamorphopsia in advanced stages of epiretinal membranes. Acta Ophthalmol. 2020;98(8):780-786.

- ❖ «the EIFL is a good predictor of metamorphopsia.»



González-Saldivar G, Berger A, Wong D, Juncal V, Chow DR. Ectopic inner foveal layer classification scheme predicts visual outcomes after epiretinal membrane surgery. *Retina* 2020;40(4):710-717.

Terashima H, Okamoto F, Hasebe H, Matsuoka N, Ueda E, Yoshida H, Togano T, Fukuchi T. Evaluation of postoperative visual function based on the preoperative inner layer structure in the epiretinal membrane. *Graefes Arch Clin Exp Ophthalmol* 2021;259(11):3251-3259.

Karasu B, Celebi ARC. Predictive value of ectopic inner foveal layer without internal limiting membrane peeling for idiopathic epiretinal membrane surgery. *Int Ophthalmol* 2022;42(6):1885-1896.

Mavi Yildiz A, Avci R, Yilmaz S. The predictive value of ectopic inner retinal layer staging scheme for idiopathic epiretinal membrane: surgical results at 12mo. *Eye (Lond)* 2021;35(8):2164-2172.

*Migliori risultati in termini di AV e riduzione del CFT operando lo stadio II rispetto al III e IV
Risultati statisticamente simili tra stadio III e IV
Risultati peggiori, come prevedibile, operando allo stadio I*



OCT preoperatorio

- ❖ Il primo aspetto prognostico considerato: Spessore Foveale Centrale (Central Foveal Thickness, CFT)
- ❖ In seguito diversi Studi hanno dimostrato l'importanza dell'integrità degli strati retinici esterni come importante fattore prognostico (come outer segment termination, COST; ellipsoide zone, EZ)
- ❖ Tuttavia, la patogenesi delle membrane epiretينية coinvolge la trazione tangenziale a carico degli strati retinici interni, per cui l'attenzione negli studi più recenti è shiftata verso questi ultimi, con i concetti di ectopia degli strati retinici interni (Ectopic Inner Foveal Layers, EIFL) e mantenimento dell'integrità delle cellule ganglionari e di Muller

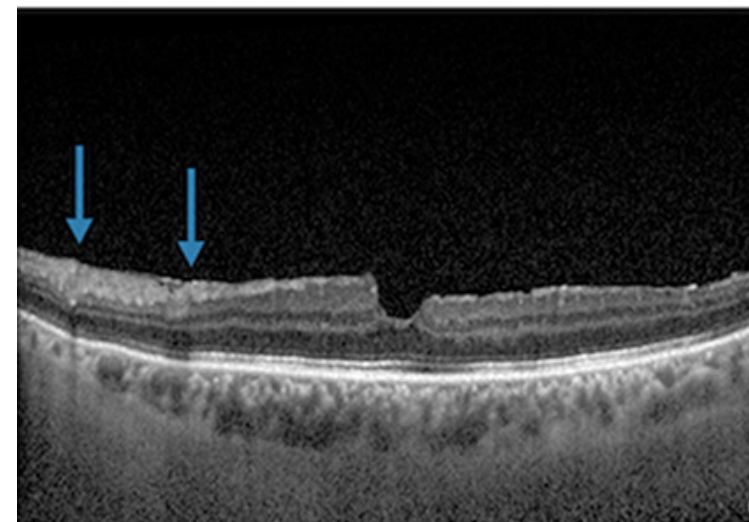
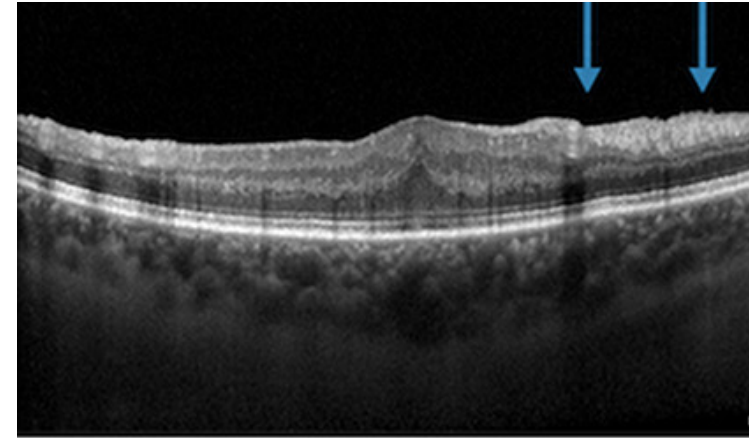


OCT postoperatorio

- Swelling of the arcuate nerve fibre layer (SANFL).
 - This transient feature lasts up to 3 months and is seen as a hyper-reflectant swelling of the retinal nerve fibre layer (RNFL) in the papillomacular bundle on SD-OCT.
 - It is thought to result from peeling of the ILM, either by direct surgical trauma to the RNFL or damage to the Muller cell endplates.
 - Early SANFL has been correlated with late focal RNFL thinning of the temporal macula up to 1 year following surgery.

