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Management of Coats Disease Microaneurysms With Fundus Fluorescein Angiography-Guided Navigated Laser

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Abstract

Purpose: The purpose of this case series is to test the safety and efficacy of navigated laser in the treatment of microaneurysms in Coats disease. **Methods:** In a multicenter, retrospective case series, 10 individuals with active, leaking Coats-related microaneurysms in the macula were included. All participants were treated with the Navilas navigated laser (OD-OS, GmbH, Teltow, Germany) in a navigated treatment mode guided by fundus fluorescein angiography with a minimum of 4-month follow-up. Primary outcomes included central retinal thickness, best-corrected visual acuity, and microaneurysm closure rate. **Results:** Mean age at navigated laser was 38.8 years (range, 14-61 years). Anatomic improvement or stabilization was noted in all participants (–10 µm), with stability within 10 letters of presenting visual acuity ($\pm$0.0 logarithm of the minimum angle of resolution [logMAR] [Snellen equivalent, 20/20]). No patient received any additional antivascular endothelial growth factor (anti-VEGF) treatment after the first navigated laser session. Patients could even discontinue previous anti-VEGF treatments. **Conclusion:** In this study, angiography-guided navigated laser treatment was a safe and effective treatment modality for Coats disease. The digital planning and navigated application of the laser seem to allow for good efficacy and a low complication rate.

Keywords

Coats disease, fundus fluorescein angiography-guided, laser therapy

Introduction

Coats disease is a unique ocular vascular disorder often causing vision impairment secondary to macular exudation.[1] The condition encompasses a broad clinical spectrum, ranging from asymptomatic temporal macular telangiectasias[2] to total exudative detachment of the retina with a poor chance for visual recovery.[3] Early manifestations include telangiectasias in the capillary network of the retina, exhibiting radially oriented aneurysmal dilations.[4-6] Subsequent leakage from these untreated vascular abnormalities may cause progressive macular edema and deposition of subretinal lipid exudates, culminating in vision loss or retinal detachment.[3]

In Coats disease, treatment is focused on the neutralization of abnormal vasculature and exudative aneurysmal dilations.[7,8] Laser photocoagulation has been the most effective modality in achieving this goal.[9] With this method, light is absorbed by hemoglobin within the vascular anomalies, where it is converted into thermal energy. Subsequent temperature elevations cause the destruction of abnormal retinal blood vessels and cessation of the exudative process. Since the laser wavelength targets hemoglobin directly, laser photocoagulation can successfully treat the disease even in the presence of excessive subretinal fluid.[10] However, the effectiveness of conventional focal lasers may decrease when multiple retinal quadrants are involved with vascular abnormalities, as excessive photocoagulation can lead to an increase in subretinal exudation and retinal detachment.[11] Long-term follow-up is also necessary, as focal photoablation has been shown to be prone to late recurrences and many new aneurysms tend to develop over time.[10,12]

The current study examines the use of Navilas, a navigated retinal laser photocoagulator, in treating microaneurysms secondary to Coats disease. Through multimodal imaging integration and unique eye-tracking technology, Navilas previously has been shown to have increased accuracy in targeting and closing microaneurysms in diabetic eyes.[13] Accurate targeting is increasingly important in Coats disease, in which the microaneurysms tend to be small and close to the fovea, and therefore

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prone to collateral injury with conventional lasers. To the authors' knowledge, however, little is known regarding the efficacy of Navilas in treating the unique ocular vascular abnormalities associated with Coats disease.

Methods

Study Design and Patients

The study was a multicenter, retrospective case series conducted in individuals with active, leaking Coats-related microaneurysms in the macula. All participants were treated with Navilas in a navigated treatment mode guided by fundus fluorescein angiography (FA).

Preoperative and Postoperative Assessments

Preoperative evaluation included central retinal thickness, best-corrected visual acuity (BCVA), intraocular pressure (IOP), and dilated fundus exam using biomicroscopy. Postoperative assessment included central retinal thickness, BCVA, IOP, and dilated fundus exam.

Fluorescein Angiography

FA was performed for baseline detection of vascular abnormalities and repeated to assess treatment success. FA facilitates early detection of vascular abnormalities in stage 1 Coats disease.[14] It further allows visualization of classic findings otherwise obscured by heavy exudates near vascular abnormalities.[15] In the current study, microaneurysms were planned on digitally imported angiograms that were subsequently overlaid onto the live fundus image prior to laser application. Areas of treatment, as recorded by Navilas, were changed in transparency to see if retreatment was performed to achieve closure. If no retreatment was required at the same location, microaneurysms were defined as closed.

