Al Direttore Generale
della Fondazione I.R.C.C.S. Policlinico "San Matteo"
Viale Camillo Golgi, 19
27100 Pavia

Il/La sottoscritto/a CACCIATORI MATTEO chiede di essere ammesso/a a:

AVVISO DI SELEZIONE PUBBLICA PER L'ATTRIBUZIONE DI INCARICO QUINQUENNALE DI DIREZIONE DELLA STRUTTURA COMPLESSA "SC OCULISTICA" (RUOLO: SANITARIO; CATEGORIA PROFESSIONALE DEI MEDICI; AREA CHIRURGICA E DELLE SPECIALITA' CHIRURGICHE; DISCIPLINA DI OFTALMOLOGIA) (ID 78411)

a tal fine dichiara:

Anagrafica
Cognome e nome: CACCIATORI MATTEO
Nato il: 0[redacted]
Codice Fiscale: C[redacted]

Documento di riconoscimento
Tipo di documento: [redacted]
Rilasciato il:

Indirizzo di residenza
Residenza: S[redacted]
Località: 2[redacted]

Eventuale indirizzo di recapito
Recapito (presso): [redacted]
Residenza:
Località:

Contatti
Telefono: [redacted] Cellulare: [redacted]
Mail: [redacted]it PEC:

Requisiti generici

Cittadinanza: Italia

Comune di iscrizione nelle liste elettorali: voghera

Condanne penali riportate: no

Procedimenti penali in corso: no

Posizione rispetto gli obblighi di leva: assolti

Destituito/dispensato/licenziato dalla P.A.: no

Data pagamento contributo: 31/01/2025

Necessità ausili / Tempi aggiuntivi per l'espletamento del colloquio: No

Requisiti specifici

Laurea: Medicina e chirurgia

Università (completa di indirizzo/pec) presso cui ha conseguito la laurea: università degli studi pavia, via strada nuova 65, 27100 pavia

Data di conseguimento della laurea: 14/07/1989

Luogo ed numero di iscrizione all'Ordine Professionale: pavia 05847

Data di iscrizione all'Ordine Professionale: 20/02/1990

Specializzazione: specializzazione conseguita in Italia - oftalmologia

Università (completa di indirizzo/pec) presso cui ha conseguito la specializzazione: universita degli studi pavia, via strada nuova 65, 27100 pavia

Data di conseguimento della specializzazione: 06/07/1993

Anzianità di servizio: 7 anni, di cui 5 nella disciplina a concorso, o equipollente, e specializzazione nella disciplina, o equipollente

Attestato di formazione manageriale: si, lo HO conseguito (allegare il certificato)

Data di conseguimento dell'attestato di formazione manageriale: 28/11/2018

Giudicati in procedimenti a proprio carico: ASSENZA a proprio carico di provvedimenti definitivi di accoglimento della domanda risarcitoria proposta dal danneggiato, passati in giudicato negli ultimi 3 anni rispetto alla data di pubblicazione del presente bando

TIPOLOGIA DELLE ISTITUZIONI

Istituzione: PRINCESS ALEXANDRA EYE PAVILION (indirizzo: LAURISTONE PLACE EDINBURGH EH3 9EN)
Tipologia: UNIVERSITY HOSPITAL - Note: allego solo la casistica chirurgica, validata dalla Direzione in quanto ai tempi non si considerava la tipologia delle istituzioni. In ogni caso si trattava di un 'ospedale universitario come risulta nell'allegato della posizione funzionale

Istituzione: raigmore hospital (indirizzo: old perth road, inverness IV2 3UJ Scozia)
Tipologia: District general hospital - Note: allegata la tipologia degli interventi, in quanto non era prevista la descrizione della tipologia dell'istituzione

Istituzione: Ospedale Sacco (indirizzo: via giovanni battista grassi)
Tipologia: ospedale universitario - Note: allego solo la casistica chirurgica, validata dalla Direzione in quanto ai tempi non si considerava la tipologia

delle istituzioni. In ogni caso si trattava di un 'ospedale universitario

Istituzione: ospedale san gerardo (indirizzo: via GB pergolesi 33, 20900 monza MB)
Tipologia: ospedale universitario - Note: allego solo la casistica chirurgica, validata dalla Direzione in quanto ai tempi non si considerava la tipologia delle istituzioni. In ogni caso si trattava di un 'ospedale universitario

Istituzione: PRINCESS ALEXANDRA EYE PAVILION (indirizzo: LAURISTONE PLACE EDINBURGH EH3 9EN)
Tipologia: UNIVERSITY HOSPITAL - Note: allego solo la casistica chirurgica, validata dalla Direzione in quanto ai tempi non si considerava la tipologia delle istituzioni. In ogni caso si trattava di un 'ospedale universitario come risulta dall'allega nella posizione funzionaleto

Istituzione: university hospital of wales (indirizzo: heath park, cardiff cf14 4xw, wales)
Tipologia: ospedale universitario - Note: allegata la tipologia degli interventi, in quanto non era prevista la descrizione della tipologia dell'istituzione

Istituzione: istituti ospitalieri di Cremona (ASST Cremona) (indirizzo: via Largo Priori 1, 26100 Cremona)
Tipologia: ospedale di primo livello - Note: Posti letto per il solo Ospedale di Cremona (non l' ASST):692 ordinari, 44 day hospital, 15 culle,9 posti per subacuti,67 posti tecnici nelle comunità psichiatriche, 24 posti tecnici di dialisi, 60 posti tecnici BIC e MAC. L'Unità Operativa Complessa di Oculistica è dotata di 15 posti letto di degenza ordinaria e 1 posto letto di DH, all'interno del dipartimento di neuroscienze. Si occupa di ogni tipologia di paziente senza limiti di età. Diagnostica e tratta tutte le malattie dell'occhio comuni e rare. Le prestazioni chirurgiche erogate in oculistica sono elencate nell'allegato: principalmente sono interventi di chirurgia vitreoretinca, cataratte, glaucomi, trapianti corneali, strabismo.

POSIZIONE FUNZIONALE

Dal 01/09/1993 al 18/12/1995
dipendente a tempo determinato a rapporto esclusivo assistente a tempo pieno (disciplina oftalmologia) presso princess alexandra eye pavilion (indirizzo lauriston place, edinburgh EH3 Scotland) (pubblica amministrazione) a tempo pieno (n. 40 ore/sett.) - Posizione funzionale: incarico di natura professionale o di base - Causa di cessazione: assunzione/trasferimento presso altro ente

Dal 15/01/1996 al 21/07/1996
dipendente a tempo determinato a rapporto esclusivo assistente a tempo pieno (disciplina oculistica) presso raigmore hospital (indirizzo old perth road, invernessIV2 3UJ scozia) (pubblica amministrazione) a tempo pieno (n. 40 ore/sett.) - Posizione funzionale: incarico di natura professionale o di base - Causa di cessazione: assunzione/trasferimento presso altro ente

Dal 30/09/1996 al 02/10/2000
dipendente a tempo determinato a rapporto esclusivo assistente medico/dirigente (disciplina oculistica) presso ospedale luigi sacco (indirizzo via gb grassi) (pubblica amministrazione) a tempo pieno (n. 38 ore/sett.) - Posizione funzionale: incarico di natura professionale o di base - Causa di cessazione: assunzione/trasferimento presso altro ente

Dal 02/10/2000 al 31/03/2008
dipendente a tempo indeterminato a rapporto esclusivo dirigente medico (disciplina oculistica) presso ospedale san gerardo (indirizzo via pergolesi 33, 20900 monza MB) (pubblica amministrazione) a tempo pieno (n. 38 ore/sett.) - Posizione funzionale: incarico di natura professionale o di base - Causa di cessazione: assunzione/trasferimento presso altro ente

Dal 01/09/2004 al 31/08/2005
dipendente a tempo determinato a rapporto esclusivo assistente a tempo pieno (disciplina oftalmologia) presso princess alexandra eye pavilion (indirizzo lauriston place, edinburgh EH3 Scotland) (pubblica amministrazione) a tempo pieno (n. 40 ore/sett.) - Posizione funzionale: incarico di alta specializzazione - Causa di cessazione: assunzione/trasferimento presso altro ente

Dal 01/03/2006 al 26/01/2007
dipendente a tempo determinato a rapporto esclusivo dirigente di uo complessa (disciplina oftalmologia) presso university hospital of wales (indirizzo heath park way, cardiff cf14 4 xw cardiff) (pubblica amministrazione) a tempo pieno (n. 40 ore/sett.) - Posizione funzionale: direttore struttura complessa - Causa di cessazione: scadenza del contratto a tempo determinato

Dal 01/06/2009 al 03/02/2025
dipendente a tempo indeterminato a rapporto non esclusivo dirigente di uo complessa (disciplina oftalmologia) presso asst cremona (indirizzo via largo priori 1 26100 cremona) (pubblica amministrazione) a tempo pieno (n. 38 ore/sett.) - Posizione funzionale: direttore struttura complessa - Causa di cessazione: nessuna, posizione ancora in corso - Note: Dall'1/4/2008 al 31/05/2009 incarico professionale a complessa rilevanza strategica, incarico di direzione di struttura complessa art. 15 septies dall 1/6/2009 al 30/06/2010. Dall' 01/07/2010 a tutt'oggi incarico di Direttore di Struttura Complessa.

TIPOLOGIA E QUANTITA' DELLE PRESTAZIONI

Casistica presso istituti ospitalieri di cremona (indirizzo: via largo priori 1, 26100 cremona)

SCHEDA RIEPILOGATIVA CASISTICA INDIVIDUALE

Allego la scheda riepilogativa della casistica individuale

PRODUZIONE SCIENTIFICA COMPLESSIVA

- POSTER/comunicazioni n. 0
Produzione scientifica complessiva: ARTICOLI in extenso n. 15 con impact factor, n. 1 senza impact factor - CAPITOLI di libro/libri n. 1 nazionali, n. 0 internazionali - ABSTRACT n. 0 con impact factor, n. 0 senza impact factor

PRODUZIONE SCIENTIFICA SIGNIFICATIVA

Articolo in extenso
Surgically Induced Macular Detachment for Treatment of Refractory Full-Thickness Macular Hole: Anatomical and Functional Results - pubblicato il 2019 - con IF (IF 1,926) - rivista: ophthalmologica - Note: articolo di chirurgia vitreoretinica

Articolo in extenso
A novel quantitative analysis method for idiopathic epiretinal membrane. - pubblicato il 2021 - con IF (IF 3,752) - rivista: PLosOne 2021 - Note: articolo di chirurgia vitreo retinica

Manifesto il mio consenso affinché i dati forniti possano essere trattati nel rispetto del GDPR 679/2016 (Regolamento europeo in materia di protezione dei dati personali) per gli adempimenti connessi alla presente procedura, nonché all'eventuale procedura di assunzione.

Sono consapevole delle sanzioni penali nel caso di dichiarazioni non veritiere, di formazione o uso di atti falsi, richiamate dall'art.76 del D.P.R. 445/2000, attesta che le dichiarazioni contenute nella presente domanda sono sostitutive di certificazione ai sensi dell'art.46 del D.P.R. 445/2000.

Autorizzo la Fondazione IRCCS Policlinico San Matteo alla pubblicazione del mio curriculum sul sito www.sanmatteo.org – sezione concorsi, in ottemperanza agli obblighi di trasparenza previsti dall'art. 15 del D.Lgs. n. 502/92, così come modificato dalla legge 189/2012.

Dichiaro che le copie dei documenti allegati alla presente domanda sono conformi all'originale in mio possesso ai sensi dell'art. 19 del D.P.R. n. 445/2000.

Dichiaro di accettare incondizionatamente tutte le clausole e le condizioni contenute nel bando.

FIRMA [redacted]

Sistema Socio Sanitario

Ospedale di Cremona

Regione Lombardia

ASST Cremona

Direzione Sanitaria

ASST DI CREMONA
IPA:ASSTCR AOO:ASSTCR
N.0051988/24 16/10/2024
1.4.11

Prot.

Cremona,

CERTIFICAZIONE TIPOLOGIA DELLE ISTITUZIONI IN CUI SONO ALLOCATE LE STRUTTURE PRESSO LE QUALI IL CANDIDATO HA SVOLTO LA SUA ATTIVITÀ E LA TIPOLOGIA DELLE PRESTAZIONI EROGATE DALLE STRUTTURE MEDESIME

Si rilascia la presente certificazione ai sensi del comma 1 – art. 8 del D.P.R. 484/97 "Curriculum professionale con riferimento alla tipologia delle istituzioni in cui sono allocate le strutture presso le quali il candidato ha svolto la sua attività e la tipologia delle prestazioni erogate dalle strutture medesime".

L'Azienda Socio Sanitaria Territoriale (ASST) di Cremona è stata istituita con L.R. N. 23 dell'11/08/2015 e formalmente costituita con DGR N. 4494 del 10/12/2015 mediante fusione per incorporazione tra la preesistente Azienda Ospedaliera "Istituti Ospitalieri di Cremona" e il nuovo soggetto giuridico.

Trattasi di un'Azienda Socio Sanitaria dotata di personalità giuridica di diritto pubblico e di autonomia organizzativa, amministrativa, patrimoniale, contabile, gestionale e tecnica che concorre, con tutti gli altri soggetti erogatori del sistema, all'erogazione dei LEA e di eventuali livelli aggiuntivi definiti dalla Regione con risorse proprie, nella logica della presa in carico della persona.