Pichi F, Lembo A, Morara M, et al. Early and late inner retinal changes after inner limiting membrane peeling. *Int Ophthalmol.* 2014;34(2):437-446.

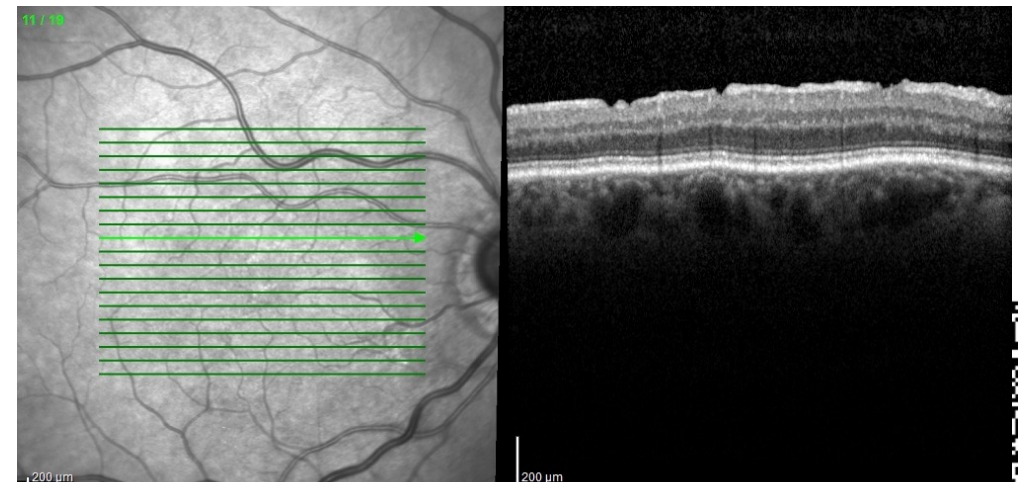
Scupola A, Grimaldi G, Abed E, et al. Arcuate nerve fiber layer changes after internal limiting membrane peeling in idiopathic epiretinal membrane. *Retina.* 2018;38(9):1777-1785.



Tadayoni R, Paques M, Massin P, Mouki-Benani S, Mikol J, Gaudric A. Dissociated optic nerve fiber layer appearance of the fundus after idiopathic epiretinal membrane removal. *Ophthalmology*. 2001;108(12):2279-2283.

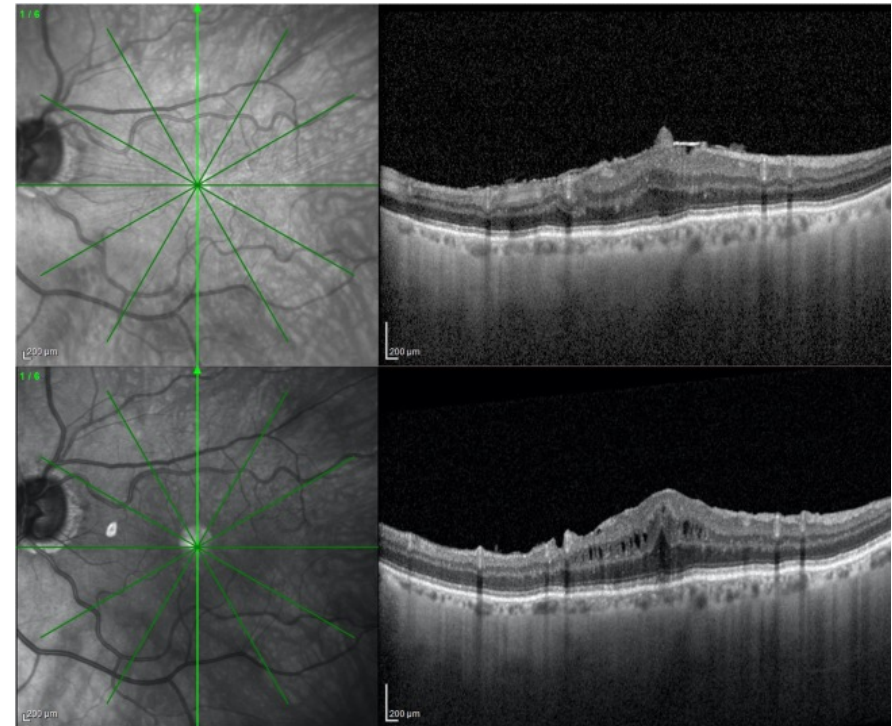
Spaide RF. “Dissociated optic nerve fiber layer appearance” after internal limiting membrane removal is inner retinal dimpling. *Retina*. 2012;32(9):1719-1726.

