




Safety and efficacy of the use of navigated retinal laser as a method of laser retinopexy in the treatment of symptomatic retinal tears

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Abstract

Purpose To investigate the safety and efficacy of the use of navigated retinal laser as a delivery method of laser retinopexy in the treatment of symptomatic retinal tears.

Methods We conducted a retrospective observational study of 69 patients presenting to a district general hospital in the United Kingdom with a diagnosis of symptomatic retinal tear who underwent retinopexy using a navigated retinal laser (Navilas 577s). Patients were followed up at two weeks or later to assess the efficacy and safety of the use of navigated retinal laser for retinopexy treatment.

Results In total, 72 retinal tears in 69 patients were identified in our cohort. Of these cases, 70 (97.2%) retinal tears were treated with retinopexy using a navigated laser with a median treatment time 200 seconds. Two retinal tears could not be imaged on the navigated laser system and so underwent cryopexy. In 67/70 (95.7%) of retinal tears, one session of laser treatment using the navigated laser system was sufficient for primary management. The remaining three tears required a second session. No retinal tears treated with navigated laser treatment progressed to retinal detachment. There were no other complications seen with the use of this laser.

Conclusions The use of navigated retinal laser as a method of laser retinopexy for the treatment of retinal tears shows comparable safety and efficacy with other studies using traditional retinal laser systems.

Introduction

The use of laser retinopexy in the treatment of retinal breaks to reduce the risk of rhegmatogenous retinal detachment has been well established for over 50 years [1]. The risk of progression to retinal detachment in untreated symptomatic retinal tears is around 50%, while laser retinopexy reduces this risk to <5% [2–4]. Laser retinopexy can be delivered at the slit-lamp, with an indirect ophthalmoscope, or intraoperatively using endolaser. Slit-lamp mounted laser remains the commonest form of laser delivery in the clinic setting given its ease of use and speed of delivery. Acute retinal breaks frequently present to trainee doctors in the emergency setting. In one retrospective study of outcomes of retinal tears treated by retinopexy by trainee doctors, 24/100

(24%) required further treatment [5]. Other studies suggest this figure may be as high as 40% [6].

The navigated laser photocoagulator (Navilas 577s, OD-OS, Teltow, Germany) uses live fundus imaging to target the retinal laser. Before treatment, fundus images are taken of the area of the retina to be treated and the laser operator then designs a laser treatment map. During the laser procedure, the navigated laser system aligns the pre-planned treatment map with live imaging to target the laser application within the retina.

Successful use of this laser technique has been demonstrated for macular conditions where the retinal treatment maps improve the safety of laser delivery close to the fovea [7, 8]. Navigated laser has also been shown to be effective in more peripheral laser treatments such as postoperative 360-degree laser retinopexy and pan-retinal photocoagulation [9, 10]. It offers several potential benefits, such as improved accuracy by live tracking, decreased treatment times and improved safety due to the ability to digitally exclude areas from treatment. Efficacy use of navigated laser in the delivery of laser retinopexy has been described in a single patient case-report [11]. However, to our

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knowledge, no other evidence exists in the literature regarding the efficacy of this laser method in a cohort of patients.

The purpose of this study is to provide safety and efficacy data for patients undergoing retinopexy using the navigated laser system. The primary aim of the study was to investigate the proportion of patients presenting with a new retinal break, which could be successfully treated using a navigated laser. Our secondary aim was to identify the proportion of patients needing retreatment and progression to retinal detachment despite prophylactic laser treatment.

Materials and methods

We conducted a single centre, retrospective, observational case series study. All patients who were treated for symptomatic retinal tears with the navigated laser system at Yeovil District General Hospital NHS Foundation Trust between November 2017 and August 2019, were included. Cases were identified using the hospital's electronic patient record system with external validation using medical records. The study followed the tenets of the Declaration of Helsinki, and all patients were asked to sign an informed consent form before treatment.

Statistical analysis was performed using a commercially available statistical software package, SPSS (IBM Corp. Released 2015. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.). We used the Kruskal–Wallis test as a non-parametric method for the testing of multiple independent samples to test the null hypothesis to rule out any significant difference in time taken for laser retinopexy based on laser operator training grade. A P value < 0.05 was considered statistically significant.

Results

Patient demographics

Seventy-one eyes of 69 patients (39 male and 30 female) were treated for symptomatic retinal tears over 21 months beginning in November 2017 until August 2019. The mean age of the group was 62.8 (± 13.5 SD) years, three (4.3%) patients had high myopia and ten (14.5%) patients were pseudophakic (Table 1).

Treatment method

After dilated slit-lamp biomicroscopy, all patients had imaging with the Navilas 577 laser system using the Mainster PRP 165 lens. The area to be treated was

Table 1 Summary data for the patient demographics recruited into this study.

