Role of OCT in Virtual Digital Surveillance Clinic within Diabetic Retinal Screening Service

Alvin Teo Wei Jun, MBBS and Daniela Vaideanu-Collins, FRCOpth, MD

South Tees Diabetic Eye Screening Programme

Introduction

Diabetic eye disease is one of the leading cause of blindness in the UK [1]. Diabetic macular oedema (DMO) is responsible for majority of the visual loss in diabetic patients [2]. In 201 0, there were about 188,000 people living with diabetic maculopathy, and this is expected to increase to 236,000 by 2020[1]. 27% of type 1 diabetic patients developed macular oedema within 9 years of having the condition [3]. The incidence of macular oedema in diabetic persons reported in the Wisconsin Epidemiology Study of Diabetic Retinopathy, a population based study, was 25.4% in those who required insulin and 13.9% in those who did not require insulin [4]. Diabetic Maculopathy is defined by the Early Treatment Diabetic Retinopathy Study as clinically significant macular oedema (CSMO) if there is (1) thickening of the retina at or within 500 µm of the centre of the macula; (2) hard exudates at or within 500 µm of the centre of the macula, if associated with thickening of the adjacent retina; or (3) a zone of retinal thickening >1-disc area, any part of which lies within 1-disc diameter of the centre of the macula; (2) Non-clinically significant diabetic oedema is defined as macular exudates without presence of retinal thickening; (3) Ischemic maculopathy and (4) Mixed pattern [5]. It is thought to arise from a breakdown of the blood-retinal barrier, characterised by pericyte loss and endothelial cell-cell junction breakdown [6].

The Diabetic Retinal Screening Services (DRSS) across the UK are fundamental to disease prevention, allowing earlier diagnoses of retinal disease and referral for appropriate treatment. A recent study put the prevalence of type 1 and 2 diabetes in the UK to be about 3.8 million people and is projected to increase to 6.25 million people in 2035[7]. This will put an increasing burden on Diabetic Retinal Screening Services (DRSS) and Hospital Eye Services (HES). About 10% of the NHS budget is spent on diabetes and its complications. A significant amount of these resources is spent treating the complications of diabetes. The cost of diabetic retinopathy screening was approximately 2.7million in 2010/11, and cost of treatment was approximately 58 million in the same time period. It is projected to increase to 3.7 million and 97 million respectively in 2035/36[7].

The current Royal College of Ophthalmology guidelines recommend fundus photography to be used in screening services, although fundus biomicroscopy remains the gold standard [8]. Dilated fundus photography is used in most DRSS instead of stereoscopic fundus photography as it is technically easier to perform clinically and results correlate closely with the latter technique [9]. However, interpretation is varied depending on the grading algorithm [10]. Recently, Optical Coherence Tomography (OCT) has been suggested to perform as well, if not better than fundus photography in diagnosing diabetic maculopathy [10, 11]. There have also been favourable comparisons with biomicroscopy, showing high sensitivity [12]. It provides objective, reproducible data regarding disease progression and treatment effectiveness and is less subject to interpretation [13]. OCT uses infra-red light to provide real time, non-invasive imaging of the retina. This ability to provide objective, serial measurements of retinal tissue have revolutionised the diagnoses of retinal diseases [14].

Recent changes to the National Institute for Health and Care Excellence (NICE) treatment guidelines for the treatment of DMO will require an increasingly robust screening tool for detecting diabetic maculopathy. Anti-Vascular Endothelial Growth Factors (anti-VEGF) are considered first line for treatment, having shown its superior effects to photocoagulation [15, 16]. They are only recommended if the central retinal thickness (CRT) is ≥400µm to improve cost effectiveness of treatment [17, 1 8]. A literature review has suggested that OCT is a useful adjunct to fundus photography in DRSS and there have been studies globally publishing their experience [19, 20]. We implemented the use of OCT into South Tees DRSS in August 201 4 with the aim to improve diagnosis of DMO and reduce the number of inappropriate referrals to HES. We also compared the appointment outcomes of DMO referrals from DRSS to HES before and after implementation of digital surveillance with OCT clinics to determine management approaches after DMO

Methods

The South Tees Diabetic Retinal Screening Programme was set up in 2008 to provide screening services to the population residing in the North Yorkshire and South Tees area of North East England. Our services cover a vast rural area, where many people live far away from hospital ophthalmic services, from Brotton on the Yorkshire coast to Hawes, Durham in the West. Our total patient register as of the time of writing is 22520. Our study population pool comes from patients who were referred to the South Tees Foundation Trust DRSS for annual screening after the initial diagnosis of diabetes, regardless of type, according to national guidelines. The screening pathway in UK is well described in literature and on the website.

The process involves invitation sent to patient following GP referral, standardised fundus photograph taken at the screening episode. Primary grading followed by secondary or tertiary grading if needed. The grading and referral criteria are standardised according to the National Screening Committee classification [8]. However, it was noted that a large number of patients who did not need or meet the requirements for treatment were referred to the hospital, increasing the burden on the Hospital Eye Services. The pathway was then refined to include a virtual digital surveillance clinic for patients who needed review more than once a year. Although this has reduced the referral rate to the hospital, there was still a significant number of maculopathy patients referred. With the introduction of anti-VEGF treatment and the strict criteria for DMO treatment, adding an OCT scan to the fundus photographs is considered by many to be needed.