- Almost half of patients who undergo ERM peeling demonstrate postoperative dark arcuate striae along the RNFL visible with blue light filters, described as “dissociated optic nerve fibre layer” (DONFL)
 - One hypothesis is that it represents regeneration of traumatised Müller cell processes. Some authors claim it may actually represent a successful peel rather than a complication.



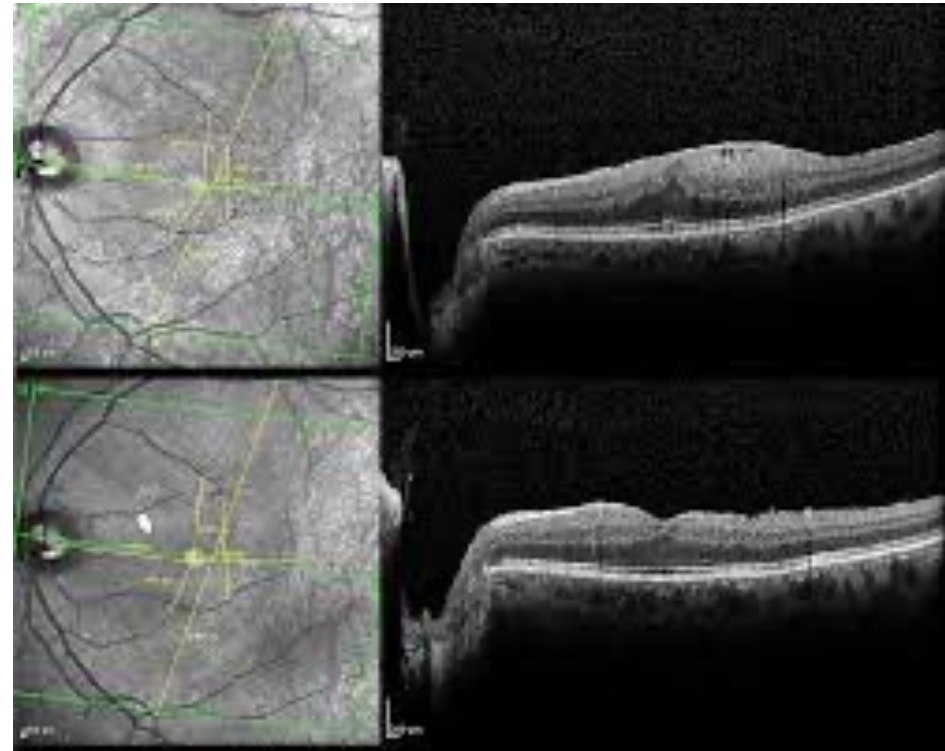
Hsieh MH, Chou YB, Huang YM, Hwang DK, Tsai FY, Chen SJ. Inner nuclear layer microcyst configuration, distribution, and visual prognosis in patients with epiretinal membrane after vitrectomy and membrane peeling. *Sci Rep.* 2019;9(1):11570.

- ❖ INL microcystic macular oedema (MMO) can precede ERM surgery but is more common after combined ERM/ILM peeling
 - ❖ The nasal quadrant is most commonly affected and the INL is thickened but the GCL thinned.
 - ❖ Some studies have identified poorer visual outcomes with MMO, particularly when present in the central and temporal quadrants.
 - ❖ One hypothesis for MMO is that it is a non-vascular retrograde maculopathy caused by ganglion cell loss affecting Müller cell water pumping function.



Loiudice P, Pellegrini M, Montesel A, et al. Negative correlation between retinal displacement and ganglion cell layer thickness changes in eyes with epiretinal membrane. Eur J Ophthalmol. 2019;30(6):1424-1431.

- ❖ Retinal displacement of the fovea towards the optic disc after surgery has been described
 - ❖ Likely due to an imbalance of nasal and temporal biomechanical forces after the release of ERM traction.
 - ❖ Stretching and thinning of the retina mostly occur temporal to the fovea, and the nasal subfield initially thickens
 - ❖ It seems to be related with persistent postoperative metamorphopsia



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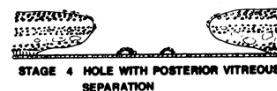
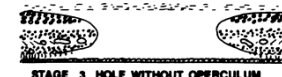
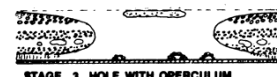
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Gass JD. Idiopathic senile macular hole: its early stages and pathogenesis. 1988. Retina. 2003 Dec;23(6 Suppl):629-39. [PubMed: 15035400]

- ❖ Stage 1 MH/impending MH: Loss of foveal depression. Stage 1A: detachment of foveola and yellow-colored spots in the center. Stage 1B foveolar detachment and yellow-colored ring surrounding detachment. Nearly 50% of Stage 1 MH undergo spontaneous resolution after vitreoretinal separation.
- ❖ Stage 2 MH: full-thickness neurosensory retinal defect in fovea but less than 400 micrometers in size. Sometimes the attached posterior cortical vitreous is evident on OCT. Almost 100% of this stage progress into stage 3.
- ❖ Stage 3 MH: full-thickness neurosensory retinal defect in fovea but greater than 400 micrometers in size. They are sometimes associated with a grayish macular rim, which indicates a cuff of subretinal fluid. Usually, PVD is started in this stage with or without operculum (but complete PVD or separation of the posterior vitreous face from the optic disc is absent), and 100% will go into stage 4.
- ❖ Stage 4 MH: stage 3 MH with complete PVD indicated by Weiss ring.