Fanno parte dell'Azienda Socio Sanitaria Territoriale di Cremona:

- l'Ospedale di Cremona
- l'Ospedale "Oglio Po" di Vicomoscano (Casalmaggiore)
- le strutture afferenti il Polo Territoriale
- Il Presidio Ospedaliero Territoriale "Nuovo Robbiani" di Soresina (sperimentazione POT) dal 20/06/2016.

Complessivamente il personale al 31/12/2023 era composto da n. 2.511 dipendenti, di cui n. 368 Dirigenti Medici.

L'organizzazione della ASST di Cremona è strutturata in 8 Dipartimenti di seguito elencati:

- Dipartimento Salute Mentale e delle Dipendenze: SC Neuropsichiatria Infantile – SSD Psicologia Clinica – SC Psichiatria – SC Servizio Dipendenze - SSD Psichiatria adolescenti
- Dipartimento Area della Donna e Materno Infantile: SC Pediatria Aziendale – SC Ostetricia e Ginecologia Aziendale – SSD Patologia Neonatale.
- Dipartimento Area Chirurgica: SC Chirurgia Generale POC – SC Chirurgia Generale POOP – SC Chirurgia Vascolare - SC Ortopedia POC - SC Ortopedia POOP – SC Urologia – SSD Endoscopia Digestiva- SC Chirurgia Toracica
- Dipartimento Area Medica: SC Pneumologia – SC Cardiologia POC – SC Cardiologia POOP – SC Medicina Generale POC – SC Medicina Generale POOP – SC Nefrologia e Dialisi – SC Malattie Infettive – SSD Centro Diabetologico – SSD Dermatologia – SC Riabilitazione Specialistica

AZIENDA SOCIO-SANITARIA TERRITORIALE DI CREMONA Viale Concordia 1, 26100 Cremona –P.IVA/C.F. 01629400191
Direzione Sanitaria ASST di Cremona - tel 0372 405 208 - e-mail direzione.sanitaria@asst-cremona.it

- Dipartimento Area Neuroscienze: SC Oculistica – SC Neurologia – SC Neurochirurgia – SC Otorinolaringoiatria- SC Neuroradiologia
- Dipartimento Area dei Servizi Diagnostici: SC Laboratorio Analisi POC - SSD Laboratorio Analisi POOP – SSD Angiografia e Radiologia Interventistica -SC Immunoematologia e Medicina Trasfusionale – SC Radiologia POC – SC Radiologia POOP – SC Anatomia Patologica- SSD centro Emostasi e trombosi .
- Dipartimento Area Emergenza-Urgenza : SC Pronto Soccorso POC – SSD Pronto Soccorso POOP – SC Anestesia e Rianimazione POC – SC Anestesia e Rianimazione POOP – SSD AAT 118 CREMONA.
- Dipartimento Area Oncologica: SC Oncologia – SC Ematologia – SC Radioterapia e Medicina Nucleare – SC Multidisciplinare di Patologia Mammaria

Gli Ospedali dell'ASST di Cremona sono così strutturati:

Ospedale di Cremona

- n. 692 posti letto per ricovero ordinario;
- n. 44 posti letto di Day Hospital;
- n. 15 culle;
- n. 9 posti letto per sub acuti;
- n. 67 posti tecnici nelle Comunità Psichiatriche;
- n. 24 posti tecnici di dialisi;
- n. 60 posti tecnici per BIC e MAC.

Ospedale Oglio Po

- n. 214 posti letto per ricovero ordinario;
- n. 8 posti letto Day Hospital;
- n. 8 posti letto per sub acuti;
- n. 12 posti letto semiresidenziali nelle comunità psichiatriche;
- n. 10 posti tecnici di dialisi;

Il Presidio Ospedaliero Territoriale "Nuovo Robbiani" di Soresina

- n. 20 posti letto per subacuti;
- n. 1 posto letto di Day Hospital;
- n. 1 posto letto di Bassa Intensità di Cura;
- n. 9 posti letto Centro Assistenza Limitata per dializzati.

I volumi di attività per l'anno 2023 sono così rappresentati:

- Ospedale di Cremona: n. 17.785 dimessi, di cui 14.741 ordinari e 3.044 Day Hospital; prestazioni ambulatoriali n. 2.781.440 di cui BIC n. 2.685 e MAC n. 18.794
- Ospedale Oglio Po: n. 3.800 dimessi, di cui n. 3.125 ordinari e 675 Day Hospital; prestazioni ambulatoriali n. 1.025.883 di cui BIC n. 1.615 e MAC n. 2.801
- Presidio Ospedaliero Territoriali Nuovo Robbiani di Soresina: n. 106 dimessi in regime di cure sub acute.

AZIENDA SOCIO-SANITARIA TERRITORIALE DI CREMONA Viale Concordia 1, 26100 Cremona –P.IVA/C.F. 01629400191
Direzione Sanitaria ASST di Cremona - tel 0372 405 208 - e-mail direzione.sanitaria@asst-cremona.it

La presente certificazione viene rilasciata al **Dr. Matteo Cacciatori** Direttore Medico della S.C. Oculistica del Presidio Ospedaliero di Cremona.

L'Unità Operativa di Oculistica è una Struttura Complessa all'interno del Dipartimento Area Neuroscienze è dotata di n. 15 posti letto di degenza ordinaria e n. 1 Day Surgery.
L'Oculistica diagnostica tratta malattie dell'occhio comuni e rare, difetti della vista (miopia, ipermetropia, astigmatismo, presbiopia), strabismo, sindrome dell'occhio secco, infiammazioni dell'occhio (congiuntivite, cheratite, iridociclite, neurite, uveite posteriore), cataratta, glaucoma, patologie degenerative della retina e manifestazioni oculari associate a malattie sistemiche.

Si occupa di **ogni tipologia di paziente**, senza limiti di età.

Presso la S.C. Oculistica vengono effettuate le seguenti prestazioni ambulatoriali:

- Prima visita
- Visita di controllo
- Visita di pronto soccorso
- Fluorangiografia retinica (FAG e ICGA)
- Topografia corneale
- Argon laser retinico
- Pachimetria corneale
- YAG laser
- Ecografia oculare
- Visita oculistica e pediatrica
- Tomografia a coerenza ottica (OCT)
- Ambulatorio ortottica
- Ambulatorio iniezioni intravitreali
- Campi visivi computerizzati e manuali

Presso la S.C. Oculistica sono attivi i seguenti Ambulatori:

- Gestione del paziente operato alla retina
- Gestione del paziente affetto da cataratta
- Gestione del paziente operato di oftalmoplasitca
- Gestione del paziente affetto da strabismo
- Gestione del paziente affetto da glaucoma
- Ambulatorio iniezioni intravitreali
- Gestione del paziente ipovedente

AZIENDA SOCIO-SANITARIA TERRITORIALE DI CREMONA Viale Concordia 1, 26100 Cremona –P.IVA/C.F. 01629400191
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Nell'anno 2023 il volume di pazienti dimessi dalla S.C. di Oculistica è stato pari a 604 pazienti.

L'attività espletata, in base ai primi 5 DRG, risulta suddivisa nel seguente modo:

DRG	Descrizione DRG	Tot
036	Interventi sulla retina	473
042	Interventi sulle strutture intraoculari eccetto retina, iride e cristallino	72
040	Interventi sulle strutture extraoculari eccetto l'orbita, età > 17 anni	21
039	Interventi sul cristallino con o senza vitrectomia	18
037	Interventi sull'orbita	10
	Totale	594

I volumi di attività ambulatoriale erogati nel 2023 (BIC escluse) sono pari a n. 28.380 prestazioni (suddivise tra n. 3.175 prestazioni di Pronto Soccorso e n. 25.205 prestazioni per esterni) di cui:

- N. 6.882 prestazioni prima visita
- N. 5.388 prestazioni visita di controllo

I volumi di attività effettuata in BIC, N. 3.417 totali:

Prestazione	Quantità
0872 - RICOSTRUZIONE DELLA PALPEBRA NON A TUTTO SPESSORE	8
0874 - RICOSTRUZIONE DELLA PALPEBRA A TUTTO SPESSORE	7
1341 - INTERVENTO DI CATARATTA CON O SENZA IMPIANTO DI LENTE INTRAOCULARE	3.402
Totale	3.417

IL DIRETTORE SANITARIO
Dr [redacted]

IL DIRETTORE MEDICO
S.C. DIREZIONE MEDICA PRESIDIO OSPEDALIERO DI CREMONA
Dr.ssa Maria Lidia Raffaela Sinatra [redacted]

IL DIRETTORE DIPARTIMENTO
AREA NEUROSCIENZE
Dr. Antonio Fioravanti

DIPARTIMENTO NEUROSCIENZE
DIRETTORE
Dr. ANTO
C.F. FRV [redacted]

IL DIRIGENTE S.S. CONTROLLO DI GESTIONE
Dott.ssa Michela Mancini [redacted]

AZIENDA SOCIO-SANITARIA TERRITORIALE DI CREMONA Viale Concordia 1, 26100 Cremona –P.IVA/C.F. 01629400191
Direzione Sanitaria ASST di Cremona - tel 0372 405 208 - e-mail direzione.sanitaria@asst-cremona.it

Sistema Socio Sanitario

Regione Lombardia

ASST Cremona

Direzione Sanitaria

ASST DI CREMONA
IPA:ASSTCR AOO:ASSTCR
N.0051988/24 16/10/2024
1.4.11

Prot.

Cremona,

CERTIFICAZIONE

Ai sensi dell'art. 6 D.P.R. n. 484/97 si certifica la casistica operatoria del Dott. Matteo Cacciatori per il periodo dal 04/10/2014 al 07/10/2024, che risulta composta da:

- n. 5 pagine come I° Operatore
- n. 2 pagine come II° Operatore

IL DIRETTORE SANITARIO
[redacted] Reitano

IL DIRETTORE
DIPARTIMENTO AREA NEUROSCIENZE
Dr. Antonio Fioravanti

DIPARTIMENTO NEUROSCIENZE
DIRETTORE DI DIPARTIMENTO
Dr. ANTONIO FIORAVANTI
[redacted]

IL DIRETTORE MEDICO
SC DIREZIOEN MEDICA PRESIDIO OSPEDALIERO DI CREMONA
Dr.ssa Maria Lidia Raffaela Sinatra [redacted]

N. Procedure ICD-9-CM per Chirurgo

(I° Operatore)

Dal 04/10/2014 Al 07/10/2024

Blocco : ***B20 POC - PIASTRA***

Reparto: ***OCULISTICA POC***

Chirurgo: **CACCIATORI MATTEO**

ICD-9-CM	Procedura Chirurgica	N. Procedure
14.9	ALTRI INTERVENTI SULLA RETINA, SULLA COROIDE E SULLA CAMERA POSTERIORE	3
13.41	FACOEMULSIFICAZIONE ED ASPIRAZIONE DI CATARATTA	2
13.90	INTERVENTI SUL CRISTALLINO, NON CLASSIFICATI ALTROVE	2
13.71	INSERZIONE DI CRISTALLINO ARTIFICIALE INTRAOCULARE AL MOMENTO DELLA ESTRAZIONE DI CATARATTA, ESEGUITI IN CONTEMPORANEA	2
12.64	TRABECULECTOMIA AB EXTERNO	2
09.43	SPECILLAZIONE DEL DOTTO NASO-LACRIMALE	1
09.42	SPECILLAZIONE DEI CANALICOLI LACRIMALI	1
14.41	PIOMBAGGIO SCLERALE CON IMPIANTO	1
	Totale	**14**

Blocco : ***B21 POC - DAY SURGERY***

Reparto: ***OCULISTICA POC***

Chirurgo: **CACCIATORI MATTEO**

ICD-9-CM	Procedura Chirurgica	N. Procedure
13.41	FACOEMULSIFICAZIONE ED ASPIRAZIONE DI CATARATTA	4.201
13.71	INSERZIONE DI CRISTALLINO ARTIFICIALE INTRAOCULARE AL MOMENTO DELLA ESTRAZIONE DI CATARATTA, ESEGUITI IN CONTEMPORANEA	2.662
14.9	ALTRI INTERVENTI SULLA RETINA, SULLA COROIDE E SULLA CAMERA POSTERIORE	1.715
12.64	TRABECULECTOMIA AB EXTERNO	163
14.41	PIOMBAGGIO SCLERALE CON IMPIANTO	142
11.99	ALTRI INTERVENTI SULLA CORNEA	102

DIPARTIMENTO NEUROSCIENZE
DIRETTORE DI DIPARTIMENTO
Dr. ANTONIO FIORAVANTI
C.F. FRV NTN 62B12 L124V

Azienda Socio-Sanitaria Territoriale di Cremona
Ospedale di Cremona
S.C. DIREZIONE MEDICA
IL DIRETTORE MEDICO
Dr.ssa MARIA LIDIA RAFFAELA SINATRA
C.F. SNT MLD 76E69 C351B