National Screening Committee Grading	International Term	Features
R0	No DR	Normal retina. Grade 0 (US)
R1	Mild non-proliferative (Mild pre-proliferative)	Haemorrhages & microaneurysms. Very minor IRMAs
R2	Moderate non-proliferative, moderate pre-proliferative	multiple blot haemorrhages intraretinal microvascular abnormality (IRMA) venous beading venous reduplication
R3a	Proliferative retinopathy	Neovascularization, pre retinal haemorrhage, vitreous haemorrhage, fibrovascular tissue proliferation, tractional retinal detachments, macular edema.
R3s	Treated proliferative retinopathy	Evidence of Peripheral Retinal Laser Treatment AND Stable retina with respect to reference images taken at or shortly after discharge from the HES
M0		no maculopathy
M1	Diabetic maculopathy	clinically significant macular edema: (1) thickening of the retina at or within 500 µm of the center of the macula (2) hard exudates at or within 500 µm of the center of the macula, if associated with thickening of the adjacent retina (3) a zone of retinal thickening >1 disc area, any part of which lies within 1 disc diameter of the center of the macula. (2) Non clinically significant diabetic edema is defined as macular exudates without presence of DMO (3) Ischemic maculopathy (4)Mixed pattern

Table 1: National Screening Committee Grading of Diabetic Retinopathy/Maculopathy [8].

In 2012, South Tees DESP has thus introduced, alongside routine annual screening clinics, a virtual digital surveillance clinic for patients who need more frequent evaluation. Although the number of DMO referrals has reduced, a significant number of patients with DMO were still referred to HES and discharged without any treatment as they did not meet NICE requirements for treatment. In 2014, a virtual spectral domain optical coherence tomography (SD-OCT) clinic was introduced in order to stratify the DMO patients further and help in deciding if further ophthalmological review was indicated.Topcon NW6, Topcon NW8 and a Canon CR2 AF are used for fundus photographs at all our clinics in the DESP. For OCT, a Topcon OCT2000 and Topcon OCT1 000 are utilised in North Ormesby and the Friarage Hospital respectively. Central Retinal Thickness is measured from the retinal pigment epithelium to the vitreoretinal interface [21]. These OCT images are then placed in the digital surveillance queue, and graded by a consultant ophthalmologist, who will decide the outcome for these patients. To assess the pathway, a retrospective audit was performed on patients who were referred to HES from the digital surveillance pathway introduced in 2012 and digital surveillance with OCT in 2014. Information was collected in two audit cycles, one in 2012-2014 and the other from 2014-2015, with dilated fundus photography and OCT utilised respectively. We also looked at the treatment outcome from the patient's first appointment with an ophthalmologist to determine if OCT results influenced management outcomes. Results were then compared by using the Chi Square Test ofindependence with a significance level of 0.05.

Results

In 2012-14, 351 patients with DMO were accepted in HES and only 69 patients from 2014-15. 321 patients and 52 patients' data were used from each period respectively, after excluding patients who did not meet the criteria or did not attend the appointments. The total number of patients in this study was 373. There were 166 females and 207 males. The mean age was 61 years.

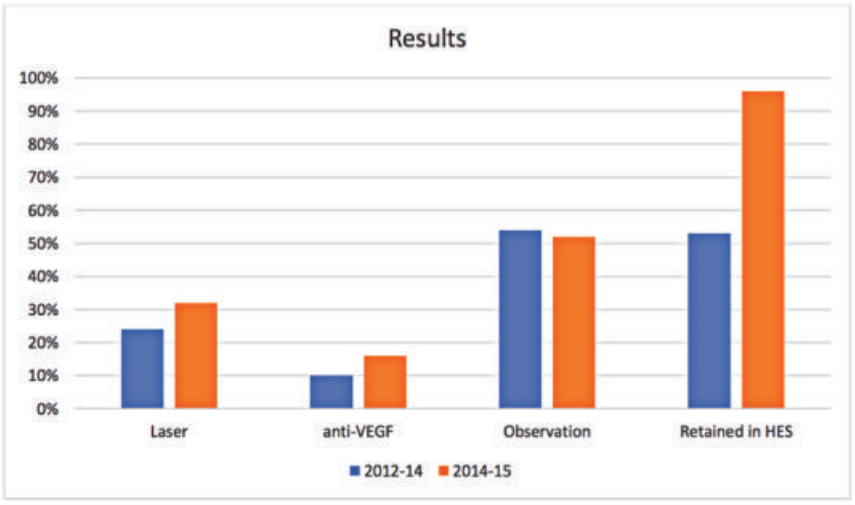


Figure 1: Clinic outcomes for referred patients after the first HES appointment.

47% of patients accepted to HES from 2012-2014 were discharged back to screening compared with only 4% in 2014-2015. The result is statistically significant ($p<0.05$). 34% of patients referred to HES in 2012-2014 received treatment whereas 48% of patients in 2014-2015 received treatment. The result is not significant ($p>0.05$). 24% of patients received laser treatment in 2012-2014 while 32% received laser treatment in 2014-2015. Anti-VEGF treatments were 10% and 16% in the respective time periods. This is not statistically significant ($p>0.05$). 54% of patients were retained for observation from 2012-2014 and 52% of patients in 2014-2015. These patients did not receive treatment after the initial appointment. This is not statistically

Discussion

One of the main objectives of population screening is to identify asymptomatic people who are at risk of developing a disease with subsequent referral for treatment if needed. Other requirements are for it to be cost effective, have high sensitivity and specificity and have easy administration. DMO can results in irreversible visual loss once symptoms occur and it is imperative to treat the condition at the earliest symptoms in order to preserve vision. Previous reports have shown that virtual OCT clinics are an effective way to monitor patient's diabetic maculopathy. We wrote this paper with the updated NICE guidance to report our experience with incorporating OCT scans as a screening strategy. Our patient referral pathway is designed to ensure that patients with diabetic maculopathy receive optimal imaging and management yet keeping service costs down.

A higher proportion of patients received treatment in 2014-15 period (48%) than in 2012-14 (34%). The increased accuracy in diagnosing DMO has led to increased rates of treatment, resulting in better visual outcomes for patients and a reduction in progression of diabetic eye complications. Our data shows that incorporating OCT scans in Digital Surveillance Clinics have resulted in a significant decrease in the number of people being discharged back to DRSS after the first hospital appointment (4% in 2014-15 compared with 47% in 2012-14). The incorporation of OCT into screening programmes resulted in patients getting appropriate imaging with follow up in HES if required. This increased sensitivity of diagnosing DMO would result in more appropriate referrals and reduce pressure on HES, which is even more crucial with the projected increase of diabetes in the population. It will also reduce the number of patients who do not attend clinics, saving valuable resources for both the clinician and the patient. Diabetic eye treatments are not without risk, and therefore being able to stratify the DMO and only refer patients that need treatment is paramount [22, 23]. Patient selection is important to avoid the patient's anxiety associated with referrals to HES.

