検索することが第一であるが，次に両眼開放下で自然に固視交代しているかどうか観察し，弱視の有無を判定する。固視交代不良の場合には，固視眼を遮閉して斜視眼が中心固視するか，固視状態は良好に持続するか，遮閉をはずした時に固視が他眼に移らずに持続するかを観察し，弱視の程度を判断する（図3）。

治療の原則は屈折の完全矯正と健眼遮閉であり，内斜視の場合には必ずアトロピン点眼を用いた調節麻痺下の屈折検査を行う。その際に家族にはアトロピン中毒症状について十分に説明し，予防のため年齢に応じて濃度を調製する（3歳未満では0.25%，3歳以上6歳未満では0.5%点眼液）。通常検査日の1週間前より1日2回点眼し，点眼後に涙嚢部を圧迫するよう指示する。乳幼児では検影法による他覚的屈折検査が基本であり，親の膝の上に座らせるなど，つとめて自然な状態で測定するのが望ましい。

遮閉治療は，完全遮閉で交代固視良好となるまで続けるが，0～2歳までは感受性が高く，軽度の弱視であれば1～2時間/日の交代遮閉で，中等度の弱視でも2～3時間/日の健眼遮閉で治療可能である。斜視眼が固視不良の場合には高度の弱視と考えられ，さらに長時間の遮閉（4～6時間/日）が必要である。

2. 斜視弱視治療の注意点

年長児ですでに偏心固視の確立した斜視弱視は治療困難であるが，斜視の早期発見により偏心固視を伴う高度の弱視は少なくなった。

アイパッチによる完全遮閉の困難な乳幼児，潜伏眼振の著明な小児，皮膚障害を起こす小児にはアトロピン遮閉を用いる。健眼に1日1回1～3週間点眼し，1～2週間休む方法で，中等度までの弱視には有効である。しかし，固視眼が逆転して健眼の弱視化をまねくことがあり，アトロピンの副作用とともに注意を要する点である。

また，斜視の治療経過中にフレネル膜プリズムを用いる際には，固視眼に膜プリズムを装用させるのが原則である。特に12Δ以上のプリズム度数になると，視力を低下させ不完全遮閉効果が出ることを覚えておきたい。

Ⅳ. 不同視弱視と微小角斜視弱視

1. 弱視の鑑別と治療方針

3歳児眼科検診により発見されるケースが増加し，治療予後が良好となった。正確な視力検査と屈折検査が診断のポイントとなる。一般に2D以上の遠視性不同視が弱視を起こしやすく，1%cyclopentolate（サイプレジン®）点眼を用いた調節麻痺下屈折検査が必要である。一方，微小

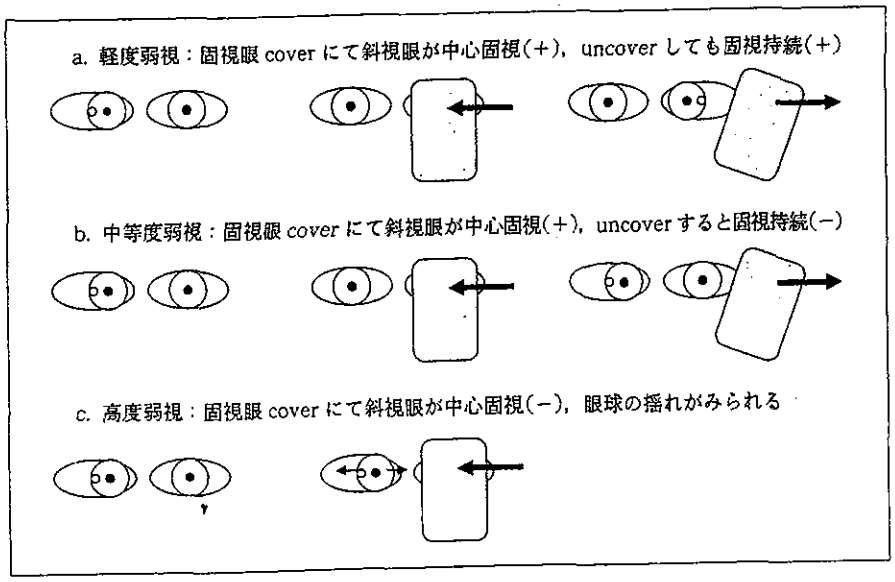

図3　斜視弱視（固視交代不良）の診かた

角斜視弱視は，斜視角が小さく不同視を伴うことが多いため不同視弱視と混同されやすい。微小角斜視弱視では偏心固視（傍中心窩固視），異常対応が成立しており，弱視治療が奏効しにくく良好な立体視は得られない。診察の際に繰り返し固視検査を行い，4Δ base out test により中心窩抑制の有無をみると鑑別が可能である。

また，近視性不同視は弱視を起こしにくく，弱視となるのは通常5D以上の不同視であるが，しばしば黄斑部に器質的障害があり予後不良である。

いずれの弱視であっても，はじめに調節麻痺下屈折値の完全矯正眼鏡を常用させるのが治療の基本である。

2. 遮閉法の選択

不同視差と視力差の少ない不同視弱視では，3歳から始めれば眼鏡装用のみで治療が可能である。眼鏡を常用させても視力が十分に向上しない場合に健眼遮閉を併用する。

遮閉法の基本は効果の高い健眼完全遮閉であり，視力0.15以下の例では絶対適応である。不同視弱視では，遮閉弱視や斜視の発生を防ぎ両眼視機能の発達を阻害しないように短時間の part-time occlusion を用いる。3歳児で3時間/日の遮閉をめやすとし，弱視の程度や年齢，治療経過によって増減する。微小角斜視弱視では3歳児で4～6時間/日の遮閉が必要である。0.3程度までは視力が向上する例が多いが，偏心固視のため視力が向上しない例，斜視角の増大する例，強力な遮閉治療により intractable diplopia を起こす例があるため十分な注意が必要である。潜伏眼振の出る例，完全遮閉のできない例ではアトロピン点眼や遮閉膜による不完全遮閉，ペナリゼーションなどを用いる。