Navigated Focal Laser Photocoagulation

Microaneurysms were treated with focal laser photocoagulation (532 nm or 577 nm) using Navilas. In the present study, planning and treatment delivery of laser photocoagulation was performed by a single retina specialist at each site who did not participate in the masked observations. Laser photocoagulation was performed with the following parameters: spot size = 100 to 200 μm on the retina, duration = 30 to 100 ms, power = 50 to 180 mW. Laser burn intensity was adjusted to achieve a barely visible burn or blanching of the microaneurysm.

Statistical Analysis

Values were expressed as the mean ± SD. In all cases, statistical significance was obtained with the Student *t* test set at $P < .05$. All statistical significance tests were 2-sided. Statistical analyses were generated with PROC GLIMMIX from SAS/STAT software, version 9.4 of the SAS System for Windows (Cary, NC, USA).

Table 1. Patient Follow-Up, Visual Acuity, and Central Retinal Thickness.[a]

		Best-Corrected Visual Acuity			Central Retinal Thickness	
Number	Follow-up	Baseline	Last	Gain	Baseline	Last
1	13	20/1500	20/600	–0.4	148	138
2	22	20/80	20/70	–0.1	342	303
3	26	20/25	20/25	0	266	270
4	8	20/25	20/20	–0.1	282	285
5	4	20/20	20/20	0	294	300
6	43	20/20	20/25	0.1	297	270
7	37	20/25	20/25	0	264	264
8	15	20/100	20/400	0.6	347	314
9	46	20/200	20/200	0	251	260
10	51	20/25	20/22	–0.06	272	267
		0.5 (0.6)	0.5 (0.6)		276 (55)	267 (49)

[a]Standard deviations presented in parentheses.

Results

Patient Demographics and Characteristics

Ten eyes of 8 male patients from 3 international sites were included. Mean age at the time of navigated laser was 38.8 ± 18.5 years (range, 14-61 years). The average time of follow-up was 27 ± 17 months. Seven of 10 eyes received pretreatment with at least 1 injection of an antivascular endothelial growth factor (anti-VEGF) medication. Three out of 10 eyes received conventional focal laser for leaks causing the edematous areas before undergoing navigated laser coagulation.

Photocoagulation Treatment Response

Researchers placed a mean of 56 ± 34 laser spots (range, 12-124) with a median power of 100 mW, duration of 100 ms, and spot size of 100 μm. Patients underwent 2.3 ± 1.6 total navigated laser sessions in the full observation time. This resulted in an average of 1.5 per year per patient. On average, 42 lesions were treated, corresponding to 46 laser spots applied per treatment.

On average 62% of the microaneurysms were closed with only 1 laser photocoagulation treatment. The remaining 38% of microaneurysms required at least 1 retreatment for closure.

At 12 months, decreased central macular thickness and retinal thickness were observed following navigated focal laser photocoagulation. Mean central retinal thickness decreased by 9 ± 18 μm (3%) from 276 ± 55 μm (148 to 347 μm) at baseline to 267 ± 49 μm (138 to 314 μm) at the last visit after laser photocoagulation ($P = .13$). Central retinal thickness changes for each patient are displayed in Table 1.

Safety

Baseline BCVA for all participants was 0.5 ± 0.6 logarithm of the minimum angle of resolution (logMAR; Snellen, 20/63 ± 20/80). Following treatment, anatomic improvement or stabilization was observed in all individuals (mean –9 μm).

Figure 1. Fluorescein angiography of Case Example 1 microaneurysms.