Duker JS, Kaiser PK, Binder S, de Smet MD, Gaudric A, Reichel E, Sadda SR, Sebag J, Spaide RF, Stalmans P. The International Vitreomacular Traction Study Group classification of vitreomacular adhesion, traction, and macular hole. *Ophthalmology*. 2013 Dec;120(12):2611-2619. [PubMed: 24053995]

Table 1. The International Vitreomacular Traction Study Classification System for Vitreomacular Adhesion, Traction, and Macular Hole

Classification	Subclassification
Vitreomacular adhesion	Size: focal ($\leq 1500 \mu\text{m}$) or broad ($> 1500 \mu\text{m}$) Isolated or concurrent
VMT	Size: focal ($\leq 1500 \mu\text{m}$) or broad ($> 1500 \mu\text{m}$) Isolated or concurrent
Full-thickness macular hole	Size: small ($\leq 250 \mu\text{m}$), medium ($> 250 - \leq 400 \mu\text{m}$), or large ($> 400 \mu\text{m}$) Status of vitreous: with or without VMT Cause: primary or secondary

VMT = vitreomacular traction.

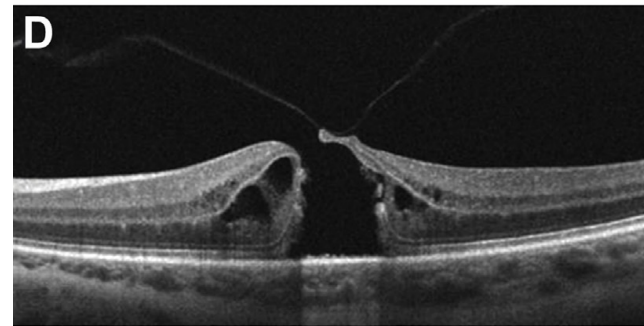
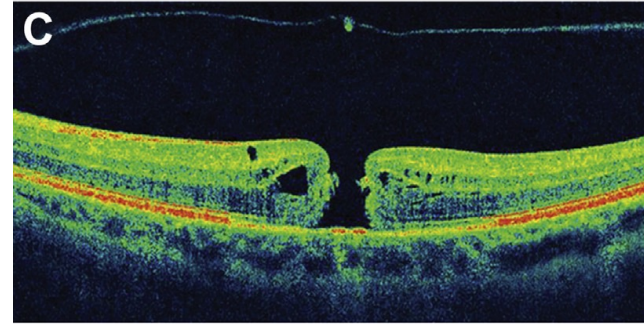
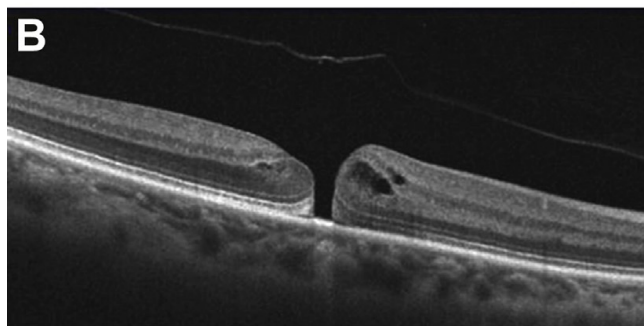
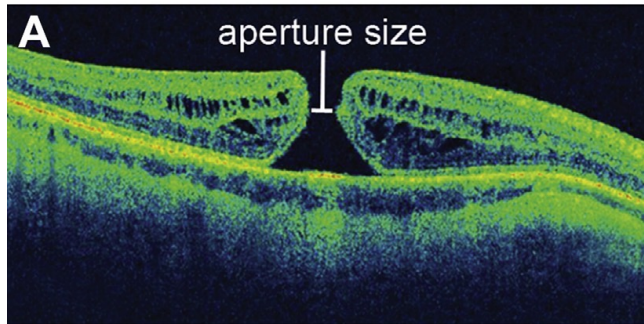


Table 2. Correlation between Commonly Used Clinical Macular Hole Stages and the International Vitreomacular Traction Study Classification System for Vitreomacular Adhesion, Traction, and Macular Hole

Full-Thickness Macular Hole Stages in Common Use	International Vitreomacular Traction Study Classification System
Stage 0	VMA
Stage 1: impending macular hole	VMT
Stage 2: small hole	Small or medium FTMH with VMT
Stage 3: large hole	Medium or large FTMH with VMT
Stage 4: FTMH with PVD	Small, medium, or large FTMH without VMT

FTMH = full-thickness macular hole; PVD = posterior vitreous detachment; VMA = vitreomacular adhesion; VMT = vitreomacular traction.