At our trust, current screening costs approximately £30 per person, compared to an OCT scan with an appointment with an ophthalmologist costing approximately £120. By having the OCT images performed earlier, we will be able to decrease expenditure on managing diabetic maculopathy. Previous papers have cited the costs of OCT to be a deterring factor, but technological advances and increasing automaton have led to a price reduction in OCT equipment.

The similar rate of observation of patients when OCT scan was implemented is to be expected. There are several possible reasons. CSMO can resolve itself between the time of screening and the first clinic appointment and the clinician, after fundus biomicroscopy, can decide not to treat due to lack of CSMO at presentation in the hospital. It also validates the fact that the behaviour of the disease doesn't change that much in the same pool of diabetic patients and therefore the proportion of patient observed should be similar. The outcome of these patients is unknown as data was only collected for the initial outcome, with the final outcome being difficult to predict.A prospective study will have to be undertaken to determine if these patients were treated or discharged to annual recall. This raises a possibility that despite objective data showing previous DMO, clinicians are not always prompted to treat DMO. This can be because it self-resolved or patient opted for a conservative approach or refused treatment.

The use of OCT scans should be interpreted in the clinical context. OCT has limitations when considering its applicability. Opacities, such as corneal oedema and corneal opacities, cataract with significant opacity, vitreous haemorrhage, among other changes of dioptric media, can attenuate the incidence and reflection of light required to final imaging [24]. Patients with more complex eye disease should be referred to an ophthalmologist for further examination to determine treatment. Literature also suggests that retinal thickness can be influenced by age, axial length and race [25], which can influence the treatment eligibility of patients with suspected DM. There is also some debate on whether different OCT instruments yield different results, but the difference remains negligible in clinical contexts [26, 27].

Recent research suggests that inner segment-outer segment junction and external limiting membrane integrity can correlate with visual outcome in DMO patients [28]. Further research in the microstructure of the retina to identify intricate pathology would allow us to identify more accurately if macular oedema affecting these areas is significant enough to be treated, rather than using retinal thickness as the sole criteria for treatment.

We hope the added visualisation of retinal oedema and thickening through OCT will aid patient understanding on the disease process. This would allow patients to understand their conditions better and encourage tighter glycaemic control, which has been widely shown to decrease the rate of progression of DMO. Current UK Diabetic Eye Retinopathy Grading Criteria is based on fundus photograph findings do not take into account OCT results. Ideally, incorporating OCT retinal thickness into the maculopathy criteria will ensure a more objective measure is used to optimise treatments for diabetic patients. One disadvantage that OCT has is the inability to show focal leakages of vessels, macular ischaemia, or areas of non-perfusion, which is responsible for irreversible and devastating visual loss [29]. However, the coexistence of macular ischemia and macular oedema is common [30]. For the purposes of screening, CSMO identification through OCT would be faster and easier than determining the extent of macular ischemia through fluorescein fundus angiography. The need to investigate foveal avascularity would best be decided after being referred to HES.

Although DMO is primarily a vascular process, research has shown that it could involve abnormal neurovascular processes resulting in decreased colour sensitivity, contrast and visual field defects [32]. Currently, no scan offers information of the intricate disease process and as such remains an academic interest without current screening implications.

Conclusion

This paper demonstrates the result of using OCT under NICE guidelines to screen for diabetic maculopathy in virtual digital surveillance clinics. It is a formidable tool in accurately diagnosing DMO and ensuring appropriate referrals are made. We have shown that there is a substantial reduction in inappropriate DMO referrals to HES when the OCT is used in the screening pathway. Providing objective and reproducible data demonstrates an advantage over current imaging techniques in screening DMO. Further cost effectiveness analysis and possible refinement of NICE guidelines should be performed to allow implementing OCT in DRSS across the UK.

References

1. Slade, J., Eye health data summary. 2014, Royal National Institute of Blind People.

2. Lightman, S. and H.M.A. Towler, Diabetic retinopathy. Clinical Cornerstone, 2003. 5(2): p. 12-21.

3. White, N.H., et al., Effect of prior intensive therapy in type 1 diabetes on 10-year progression of retinopathy in the DCCT/EDIC: comparison of adults and adolescents. Diabetes, 2010. 59(5): p. 1244-1253.

4. Klein, R., et al., The Wisconsin Epidemiologic Study of Diabetic Retinopathy XV. Ophthalmology, 1995. 102(1): p. 7-16.

5. Early Treatment Diabetic Retinopathy Study Group, Photocoagulation for diabetic macular edema. ETDRS report number 1. Archives of Ophthalmology, 1985. 10.

6. Das, A., P.G. McGuire, and S. Rangasamy, Diabetic Macular Edema: Pathophysiology and Novel Therapeutic Targets. Ophthalmology. 122(7): p. 1375-1394.

7. Hex, N., et al., Estimating the current and future costs of Type 1 and Type 2 diabetes in the UK, including direct health costs and indirect societal and productivity costs. Diabetic Medicine, 2012. 29(7): p. 855-862.

References

8. Royal College of Ophthalmologists, Diabetic Retinopathy Guidelines. 2012.

9. Kinyoun, J., et al., Detection of Diabetic Macular Edema. Ophthalmology, 1989. 96(6): p. 746-751.

10. Wang, Y.T., et al., COmparison of prevalence of diabetic macular edema based on monocular fundus photography vs optical coherence tomography. JAMA Ophthalmology, 2016. 134(2): p. 222-228.

11. Strøm, C., et al., Diabetic Macular Edema Assessed with Optical Coherence Tomography and Stereo Fundus Photography. Investigative Ophthalmology & Visual Science, 2002. 43(1): p. 241-245.