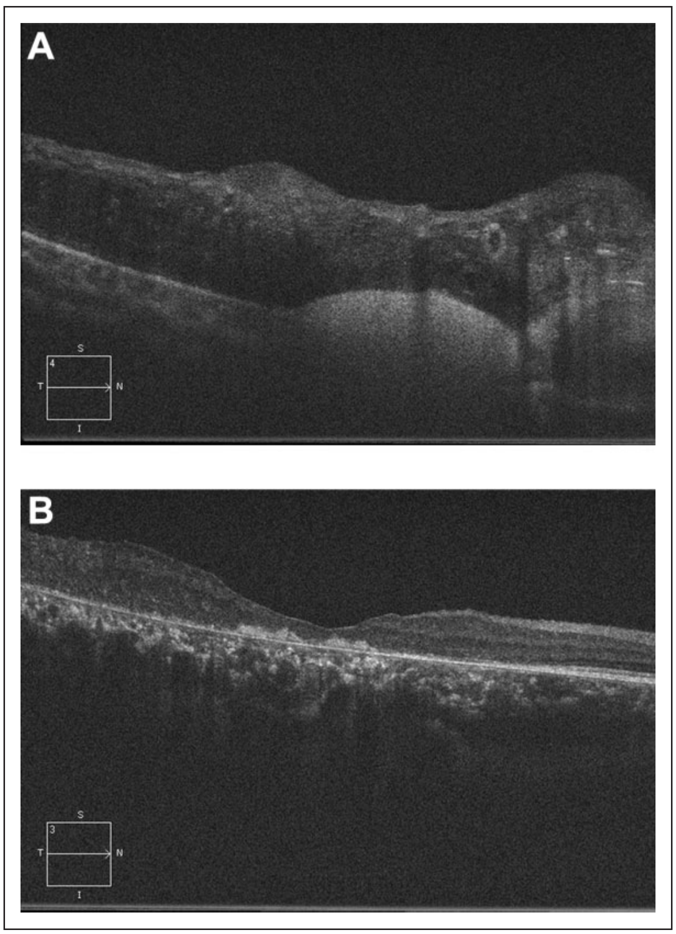

Figure 2. Optical coherence tomography (A) before and (B) after treatment with navigated laser treatment.

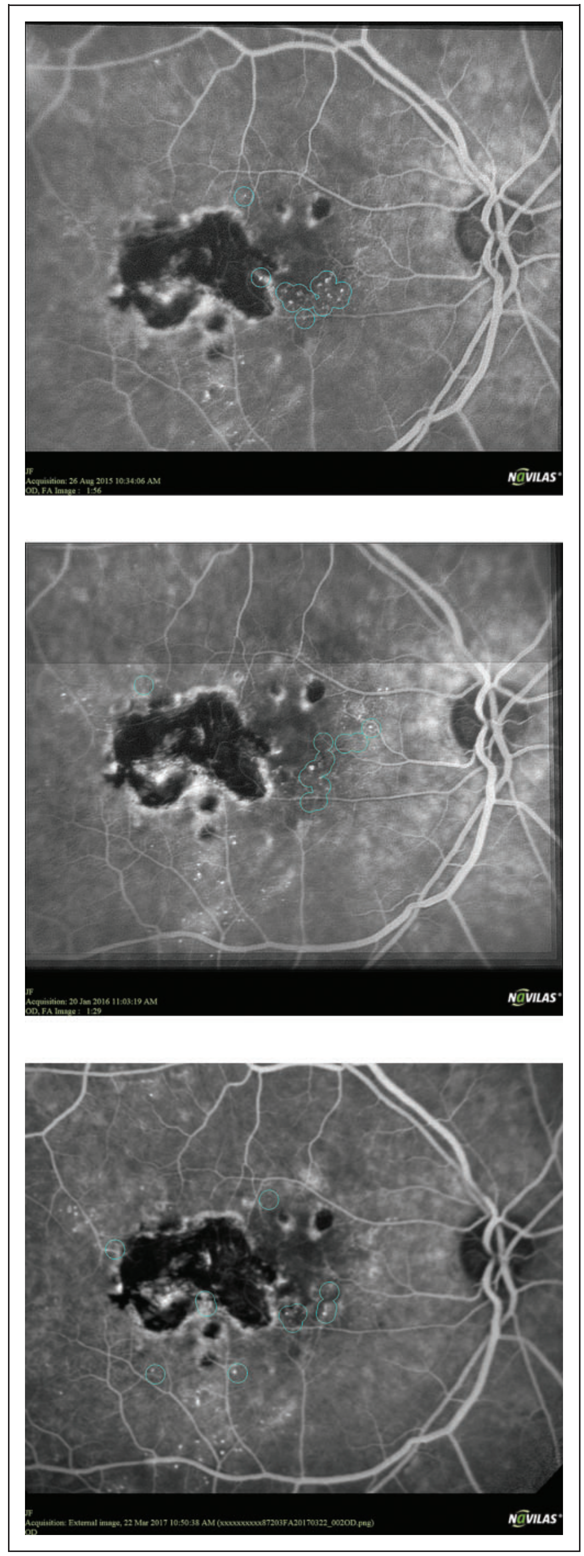

Figure 3. Fluorescein angiography of Case Example 2 microaneurysms.