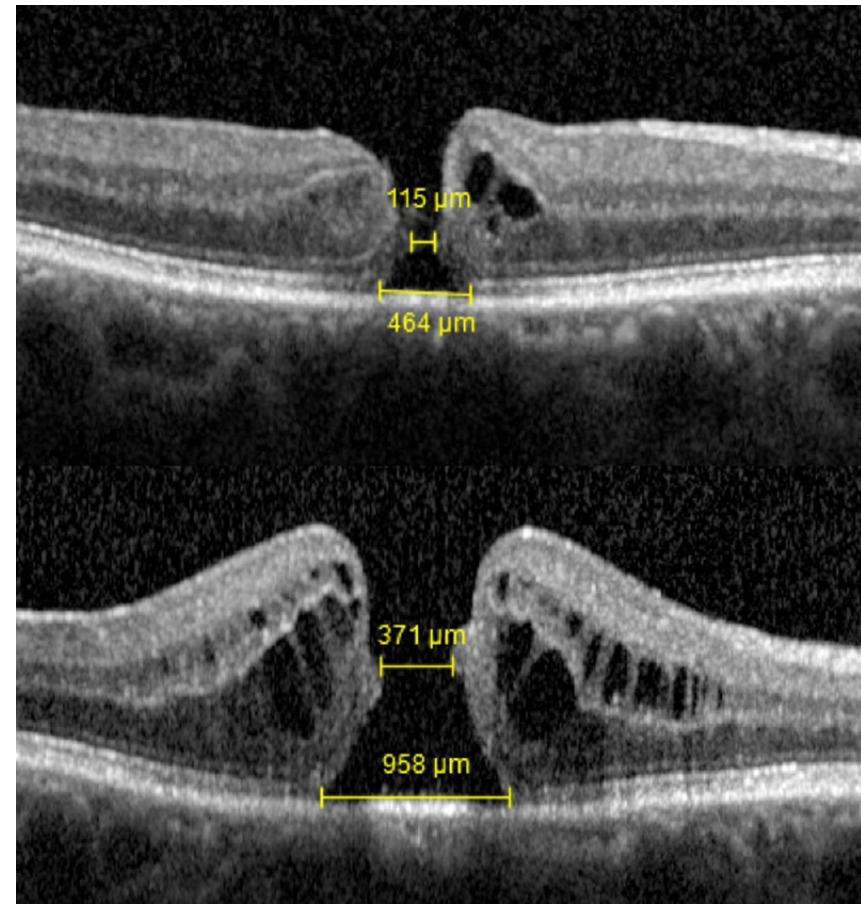
Full-Thickness Macular Hole (FTMH)



Macular hole size as a prognostic factor in macular hole surgery. S Ullrich, C Haritoglou, C Gass, M Schaumberger, M W Ulbig, A Kampik. Br J Ophthalmol 2002;86:390–393

Frequently assessed and used prognostic factors for outcome after macular hole surgery. Roth et al. Ophthalmology (2021) 21:398