V．非正視（屈折異常）弱視

非正視弱視は1%cyclopentolate点眼による調節麻痺下の屈折検査に基づき，完全矯正を行えば予後良好である。就学前後の年長児の場合には，普通瞳孔下での自覚的視力検査を行い最高視力の得られる度数まで減ずる。小児では原則として乱視は完全矯正とする。

視力の測定状況によって，単なる屈折異常でも矯正視力が出ないことがある。調節麻痺下屈折値をもとに，測定方法を工夫しながら日をあらためて繰り返し検査し，弱視かどうか判断する。どの程度の屈折異常がある場合に弱視を発生するかは年齢や個々の条件によって違うが，一般に一定以上の遠視，乱視がある場合には弱視となる危険が高い（表2）[4]。したがって弱視の予防，治療のために積極的に矯正眼鏡を装用させる。就学前の小児に対する適切な屈折矯正眼鏡の処方は，集団生活へ向けての知的身体的発達を促すためにも有用である。

表2 矯正の対象となる屈折異常

遠視	+3.0D以上
遠視性単乱視	cyl+2.0D以上
遠視性複乱視	+2.25D cyl+1.0D以上
雑性乱視	cyl 2.0以上

通常は治療開始後6ヵ月程度で視力が向上するが，奏効しない場合には眼鏡の装用状態を確認するとともに固視，眼位を再検査し，微細な眼振，黄斑ジストロフィーや視神経疾患などの器質的眼疾患，中枢神経系疾患がないかどうか，もう一度検索する必要がある。

おわりに

日常遭遇するさまざまな弱視の基本的な診かたと治療方針について述べた。特に乳幼児期の眼疾患に起因する弱視は，臨床の場における適切な早期診断が大きく予後を左右することをあらためて強調したい。

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先天白内障

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先天白内障は，疾患そのものの治療（手術・術後管理）と弱視治療とが長期的に成功してはじめて良好な視機能が得られる疾患である。形態覚遮断弱視が確立すると手術は無効となり，いたずらに術後合併症の危険を増加させるだけである。完全白内障であれば両眼性で生後2～3か月以内，片眼性では生後1か月以内の早期手術が必要であり，眼・全身合併症が高率のため術前の評価が非常に重要である。弱視治療の成功の見込み，手術や全身麻酔に伴うリスク，術後合併症の長期管理が不可欠であることなどを十分に家族に説明して，手術適応を決めることが大前提である。

われわれの施設で過去に治療を行った先天白内障では，何らかの眼・全身合併症を伴う患児が両眼性で64%，片眼性で48%を占めていた。このような他の先天異常を伴う白内障の治療経験をもとに術前評価，術中・術後の留意点と代表的な眼合併症例の対応策について以下に述べたい。

術前評価と術式の選択

1．術前検査

遮断弱視の形成の有無と程度の評価，白内障の原因検索，全身合併症の検索は，全身麻酔下白内障手術の適応を決めるため必要不可欠である。弱視や視路の評価には視覚誘発電位（visual evoked potential：VEP）が最も有用であるが，はじめに患児の発達状態，斜視や眼振・異常眼球運動の有無，白内障の形態をよく観察して必要な検査を迅速に進めることが大切である。眼底が観察できる程度の左右差のない層間白内障や核白内障で，検影法（skiascopy）で十分な徹照が得られる場合には，早期手術は不必要なため，選択視法（prefereutial looking：PL）やTeller Acuity Cardsを用いた視力検査を取り入れながら経過観察する。脳性盲や重篤な全身疾患の合併例では手術の適応とはならない。

術前に散瞳下細隙灯検査や双眼倒像鏡眼底検査を行って白内障の形態や合併症の有無を直接観察し，さらに術直前に全麻下検査を行うのが基本である。水晶体を含めた前眼部の形成異常について，すなわち小角膜・角膜混濁の有無，前房の深さ，虹彩と隅角所見，散瞳の良否，水晶体の形状（膨隆，菲薄化，硬化，膜状，球状，偏位）をよく観察するのがポイントである。また詳細な眼底検査が困難なため，必ず超音波検査を行って後眼部の異常の有無，すなわち小眼球，コロボーマ，網膜ひだや網膜剝離，第一次硝子体過形成遺残（persistent hyperplastic primary vitreous：PHPV），視神経低形成などを検出する。必要に応じて頭部および眼窩CT検査を行う。

2．術式の選択[1)]

学童期以降の白内障では通常眼内レンズ（IOL）挿入術を行うが，乳幼児の白内障，ことに眼合併症のあるものにはIOLは挿入せずコンタクトレンズ（CL）または眼鏡矯正とする。合併異常の頻度の高い先天白内障の早期手術においては，経角膜輪部水晶体・前部硝子体切除術を基本術式としている。経毛様体扁平部・皺襞部法に比べて角膜や虹彩・隅角への侵襲が大きいが，一方発達途上

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の毛様体や硝子体基底部を損傷する危険性がない。PHPVをはじめ，先天白内障眼には予期せぬ周辺部網膜や毛様体の構造異常が存在する可能性があり，経毛様体法では術中鋸状縁断裂や晩期合併症としての網膜剝離を誘発するおそれがある。ここでは，経角膜輪部法における留意点を中心に述べる。

術中・術後の留意点

1. 手術手技のポイント

水晶体・前部硝子体切除には通常20Gの硝子体手術用カッターを用いる。小角膜，浅前房の場合は25Gカッターを用いる。第1のポイントは創口形成である。乳児は術野が狭く，特に鼻側の器械の操作が難しい。器械の挿入方向を確認して3時，9時付近の2か所，輪部の強膜寄りに硝子体メスで創口を形成する。このとき創口が後方すぎると隅角を損傷して前房出血をきたし，前方すぎると角膜混濁を生じる。創口の片方から眼内灌流液につないだ21G針を挿入し，他方から硝子体カッターを挿入して水晶体切除を開始する。

第2のポイントは前房内操作である。前嚢中央を切除して水晶体皮質を吸引切除するが，乳児の強膜や角膜は軟らかく歪みやすいため，創口に不適切な圧力が加わると容易に前房消失して後嚢破損をきたす。器械の出し入れは最小限とし，操作中には前房の保持に十分な注意を払う。