Blocco : ***B21 POC - DAY SURGERY***

Reparto: ***OCULISTICA POC***

Chirurgo: CACCIATORI MATTEO

ICD-9-CM	Procedura Chirurgica	N. Procedure
11.64	ALTRA CHERATOPLASTICA PERFORANTE OMOLOGA	94
14.75	INIEZIONE DI SOSTITUTI VITREALI	83
08.72	ALTRA RICOSTRUZIONE DELLA PALPEBRA, NON A TUTTO SPESSORE	56
13.90	INTERVENTI SUL CRISTALLINO, NON CLASSIFICATI ALTROVE	52
08.21	ASPORTAZIONE DI CALAZIO	33
12.66	REVISIONE POSTOPERATORIA DI INTERVENTI DI FISTOLIZZAZIONE DELLA SCLERA	33
14.6	RIMOZIONE DAL SEGMENTO POSTERIORE DELL'OCCHIO DI MATERIALE IMPIANTATO CHIRURGICAMENTE	19
08.44	RIPARAZIONE DI ENTROPION O ECTROPION CON RICOSTRUZIONE DELLA PALPEBRA	17
15.11	ARRETRAMENTO DI UN MUSCOLO EXTRAOCULARE	15
13.72	IMPIANTO SECONDARIO DI CRISTALLINO ARTIFICIALE	12
09.6	ASPORTAZIONE DEL SACCO E DELLE VIE LACRIMALI	11
12.39	ALTRA IRIDOPLASTICA	10
13.8	RIMOZIONE DI CRISTALLINO IMPIANTATO	10
15.3	INTERVENTI SU DUE O PI¿ MUSCOLI EXTRAOCULARI CHE RICHIEDONO DISTACCO TEMPORANEO DAL BULBO, UNO O ENTRAMBI GLI OCCHI	10
11.62	ALTRA CHERATOPLASTICA LAMELLARE	10
15.13	RESEZIONE DI UN MUSCOLO EXTRAOCULARE	9
12.65	ALTRA FISTOLIZZAZIONE SCLERALE CON IRIDECTOMIA	9
10.49	ALTRA CONGIUNTIVOPLASTICA	8
14.52	RIPARAZIONE DI DISTACCO RETINICO CON CRIOTERAPIA	8
08.23	ASPORTAZIONE DI LESIONE ESTESA DELLA PALPEBRA NON A TUTTO SPESSORE	8
12.99	ALTRI INTERVENTI SULLA CAMERA ANTERIORE	8
11.59	ALTRA RIPARAZIONE DELLA CORNEA	7
14.71	VITRECTOMIA PER VIA ANTERIORE (LIMBARE)	7
12.69	ALTRI INTERVENTI DI FISTOLIZZAZIONE DELLA SCLERA	7

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Blocco : ***B21 POC - DAY SURGERY***

Reparto: ***OCULISTICA POC***

Chirurgo: CACCIATORI MATTEO

ICD-9-CM	Procedura Chirurgica	N. Procedure
08.24	ASPORTAZIONE DI LESIONE ESTESA DELLA PALPEBRA, A TUTTO SPESSORE	6
14.59	ALTRA RIPARAZIONE DI DISTACCO RETINICO	6
12.87	RINFORZO DI SCLERA MEDIANTE INNESTO	4
08.42	RIPARAZIONE DI ENTROPION O ECTROPION CON TECNICA DI SUTURA	4
12.79	ALTRI INTERVENTI PER GLAUCOMA	4
16.89	ALTRA RIPARAZIONE DI LESIONE DEL BULBO OCULARE O DELL¿ORBITA	4
10.91	INIEZIONE SOTTOCONGIUNTIVALE	3
14.72	ALTRA RIMOZIONE DEL CORPO VITREO	3
08.36	CORREZIONE DI BLEFAROPTOSI CON ALTRE TECNICHE	3
12.85	RIPARAZIONE DI STAFILOMA DELLA SCLERA CON INNESTO	3
11.49	ALTRA RIMOZIONE O DEMOLIZIONE DI LESIONE DELLA CORNEA	3
11.53	RIPARAZIONE DI LACERAZIONE O FERITA DELLA CORNEA CON LEMBO CONGIUNTIVALE	3
08.61	RICOSTRUZIONE DELLA PALPEBRA CON LEMBO O INNESTO CUTANEO	3
11.39	ALTRA ASPORTAZIONE DELLO PTERIGIUM	3
08.74	ALTRA RICOSTRUZIONE DELLA PALPEBRA, A TUTTO SPESSORE	2
08.33	CORREZIONE DI BLEFAROPTOSI CON RESEZIONE O AVANZAMENTO DEL MUSCOLO ELEVATORE O SUA APONEUROSI	2
10.31	ASPORTAZIONE DI LESIONE O TESSUTO DELLA CONGIUNTIVA	2
14.32	RIPARAZIONE DI LACERAZIONE DELLA RETINA MEDIANTE CRIOTERAPIA	2
11.60	TRAPIANTO DI CORNEA, NON ALTRIMENTI SPECIFICATO	2
12.33	LISI DI SINECHIE POSTERIORI	2
16.39	ALTRA EVISCERAZIONE DEL BULBO OCULARE	2

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Blocco : ***B21 POC - DAY SURGERY***

Reparto: ***OCULISTICA POC***

Chirurgo: CACCIATORI MATTEO

ICD-9-CM	Procedura Chirurgica	N. Procedure
08.22	ASPORTAZIONE DI ALTRA PICCOLA LESIONE DELLA PALPEBRA	2
16.42	ENUCLEAZIONE DEL BULBO OCULARE CON ALTRO IMPIANTO CONTEMPORANEO	2
16.51	EVISCERAZIONE DELL'ORBITA CON RIMOZIONE DI STRUTTURE ADIACENTI	1
13.2	ESTRAZIONE EXTRACAPSULARE DELLA CATARATTA CON TECNICA DI ESTRAZIONE LINEARE	1
09.49	ALTRE MANIPOLAZIONI DELLE VIE LACRIMALI	1
10.6	RIPARAZIONE DI LACERAZIONE DELLA CONGIUNTIVA	1
08.49	ALTRA RIPARAZIONE DI ENTROPION O ECTROPION	1
10.32	DEMOLIZIONE DI LESIONE DELLA CONGIUNTIVA	1
16.09	ALTRA ORBITOTOMIA	1
12.72	CICLOCRIOTERAPIA	1
11.32	ASPORTAZIONE DELLO PTERIGIUM CON INNESTO DELLA CORNEA	1
09.91	OBLITERAZIONE DEL PUNTO LACRIMALE	1
09.81	DACRIOCISTORINOSTOMIA (DCR)	1
12.83	REVISIONE DI FERITA OPERATORIA DEL SEGMENTO ANTERIORE DELL¿OCCHIO NON CLASSIFICATA ALTROVE	1
14.79	ALTRI INTERVENTI SUL CORPO VITREO	1
16.98	ALTRI INTERVENTI SULL¿ORBITA	1
12.32	LISI DI ALTRE SINECHIE ANTERIORI	1
14.54	RIPARAZIONE DI DISTACCO RETINICO MEDIANTE FOTOCOAGULAZIONE LASER	1
08.73	RICOSTRUZIONE DELLA PALPEBRA INTERESSANTE IL MARGINE PALPEBRALE, A TUTTO SPESSORE	1
12.31	LISI DI GONIOSINECHIE	1
09.43	SPECILLAZIONE DEL DOTTO NASO-LACRIMALE	1
12.14	ALTRA IRIDECTOMIA	1
10.21	BIOPSIA DELLA CONGIUNTIVA	1
12.13	ESCISSIONE DI IRIDE PROLASSATA	1

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Blocco : ***B21 POC - DAY SURGERY***

Reparto: ***OCULISTICA POC***

Chirurgo: CACCIATORI MATTEO

ICD-9-CM	Procedura Chirurgica	N. Procedure
15.29	ALTRI INTERVENTI SU UN MUSCOLO EXTRAOCULARE	1
08.62	RICOSTRUZIONE DELLA PALPEBRA CON INNESTO O LEMBO DI MUCOSA	1
15.9	ALTRI INTERVENTI SU MUSCOLI E TENDINI EXTRAOCULARI	1
08.43	RIPARAZIONE DI ENTROPION O ECTROPION CON RESEZIONE CUNEIFORME	1
10.33	ALTRI INTERVENTI DI DEMOLIZIONE SULLA CONGIUNTIVA	1
10.43	ALTRA RICOSTRUZIONE DI CUL DE SAC CONGIUNTIVALE	1
08.64	RICOSTRUZIONE DELLA PALPEBRA CON LEMBO TARSOCONGIUNTIVALE	1
15.21	INTERVENTI DI ALLUNGAMENTO DI UN MUSCOLO EXTRAOCULARE	1
12.00	RIMOZIONE DI CORPO ESTRANEO INTRAOCULARE DAL SEGMENTO ANTERIORE DELL'OCCHIO, SAI	1
	Totale	**9.622**

DIPARTIMENTO NEUROSCIENZE
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N. Procedure ICD-9-CM per Chirurgo

(II° Operatore)

Dal 04/10/2014 Al 07/10/2024

Blocco : ***B21 POC - DAY SURGERY***

Reparto: ***OCULISTICA POC***

Chirurgo: CACCIATORI MATTEO

ICD-9-CM	Procedura Chirurgica	N. Procedure
14.9	ALTRI INTERVENTI SULLA RETINA, SULLA COROIDE E SULLA CAMERA POSTERIORE	360
14.41	PIOMBAGGIO SCLERALE CON IMPIANTO	42
13.41	FACOEMULSIFICAZIONE ED ASPIRAZIONE DI CATARATTA	29
13.71	INSERZIONE DI CRISTALLINO ARTIFICIALE INTRAOCULARE AL MOMENTO DELLA ESTRAZIONE DI CATARATTA, ESEGUITI IN CONTEMPORANEA	28
12.64	TRABECULECTOMIA AB EXTERNO	24
11.64	ALTRA CHERATOPLASTICA PERFORANTE OMOLOGA	9
15.11	ARRETRAMENTO DI UN MUSCOLO EXTRAOCULARE	9
11.99	ALTRI INTERVENTI SULLA CORNEA	8
15.13	RESEZIONE DI UN MUSCOLO EXTRAOCULARE	5
15.3	INTERVENTI SU DUE O PI¿ MUSCOLI EXTRAOCULARI CHE RICHIEDONO DISTACCO TEMPORANEO DAL BULBO, UNO O ENTRAMBI GLI OCCHI	3
12.72	CICLOCRIOTERAPIA	2
15.4	ALTRI INTERVENTI SU DUE O PI¿ MUSCOLI EXTRAOCULARI, UNO O ENTRAMBI GLI OCCHI	2
12.69	ALTRI INTERVENTI DI FISTOLIZZAZIONE DELLA SCLERA	2
16.42	ENUCLEAZIONE DEL BULBO OCULARE CON ALTRO IMPIANTO CONTEMPORANEO	2
09.6	ASPORTAZIONE DEL SACCO E DELLE VIE LACRIMALI	1
12.89	ALTRI INTERVENTI SULLA SCLERA	1
11.51	SUTURA DI FERITA CORNEALE	1
10.49	ALTRA CONGIUNTIVOPLASTICA	1
08.42	RIPARAZIONE DI ENTROPION O ECTROPION CON TECNICA DI SUTURA	1
14.52	RIPARAZIONE DI DISTACCO RETINICO CON CRIOTERAPIA	1

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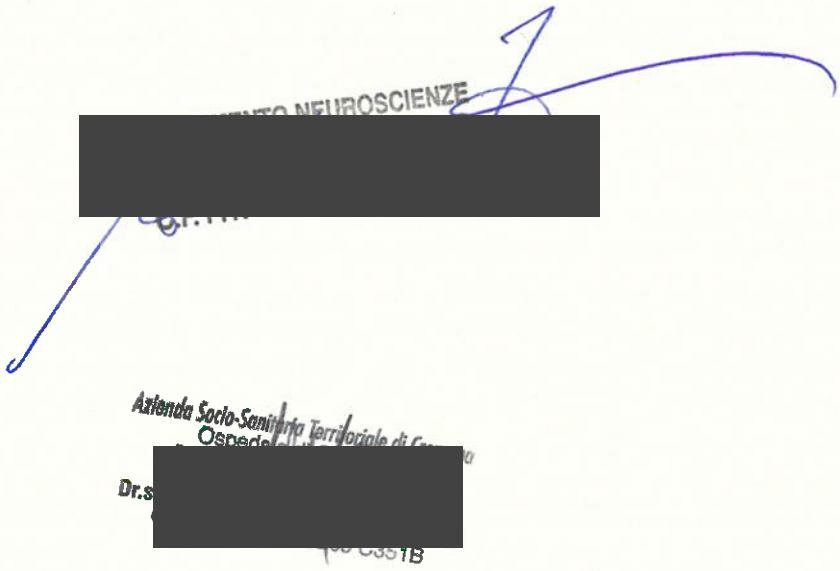
Blocco : ***B21 POC - DAY SURGERY***

Reparto: ***OCULISTICA POC***

Chirurgo: **CACCIATORI MATTEO**

ICD-9-CM	Procedura Chirurgica	N. Procedure
08.72	ALTRA RICOSTRUZIONE DELLA PALPEBRA, NON A TUTTO SPESSORE	1
11.53	RIPARAZIONE DI LACERAZIONE O FERITA DELLA CORNEA CON LEMBO CONGIUNTIVALE	1
08.24	ASPORTAZIONE DI LESIONE ESTESA DELLA PALPEBRA, A TUTTO SPESSORE	1
13.72	IMPIANTO SECONDARIO DI CRISTALLINO ARTIFICIALE	1
14.71	VITRECTOMIA PER VIA ANTERIORE (LIMBARE)	1
08.23	ASPORTAZIONE DI LESIONE ESTESA DELLA PALPEBRA NON A TUTTO SPESSORE	1
	Totale	**537**



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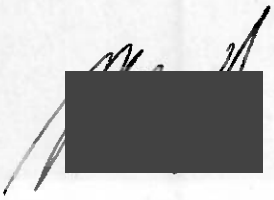

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PRODUZIONE SCIENTIFICA PUBBLICATA NELL'ULTIMO DECENNIO RISPETTO ALLA DATA DI PUBBLICAZIONE DEL PRESENTE AVVISO

Surgically Induced Macular Detachment for Treatment of Refractory Full-Thickness Macular Hole: Anatomical and Functional Results.