12. Virgili, G., et al., Optical Coherence Tomography versus Stereoscopic Fundus Photography or Biomicroscopy for Diagnosing Diabetic Macular Edema: A Systematic Review. Investigative Ophthalmology & Visual Science, 2007. 48(11): p. 4963-4973.

13. Mookiah, M.R.K., et al., Application of different imaging modalities for diagnosis of Diabetic Macular Edema: A review. Computers in Biology and Medicine, 2015. 66: p. 295-315.

14. Trichonas, G. and P.K. Kaiser, Optical coherence tomography imaging of macular oedema. British Journal of Ophthalmology, 2014. 98(Suppl 2): p. ii24-ii29.

15. Dr Gemma, S.L.M., S. Dr Emily Han, and R.J.T. Mr Simon, Treatment of diabetic maculopathy. British Journal of Hospital Medicine, 2015. 76(1): p. 35-40.

16. The Diabetic Retinopathy Clinical Research, N., Aflibercept, Bevacizumab, or Ranibizumab for Diabetic Macular Edema. New England Journal of Medicine, 2015. 372(13): p. 1193-1203.

17. National Institute for Health and Clinical Excellence, Ranibizumab for treating diabetic macular oedema. 2013.

18. National Institute for Health and Clinical Excellence, Aflibercept for treating diabetic macular edema. 2015.

19. Mackenzie, S., et al., SDOCT Imaging to Identify Macular Pathology in Patients Diagnosed with Diabetic Maculopathy by a Digital Photographic Retinal Screening Programme. PLoS ONE, 2011. 6(5): p. e14811.

20. Chelala, E., et al., [Screening of diabetic retinopathy and maculopathy in Lebanese population using retinography and SD-OCT: The role of telemedicine]. Le Journal medical libanais. The Lebanese medical journal, 2015. 63(2): p. 59-65.

21. Chan, A., et al., Normal Macular Thickness Measurements in Healthy Eyes Using Stratus Optical Coherence Tomography. Archives of ophthalmology, 2006. 124(2): p. 193-198.

22. Ghasemi Falavarjani, K. and Q.D. Nguyen, Adverse events and complications associated with intravitreal injection of anti-VEGF agents: a review of literature. Eye, 2013. 27(7): p. 787-794.

23. Dowler, J.G.F., Laser management of diabetic retinopathy. Journal of the Royal Society of Medicine, 2003. 96(6): p. 277-279.

24. Hannouche, R.Z. and M.P.d. Ávila, Retinal thickness measurement and evaluation of natural history of the diabetic macular edema through optical coherence tomography. Arquivos Brasileiros de Oftalmologia, 2009. 72: p. 433-438.

25. Duan, X.R., et al., Normal macular thickness measurements using optical coherence tomography in healthy eyes of adult Chinese persons: the Handan Eye Study. Ophthalmology, 2010. 117(8): p. 1585-94.

26. Heussen, F.M., et al., Comparison of manually corrected retinal thickness measurements from multiple spectral-domain optical coherence tomography instruments. Br J Ophthalmol, 2012. 96(3): p. 380-5.

27. Sander, B., et al., Do different spectral domain OCT hardwares measure the same? Comparison of retinal thickness using third-party software. Graefe's Archive for Clinical and Experimental Ophthalmology, 2015. 253(11): p. 1915-1921.

28. Shen, Y., K. Liu, and X. Xu, Correlation Between Visual Function and Photoreceptor Integrity in Diabetic Macular Edema: Spectral-Domain Optical Coherence Tomography. Curr Eye Res, 2016. 41(3): p. 391-9.

29. Bresnick, G.H., et al., REtinal ischemia in diabetic retinopathy. Archives of Ophthalmology, 1975. 93(12): p. 1300-1310.

30. Sim, D.A., et al., The Effects of Macular Ischemia on Visual Acuity in Diabetic RetinopathyNovel Angiographic Parameters for Macular Ischemia. Investigative Ophthalmology & Visual Science, 2013. 54(3): p. 2353-2360.