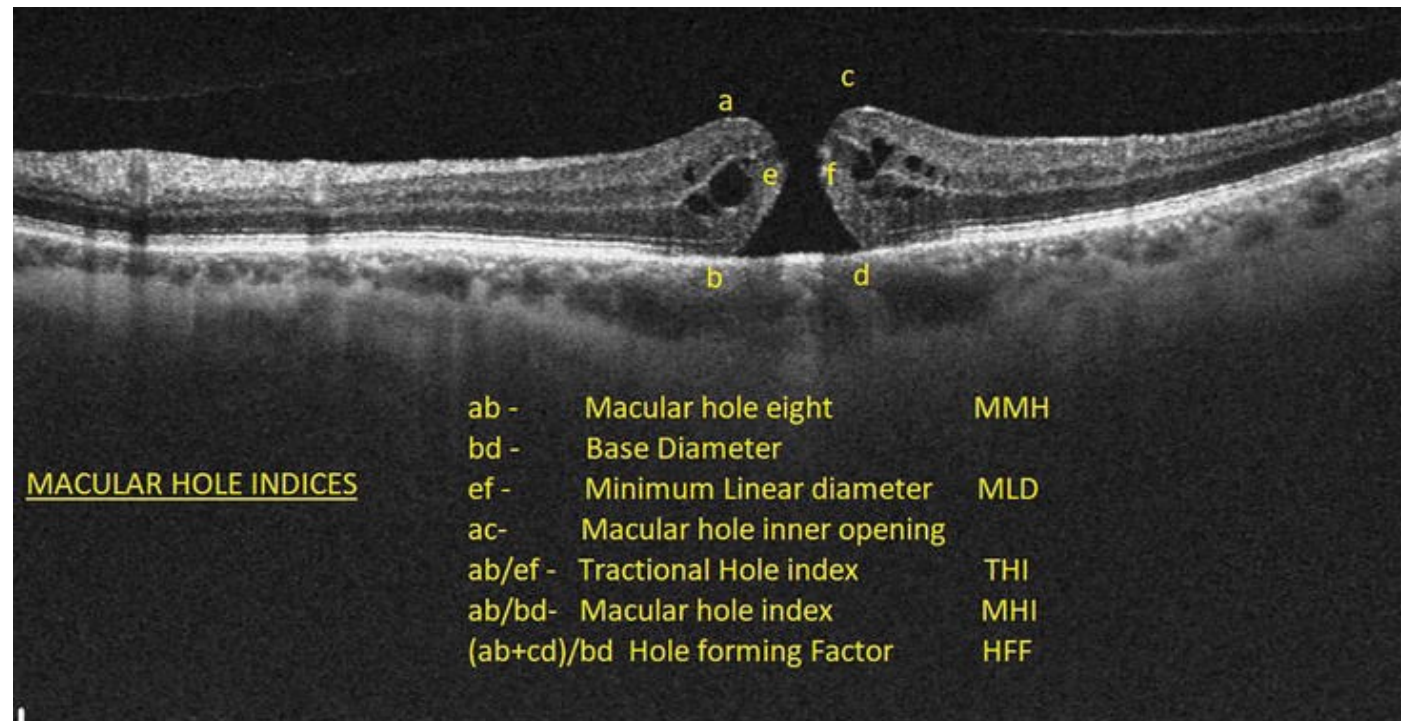
- ❖ The minimum linear diameter serves as an easily assessed prognostic factor with the best predictive properties. This result is of great importance for clinical practice, as it simplifies the postsurgical prognosis.



Kusuhara S, Teraoka Escaño MF, Fujii S, Nakanishi Y, Tamura Y, Nagai A, Yamamoto H, Tsukahara Y, Negi A. Prediction of postoperative visual outcome based on hole configuration by optical coherence tomography in eyes with idiopathic macular holes. Am J Ophthalmol. 2004 Nov;138(5):709-16.

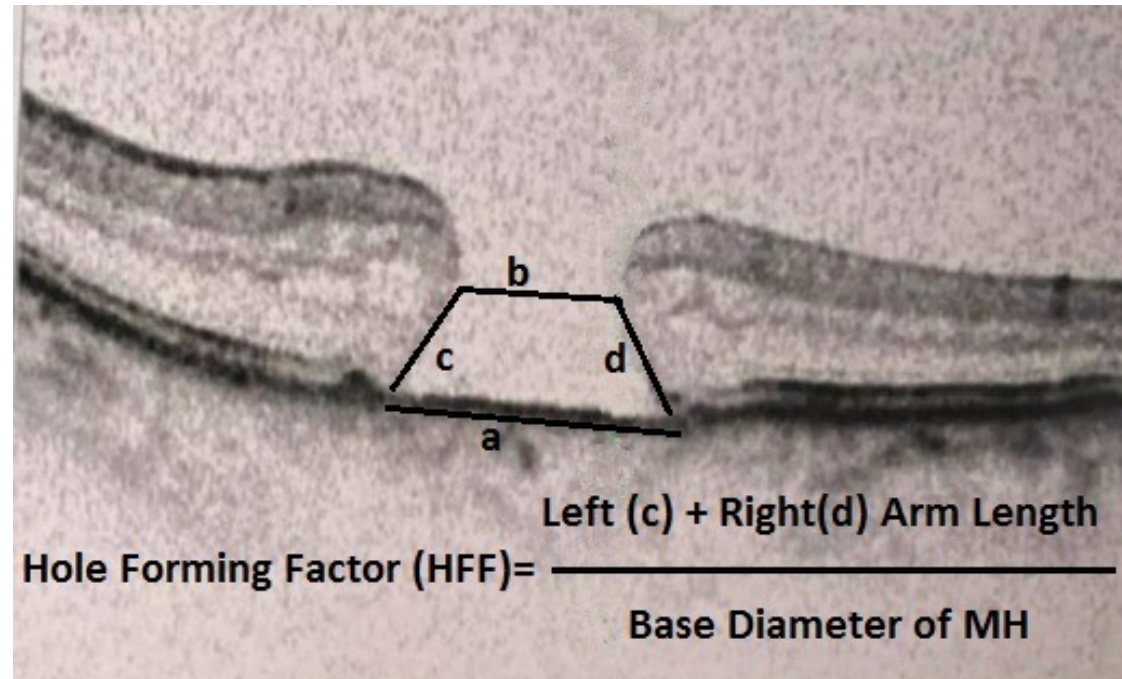
Ruiz-Moreno JM, Staicu C, Piñero DP, Montero J, Lugo F, Amat P. Optical coherence tomography predictive factors for macular hole surgery outcome. Br J Ophthalmol. 2008 May;92(5):640-4.