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Ophthalmologica. 2019;242(2):98-105.

Impact factor 1.926.

21/2/25

A novel quantitative analysis method for idiopathic epïretinal membrane.

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PLosOne 2021 Mar 17;16(3):e0247192. doi: 10.1371/journal.pone.0247192. eCollection 2021.

Impact factor 3.752

21/2/25

Research Article

Ophthalmologica

Ophthalmologica 2019;242:98–105
DOI: 10.1159/000500573

Received: December 26, 2018
Accepted after revision: April 25, 2019
Published online: June 20, 2019

Surgically Induced Macular Detachment for Treatment of Refractory Full-Thickness Macular Hole: Anatomical and Functional Results

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Keywords

Full-thickness macular hole · Fundus autofluorescence · Macular detachment · Optical coherence tomography · Pars plana vitrectomy · Subretinal fluid

Abstract

Purpose: The purpose of this study was to investigate the efficacy and safety of surgically induced macular detachment (MD) for the treatment of refractory full-thickness macular hole (FTMH). ***Materials and Methods:*** Clinical data were age, gender, lens status, and best corrected visual acuity (BCVA). Preoperative tomographic parameters were: FTMH morphology (intraretinal cyst and elevated or flat edges) and FTMH diameter. Postoperative FTMH closure and outer retinal layer (ORL) restoration were evaluated. Fundus autofluorescence (FAF), optical coherence tomography (OCT) findings, and BCVA were analyzed at the 1st, 3rd, and 6th postoperative month. The interval between the first surgery for idiopathic FTMH and the surgically induced MD for refractory FTMH was collected (intersurgical interval, days). ***Results:*** Ten eyes of 10 patients were included. The mean age was 68.8 ± 6.8 years. FTMH closure was obtained in 9 patients; in 8 patients, ORL restoration was detected. BCVA improved from 1.06 ± 0.1 (baseline) to 0.56 ± 0.2 (final) logMAR ($p = 0.0001$). A negative correlation between the intersurgical interval and postoperative visual gain was demonstrated ($r = -0.3618$). FAF and OCT showed a permanent retinal pigment epithelium (RPE) damage corresponding to the retinotomy points. ***Conclusion:*** This study demonstrates the efficacy of this technique and highlights the risk of RPE damage, suggesting the need to perform the retinotomy points outside the macula.

Introduction

The current treatment of idiopathic full-thickness macular hole (FTMH) is pars plana vitrectomy (PPV), peeling of the epiretinal membrane (ERM) and/or internal limiting membrane (ILM) [1]. The success of the surgery, with FTMH closure, is higher than 90% [2, 3]. Although the rate of failure is relatively low, many surgical techniques have been proposed to treat a refractory FTMH.

The limitations of surgical management of refractory FTMH are related to the lack of an ILM, if it was previously removed. In the past, some authors proposed to extend the peeling area of the ILM, to tamponade the FTMH with a heavy silicon oil, or to inject various adjuvant blood components, including autologous serum and platelet concentrates, with the aim of taking advantage of the regenerating potential of the growth factors contained in it [4–13]. More recently, new techniques

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of filling or covering the FTMH with different tissues, such as autologous ILM flap, autologous anterior or posterior lens capsule flap, neurosensory retinal autologous free flap, or amniotic membrane, have been proposed [14–23]. Although the morphological results seem to be good, the role that the tissue plays inside the FTMH is only partially known. The hypothesis is that the transplanted tissue could work as a scaffold for proliferation and migration of Müller cells, or as a barrier that separates the retinal pigment epithelium (RPE) inside the FTMH from the vitreous chamber, allowing the subretinal fluid (SRF) to be gradually removed by the RPE pump. Furthermore, the success of the surgery is strongly related to the correct position of the transplanted tissue, even if it is not clear whether it has to cover or to fill the FTMH in order to induce a foveal restoration.

In 2011, Oliver and Wojcik [24] proposed an alternative surgical technique: induction of a macular detachment (MD) by injection of fluid in the subretinal space using a 41-gauge needle. The rationale is to reduce the stiffness and the tension of the retina by injecting balanced saline solution (BSS), making it more compliant to allow a subsequent realignment of the edges of the FTMH, facilitated also by the separation of the tight adhesions of the retina and the RPE at the edge of a chronic FTMH [25]. The purpose of this study was to investigate the efficacy and safety of surgically induced MD for the treatment of refractory FTMH.

Materials and Methods

Design: Interventional Case Series

A series of consecutive patients affected by refractory FTMH after PPV and peeling of ERM and ILM were recruited and underwent surgically induced MD, gas tamponade, and postoperative face-down position. This study was approved by the local ethics committee. At the time of surgery, every patient was informed about the aims, methods, benefits, and potential risks of the treatment. Informed consent was obtained from all patients. The following clinical data were collected: age (years), gender (male/female), eye (right/left), lens status (phakic, pseudophakic), and preoperative and postoperative best corrected visual acuity (BCVA) reported in the logarithm of the minimum angle of resolution scale (logMAR). High-resolution spectral-domain optical coherence tomography (OCT) was performed in order to evaluate the following morphological parameters: the preoperative outer (base diameter) and inner diameter (aperture apex) of FTMH measured in μm, the morphology of the FTMH edges (flat or elevated), the presence of intraretinal cysts, the postoperative closure of FTMH, and the restoration of outer retinal layers (ORL). Fundus autofluorescence (FAF) was performed to detect the changes of RPE corresponding to the point of the retinotomy performed with a 41-gauge needle. The follow-up function was used to precisely reproduce the measurements of the tomographic parameters during each time point of follow-up. BCVA, OCT, and FAF were performed at the 1st, 3rd, and 6th postoperative month. The interval between the first surgery (PPV and ERM/ILM peeling for idiopathic FTMH) and the second surgery (surgically induced MD for refractory FTMH) was collected (intersurgical interval, days).

Surgical Technique

A standard 23-gauge 3-ports PPV was performed in all cases. An infusion cannula was placed in the inferotemporal quadrant through a 23-gauge port, the other 23-gauge port was used for the introduction of a hand light probe, and a 20-gauge sclerotomy, instead of a 23-gauge one, was performed at the site of the dominant hand for the introduction of a 41-gauge rigid cannula (Dutch Ophthalmic, Zuidland, The Netherlands) that would be used to obtain a retinal hydrodissection. The infusion of BSS through the 41-gauge needle was controlled by connecting the cannula to the injection line of the vitrectomy machine (Constellation, Alcon Laboratories, Inc., Fort Worth, TX, USA). The infusion pressure was set from 0 to 30 mm Hg. A continuous flow through the 41-gauge needle was firstly tested outside the eye, and a low and stable pressure of injection was set. To induce a MD, the authors suggest activating the BSS infusion just before performing the retinotomy in order to allow the needle to pierce the neuroretina with an active and continuous fluid infusion. This maneuver allowed the surgeon to inject the fluid into the subretinal space without touching and damaging the RPE with the needle. The insertion of the needle was stopped as soon as the subretinal bleb appeared, and BSS was infused through the retinotomy into the subretinal space until the bleb stopped its expansion. Puncture retinotomies were made in 1 or more quadrants. If the MD was not wide enough, the surgeon performed additional retinotomies far from the first one and injected BSS until the new bleb merged with the first one. MD was then enlarged with a repeated fluid-air-fluid exchange by aspirating the remaining fluid in the vitreous cavity with a backflush needle. Once a total MD was obtained with the edges of the FTMH raised (Fig. 1), a final fluid-air exchange was performed. The authors suggest not performing the SRF drainage through the FTMH but placing the backflush needle in front of the optic nerve head. The direct drainage through the FTMH is a dangerous maneuver with a high risk of engaging the edges of FTMH with a consequent retinal damage. After surgery, a face-down position for the first postoperative 24 h was recommended. All surgeries were performed by 2 surgeons (R.F. and M.C.).

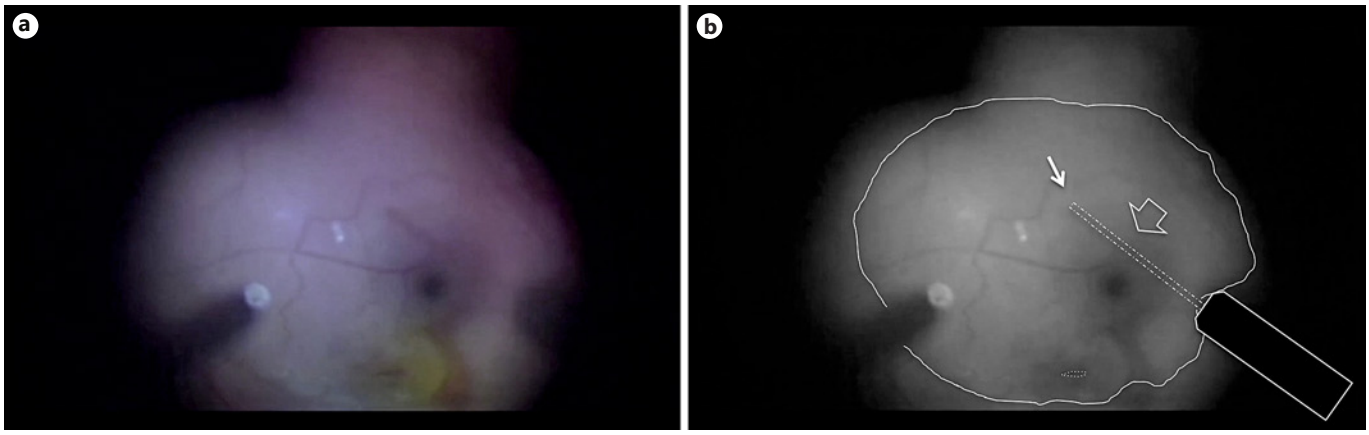
Results

Ten eyes (4 right eyes and 6 left eyes) of 10 male patients affected by refractory FTMH underwent surgery between September 2016 and December 2017. The mean age of the patients was 68.8 ± 6.8 years, ranging from 57 to 74 years. Seven patients (70%) underwent cataract surgery at the time of the first surgery for the treatment of FTMH, the other 3 underwent phacoemulsification and intraocular lens implantation combined with surgically induced MD.

Table 1. Preoperative functional and morphological parameters of patients

Patient No	Age, years	Lens status, P or PP	Previous surgery for FTMH PPV (23- or 25-g) + ILM peeling + SF6 cataract surgery	BCVA Snellen (logMar)	FTMH outer diameter, μm	FTMH inner diameter, μm	FTMH morphology, elevated or flat edges + IRC
1	74	PP	23-g + ILM peeling + SF6 cataract surgery	20/200 (1)	702	149	Elevated edges + IRC
2	74	PP	23-g + ILM peeling + SF6 cataract surgery	20/320 (1.2)	1,400	480	Elevated edges + IRC
3	67	PP	23-g + ILM peeling + SF6 cataract surgery	20/250 (1.1)	843	203	Elevated edges + IRC
4	57	P	25-g + ILM peeling + SF6	20/200 (1)	729	178	Flat
5	57	P	23-g + ILM peeling + SF6	20/200 (1)	801	146	Flat
6	67	P	23-g + ILM peeling + SF6	20/320 (1.2)	1,309	356	Elevated edges + IRC
7	73	PP	23-g + ILM peeling + SF6	20/200 (1)	876	198	Flat
8	74	PP	25-g + ILM peeling + SF6 cataract surgery	20/200 (1)	755	149	Elevated edges + IRC
9	73	PP	23-g + ILM peeling + SF6 cataract surgery	20/200 (1)	827	120	Flat
10	72	PP	23-g + ILM peeling + SF6	20/250 (1.1)	985	322	Elevated edges + IRC

BCVA, best corrected visual acuity; FTMH, full-thickness macular hole; g, gauge; IRC, intraretinal cyst; logMAR, logarithm of the minimum angle of resolution; P, phakic; PP, pseudophakic; PPV, pars plana vitrectomy; SF6, sulfur hexafluoride 18% gas tamponade.



Color version available online

Fig. 1. a, **b** Subretinal fluid injection using a 41-gauge needle (empty arrow, **b**) through the retinotomy (white arrow, **b**). The continuous line indicates the macular detachment area and the dotted line the elevated edges of the macular hole.

The mean outer diameter of FTMH was 923 ± 242.2 μm, ranging from 702 to 1,400 μm; the mean inner diameter was 230 ± 117.2 μm, ranging from 120 to 480 μm. In 6 eyes, the edges of the FTMH were elevated with intraretinal cysts, while the other 4 eyes were affected by a flat FTMH without intraretinal cysts. Table 1 reports the preoperative functional and morphological data of each patient.