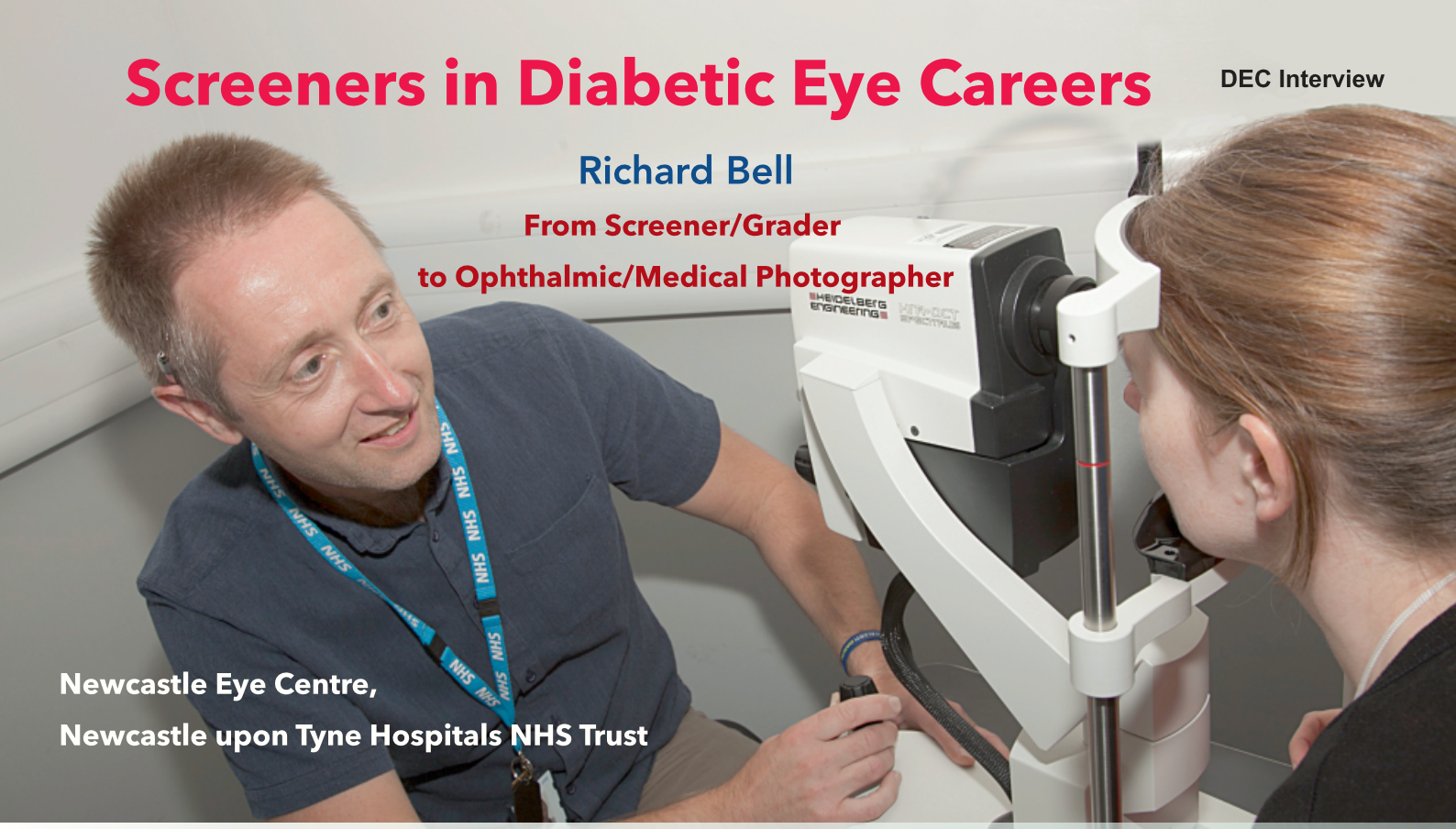
31. Mathew, C., A. Yunirakasiwi, and S. Sanjay, Updates in the Management of Diabetic Macular Edema. Journal of Diabetes Research, 2015. 2015: p. 8.

32. Antonetti , D.A., R. Klein , and T.W. Gardner Diabetic Retinopathy. New England Journal of Medicine, 2012. 366(13): p. 1227-1239.

Screeners in Diabetic Eye Careers

Richard Bell

From Screener/Grader to Ophthalmic/Medical Photographer



Newcastle Eye Centre,
Newcastle upon Tyne Hospitals NHS Trust

Q: What made you go into a Diabetic Eye Career and progress to an Ophthalmic/Medical Photographer?

A: With having Type 1 diabetes myself, I was always fascinated by the images produced when I used to go for my own retinal screening. Whenever I was shown the images, I was amazed at how good they were. The quality and clarity they produced and how, from the blood vessels and capillaries, indications highlight how good or bad your overall diabetic control is. That was where the interest started. I have always been a photographer, having my own business for over 20 years, but decided to close it down in 2009 as an opportunity arose for a screener/grader position at the North Yorkshire DESP. Having successfully acquired the position, I began ploughing my way through the City & Guilds Diploma with the help of my assessor Shelley Widdowson (National Grading Lead). It was whilst doing the diploma that I realised what a good job I have. Not only was I learning more about diabetes and the complications associated with eyes, but I was engaging with patients who were the "same as me".

In 2013, I moved up North to join the North of Tyne & Gateshead DESP. It was here where I began to learn more about other eye conditions whilst grading, which piqued my interest. I was keen to learn what happens to a patient who is referred to the hospital eye service, what type of images are taken and what treatment is on offer. I didn't get that opportunity whilst screening, to be able to fully engage with the hospital eye service. In 2016, I was fortunate enough to get a job as an ophthalmic/medical photographer, and for me, that was the icing on the cake! Not only would I be able to follow referrals from the diabetic eye screening service, but I'd be engaging and learning about other eye conditions through different methods of capture (i.e. OCT's, FFA's, wide-field imaging, slit lamp and retinal photography). These are valuable skills. I'm lucky enough to work with some wonderful consultants who take pride and care in teaching and deliver high standards towards work colleagues. I still feel as though I'm part of diabetic eye screening but at the next level.

Q: Can you tell us about some of your achievements so far?

A: In 2011, I completed the City & Guilds Level 3 Diploma in Diabetic Retinopathy Screening.

In 2013, I became an assessor for the City & Guilds Diploma concentrating on units 2 & 6. I also completed the Heartlands (Birmingham) Diabetic Retinopathy Screening Course. In 2014, I completed the Heartlands (Birmingham) Advanced Diabetic Retinopathy Screening Course and attended World Sight Day in London. In 2015, I attended the National Diabetic Eye Screening Conference (Royal Society of Medicine), World Sight Day (London) and was fortunate enough to be elected by my peers as a council member for BARS, for which I manage the website. I also won the BARS photography competition clinical category for an image showing age-related macular degeneration in a diabetic patient. In 2016, I demonstrated retinal imaging at the Diabetes UK Professional Conference in Glasgow. I was on a stand representing England with screening members from Scotland, Wales and Northern Ireland to highlight the 4 nations collaborating together. I also presented my first ever case study at the BARS conference in Birmingham. In 2017, I attended the Haag-Streit Retinal Symposium in Manchester (see April 2017 edition of DEJ) and successfully completed a Certificate of Higher Education in Health Sciences with the Open University to aid and promote patient care.

Q: Any failing moments or low points?

A: Oh yes, but I don't let them get me down. I'm a positive person and I've applied for jobs within eye screening (there's been a few) to progress my career but have been unsuccessful. I've always believed that there was a reason why I didn't succeed, it wasn't meant to be and that something better will come along, and it did! :)

Q: Do you find it important in your job role to continue education?

A: 100% yes. I'm a firm believer in the saying, "Every day is a school day", which was why I decided to do the Certificate of Higher Education in Health Sciences. It gave me a better understanding of various health conditions, of which some were associated with diabetes, and I have been able to pass my new knowledge onto colleagues and patients alike. Having that understanding and knowledge can only be a good thing.