皮質をすべて吸引切除後，後嚢切除を行い，引き続き前部硝子体切除を行うが，第3のポイントは十分に嚢切除と硝子体切除を行っておくことである。乳児では術後に急速に厚く硬い後発白内障を生じやすく，残存した嚢の強い収縮によって網膜剝離をきたすおそれもある。また残存皮質や嚢により高度の術後炎症や瞳孔癒着を起こすことがある。虹彩裏面の操作は特に難しいが，硝子体カッターを虹彩と嚢の間に挿入し，吸引口を下にして全周赤道部まで徹底的に嚢を切除する。続いて瞳孔領の後方にカッターを挿入して全周にわたり前部硝子体切除を行うが，この際に不用意な硝子体の牽引や硝子体の嵌頓に十分注意する。

乳児では十分に前部硝子体切除を行うと低眼圧となり軟らかい眼球が虚脱したようになることも稀ではない。最後に，開瞼器の圧迫をゆるめて適宜灌流液を追加し眼圧を一定に保つ必要がある。また創口は小さいが，10-0ナイロン糸で確実に縫合を行うことが大切である。

2. 術中合併症に対する注意と対策

経角膜輪部法で特に注意を要する術中合併症は角膜混濁と虹彩・隅角の損傷である。カッターの吸引口は横向き，21Gの灌流針は下向きにして挿入し，器械の出し入れや挿入方向に細心の注意を払う。虹彩・隅角損傷による出血は少量であれば自然吸収されるが，術中の出血や縮瞳は視認性を低下させて以後の操作が困難となる。また角膜混濁が高度になると視認性が低下し，術後乱視や弱視の原因ともなるため，器具の出し入れや前房操作の際に歪みを生じないように留意し，なるべく短時間で操作を終える。

皮質を吸引切除する前に後嚢破損をきたしたときには，硝子体を吸引しないように注意しながら，残りの皮質を落下させないように吸引把持して手早く切除する。創口への硝子体嵌頓の有無は最後にオビソート®を前房に注入して確認し，嵌頓硝子体は再度カッターにて虹彩上を払うように除去し瞳孔領で切除を加える。後嚢破損のなかった場合でも，術中に眼底検査を行って合併症の有無を確認する。

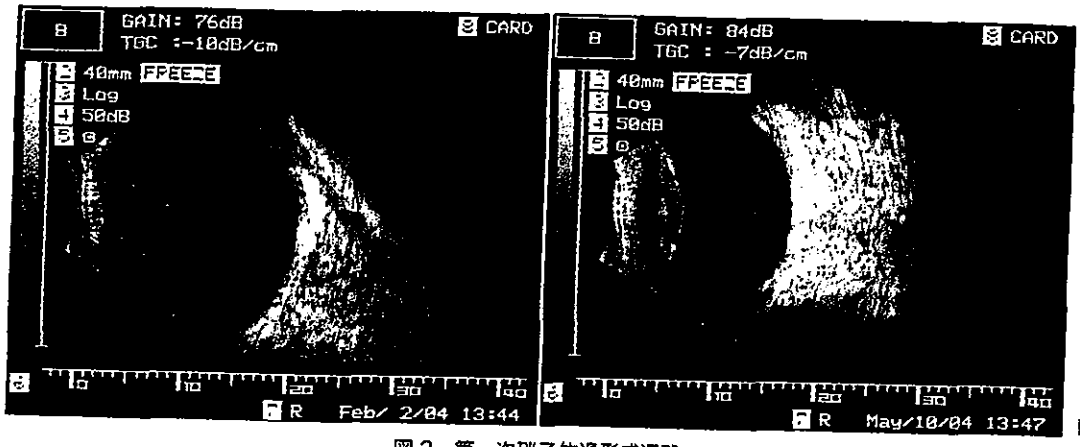
3. 術後合併症の管理と対策

重篤な術後合併症として後発白内障，緑内障，網膜剝離が挙げられる。後発白内障を生じた場合には弱視治療が困難となるため迅速な再手術が必要である。乳児では成人と異なり厚い線維性膜組織を形成していることが多く，硝子体カッターや剪刀による処理が必要である。

緑内障は特に小角膜や虹彩低形成，PHPVなどの先天異常を伴う白内障眼に頻度が高く，長期にわたる管理が必須である。乳幼児のうちは発見が遅れがちとなるため，定期的に全身麻酔下検査を行うのが望ましい。外来では正確な眼圧を測定することは困難なため，角膜や前房所見，視神経乳頭所見，屈折変化などに注意して早期発見に努め

a b

図1 Hallerman-Streiff 症候群の2か月男児にみられた両眼小眼球・先天白内障
25G 硝子体カッターを用いて虹彩下の後嚢を切除した (b)。



a b

図2 第一次硝子体過形成遺残
a：軽度の前部型 PHPV を伴う先天白内障，b：硝子体血管遺残を伴う先天白内障。

る。眼圧下降薬の点眼のみで眼圧コントロール可能な例では一般に予後がよいが，先天異常眼ではしばしば隅角異常を合併し重篤な緑内障をきたす。薬物治療が奏効しない場合にはトラベクロトミー，トラベクレクトミーによる手術治療を行うが，難治性であり視力予後不良となる。

乳幼児期の網膜剝離は最も重篤な術後合併症である。高度の増殖性変化をきたし硝子体手術を必要とする例が多いが，残存硝子体を完全に処理することは困難であり手術予後は不良である。網膜剝離は特に全身合併症を伴う発達遅延の患児に多い。目押しや眼球打撲に十分注意を払うよう家族に説明し，自傷行為や多動の目立つ患児にはヘルメットや保護眼鏡の装着を勧める。