Regarding BCVA, all patients were stable within 10 letters (±0 logMAR; Snellen, 20/20). Table 1 displays visual acuity before and after treatment for each patient.

No patient received any additional anti-VEGF treatment after the first navigated laser session. There were no serious adverse events associated with treatment. Though there were only 4-month postoperative results for Patient 5, this was a result of loss of follow-up unrelated to the treatment.

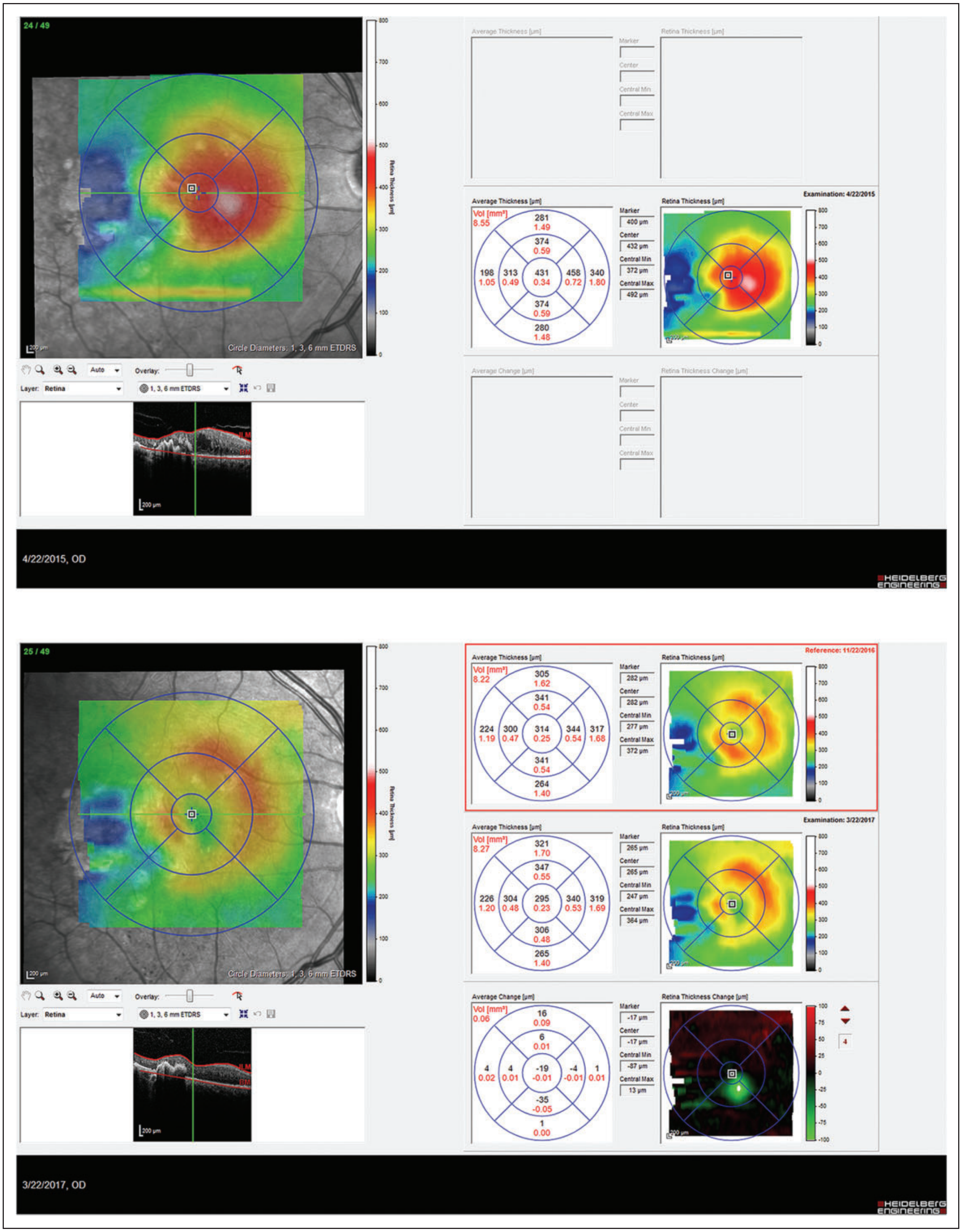

Figure 4. Navigated laser therapy for Case Example 2.