Q: Do you think screening allows career progression?

A: I believe it can. There are openings out there, but you have to work hard to find them. In my old programme, which had changed provider only months before I joined, some of the screener/graders were administrative staff before progressing. And some of them are now doing slit lamp examinations in screening clinics with SLB clinics running alongside. I believe that this will become standard practice over the next few years with many of the programmes in order to ease up referrals to the hospital eye services.

Q: Where do you see yourself in 5 years from now?

A: That's a difficult one to answer! I will have completed my Post Graduate Certificate in Clinical Photography. I'd like to be an established photographer in the world of ophthalmology and in terms of my skills, be able to pass them onto other screeners/photographers in the form of a module towards recognised certification. BARS is looking at the possibillity of developing some additional qualifications for screening staff over the next couple of years, and I would like to be part of that in terms of image capture.

Q: As a photographer, are you able to share any tips to help get better fundus images and/or OCT's?

A: I will. There will always be times when you aren't able to get the perfect image. There are obstacles which can test the screener/photographer's experience to the edge. Below you will see some examples of a fundus image, an OCT scan, fundus image and OCT scan combined, how to photograph around a cataract and an anterior image showing a cataract. But first, I will give a few tips on positioning the patient and general set up.

I. I think one of the main priorities is that you're more likely to get a good image and patient co-operation if the patient is positioned correctly and comfortably at the camera. Make sure they're not hunched up or over stretching to get their head on the chin rest.

II. Good dilation. If possible allow at least 20 mins for pupils to enlarge in order to get a clear view of the retina. It will also aid in focussing too.

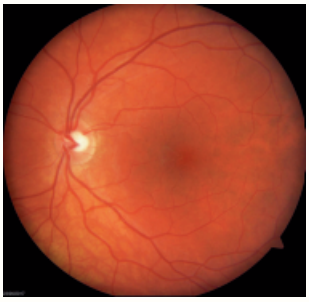
III. Fixation points. Make sure the patient can see the internal fixation point (usually a flashing green or blue light) within the camera. If you're new to screening or OCT, take the time to familiarise yourself by viewing the camera from the patients perspective. This means if the patient struggles to see the internal fixation point, use the external fixation arm (if camera supplies one) or your hands to guide the patient to look toward the correct point.

IV. Cataracts and small pupils. These can be a nightmare in trying to get good images. I have found that one of the best ways to deal with this is to take multiple images (often known as a jig-sawing) of the retina at different fixation points. The idea of these is to piece together the images like a jigsaw so it can be graded without the need for the patient to be recalled or sent to an SLB clinic. This method may not always work as it depends on how severe or how dense the cataract is. In these cases, always take an anterior fundus photograph.

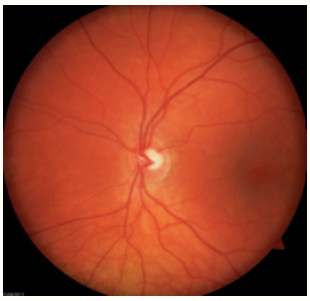
V. Anterior fundus photographs. A good anterior photograph can really help in diagnosis of certain conditions. This is particularly ideal for cataracts and rubeosis. The patient does not need to have their forehead touching the head bar so I usually ask the patient to move back slightly (some cameras supply an adapter which is placed on the head bar to aid the patient). Always make sure that the dioptre is out and I usually focus on the pupil. It may be necessary sometimes to reduce the flash setting on the camera as it may be slightly overexposed and look a little bleached out. Alternatively, the image may be underexposed and a little dark so an increase in the flash may be required. This can also be said for retinal images too. It may be worth experimenting with a colleague.

Some examples of images showing correct positioning in order to get the best quality image.

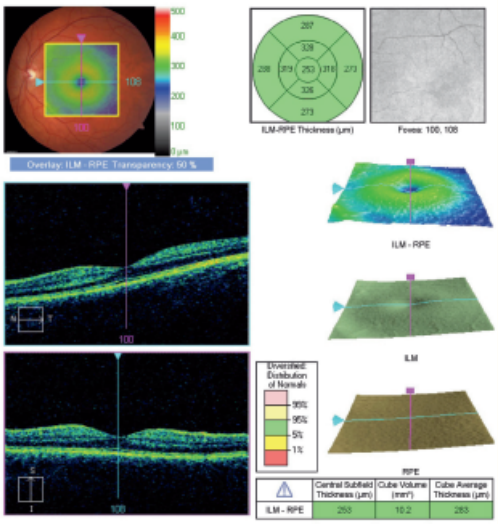
Example 1. Macular view centred correctly:



Example 2. Disc view centred correctly:

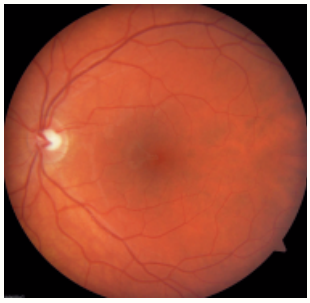


Example 3. Macular view of fundus and OCT combined

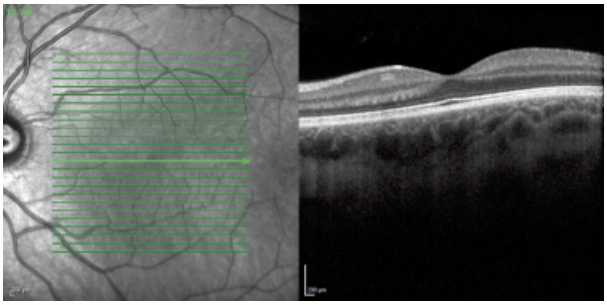


The **example 3** is the macular photo from the combine scan. When doing a scan and photo combination, an OCT is produced before the image is captured. OCT shows the thickness readings to be interpreted. All images shown in the **examples 1, 2, 3, 5 and 6** were taken on a Zeiss Cirrus Retinal Camera which combines both OCT and retinal photography. When photographing using this combination method, make sure the OCT is aligned correctly in the viewing box and if need be adjust using the joystick so that it is visible across the middle of the viewing box and the fovea is seen.