代表的な合併症例

1. 小角膜・前眼部形成不全

高度の小角膜ほど術後緑内障の発症率が高い[2]。われわれの調べた長期観察結果では角膜径8～9 mm で 22%，8 mm 以下では 58% に緑内障（眼圧＞21 mmHg）をきたした。高度の小角膜眼では Peters 奇形，虹彩低形成，コロボーマ，水晶体形態異常など種々の前眼部形成異常を認め，隅角形成異常による重篤な緑内障の発症が多い。このような例では両眼性の場合のみ手術適応となるが，虹彩や隅角への侵襲を最小限にとどめ，角膜混濁が増強しないように短時間で水晶体・前部硝

子体を完全に切除しなければならないため高度の技術を要する。著しい小角膜眼では，最近は25Gの硝子体カッターを使用している（図1）。また膜状白内障や硬化白内障を伴うことがあり，カッターで全切除が困難な場合には，一部を硝子体鑷子で摘出する。

2. 第一次硝子体過形成遺残（PHPV）

特に片眼先天白内障ではさまざまな型のPHPVを伴うことが多い[3]。前部型PHPVの場合には手術適応となるが，術前に超音波検査を行って周辺部網膜や毛様体，水晶体の牽引偏位の有無をできるだけ観察する。また片眼もしくは両眼例においても，しばしば水晶体後嚢裏面に軽度の遺残血管組織を認めることがある（図2）。後嚢の変形を伴う場合には，術中に後嚢破損のおそれがあるため慎重な前房内操作が必要である。

経角膜輪部法では創口形成や器具の出し入れの際にPHPVに牽引された周辺部網膜を損傷するおそれはないが，虹彩下で後嚢切除を行う際に盲目的に周辺まで切除を進めないよう注意する。また後嚢に連続した血管組織を認める場合には，後嚢切除を開始後，中央部を切除する前に眼内バイポーラで止血処置を行う。カッターで切除困難なPHPVは硝子体剪刀で切除して摘出する。

3. 網膜ひだ

高度の両眼白内障で片眼のみでも視力を向上させようとする場合に手術を検討する。網膜ひだなどの後眼部異常を伴う白内障眼の手術は，あらかじめ網膜硝子体手術を念頭において準備する。後嚢および前部硝子体切除の際には増殖組織や牽引された網膜を損傷しないように十分注意し，術中の眼底検査により追加処置を検討する。

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MEDICAL BOOK INFORMATION ——— 医学書院

＜総合診療ブックス＞

ギア・チェンジ

緩和医療を学ぶ二十一会

編集　池永昌之・木澤義之

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避けられない死を目の前にした患者に必要な医療とケアは，それまで受けてきたものとは異なり，車の速度に合わせてギアを入れかえるように，切り換えが求められる。本書は，死にゆく患者に対応するすべての医師と医療スタッフに向けて，患者が人生最後の日々を迎えたときの対応を学ぶ一期一会を，21の教訓的な症例をもとに解説する。

下町流往診日記

川人　明

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病棟，外来からとび出して20年。往診回数3万回を超える著者が，下町庶民との濃密な交わりの中から紡ぎ出した珠玉の「物語」。生と死の境界で生きる患者家族の哀歓とドラマを軽妙な名文で描く他人の作。時に往診医をうならせる抱腹絶倒の世態人情小噺集。往診でのみ感じる臨床の醍醐味をいきいきと描いた秀作。

TRANS-TENON RETROBULBAR TRIAMCINOLONE INFUSION FOR CHRONIC MACULAR EDEMA IN CENTRAL AND BRANCH RETINAL VEIN OCCLUSION

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Chronic macular edema associated with central retinal vein occlusion (CRVO) and branch retinal vein occlusion (BRVO) is often refractory to treatment including topical and oral corticosteroids, oral acetazolamide, and grid pattern laser photocoagulation.[1,2] Recently, more invasive therapies, including vitrectomy and intravitreal corticosteroid injections, have been investigated as a means of treating macular edema,[3,4] although these carry risks of severe complications, including vitreous hemorrhage, retinal detachment,

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and endophthalmitis. We previously reported the use of trans-Tenon retrobulbar infusion of triamcinolone acetonide to treat macular edema and other manifestations of uveitis.[5] Here we report on use of the same to treat chronic macular edema in association with CRVO and BRVO.

Methods

Five eyes of five patients with CRVO and 11 eyes of 11 patients with BRVO were studied. The median patient age was 71 years (range, 30–80 years); three patients had a history of diabetes mellitus and seven had hypertension. Four of the CRVO eyes were ischemic, all having received panretinal photocoagulation, and one eye was nonischemic. One CRVO eye had optic disk neovascularization and an additional CRVO eye had retinal neovascularization elsewhere. One BRVO eye had received scatter photocoagulation to nonperfused areas of retina. All eyes had macular edema of greater than 3 months' duration that was unresponsive to topical corticosteroid therapy. Two CRVO eyes had undergone vitrectomy for the macular edema, one with epiretinal membrane peeling in addition, but both eyes were without improvement. No eyes had received grid pattern laser photocoagulation to the macula.

Informed consent was obtained before each procedure. The patient's eye was prepped and draped, with topical instillation of 4% Xylocaine. The conjunctiva and Tenon capsule were incised in the inferotemporal quadrant, followed by insertion to the hub of a 23-gauge curved blunt cannula approximately 2.1 cm in length (#HS-2764; Handaya Co., Tokyo, Japan) into the sub-Tenon space and infusion of 20 mg triamcinolone acetonide (Bristol Pharmaceutical, K.K., Tokyo, Japan). The wound was left unsutured, and 0.5% levofloxacin was instilled three times daily for 1 week.

Patients were examined after the procedure at 2 to 4 weeks, 2 months, 3 months, and 6 months. Eyes were evaluated by measurement of best corrected decimal visual acuity (VA) and intraocular pressure (IOP), slit-lamp examination, dilated funduscopy, fluorescein angiography, and optical coherence tomography (OCT). VA improvement or worsening was defined as a change of 0.2 logMAR or greater. Foveal thickness was defined as retinal thickness at the center of the fovea by OCT, taking the mean of two cross-hair images. Efficacy of treatment was defined as a foveal thickness decreased by 30% or more within 3 months from the pretreatment foveal thickness. Recurrence of macular edema was defined as a 20% or more increase in foveal thickness over the thinnest documented previously. Repeat triamcinolone infusion was considered for recurrence of macular edema or for an inadequate response to the initial infusion, and only in the absence of elevated IOP. Clinical records were reviewed retrospectively.