Case Example 1

A 31-year-old male patient suffering from multiple focal leaks presented with decreased central vision. His baseline visual acuity was Snellen 20/1500. The patient underwent no pretreatments with focal laser treatment or anti-VEGF injections. He underwent 2 navigated treatments, each consisting of approximately 31 spots at 100 µm and 100 ms. Visual acuity at 3-month follow-up was found improved to 20/600. At 1 year, after his second laser treatment, his vision has remained stable. Navigated laser treatment of this patient's microaneurysms is displayed in Figure 1. Figure 2 shows the microaneurysms before and after treatment as seen on optical coherence tomography.

Case Example 2

A 40-year-old male patient with Coats disease presented with metamorphopsia due to focal leaks. He had previously undergone 13 anti-VEGF injections and 7 conventional focal lasers without achieving stability of disease. In 2014, his visual acuity was 20/25 Snellen. He subsequently underwent 2 navigated laser treatments over 2 years, conducted with 100 to 200 µm and 100 ms. In 2016, his visual acuity was found to have remained stable at 20/25 Snellen. Navigated laser treatment is shown in Figures 3 and 4.

Discussion

The present study evaluates the efficacy and safety of navigated laser photocoagulation in closing leaking microaneurysms in eyes with Coats disease. In the 10 patients studied, most microaneurysms (minimum, 62% per treatment) could be closed with minimal tissue damage. This closure rate closely corresponds to previously reported findings in diabetic macular edema, in which 69% of microaneurysms remained closed at 3 months following treatment with the Navilas laser.[16]

While microaneurysms are one of several pathological manifestations of diabetic retinopathy, in Coats disease they are the main pathologic feature. Microaneurysms result from congenital structural weakness as opposed to temporary metabolic change, which occurs in diabetic retinopathy. As such, they may be more resistant to therapies including laser photocoagulation. To the authors' knowledge, the current study is the first to assess the utility of the Navilas navigated laser in treating macular microaneurysms secondary to Coats disease.

In the largest case series of Coats patients to date, Shields et al reported the visual outcomes of 124 eyes following various treatment procedures including observation, cryotherapy, laser photocoagulation, and modes of retinal detachment procedures. Poor visual outcomes, defined by acuity of 20/200 Snellen or worse, were found in 0% of eyes with stage 1, 53% with stage 2, 74% with stage 3, and 100% of stages 4 and 5 Coats disease.[11] In comparison, the current study achieved 20/25 Snellen or better vision in 60% of eyes treated with the Navilas navigated laser. The marked difference in outcomes can be partially attributed to selection bias in the Shields cohort, as those patients were primarily potential tumor referrals with a larger degree of exudation. Even taking this into account, Navilas appears to compare favorably to the current management paradigm.

The Navilas navigated laser closed related to Coats disease and allowed discontinuation of alternative treatment options. Following Navilas laser treatment, no patients in the current study required further administration of anti-VEGF injections. Instead, select patients unable to achieve disease stability following these alternative therapies were able to achieve stability following treatment with the Navilas, as highlighted by Case Example 2. No serious adverse events were associated with the navigated laser treatment.

High microaneurysm closure rate and a low complication rate may be credited to the digital planning and navigated application of the laser. Navilas integrates multimodality imaging to facilitate the process of marking, planning, and treating vascular abnormalities. The device also allows for linked eye-tracking registration, coordinating the delivery of laser pulses with patient eye movements to maximize accuracy. The complete mapping of microaneurysm distribution and ability to target all of them is crucial in diseases such as Coats disease. Together, these features allow for precise and targeted therapy of microaneurysms to maximize long-term closure and maintain visual acuity.

Angiography-guided navigated laser treatment was safe and effectively closed the microaneurysms secondary to Coats disease in this case series. The main limitation of the current study is the small sample size. Coats disease is, however, an infrequent ocular condition and the cases in this study were classic for typical Coats disease and demonstrate a universal response to eye-tracking laser management. Also, while several of the cases had historical anti-VEGF injection therapy, this study does not address the role, if any, of adjuvant anti-VEGF therapy in addition to guided laser as the cases were controlled with the laser therapy alone.

Ethical Approval

This study was approved by the Houston Methodist Hospital Institutional Review Board.

Statement of Informed Consent

Written informed consent was obtained from all participants before the study.

Declaration of Conflicting Interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: David Brown is a consultant for OD-OS, GmbH.

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