Example 3. Macular view of fundus



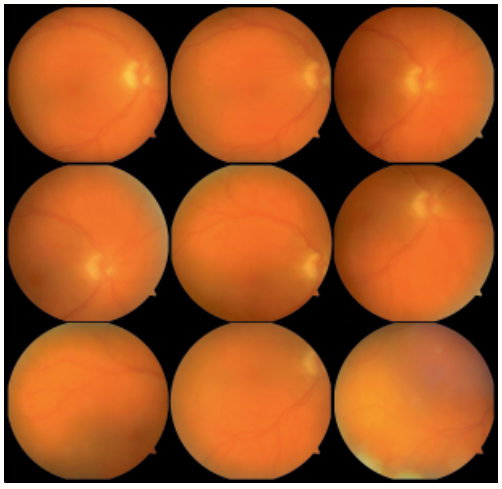
Example 4. An OCT of a maculae



The **image 4** was taken on a Heidelberg Spectralis OCT camera. The laser has produced 25 cuts of the macular and notice how the retina (**right image**) is in the top half of the viewing box. This is to give the best quality scan and also shows the choroid layer. OCT scans are ideal for highlighting fluid within the retinal layers.

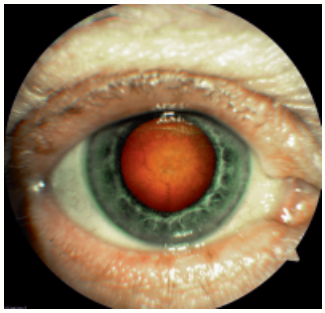
Example 5. How to capture around a cataract

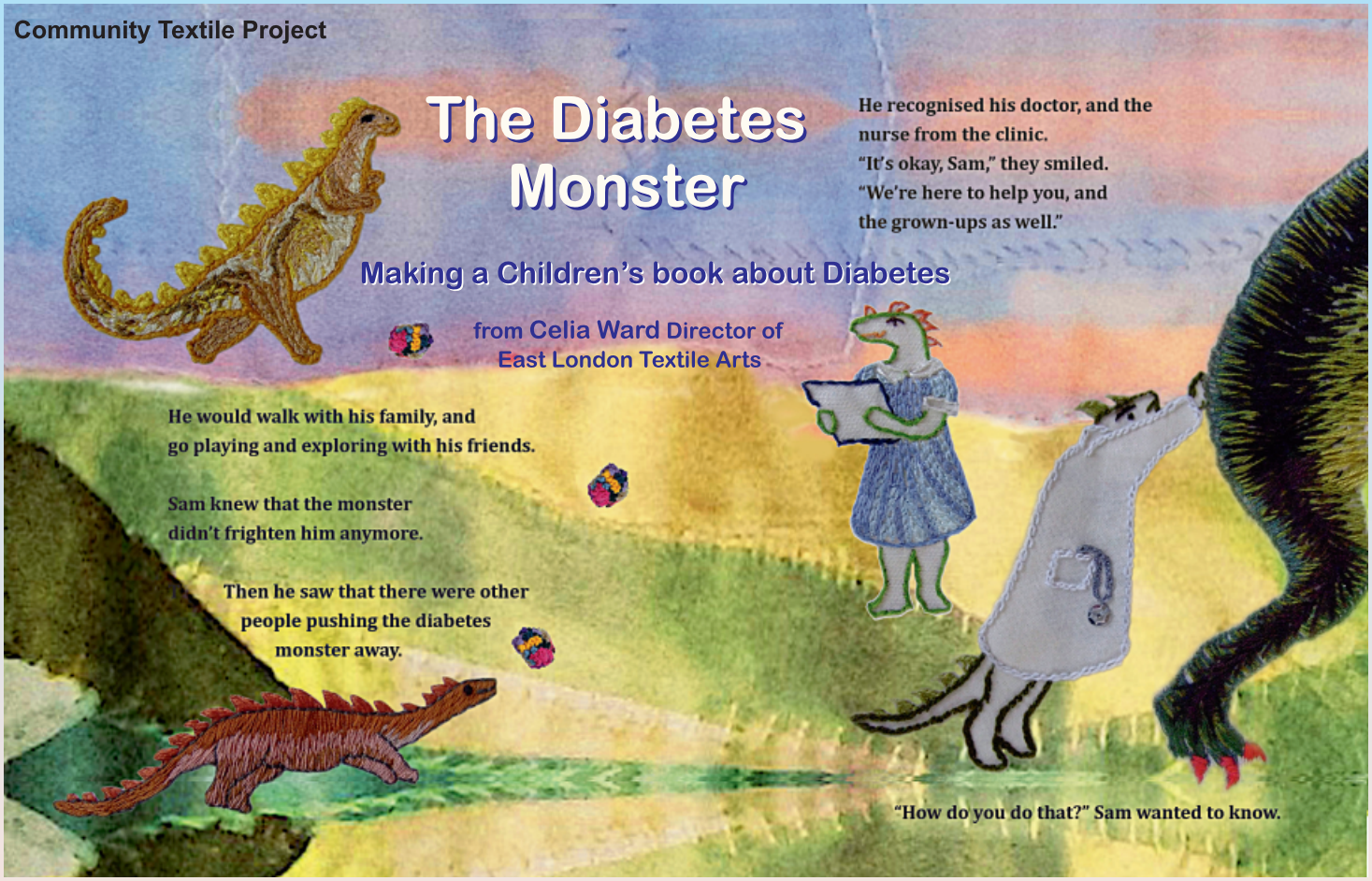
The image below shows 9 different images of a Type 2 diabetic with quite a dense cataract (**see example 6**). I moved the internal fixation point within the camera for the patient to follow. By doing this procedure, you are able to see various parts of the retina creating this sort of jigsaw effect and hopefully minimize the need for a recall or send the patient to an SLB clinic. If the patient is unable to see the internal fixation point then try using an external fixation arm if camera is supplied with one or your hand, and as the patient follows it, you'll be able to capture different parts of the retina.