Case Report

A 73-year-old woman (Table 1, patient no. 2) presented 14 months after the onset of CRVO in her right eye. She had received scatter peripheral retinal photocoagulation at 1 month after onset. At presentation, the VA was 0.2, and dilated funduscopy revealed retinal venous sheathing consistent with an old CRVO, peripheral laser scars, and severe cystoid macular edema (Figure 1A, B). The foveal thickness was 368 μm. Two weeks after triamcinolone infusion, the visual acuity had improved to 0.4 with a foveal thickness of 57 μm (Figure 1C). At approximately 13 months, the visual acuity was unchanged at 0.4 and the foveal thickness was 140 μm. No complications were observed.

Results

Visual acuity and OCT results of each patient are presented in Table 1. The median time between onset of vein occlusion and triamcinolone infusion was 13.9 months (range, 3.8 months to 10 years), and the median post-triamcinolone infusion follow-up period was 7.0 months (range, 3.0–22 months). Before treatment, one eye (6.3%) had a VA of 0.6 or better; 14 eyes (87.5%) had a visual acuity of worse than 0.6 but better than 0.1, and one eye (6.3%) had a visual acuity of 0.1 or worse. After treatment, four eyes (25.0%) had a VA of 0.6 or better; 10 eyes (62.5%) had a VA of worse than 0.6 but better than 0.1, and two eyes (12.5%) had a VA of 0.1 or worse. At the time of best VA and at final examination, VA improvement was documented in 8 of 16 eyes (50.0%). At final examination, two eyes (12.5%) had VA worsening, presumably due to persistent macular edema.

Treatment was judged to be effective in 13 of 16 eyes (81.3%) by 3 months after a single infusion, 5 of 5 CRVO eyes (100%) including the 2 eyes status-post vitrectomy, and 8 of 11 BRVO eyes (72.7%). Of the three eyes in which initial treatment was judged not to be effective, two eyes (both with BRVO) underwent a second triamcinolone infusion at 3 months and at 6 months, but without improvement in the macular edema. Of the 13 eyes in which initial treatment was judged to be effective, 8 eyes (61.5%) had recurrences at 2 weeks to 9 months after treatment. Five of these recurrence eyes received a second triamcinolone infusion, four eyes at 3 months and one eye at 9 months after the initial infusion. One recurrence eye eventually received a total of four infusions over a 1-year, 4-month period. After repeat triamcinolone infusion for recurrence of macular edema, treatment was

Table 1. Visual Acuity and Foveal Thickness after Triamcinolone Infusion

Patient No.	Diagnosis	Duration* (months)	Initial VA	Best VA	Time of best VA† (months)	Final VA	Time to recurrence§ (months)	Number of infusions	Follow-up (months)	Initial FT (μm)	Best FT (μm)	Final FT (μm)
1	CRVO	5.2	0.4	1.0	12	1.0‡	3	4	22	708	249	249
2	CRVO	14	0.2	0.4	0.5	0.4	9	2	13	368	57	140
3	CRVO	8.9	0.2	0.4	1	0.1	1	2	10	509	227	481
4	CRVO	6.1	0.2	0.5	1	0.5	NR	1	6.9	340	57	124
5	CRVO	10.6	0.2	0.4	3	0.4	NR	1	7.0	396	113	150
6	BRVO	23	0.5	0.8	12	0.8	1	2	13	396	170	516
7	BRVO	120	0.7	0.8	0.5	0.7	1	1	4.5	395	226	340
8	BRVO	3.8	0.2	0.5	3	0.5‡	NR	2	12	368	198	556
9	BRVO	14	0.4	0.4	NA	0.4	NR	2	10	340	283	526
10	BRVO	17	0.4	0.5	6	0.4	NR	1	7.0	283	NA	375
11	BRVO	20	0.4	0.6	3	0.5	NR	1	6.2	509	425	828
12	BRVO	23	0.5	0.5	NA	0.5	NR	1	3.1	283	113	150
13	BRVO	5.0	0.2	0.2	NA	0.1	3	2	4.7	509	283	573
14	BRVO	27	0.2	0.2	NA	0.2	1	1	3.3	255	170	210
15	BRVO	16	0.1	0.4	1	0.4	1	1	3.5	379	182	263
16	BRVO	8.8	0.5	0.9	1	0.8	NR	1	3.0	521	131	131
	median	13.9	0.3	0.5	2	0.5			7.0	387	182	302

BRVO, branch retinal vein occlusion; CRVO, central retinal vein occlusion; FT, foveal thickness; NA, not applicable; NR, no recurrence; VA, visual acuity.

* Duration between time of onset and triamcinolone infusion.

† Earliest time at which best VA or best FT was achieved after triamcinolone infusion.

‡ Visual acuity partially affected by cataract progression.

§ Time of first recurrence measured from time of initial triamcinolone infusion.

judged to be effective in two eyes and not effective in three eyes.

Cataract progression was documented in three eyes (18.8%), one eye having received four triamcinolone infusions. IOP elevation, infection, and other complications were not noted.

Discussion

Chronic macular edema remains one of the most difficult to treat sequelae of CRVO and BRVO. Although some eyes improve spontaneously, 58% of eyes with macular edema due to CRVO will have a visual acuity worse than 20/100 after 3 years and less than 20% of eyes will gain two or more lines of visual acuity.[1] The Central Vein Occlusion Study demonstrated that grid pattern laser photocoagulation had no significant impact on the final visual acuity of eyes with CRVO and macular edema.[1]

Triamcinolone acetonide is a potent, relatively insoluble corticosteroid used for the treatment of intraocular inflammation by periocular injections. We have recently shown efficacy of trans-Tenon retrobulbar infusion of this drug for the treatment of vitritis and cystoid macular edema in association with uveitis.[5] The mechanism by which triamcinolone infusion can decrease chronic macular edema in eyes with CRVO and BRVO is unclear, but stabilization of the blood-retinal barrier via reduction of inflammatory cytokines may play a role. Chronic macular edema with CRVO or BRVO may also be due to traction on the retina by posterior vitreous cortex or epiretinal membrane. However, the fact that two CRVO eyes in our study, which did not improve after vitrectomy, responded to triamcinolone infusion suggests that vitreoretinal traction alone was not the cause of the macular edema.