Dai YM, Shen J, Li JK, Jin XH, Li YM. [Optical coherence tomography predictive factors for idiopathic macular hole surgery outcome]. Zhonghua Yan Ke Za Zhi. 2013 Sep;49(9):807-11.



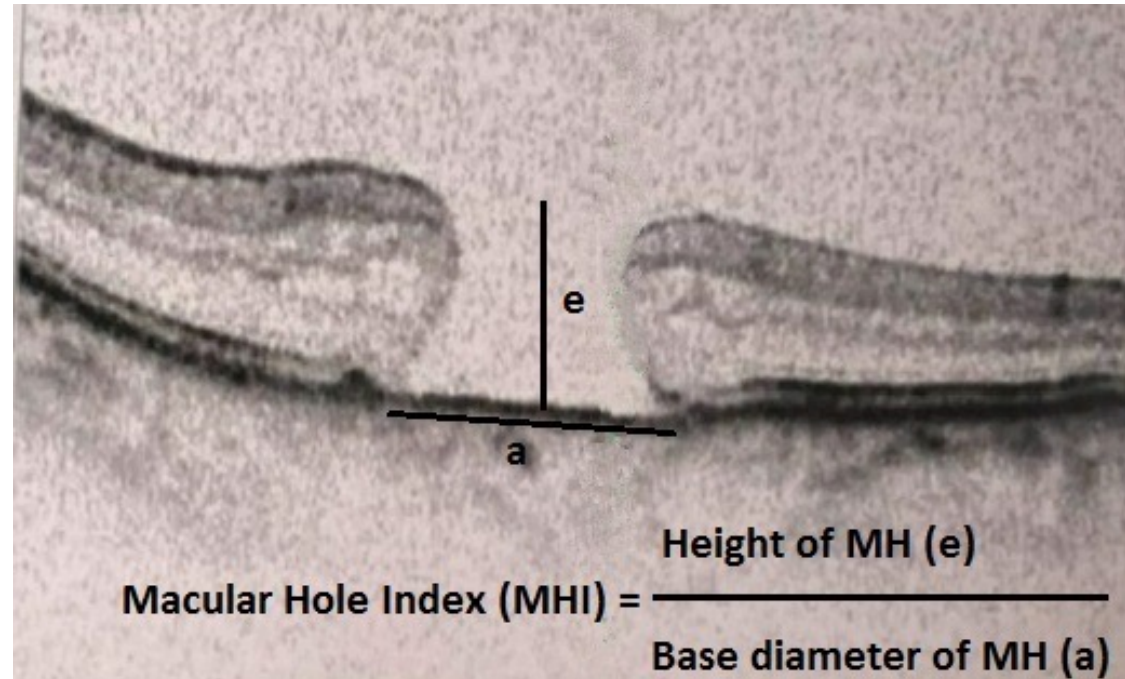
Hole Forming Factor (HFF)

- ❖ It is the ratio of the right and left arm length (measured to the minimum diameter of the hole from the base) to the base diameter of the MH. HFF greater than 0.9 carries a good prognosis, and less than 0.5 carries a poor prognosis for anatomical closure.



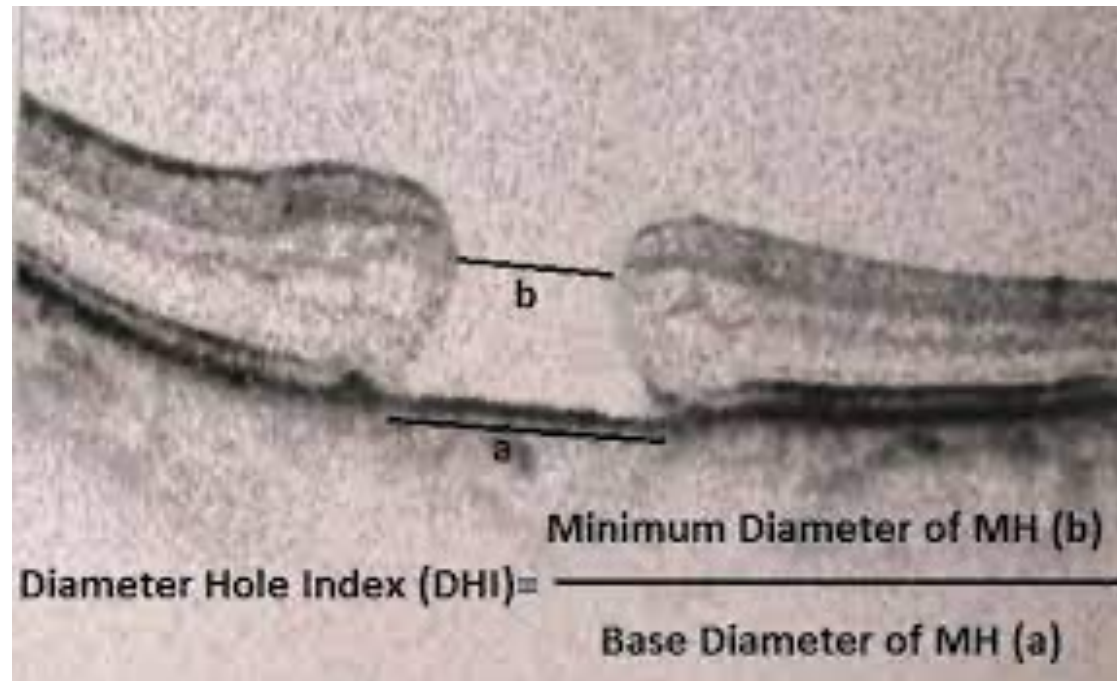
Macular Hole Index (MHI)