BCVA improved from 1.06 ± 0.1 logMAR (ranging from 1 to 1.2 logMAR) at baseline to 0.78 ± 0.14 logMAR (ranging from 1 to 1.3 logMAR) at the 1st postoperative month, to 0.58 ± 0.2 logMAR (ranging from 0.5 to 1 logMAR) at the 3rd postoperative month, and finally to 0.56 ± 0.2 logMAR (ranging from 0.3 to 1 logMAR) at the 6th postoperative month (paired *t* test, $p = 0.0001$). The closure of the FTMH was obtained in 9 of 10 patients (90%). In 8 of these 9 patients, a complete restoration of the ORL was obtained; in 1 patient, there was only a reduction of the ORL defect. The mean intersurgical interval was 52 ± 16.8 days, ranging from 35 to 75 days. A negative correlation between the intersurgical interval

Table 2. Intraoperative parameters and postoperative morphological and functional data

Patient No	Intersurgical interval, days	Surgically induced MD, cataract surgery	FTMH closure, closed or opened	ORL: complete restoration, ORL defect reduction, unchanged	Final BCVA Snellen (logMAR)
1	38	Surgically induced MD	Closed	Complete restoration	20/40 (0.3)
2	35	Surgically induced MD	Opened	Unchanged	20/200 (1)
3	63	Surgically induced MD	Closed	Complete restoration	20/80 (0.6)
4	37	Surgically induced MD, cataract surgery	Closed	Complete restoration	20/50 (0.4)
5	64	Surgically induced MD, cataract surgery	Closed	Complete restoration	20/80 (0.6)
6	75	Surgically induced MD, cataract surgery	Closed	ORL defect reduction	20/125 (0.8)
7	72	Surgically induced MD	Closed	Complete restoration	20/80 (0.6)
8	36	Surgically induced MD	Closed	Complete restoration	20/50 (0.4)
9	62	Surgically induced MD	Closed	Complete restoration	20/80 (0.6)
10	35	Surgically induced MD	Closed	Complete restoration	20/40 (0.3)

BCVA, best corrected visual acuity; FTMH, full-thickness macular hole; logMAR, logarithm of the minimum angle of resolution; MD, macular detachment; ORL, outer retinal layer.

and the postoperative visual gain was demonstrated (Pearson's $r = -0.3618$): the longer the interval, the poorer the improvement of BCVA. Table 2 reports the intraoperative data and surgical outcomes. In all cases FAF showed an area of absence of autofluorescence (AF) corresponding to the retinotomy point surrounded by an inhomogeneous AF halo. These findings did not change during the postoperative follow-up. On OCT, the retinotomy point was characterized by a hypertrophy of the RPE, and the inhomogeneous AF halo was characterized by an irregular RPE profile (Fig. 2a–g).

Discussion

This study demonstrated that this technique is effective for the treatment of refractory FTMH, with only 1 case in which the FTMH did not close (Fig. 2h). The authors hypothesized that the surgical failure was due to the larger diameter of the FTMH compared to the other ones (outer diameter of 1400 μm and inner diameter of 480 μm compared to a mean value of outer and inner diameter of the whole group of patients, respectively, of 923 and 230 μm). Conversely, the intersurgical interval in this case was not longer than in the others (35 days compared to a mean intersurgical interval of 52 days). It is very interesting to speculate on how these refractory FTMHs close. The surgically induced MD technique induces the detachment of the macular hole edges (Fig. 3a, b), promoting the closure of the inner layers (Fig. 3c, d) and later of the outer layers (Fig. 3e, f). This explains the temporary presence of a subfoveal space (Fig. 3c–e) that could support the restoration of the ORL (Fig. 3e, f). In the current study, the FTMH closure was associated with complete restoration of the ORL in 8 of 9 patients. The final U-shape configuration of the fovea with a complete restoration of the ORL and a good visual recovery confirms what was already observed by Michalewska et al. [26] about the correlation of morphological changes of FTMH closure with functional recovery.

On the other hand, these surgical maneuvers are not without risks. In the last decade, surgically induced MD has been frequently used to treat the complications of previous retinal surgeries, but its safety has been investigated very little. Solomon et al. [27] reported a risk of retinal detachment (RD) after submacular surgery of 9%. It is well known that RD triggers a series of cellular reactions mediated by biochemical mediators that may cause irreversible retinal damage [28–31]. These pathological mechanisms start from a few hours after a RD and continue in the following days. In the specific case of temporary surgical induction of RD, the effects on the neuroretina and the RPE are unknown. Although it is a short-term-induced RD, the risk of retinal and RPE damage should be considered.

The interesting findings in this study concern the FAF changes after the SRF injection through the reti-

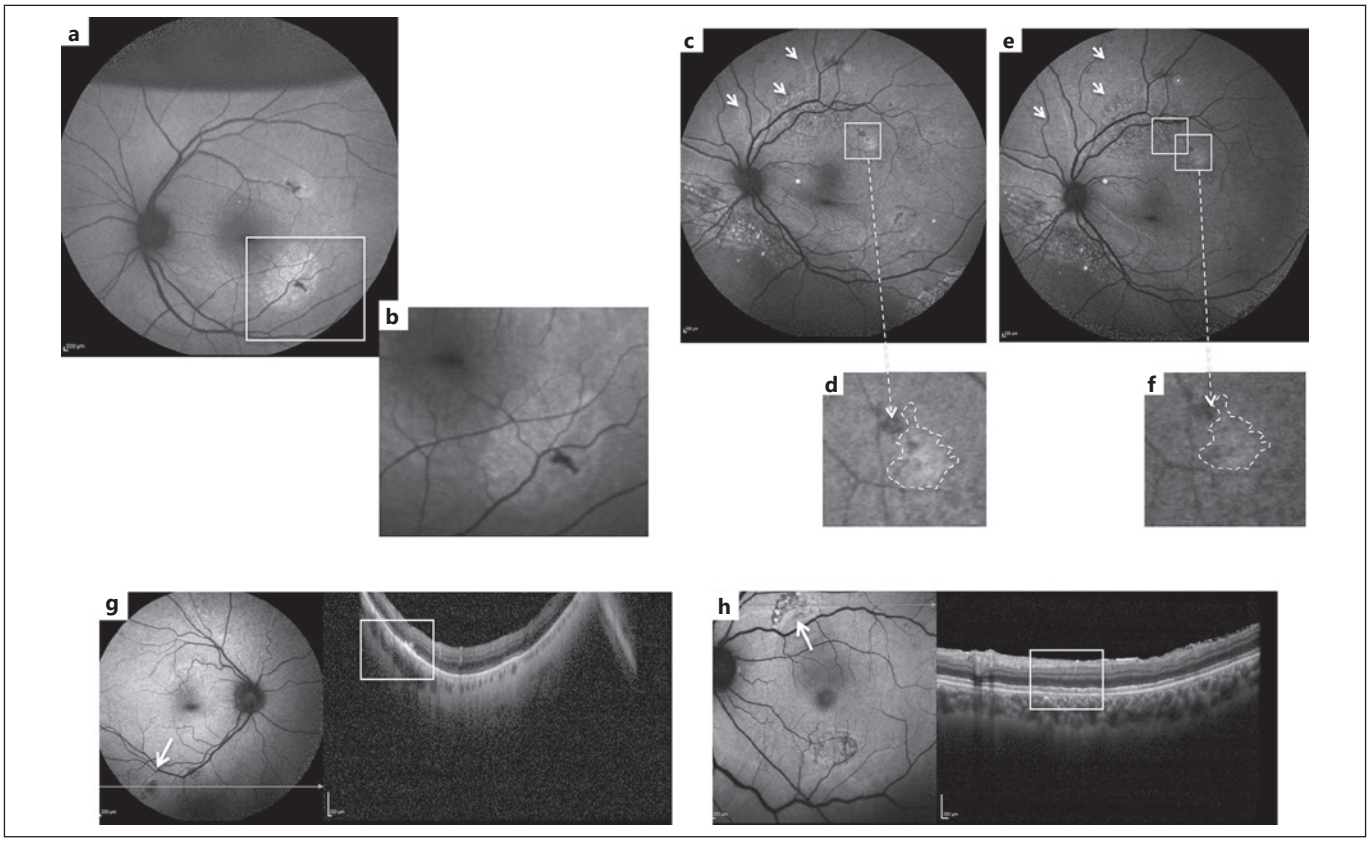


Fig. 2. a, **b** Case 1, patient No. 4. **a** Autofluorescence imaging a few days after surgery (white arrows indicate the air bubble) shows the retinotomy point (black area) surrounded by an inhomogeneous autofluorescent halo (inside the outer white border). **b** Magnified image. **c–f** Case 2, patient No. 5. Autofluorescence at 1 postoperative month. **c** Retinotomy point (black area) surrounded by inhomogeneous autofluorescent halo (inside the outer white border). **d** Magnified image of the retinotomy point (white arrow) and inhomogeneous autofluorescent halo (white dotted line). Hyperautofluorescent outlines adjacent to the retinal blood vessels indicate the previous position of the vasculature before macular detachment (white arrows). **e** Autofluorescence image at 6 postoperative months. **f** Magnified image. **g** Case 3, patient No. 8. Optical coherence tomography (OCT) scan passing through the retinotomy point (white arrow) highlighting a retinal pigment epithelium (RPE) hypertrophy (inside the outer white border). **h** Case 4, patient No. 2. FTMH opened after surgically induced macular detachment.

notomy point. The authors performed FAF and OCT before and after surgery, focusing on the changes at the site of retinotomy and SRF injection, and looking at the recorded surgical videos, in order to find the exact 41-gauge needle entry point. The most common findings were an RPE dystrophy, detected by OCT, and an inhomogeneous AF halo around the retinotomy, detected by FAF. The persistence of these changes during the follow-up leads the authors to hypothesize that they could be due to a traumatic damage of the RPE rather than to a temporary inflammatory reaction. It remains unclear if the damage is secondary to the contact of the needle with the RPE or to the SRF injection. Anyhow, the authors suggest performing the retinotomy as far as possible from the macular area.

Regarding the timing of surgery, in light of the better visual gain achieved in the patients who underwent surgery in a shorter intersurgical interval, the authors suggest performing surgery as soon as possible. How the FTMH closes after PPV with ILM peeling, performed in the first surgery, and why in some cases the treatment does not function are still open questions. The edges of the FTMH get closer if there is a reduction of the tangential tractional forces on it, obtained by the removal of the vitreous and the peeling of the ILM, and if the retina is enough compliant to allow the edges of the hole to get closer. There are different surgical approaches to a refractory FTMH. The traditional one, the enlarging of the ILM peeling, seems not to have the same success as techniques that provide a scaffold for the glial cells to proliferate. The

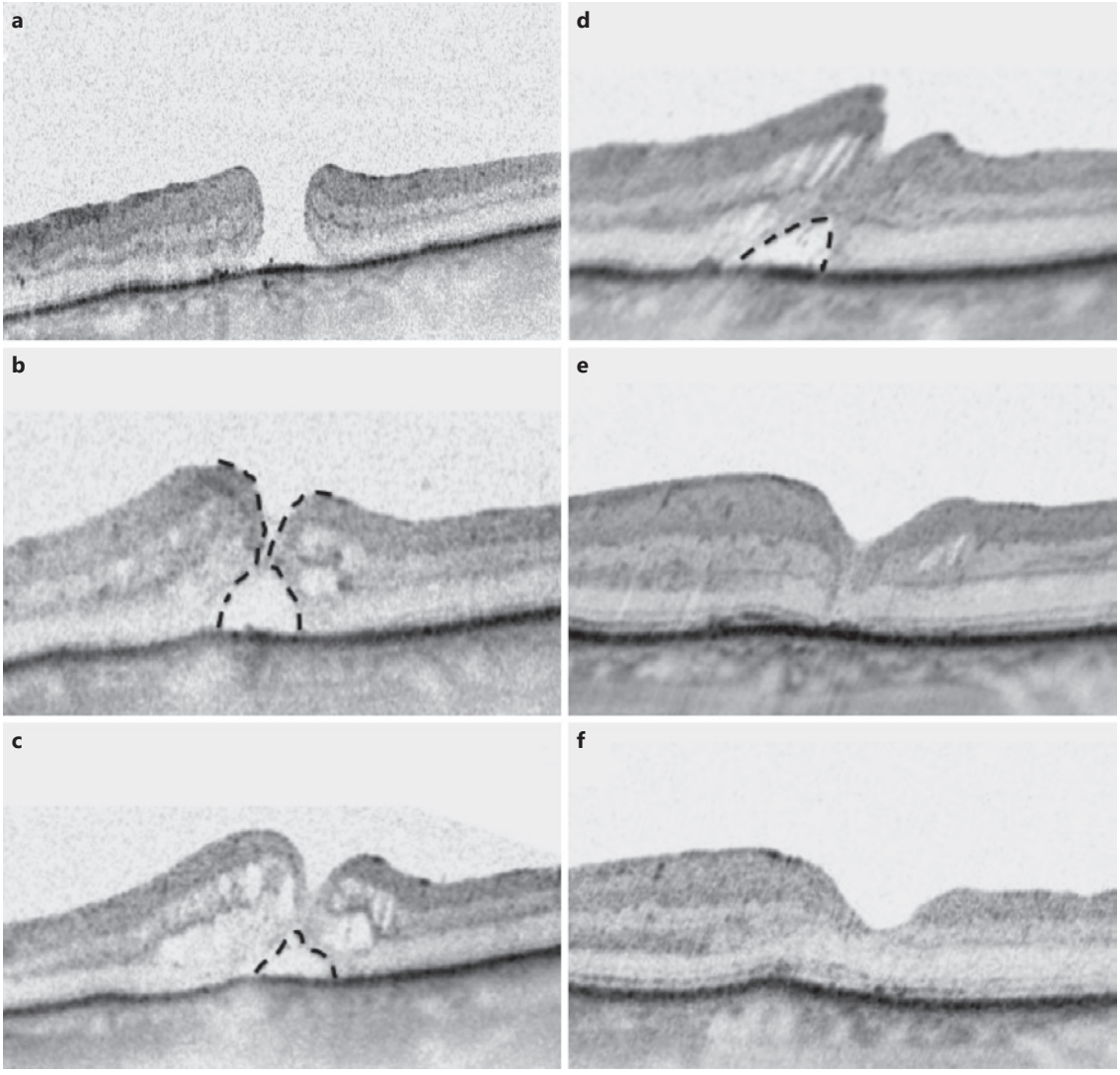


Fig. 3. a Refractory full-thickness macular hole (FTMH) after pars plana vitrectomy and internal limiting membrane peeling. **b–d** Postoperative progressive closure of the FTMH detected from the 1st postoperative day (after the reduction of air bubble volume) to the 3rd day. **e**, **f** Later complete restoration of the outer retinal layers (ellipsoid zone and external limiting membrane).