Treatment efficacy by OCT was obtained in 13 of 16 eyes (81.3%) after a single triamcinolone infusion, but 8 of these initially responding eyes had recurrence of macular edema. Two of five recurrence eyes that underwent repeat triamcinolone infusions subsequently responded. Therefore, overall efficacy was obtained in 7 of 16 eyes (43.8%) in this study. Recurrences are a clear limitation of this treatment, and longer follow-up is required to investigate this issue. However, since 50% of eyes experienced visual acuity improvement, the clinical course after triamcinolone infusion appears to represent an improvement over natural history.[1]

Conclusion

Trans-Tenon retrobulbar infusion of triamcinolone acetonide may be effective in decreasing foveal thick-

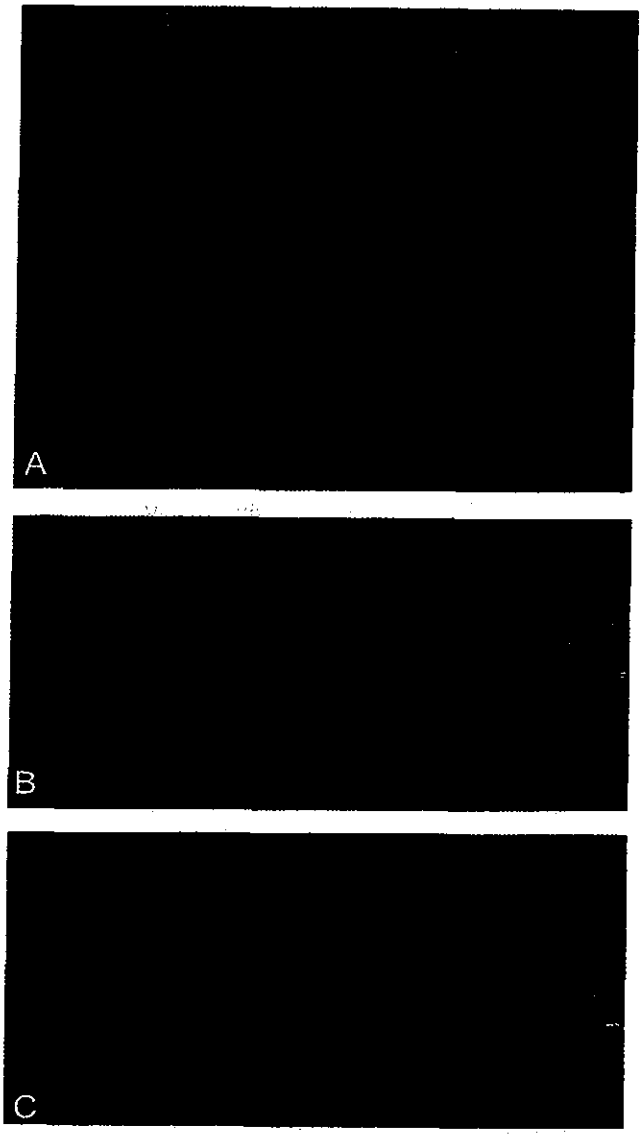

Fig. 1. *Fundus photograph* (**A**) of a 73-year-old woman at 14 months after onset of central retinal vein occlusion in her right eye. Optical coherence tomography examination revealed a foveal thickness of 368 μm before (**B**) and 57 μm at 2 weeks after (**C**) trans-Tenon retrobulbar triamcinolone infusion.

ness and improving visual acuity in eyes with chronic macular edema due to BRVO or CRVO.

Key words: branch retinal vein occlusion, central retinal vein occlusion, macular edema, triamcinolone acetonide.

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Vitrectomy for Myopic Posterior Retinoschisis and/or Foveal Detachment

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Abbreviated title: Vitrectomy for Myopic Macular Detachment

None of the authors have proprietary interests in the contents of this research.

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Abstract

Purpose: To evaluate the efficacy of vitrectomy for posterior retinoschisis (RS) and/or foveal detachment (FD) associated with posterior staphyloma in myopic eyes.

Methods: Sixteen eyes in 14 consecutive patients (52 to 78 years of age) with progressive visual impairment as a result of myopic RS and/or FD were examined. Optical coherence tomography demonstrated the presence of a variety of RS and FD characteristics. Five eyes had RS alone, and 11 eyes had RS and FD. Two eyes with RS and severe FD developed retinal detachment in conjunction with a tiny macular hole. We performed vitrectomy, including posterior vitreous separation in all eyes and internal limiting membrane (ILM) peeling in 6 eyes. The patients were followed postoperatively for 6 to 66 months (mean, 24 months). The anatomic outcome and visual acuity were then retrospectively analyzed.

Results: Although 2 eyes with RS and severe FD developed retinal detachment with a macular hole after an initial vitrectomy, final retinal reattachment was achieved in all 16 eyes. Visual acuity improved in 9 eyes and remained unchanged in 7 eyes.

Conclusion: Vitrectomy with posterior vitreous separation is effective for reattaching the macula and preventing a deterioration of vision, although eyes with RS and severe FD may be at risk for the development of a macular hole after the initial vitrectomy.

Keywords: high myopia, macular detachment, optical coherence tomography (OCT), retinoschisis, vitrectomy

Contents of manuscript

Introduction

Posterior retinal detachment associated with a macular hole is a well-known complication in highly myopic eyes with posterior staphyloma. However, localized shallow posterior retinal detachment inside posterior staphyloma can also exist in the absence of a macular hole. In 1958, Phillips noted that localized posterior retinal detachment over posterior staphyloma might occur in the absence of a retinal hole.[1] Using optical coherence tomography (OCT), Takano and Kishi reported that foveal retinoschisis or foveal retinal detachment occurs frequently in severely myopic eyes with posterior staphyloma, even in the absence of a macular hole.[2] They suggested that retinal detachment may precede the formation of a macular hole in highly myopic eyes. However, the pathological mechanism responsible for posterior retinoschisis and the process of macular hole development are not well understood.