- ❖ It indicates the ratio of MH height to MH base diameter. MHI greater than 0.5 carries a better prognosis



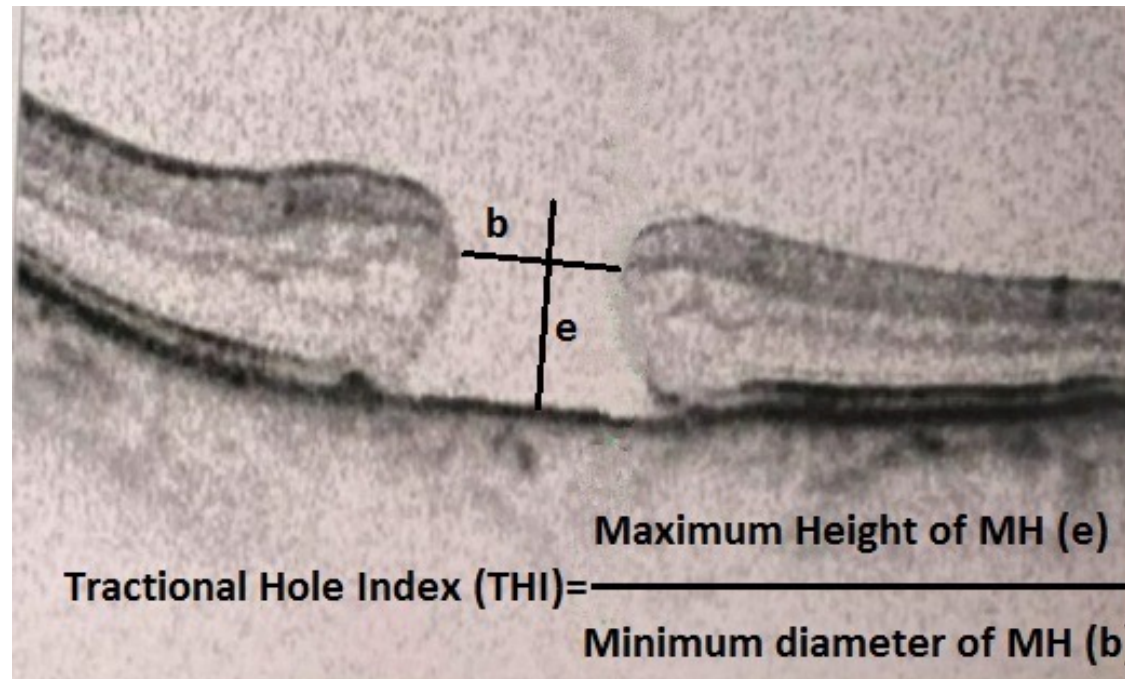
Diameter Hole Index (DHI)

- ❖ It is the ratio of the minimum diameter of the hole to the diameter of the hole base. It signifies tangential traction. DHI less than 0.5 carries a good prognosis.



Tractional Hole Index (THI)

- ❖ It indicates the ratio of maximum MH height to the minimum diameter of MH. It signifies vertical traction or retinal hydration. THI greater than 1.41 indicates a better prognosis.



Kang SW, Ahn K, Ham DI. Types of macular hole closure and their clinical implications. Br J Ophthalmol. 2003 Aug;87(8):1015-9. [PMC free article: PMC1771782] [PubMed: 12881347]

Postoperative Prognostic Factors

- ❖ The integrity of the inner segment: outer segment junction (IS: OS junction) or ellipsoid zone in OCT
- ❖ Type of closure: Type 1, i.e., without foveal neurosensory retinal (NSR) defect, carries a good prognosis, while type 2, i.e., with foveal NSR defect, carries a bad prognosis.