more extensively used scaffold is the ILM, taken from the periphery of the retina. If no ILM is available, various authors have described other substrates that may be used, such as amniotic membrane, neuro-retinal patch, or lens capsule. Adjuvant blood components are also an option that seems, however, to provide minor success. In some cases, the use of a scaffold might not be sufficient: the failure of the surgery may also be due to a rigid underlying retina that does not allow the edges of the FTMH to come closer. This tension may be reduced by using the technique described in the current study. Furthermore, the use of an autologous scaffold may stimulate glial repair of the hole without a functional recovery of the fovea or the presence of hyperreflective material visible for a long time on postoperative OCT. With surgically induced MD, no cases of retinal fibrosis were observed and the restoration of ORL was spontaneous. Although it is an invasive and demanding technique that requires considerable surgical experience, it is increasingly used by vitreoretinal surgeons, and the publication of many case reports confirms the common agreement on the use of this surgical procedure [25, 32, 33]. The success rate of FTMH closure of surgically induced MD is in line with the results reported by using different techniques: autologous transplantation of the ILM technique (90% of FTMH closure) [14–18], autologous retinal transplantation technique (FTMH clo-

sure ranging from 66.7 to 87.8%) [20–22], lens capsular flap transplantation (90% of FTMH closure) [19], vitrectomy technique with autologous platelet concentrate (85.2% of FTMH closure) [11–13], and injection of heavy silicon oil (86.95% of FTMH closure) [9, 10]. The variability of the inclusion criteria of recruitment (myopic holes, idiopathic holes, and holes associated with RD) and the different number of cases does not allow us to compare these studies.

In conclusion, this paper confirms the efficacy of this surgical technique, demonstrates the importance of performing surgery quickly in order to achieve a better functional recovery, and highlights RPE changes and damages at the site of SRF injection, suggesting performing the retinotomies outside the temporal vascular arcades.

Acknowledgement

The authors have no government and nongovernment support and no financial disclosures. All authors attest that they meet the current ICMJE criteria for authorship.

Statement of Ethics

The authors have no ethical conflicts to disclose.

Disclosure Statement

The authors declare that they have no conflict of interest.

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PLOS ONE

RESEARCH ARTICLE

A novel quantitative analysis method for idiopathic epiretinal membrane

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Citation: Allegrini D, Montesano G, Marconi S, Rosso N, Ometto G, Raimondi R, et al. (2021) A novel quantitative analysis method for idiopathic epiretinal membrane. PLoS ONE 16(3): e0247192. https://doi.org/10.1371/journal.pone.0247192

Editor: Demetrios G. Vavvas, Massachusetts Eye & Ear Infirmary, Harvard Medical School, UNITED STATES

Received: November 17, 2020

Accepted: February 2, 2021

Published: March 17, 2021

Data Availability Statement: All relevant data are within the paper and its Supporting Information files.

Funding: Unfunded studies The author(s) received no specific funding for this work.

Competing interests: The authors have declared that no competing interests exist.

Abstract

Purpose

To introduce a novel method to quantitively analyse in three dimensions traction forces in a vast area of the ocular posterior pole.

Methods

Retrospective analysis of 14 eyes who underwent peeling surgery for idiopathic, symptomatic and progressive epiretinal membrane. The technique measures the shift in position of vascular crossings after surgery from a fixed point, which is the retinal pigmented epithelium. This shift is defined as the relaxation index (RI) and represents a measure of the postoperative movement of the retina due to released traction after surgery.

Results

Best-corrected visual acuity was significantly better than baseline at all follow ups while the RI had its maximum value at baseline. Moreover, we found a significant correlation between best-corrected visual acuity at 6 months and RI at baseline.

Conclusion

While all previous published methods focused on bi-dimensional changes observed in a small region, this study introduces a three-dimensional assessment of tractional forces. Future integration of RI into built-in processing software will allow systematic three-dimensional measurement of intraretinal traction.

Introduction

Epiretinal membrane (ERM) is a fibrocellular proliferation at the vitreoretinal interface above the inner limiting membrane (ILM) [1]. The prevalence of ERM increases with age and is reported between 2,2% in a population from Beijing (China) without a significative difference in patients that underwent cataract surgery and 28,9% in a multiethnic United States population with higher rates in patients that underwent cataract surgery and in patients of Chinese ethnicity [2–4]. A key element in ERM development is the fibrotic process which is sustained by collagen deposition and transdifferentiation into myofibroblast of retinal Müller cells, retinal pigmented epithelium (RPE) cells and hyalocytes [5–7]. The result is a semitranslucent, thick and contractile membrane that exerts a tractional force tangential to the retinal plane leading to macular puckering [4]. Patients symptoms range from being completely asymptomatic to complaining of metamorphopsia and loss of vision depending on macular involvement [4]. Disease progression leads to gradual but mild vision loss, a retrospective study reported that 21% of patients required surgery at 4 years if baseline visual acuity was $\geq$ 20/40 [8]. Treatment options consist of mainly in watchful waiting or vitrectomy surgery with peeling of the membrane [9]. The time point in which irreversible damage occurs is currently not clear, this causes uncertainty about surgical timing and an unevenness of protocols between centers. A classification by Gass [10] based on fundus appearance has been widely used to stage the disease. However, the introduction of spectral domain optical coherence tomography (SD-OCT) technology dramatically improved diagnosis and led to multiple OCT-based classifications. Hwang et al. [11] introduced a system grounded on foveal characteristics and validated with multifocal electroretinography (mERG) to demonstrate the functional differences between stages. Konidaris et al. [12] proposed a classification based on vitreous state and morphology, but validation was never carried out, thus this classification remains of uncertain clinical usefulness. Stevenson et al. [13] suggested the inclusion of central foveal thickness and inner segment ellipsoid band integrity as key morphologic parameters. Lastly, Govetto et al. [14] introduced a classification system with four stages based on the presence of the foveal pit and the integrity of outer and inner retinal layers. These classifications can be useful to link morphological features of the retina to postoperative prognosis. However, they mostly rely on qualitative descriptions of visible alterations. A more informative characterization of the disease could come from a quantitative and three-dimensional analysis of the retinal traction caused by the ERM.

In this study we introduce the Relaxation Index (RI) which allows a three-dimensional quantitative analysis of retinal tissue release, at different time points after removal of ERM in eyes affected by progressive epiretinal traction. We also relate the amount of relaxation to the functional visual outcome of the patients.

Methods

Sample description

The electronic medical records of the Ophthalmology Department of Humanitas Gavazzeni-Castelli Hospital of Bergamo and at the Ophthalmology Service ASST of Cremona were queried to identify all patients 18 years or older affected by idiopathic, symptomatic and progressive epiretinal membrane (ERM) that underwent peeling surgery between January and June 2019 (n = 142). The progression was defined as decrease of visual function, the presence of concomitant metamorphopsia and increased central macular thickness secondary to epiretinal traction. Exclusion criteria were: myopia greater than 6 diopters (n = 21), a history of mayor ocular surgeries not including cataract surgery (n = 15), macular edema secondary to vascular

and tractional diseases (n = 6), uveitis (n = 3), diabetic retinopathy (n = 28), age-related macular degeneration (n = 16), complete follow up data not available (n = 53).

Therefore, we retrospectively analyzed 14 eyes from 14 patients who underwent peeling of the ERM and the ILM to treat visually significant ERM. Informed consent before surgery was obtained from all subjects, this study conformed to the Declaration of Helsinki and ethics approval was approved by the Ethics Committee of Humanitas Gavazzeni Hospital with the protocol number 42/20 GAV.

Surgeries were performed by two different surgeons (M.R.R.) and (M.C.). All patients were examined at one, three and six months after surgery. At all visits, best corrected visual acuity (BCVA) was measured in decimals. In four cases, the peeling was coupled with cataract surgery (Phaco-Peeling), the remaining eight patients were already pseudophakic.

Relaxation index

The RI measures in, millimetres (mm), the shift in position of a vascular crossing after surgery from a fixed reference point, defined as the vertical projection of that same crossing onto the RPE at the last visit. This shift represents a measure of the postoperative movement of the retina due to released traction after surgery. For this analysis, we assumed that the last visit at 6 months was the maximally relaxed state. The RI used for the analysis is the average of the shifts of all the crossings identified by the graders for a given scan (see later).

The RI Index of the retinal tissue was measured using the OCT angiography (OCT-A) scans. A Spectralis SD-OCT, (Heidelberg Engineering, Germany) was used to acquire OCT-A scans of the posterior pole at all time points with a field of view of 30˚, using the follow-up mode. This employs a fundus tracking technology to ensure that OCT acquisitions are performed at the same location on the retina. The reference image is an infrared (IR) fundus picture paired with the OCT scans. Axial length was measured with a LS 900 TC optical low-coherence reflectometry biometer (Haag-Streit Diagnostics, Koeniz, Switzerland). A custom software was developed in Matlab (The MathWorks, Natick, USA), to enable a manual marking of any number of vessels crossing on OCT-A images acquired at different times. The software provides the coordinates of each selected crossing and computes their distances (Fig 1). Two independent graders (N.R. and M.C.) manually marked clearly identifiable vessel crossings on the baseline OCT-A. The graders then identified the same crossings on the aligned follow-up scans, so that their positions could be tracked in time. For all crossings, corresponding retinal thickness values were manually recorded using the Heidelberg Eye Explorer software, which computes thickness as the difference between ILM and RPE segmentations. OCT-A scans at all time points were studied for each of the 14 patients. All planar distances were corrected for ocular magnification using the axial length values and the schematic eye developed by Drasdo and Fowler [15].

We speculate that we can consider the scan at 6 months post-op (last available follow-up) as the maximum retinal relaxed state that was observed after surgery. Assuming that the outer retina is anchored to the RPE [16] so that no horizontal sliding of the retina is possible, the stretch of the tissue over time can be measured as the distance between the position at 6 months of RPE at a specific vessel crossing and the different positions of the same crossing over time (Fig 2). The length of this connecting segment represents the RI of the retina due to the superficial traction from the ERM, which is maximum in the pre-operative scan (baseline). The RI uses position changes of retinal vessels to describe the movement of the innermost retinal surface relative to the RPE. In the maximum relaxed state (6 months), it is simply the retinal thickness corresponding to each crossing. At each time point, the mean RI is calculated as the average of all measurements in each scan. In practical terms, the planar distance from the

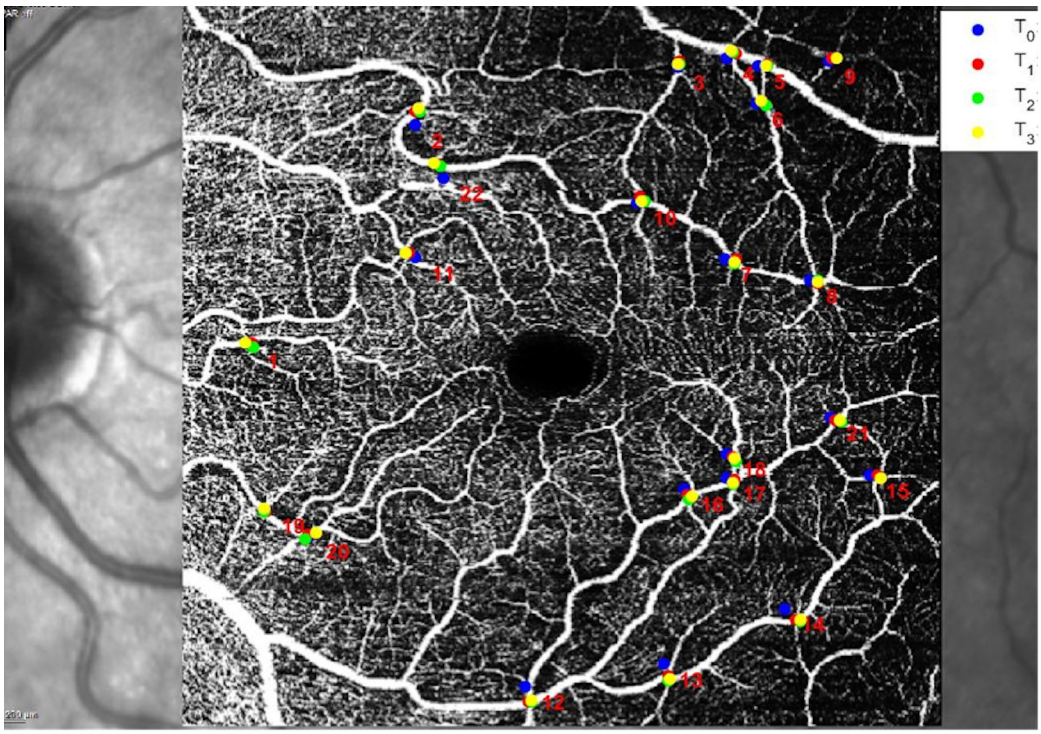

Fig 1. Example of vessel crossings marks at different timepoints on an elaborated OCTA scan. T_0 = baseline (pre-op), T_1 = 1 month post-op, T_2 = 3 months post-op, T_3 = 6 months post-op.

https://doi.org/10.1371/journal.pone.0247192.g001

final position and the local thickness at each point in time represented the two orthogonal sides of a right triangle. Hence, the length of the segment was calculated as the squared root of the sum of squares of the planar distance from the final position at 6 months and the local thickness at each time-point for any individual vessel crossing.