Recently, several authors have reported that vitrectomy, internal limiting membrane (ILM) peeling, and gas tamponade are useful for the treatment of foveal retinoschisis in highly myopic eyes.[3-7] Kobayashi and Kishi also suggested that vitreous surgery might be indicated as a prophylactic treatment in highly myopic eyes at high risk of macular hole development.[4] However, myopic foveal retinoschisis exhibits a variety of profiles,[8,9] and the data that has been accumulated on surgical cases remains insufficient to prove whether vitrectomy is effective for the alleviation of this condition.

The purpose of the present study was to examine the clinical outcomes of vitrectomies performed in 16 eyes in 14 consecutive patients with localized shallow posterior retinal detachment inside posterior staphyloma with no retinal breaks and who exhibited signs of progressive visual impairment. Different clinical terms have been used to describe this pathological condition in previous reports, including foveal retinoschisis,[2] foveal detachment and retinoschisis,[2,4] macular retinoschisis,[5,9] shallow detachment of the macula,[1,13] and foveal

retinal detachment without a macular hole.[8] In this paper, we used the terms posterior retinoschisis (RS) and foveal detachment (FD) to describe this pathological condition.

Patients and Methods

Sixteen eyes in 14 consecutive patients with myopia and posterior staphyloma who exhibited progressive visual impairment as a result of RS and/or FD were enrolled in the study. The records were retrospectively reviewed, and approval of the Institutional Review Board was not required. The fundus of all patients was pre- and postoperatively examined using indirect ophthalmoscopy and slit-lamp biomicroscopy using a Goldman contact lens and a 90-diopter non-contact fundus examination lens (SuperField Lens®). The best-corrected visual acuity (VA) was recorded. OCT (Zeiss-Humphrey, San Leandro, Calif) was used to observe the posterior retinal changes. The anatomic outcome and VA were retrospectively analyzed for all eyes.

Surgery was initiated once the patient's vision had begun to deteriorate and the macular detachment had persisted or progressed for 3 months or longer. Two eyes (Case 13, 14) with RS and severe FD developed retinal detachment with a tiny macular hole before the vitrectomy. All the surgeries were performed by the same surgeon (AH) between September 1998 and February 2004. Vitrectomy including posterior vitreous cortex removal from the retinal surface was performed in all eyes, and internal limiting membrane (ILM) peeling was performed in 6 eyes. ILM peeling was regarded as being indicated in eyes in which the presence of posterior hyaloid separation or induction over the macula was uncertain during the vitreous surgery. After core vitrectomy, complete removal of the posterior vitreous cortex (typically appearing as a thin membrane) from the posterior retinal surface was initiated by cutting with a micro-vitreo-retinal knife (20 gauge) or a diamond-dusted membrane scraper.[10] A viscodissection technique[11] was used to advance the posterior hyaloid separation gently over

the areas of retinoschisis in the posterior staphyloma. Triamcinolone acetonide (TA) was used intraoperatively in five cases to highlight the posterior hyaloid membrane.[12] The ILM over the posterior pole was peeled after ICG staining (5 mg/ml) in 6 eyes. In 12 eyes, fluid-air exchange was performed without drainage of the subretinal fluid, followed by gas tamponade with either 20% sulfur hexafluoride (SF_6) or 14% perfluoropropane (C_3F_8). The patients were placed in a face-down position postoperatively. In 2 eyes (Patients 5 [right eye; R] and 10), silicone oil tamponade was performed because of poor vision in the opposite eye.

Twelve eyes were phakic before surgery, and 4 eyes had received phacoemulsification with intraocular lens implantation for the treatment of senile cataracts. Among the 12 phakic eyes, phacoemulsification with intraocular lens implantation was performed simultaneously with the vitrectomy in 2 eyes and after the vitrectomy in 6 eyes.

The patients were followed for 6 to 66 months (mean, 24 months) after surgery.

Results

Case Reports

Patient 1. A 59-year-old man presented with several months history of metamorphopsia in his right eye. He had a history of von Recklinghausen disease and refractive amblyopia. Examination of the right eye revealed a VA of 0.5 and a shallow serous macular detachment over the posterior staphyloma (Fig. 1A). OCT confirmed the presence of FD and RS (Fig. 1B).

After observation for 3 months, he complained of increasing metamorphopsia, although an examination of the patient's vision revealed the same results. Vitrectomy was performed, with removal of the posterior hyaloid membrane and ILM peeling by viscodissection, followed by air-fluid exchange and 14% C_3F_8 gas tamponade.

Two months postoperatively, an OCT examination showed a marked resolution in the retinal detachment, and the patient reported an improvement in the metamorphopsia. Six

months postoperatively, the patient developed nuclear sclerosis of the lens, so phacoemulsification with intraocular lens implantation was performed. Consequently, the patient's VA further improved to 0.7. The posterior retina was found to be completely reattached, with no further changes, during a 54-month follow-up examination. An OCT examination revealed a nearly normal configuration of the fovea (Fig. 1C).

Patient 2. A 53-year-old woman with a history of vitrectomy for a macular hole retinal detachment in her left eye 3 years earlier was noted to have a shallow elevation of the macula in her asymptomatic right eye during a routine follow-up examination. OCT revealed RS in the right eye.

One year later, she complained of a slight decrease in central vision and metamorphopsia in her right eye. Although her visual acuity decreased from 0.8 to 0.4, an OCT examination showed no obvious changes in the severity of the RS (Fig. 2A). Vitrectomy and phacoemulsification with intraocular lens implantation were performed. Intraoperatively, marked syneresis of the vitreous was observed. Following core vitrectomy, we were able to easily induce posterior vitreous detachment (PVD) by suctioning with the vitreous cutter everywhere except for over the posterior pole; ILM peeling was necessary to ensure the complete removal of the posterior hyaloid inside the staphyloma. Fluid-air exchange without subretinal drainage was performed, followed by gas tamponade with 14% C_3F_8. Two months after surgery, the patient reported that her metamorphopsia had diminished. An OCT examination showed a marked resolution of the RS (Fig. 2B). Six months after surgery, although the VA remained unchanged at 0.5, the patient reported an improvement in the metamorphopsia. Six years after the operation, an OCT examination confirmed the complete reattachment of the retina (Fig. 2C), and the patient's VA had been restored to 0.8.