Demographic	Data
Age	62.8 years \pm (13.5 SD)
Gender (M:F)	39 male and 30 female
Treatment time	200 s \pm (105 s SD)
Average length of follow-up	61 days \pm (109 days SD)

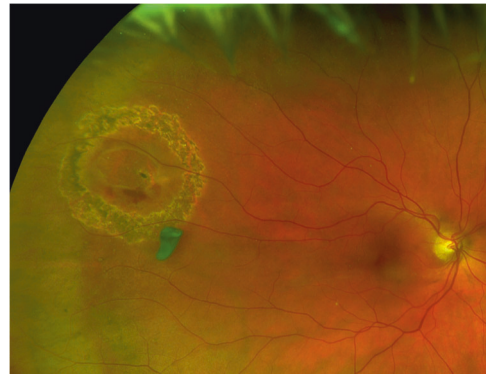


Fig. 1 An Optos[®] ultra-widefield retinal photograph demonstrates a peripheral retinal break treated by the navigated laser system.

photographed on the laser machine itself and the treatment plan was made using the in-built software. This includes the laying down of caution zones to exclude areas from accidental treatment and marking the area around the tear with at least three contiguous or near contiguous burns. The software then superimposes the plan on the live image. Activating the footswitch delivers the laser precisely according to the plan with live tracking. A spot size of 390 μ m for 20 ms using a hexagonal spacing pattern was used. Laser power was started at 360 mW and titrated until a visible retinal burn was seen. For all patients a 360-degree encirclement with laser burns was attempted (Fig. 1). If this was not possible because the tear was too anterior then an “ora to ora” laser retinopexy was applied around the retinal break. All patients had treatment initially attempted using the navigated laser system. If the tear could not be imaged adequately, the patient was treated with cryopexy and no other laser system was used. The patients were reviewed at two-weeks post-treatment for visible retinal burns when they were either re-treated or discharged.

Primary endpoint

In 70/72 (97.2%) cases of retinal tear, the navigated laser system could successfully image the tear, and retinopexy could be applied. In the remaining two eyes, the tears were too anterior to be imaged by the system in the presence of

pseudophakia and peripheral capsular opacification, and they were treated with cryopexy.

Secondary endpoints

Overall, 66/69 (95.7%) of the patients required only one laser session. The remaining three patients (4.3%) required a second laser session. Retreatment with laser was required for two patients as the laser was not contiguous on the two-week follow-up appointment. In the remaining one patient, retreatment was required as the patient had an episode of vasovagal syncope during the initial laser session, and the laser treatment could not be completed. This patient had the retinopexy completed one week later. No patients required any further laser treatment. No patients progressed to a retinal detachment, and 12/69 (17.4%) patients remained under our long-term care for other ocular comorbidities.

In total, 3/69 (4.3%) patients returned to eye casualty for new symptoms after the two-week clinic appointment. One patient returned with a new inferior retinal tear (the original tear was superotemporal) associated with an inferior retinal detachment. The second patient returned with a new retinal tear in a different location, which was successfully lasered. The third patient returned twice with worsening symptoms of photopsia and floaters, but there were no new retinal breaks.

The median time taken to administer the laser retinopexy across all levels of expertise was 200 s (± 105 s SD) (range 55–645 s). Of the 69 patients treated, 16 were applied by a consultant, 19 by a senior specialty doctor and 34 by a trainee grade ophthalmologist. There was no significant difference in the time taken for the actual retinopexy laser based on ophthalmologist seniority (Kruskal–Wallis test $P = 0.658$) (Fig. 2, Table 2).

Discussion

This study has demonstrated that laser retinopexy is safe and effective with the Navilas 577s, in the majority (97.1%) of patients presenting with an acute symptomatic retinal break. Furthermore, the study has shown that this laser can effectively deliver treatment quickly (median 200 s) and by a range of different laser operators. These results are comparable to previous studies using conventional laser methods [9]. In this study, the treatment was successful for 95.7% of patients with a single laser session and 100% of patients with two laser sessions. This compares favourably with other studies that have demonstrated higher rates of further treatment (~20%) [2, 11, 12].

Several studies have demonstrated a significantly higher retreatment rate when the laser was administered by a more junior operator [4, 11]. Our study shows a significantly

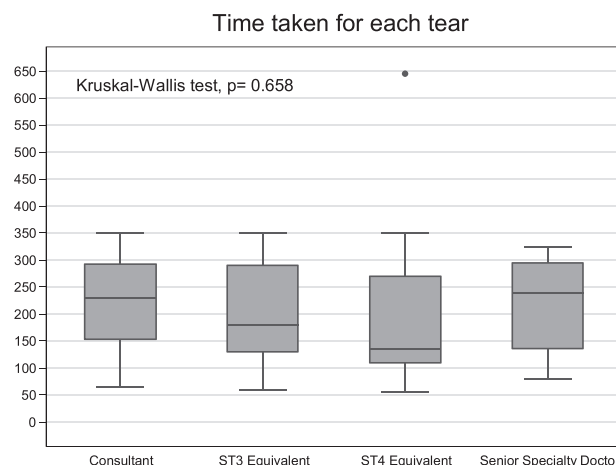


Fig. 2 The median and interquartile ranges (p25, p75) for the time taken to perform a laser retinopexy for a retinal tear based on laser operator seniority.