Statistical analysis

The inter-grader agreement was measured using a Bland-Altman plot and the 95% limits of agreement. Since each grader could select a different number of vessel crossings, the agreement was measured on the mean RI. For subsequent analyses, we used the average of the two mean RI from each grader.

The changes in BCVA and RI over time were explored using linear mixed effect models using the lme4 package for R [17]. Random effects were used to account for repeated measurements over time on the same eye. The fixed effect predictor was time, used as a categorical factor. These models were used to compare values at different follow-up visits with the baseline visit. Other comparisons that were not based on repeated measurements were performed with simple linear regressions. In particular, we studied the correlation between baseline RI and baseline BCVA using a univariate linear regression and the correlation between baseline RI and BCVA at 6 months using a multivariate linear regression that included the baseline BCVA as a covariate. The significance threshold was set at 0.05. The p-values were obtained from a t-type statistic for either the pair-wise differences between the time-points or for the regression coefficients. For pairwise comparisons between different time-points, the p-values were corrected for multiple (N = 4) tests using the Bonferroni-Holm method from the package lsmeans for R [18].

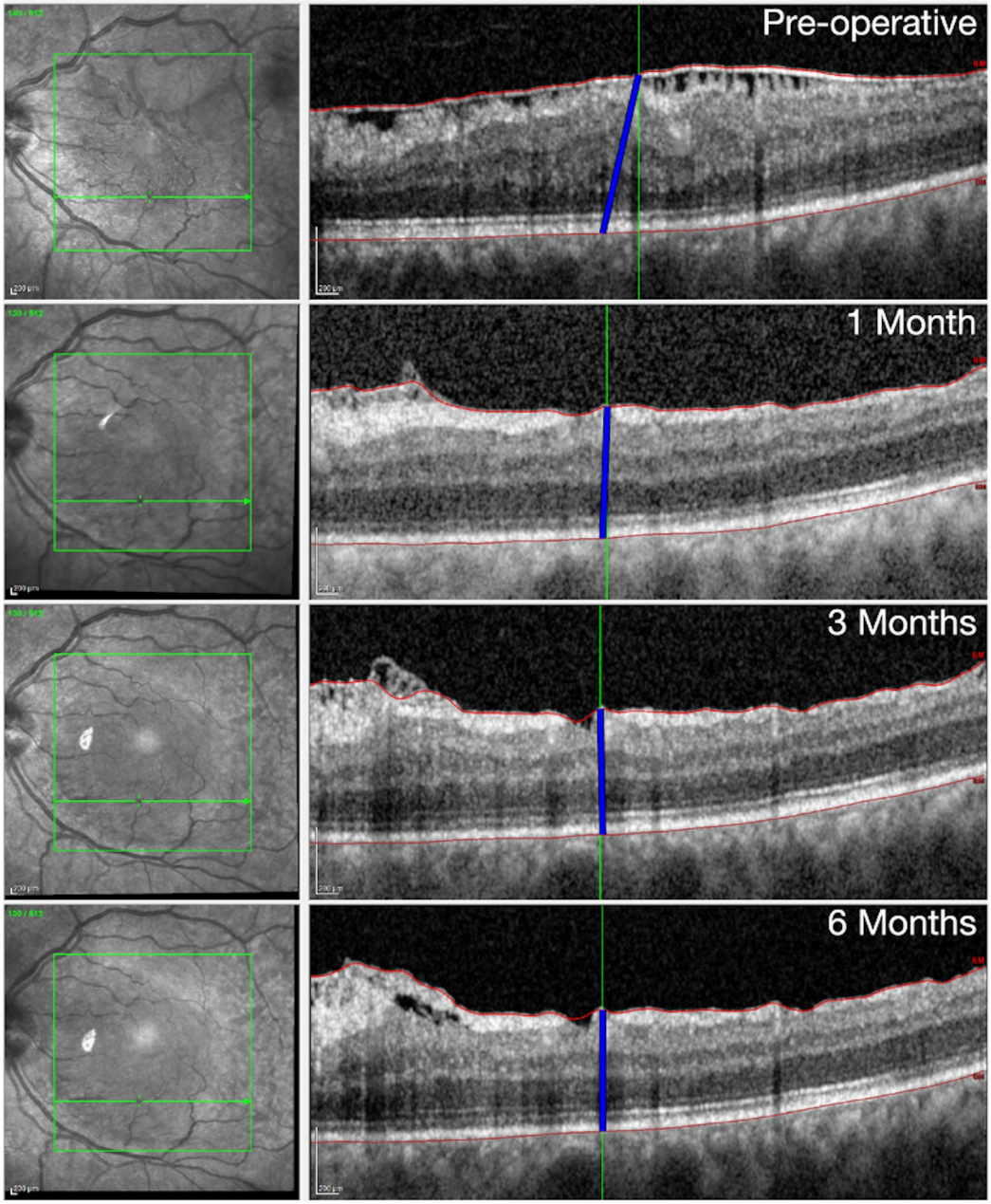

Fig 2. Example of how the position of a tracked vessel crossing changes its positions after surgery. The blue line connects the position on the Retinal Pigment Epithelium corresponding to the final position of the vessel crossing to its current position at the level of the inner limiting membrane over time. The length of the segment represented by the blue line is the Relaxation Index. Notice that this is a schematic representation on one B-scan but the actual calculation accounted for the length of the segment in the three dimensional volume scan.

https://doi.org/10.1371/journal.pone.0247192.g002

Results

The average age at baseline was 70 ± 5 yeas (Mean ± Standard Deviation). The preoperative BCVA was 0.4 ± 0.1 (range 0.2–0.6). and the axial length was 23.9 ± 1 mm.

There was an excellent inter-operator agreement for the mean RI between the two graders (Fig 3, 95% limits of agreement: -0.003, 0.043 mm). The average number of marked crossings

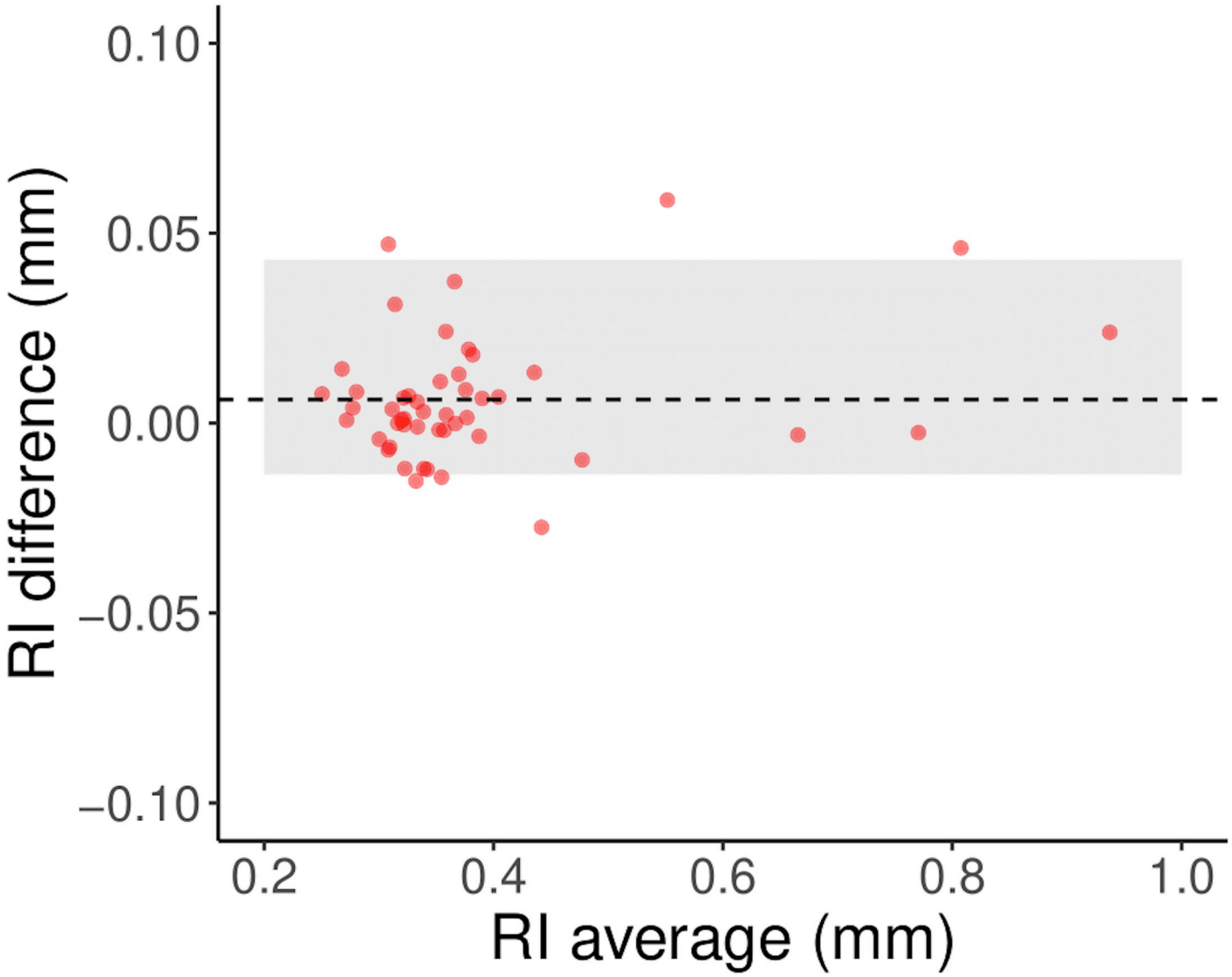

Fig 3. Bland-Altman plot showing the variability of the mean RI. The horizontal axis shows the average of the mean RI calculated from the measurements taken by each operator. The vertical axis reports its difference. The shaded area represents the 95% limits of agreement. The dashed line represents the mean difference. The figure reports the average and difference for 48 mean RI pairs, one pair for each scan.

https://doi.org/10.1371/journal.pone.0247192.g003

per OCT-A scan was 65 ± 14 for Grader 1 and 82 ± 13 for Grader 2. The average inter-operator difference was 0.006.

BCVA increased over time (Fig 4) and was significantly better than baseline at all follow ups (Tables 1 and 2). An opposite trend was observed for the RI, which was maximum at baseline and then declined over time. The RI was also significantly smaller at all time points compared to baseline (Tables 1 and 2). There was no significant change in RI after the first month compared to 6 months (Table 2). However, the BCVA at the first month was still significantly smaller than at 6 months ($p = 0.0190$). There was a significant correlation between the RI and the BCVA ($p < 0.001$).