Patient 11. A 70-year-old woman with a history of phacoemulsification with intraocular lens

implantation complained of a 4-month history of metamorphopsia in her right eye. The patient's VA was 0.4, and a shallow retinal elevation was noted extending from the superotemporal to the inferotemporal arcades over posterior staphyloma. No retinal breaks were detected. OCT revealed an RS that appeared to be connected to the conus of the optic disc, as well as a large outer layer detachment at the macula and a partial posterior hyaloid separation surrounding the RS (Fig. 3A).

Vitrectomy and 20% SF_6 gas tamponade was performed with the adjunctive use of TA intraoperatively. The use of TA to observe the posterior hyaloid intraoperatively appears to be a useful technique when attempting to completely separate tight adhesions to the retina. One month after the surgery, the patient reported that her metamorphopsia had diminished. The patient's VA was 0.5, and an OCT examination showed a marked improvement in the inner layer separation and outer layer detachment (Fig. 3C). At 6 months after the operation, an OCT examination showed complete retinal reattachment. One year after the operation, the VA had been restored to 0.7.

Pre-operative clinical characteristics

The clinical characteristics of all 14 patients are shown in Table 1. Eleven patients were women and 3 were men, ranging in age from 53 to 77 years (mean $\pm$ standard deviation [SD], 64.8 $\pm$ 7.7 years). All the patients were healthy and of Japanese ancestry and had complained of metamorphopsia or reduced vision in the affected eye for several months. The refractive errors ranged from -6.0 to -19.25 diopters (-13.2 $\pm$ 3.8 D) in 12 phakic eyes. The axial lengths ranged from 24.9 to 30.4 mm (27.6 $\pm$ 1.6 mm). The eye of Patient 7 was not highly myopic, but posterior staphyloma and glaucomatous cupping of the optic disc were present. The posterior staphyloma extended over a wide area in all 16 eyes. The decimal preoperative VA values ranged from 0.01 to 0.5 (mean, 0.14).

OCT examinations disclosed various profiles of macular change. The presence of RS or FD was confirmed preoperatively in all eyes. Five eyes had RS alone. In 4 of these eyes, an extensive hyporefractive space had split the retina into a thick inner layer and a thin outer layer lying on the retinal pigment epithelium (RPE) (Patients 1 [left eye; L], 3, 5 [R], and 6) (Fig. 4A). One eye (Patient 2) had a similar appearance, but the fovea was not split and did not show a defect in the roof of the central cyst, giving the appearance of a lamellar hole (Fig. 2). The VA in 4 of the 5 eyes with RS without FD was better than 0.2.

Eleven eyes had RS associated with FD (Figs. 1, 3, 4). The VA of these eyes seemed to be worse than that of the eyes without FD, but 6 of the 11 eyes with FD had a VA that was better than 0.2. Two eyes developed macular hole retinal detachment during the routine follow-up period, and the VA decreased from 0.3 to 0.1 in Patient 13 and from 0.2 to 0.06 in Patient 14. Figures 6 and 7 show the changes in the macular configurations associated with the reduction in VA during the follow-up period in patients 13 and 14.

The presence of partially detached posterior hyaloid was disclosed in 7 eyes (Figs. 3, 4, 5). The separation of posterior hyaloid beside the conus of the optic disc was observed in all of these 7 eyes. Advanced vitreous syneresis was observed in all the eyes, but PVD was not observed in the other 9 eyes preoperatively.

Regarding the fellow eyes of the patients, 3 patients had a medical history of macular hole detachment, 5 patients had a history of RS and/or FD, one patient had a history of myopic posterior chorioretinal atrophy, and one patient had a history of primary open angle glaucoma.

Anatomical results

In all 5 eyes that had RS without FD, the retina reattached after the initial vitrectomy. Retinal reattachment was achieved in 8 out of 11 eyes with both RS and FD, including 2 cases that had progressed to macular hole retinal detachment (Patients 13 and 14) before the initial

vitrectomy. We removed the silicone oil about five and two months after the vitrectomies in patients 5 (R) and 10, respectively. The retina remained reattached after the removal.

Three eyes required re-operation because of recurrent retinal detachment. In 2 of these 3 eyes, a full thickness macular hole associated with posterior retinal detachment occurred one month after vitrectomy with (Patient 8) and without ILM peeling (Patient 9) (Fig. 8). We performed a second operation, consisting of extensive ILM peeling and silicone oil tamponade. At 5 months (Patient 8) and 3 months (Patient 9) after the second surgery, we removed the silicon oil. One eye (Patient 5L) developed retinal detachment caused by a peripheral retinal break immediately after the initial vitrectomy. A second vitrectomy was thus performed to repair the retinal detachment.

Final retinal reattachment was achieved in all 16 eyes. No recurrences were observed.

Visual Acuity Results

An improvement in the VA of 0.2 logMAR or greater was documented in 9 of the 16 eyes. The VA of 7 eyes remained unchanged. The VA of the left eye of patient 5 improved from 0.06 to 0.1 at 12 months after the vitrectomy, but decreased again to 0.06 at 16 months, with no remarkable changes in the retinal findings. During this follow-up period, we performed a vitrectomy for the treatment of RS in the right eye, which resulted in an improvement of VA from 0.2 to 0.6.

Fourteen of the 16 eyes had a final VA of 0.1 or better, and 6 eyes had a VA of better than 0.5.

Complications

Intraoperative or postoperative complications were observed in 7 eyes. The retina re-detached in 3 eyes (Patients 5 [L], 8 and 9), as described above.

A full-thickness macular hole was observed after the initial vitrectomy in 5 out of 16 eyes.