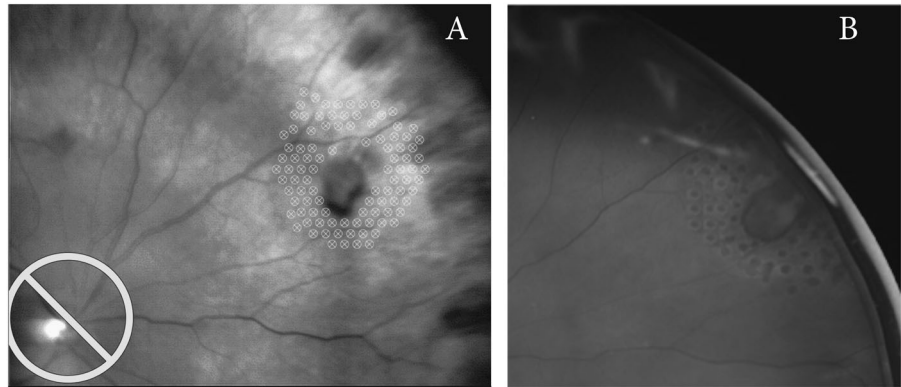
Table 2 Summary data for the patient demographics recruited into this study by operator experience.

Level of experience	Number of patients	Median time (seconds)
Consultant	16	230 [152.5, 292.5]
ST3 equivalent	15	180 [130, 290]
ST4 equivalent	19	135 [110, 270]
Senior specialty doctor	19	240 [135, 295]
Total	69	200 [120, 285]

reduced retreatment rate (4.3%) due to the improvement of clinical efficacy in this sub-group. Given the low rates of retreatment, our study was not sufficiently powered to perform sub-group analysis based on laser operator type. However, we hypothesise that navigated laser may be particularly advantageous in junior operators due to accurate retinal mapping before treatment. We have shown in this study that there is no significant difference in time taken for the laser based on the operator grade. Our experience was that junior staff benefit from the use of the live fundus imaging while using the navigated laser system. Imaging after the completed retinopexy was a useful tool for junior team members to review the application of the laser, ensure complete encirclement and to improve on their technique of laser delivery (Fig. 3a and b). Finally, live imaging was a useful tool for senior staff to supervise junior staff during training and treatment of retinal breaks.

No patients within our study group had progression of the treated retinal tear to retinal detachment. One patient presented with a second retinal tear, which had progressed before presentation to an inferior retinal detachment. Progression to retinal detachment after retinopexy laser treatment is rare. Sub-group analysis of the Scottish retinal detachment study data, a two-year longitudinal study, identified a rate of

Fig. 3 a This image shows the left eye of a patient who underwent a 360-degree encircling retinopexy as seen on the navigated laser system immediately after completing the procedure showing coverage of the anterior edge of the tear. **b** An Optos® ultra-widefield retinal photograph of the same eye (but only shows the posterior treated edge).



detachment in 3.16% of patients undergoing a primary laser retinopexy [13, 14]. This figure also includes patients who presented with retinal detachment from a secondary break. In our study, one patient (1.4%) returned with a retinal detachment from a secondary break. Given our study size (69 eyes), if navigated laser was equally efficacious as traditional laser we would have expected two patients (3%) to return with a retinal detachment.

This study has a few notable limitations. The study did not capture late retinal detachment after successful retinopexy that may manifest several weeks or months after laser treatment [4]. In particular, anterior breaks which could not be treated with 360-degree retinopexy and were treated with posterior barrier laser only (albeit this was applied from the ora serrata to ora serrata on either side of the break) may have a higher risk of late detachment and thus may present after the 2-week follow-up period. However, if patients re-attended our eye casualty after their two-week follow-up clinic appointment, then their clinical outcomes were recorded within this study. Equally, if the patient did not attend the hospital or attended a different hospital, then any adverse outcome would not have been included in this study. A second potential limitation was that this study had several different laser users. The clinical efficacy of laser is known to vary based on laser user [9]. However, we were not able to perform sub-group analysis and compare the data within the operator groups because the sample sizes and complication rates were too small. Another limitation of our observations is that we did not consider the time taken before the retinal tear was found and photographed on the Navilas system. In our experience, this is the step that can take the most time while the clinician is learning this new method of laser treatment.

A future study could consider a comparative trial of the use of navigated laser and traditional laser for the treatment of retinal breaks and, if sufficiently powered, could compare results dependent on the seniority of the laser operator.

In conclusion, this study has demonstrated that the use of navigated laser retinopexy has an improved safety profile in

comparison to non-navigated laser systems and similarly effective to traditional laser delivery systems. Furthermore, navigated laser remains more informative and efficacious when used by junior laser operators.

Summary

What is known about topic

- Laser retinopexy reduces the risk of retinal detachment in untreated retinal tears by <5%.
- There is a retreatment rate when the laser is administered by a more junior operator.

What this study adds

- The use of navigated laser retinopexy has an improved safety profile in comparison to non-navigated laser systems, and it is similarly effective to traditional laser delivery systems.
- Navigated laser remains more informative and efficacious when used by junior laser operators.

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Compliance with ethical standards

Conflict of interest The authors have no financial or proprietary interest in any material or method mentioned. PS has received travel grants from OD-OS.

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