There was no significant correlation between RI and BCVA at baseline ($p = 0.268$, correlation coefficient = 0.35). A larger baseline RI was shown to have significant correlation with a

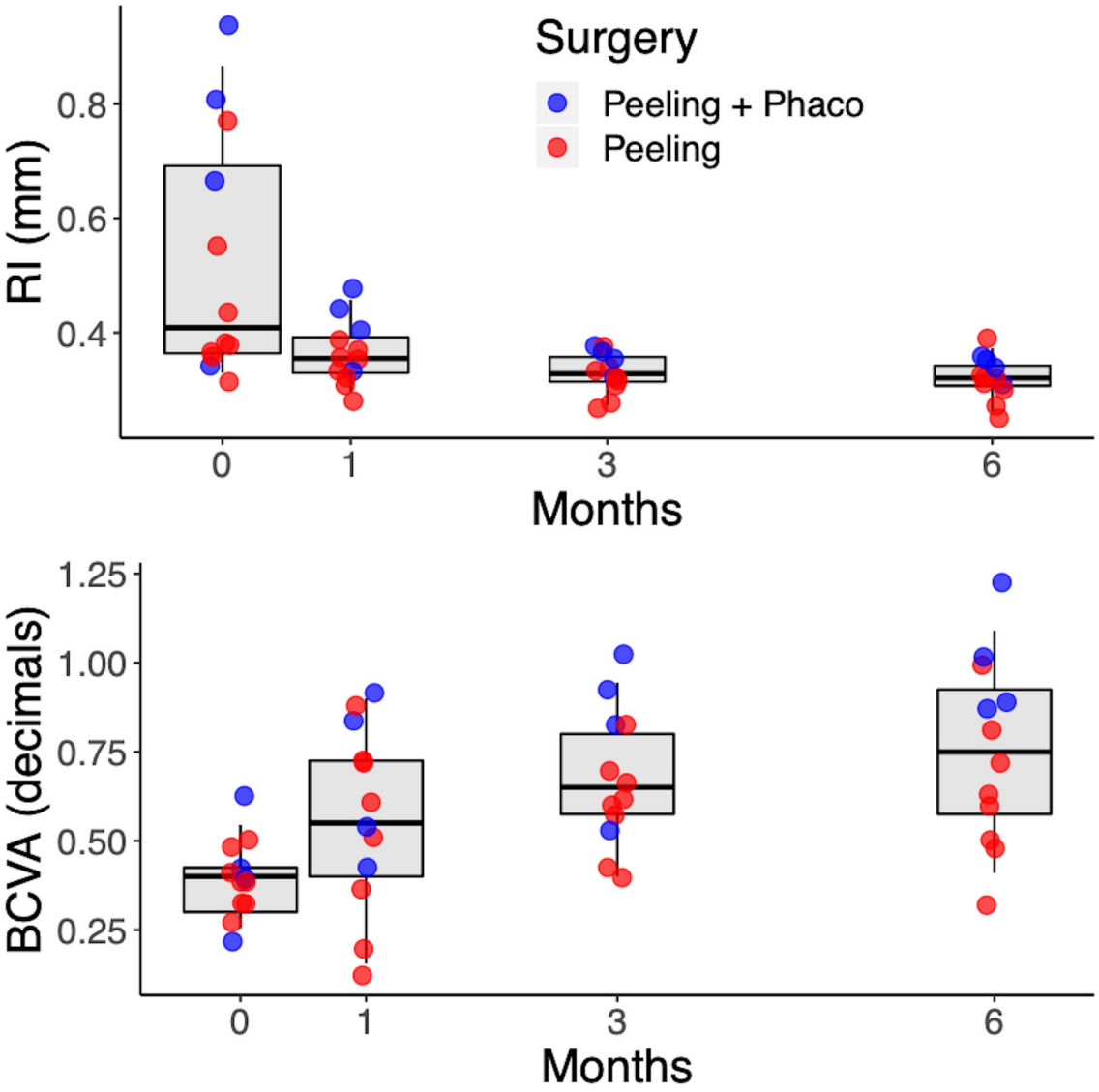

Fig 4. Changes in RI (top) and BCVA over time. The dots show the individual subjects, according to the surgical procedure they received.

https://doi.org/10.1371/journal.pone.0247192.g004

better postoperative BCVA at 6 months (Fig 5) when stratified by baseline BCVA (p = 0.0489, multivariate correlation coefficient = 0.62), meaning that the improvement in visual acuity was significantly correlated with retinal relaxation obtained after surgery.

Table 1. BCVA and RI values at different time points (mean [95% confidence intervals]).

	BCVA (decimals)	RI (mm)
Baseline	0.39 [0.27–0.52]	0.53 [0.46–0.59]
One month	0.56 [0.43–0.69]	0.36 [0.30–0.43]
Three months	0.67 [0.54–0.79]	0.33 [0.26–0.40]
Six months	0.75 [0.62–0.88]	0.32 [0.25–0.39]

The p-values refer to comparisons with the baseline.

https://doi.org/10.1371/journal.pone.0247192.t001

Table 2. P-values for the pairwise comparisons of BCVA and RI at different time points.

BCVA (pairwise comparisons)			
	One month	Three months	Six months
Baseline	0.0383	0.0006	< 0.0001
One month	-	0.1928	0.0190
Three months	-	-	0.1971
RI (pairwise comparisons)			
	One month	Three months	Six months
Baseline	0.0011	0.0001	0.0001
One month	-	0.8675	0.8675
Three months	-	-	0.8675

P-values were corrected for multiple testing using the Bonferroni-Holm method.

https://doi.org/10.1371/journal.pone.0247192.t002

Discussion

ERM development involves a vast surface of the posterior pole [4]. However, all previous studies focused on bi-dimensional changes observed in the foveal region. In this study, we elaborated a method to evaluate in three-dimensions a vast area of the posterior pole.

Fibrocellular tissue contraction is a paramount feature of the fibrosis that occurs in ERM, which ultimately threatens sight [4]. This study introduces a simple and innovative method to measure retinal distortion caused by tangential traction. We measured the position shift of vascular structures after ERM peeling in progressive ERM, interpreted as a measure of released traction. RI was highest at baseline and reached final state at 1 month. No statistically

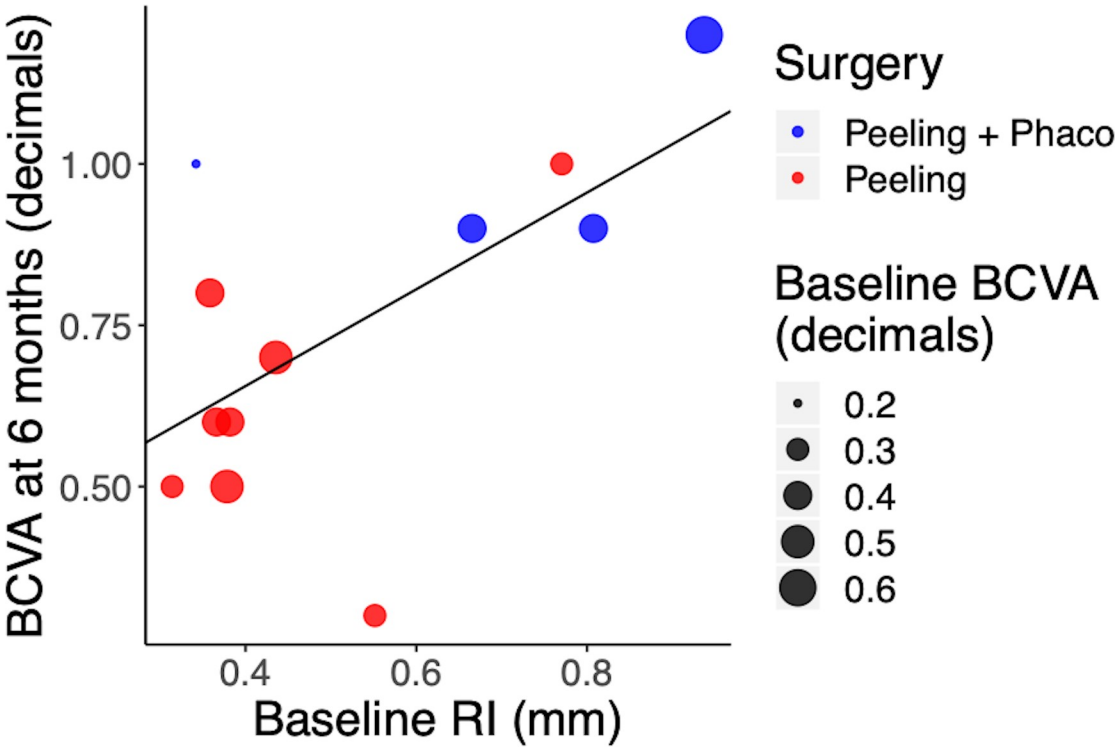

Fig 5. Relationship between the BCVA at 6 months and the RI at baseline. The size of the dots represents the BCVA at baseline.

https://doi.org/10.1371/journal.pone.0247192.g005

significant difference ($p < 0.05$) was noted with further assessments (Table 1). This finding may indicate that ERM peeling was successful in releasing traction allowing retinal layers distension and that this initial release accounted for the majority of the post-operative remodeling. Hartman et al. [19] reported, on average, a restoration of the normal anatomy 4 months after surgery. This is coherent with the idea that surgery offers an early release of traction and allows for retinal reorganization.

In this study, the scan at 6 months was considered as the maximum retinal relaxed state after surgery that we observed; however, our experimental evidence highlights that the RI does not change significantly after the first month and that the residual change between three and six months is minimal (0.01 average difference). Indeed, the major changes in both BCVA and RI happened at one month, indicating that retinal traction quantified by the RI is the major factor determining BCVA.

Furthermore, the present study found that BCVA was significantly better at every follow-up after surgery, with a gradual improvement in each visit; however, the change was small and not significant between 3 and 6 months. According to our results, the RI might not be sufficiently sensitive to predict subtle changes in BCVA after the first major retinal relaxation. Interestingly, we found a significant correlation between BCVA at 6 months and RI at baseline and in particular, cases with higher baseline RI (indicative here of larger relaxation after surgery) reached a higher BCVA at 6 months (Fig 5). Relaxation after surgery strictly depends on the grade of intra-retinal and epiretinal fibrosis, which is the result of the bond between Müller cells and ILM sustained by glial fibrillary acidic protein (GFAP) overexpression [20].

Traction has been recognized as an important prognostic factor in another study, that however focused on intra-retinal changes while measuring traction depth [21]. Moreover, many studies evaluated the relation between retinal layers morphology and BCVA, finding that the inner segment/outer segment (IS/OS) layer morphology can predict functional outcomes [22–24]. Nevertheless, intra-retinal modifications can be difficult to measure. On the other hand, qualitative descriptions of retinal changes can offer interesting insights but are ultimately limited by the narrow portion of retina considered and the subjectivity of clinical judgment.

On the contrary, our proposed index offers an objective measurement of traction release, providing a methodology to assess a successful surgery through the reduction in the RI. Even so, other features not described by the RI, such as changes to the IS/OS or to the photoreceptors, will likely need to be integrated in a multifactorial index to accurately describe the effects of ERMs on the retina and their functional consequences and this will be the objective of future work.

Of course, our current application is limited by the retrospective nature of the analysis. This implies that only RI reduction could be observed in our dataset by comparing the pre-operative state with the relaxed retina at 6 months after surgery, assumed to be at maximum relaxation. Nonetheless, this is not an intrinsic limitation of the methodology. Indeed, such a measure could be used in prospective observations to precisely track changes in retinal morphology over time. This latter aspect should be explored in a prospective study with long pre-operative follow-up series and will be the objective of future work.

To the best of our knowledge, this is the first study introducing a measurement for epiretinal traction and demonstrating its efficacy in the assessment of patients undergoing surgical treatment.

Our analysis is fraught by some limitations. The major hurdle for wide-scale clinical application is the need for manual landmark placement to detect vascular shifts therefore, automation of this process will be a crucial step in development of the technique. More sophisticated image analysis, including machine learning approaches, could be relatively fast and effective, but will likely need larger datasets to be implemented. The measurement of the local retinal

thickness could also be automated with direct access to segmentation data, possibly aided by the use of freely available segmentation software [25, 26]. In addition, our analysis rests on the assumption that the built-in fundus tracking software used by the Spectralis SD-OCT was able to effectively register images in our follow-up scans. Despite being a proprietary technology whose details have not been disclosed, we can safely assume that the registration software relies heavily on vascular structures, which are the major features used for alignment of fundus images [27–29]. These structure are, however, continuously changing in the post-operative phase and this is indeed the basis for our analysis. Consequently, careful evaluation of alignment accuracy for this specific application is of paramount importance, with the possible need for the implementation of bespoke alignment algorithms. Nevertheless, in our dataset, we could not detect, at least by visual inspection, any major errors in the alignment process. Particularly, the optic nerve head and the major vessel branches were always aligned, except in the parafoveal region, where post-operative changes were indeed expected. One assumption of our index is that photoreceptors are anchored to the RPE and that no horizontal sliding of the retina occurs in the post-operative phase. We feel that this assumption is justified given the current understanding of RPE-photoreceptor adhesion [16], but specific evidence to support this in the post-operative phase is still lacking. Furthermore, we included patients undergoing combined surgery (Phaco-Peeling) could have influenced our measurement of BCVA results.

Finally, the small sample size could have limited our ability to detect subtle changes beyond the early post-operative phase. We highlight that at this stage RI can only be calculated based on the relaxed state at 6 months and therefore cannot be used to predict the outcome before surgery. Future research based on pre-operative longitudinal follow-ups will determine whether this index can accurately predict post-operative visual outcomes. Indeed, future work will focus on further development and validation of the technique on larger datasets, which will likely require a cooperative effort from multiple clinical centers.

Conclusion

This proposed new method measures retinal stress induced by epiretinal traction, allowing a precise and comprehensive evaluation of the macular region and its changes. This study demonstrates that patients with higher release of traction after surgery reached a higher BCVA at 6 months. Therefore, tangential traction can be easily measured and correlated with functional outcomes. In the future, the integration of RI measurement into clinical imaging systems will enable a systematic three-dimensional assessment of epiretinal traction progression.

Supporting information

S1 File.
(XLSX)

Acknowledgments

We acknowledge Mrs. Alison Rhodes for revising the English language in the manuscript.

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Writing – review & editing: Giovanni Montesano, Nicoletta Rosso, Raffaele Raimondi, Matteo Cacciatori, Mario R. Romano.

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