Example 6. Anterior Image showing a cataract

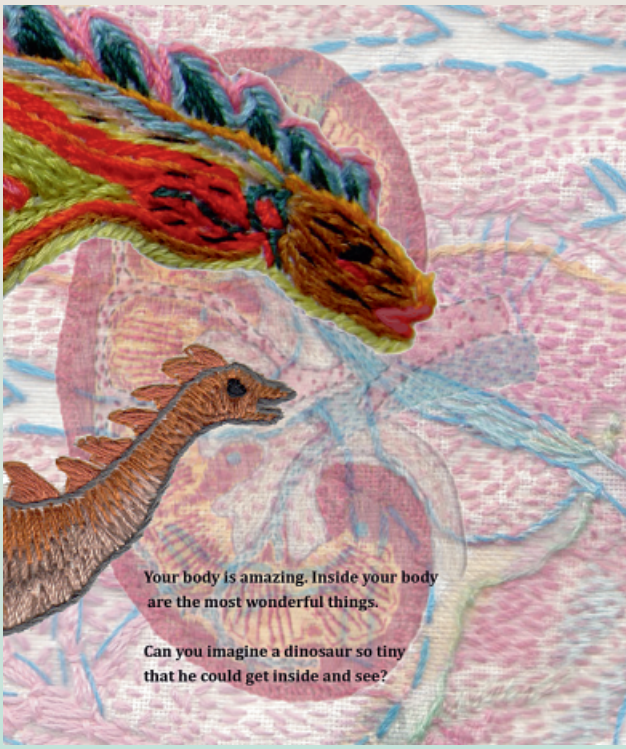
The image below was from the same patient from **example 5**. You can see the severity of the cataract which can help with grading as it can emphasize the poor quality of the images captured during the screening procedure.



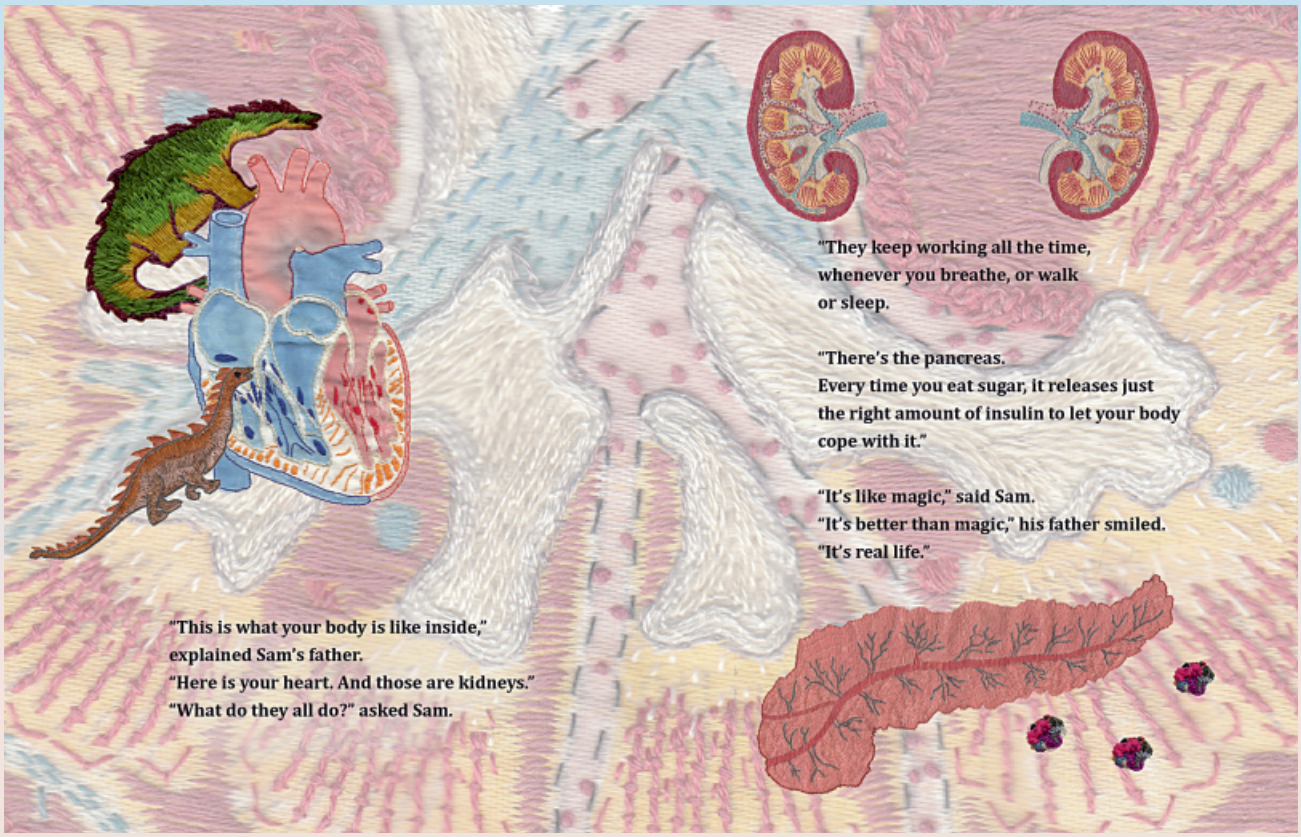


East London Textile Arts (ELTA) is the community textile project I run in East London. This book arose when a dentist one day knocked at the door, asking if our organisation would do a textile project about oral health. She was fed up with going into care homes and treating people who had nothing to do all day, yet whose teeth were in very poor condition! She believed that learning about oral health, through creative activity, might stimulate them to look after their teeth better. With £10,000 lottery funding, we produced an exhibition of textile works on the theme of dental care, with an accompanying booklet. *"Well,"* the dentist said as we finished, *"now you had better do a project on diabetes!"*

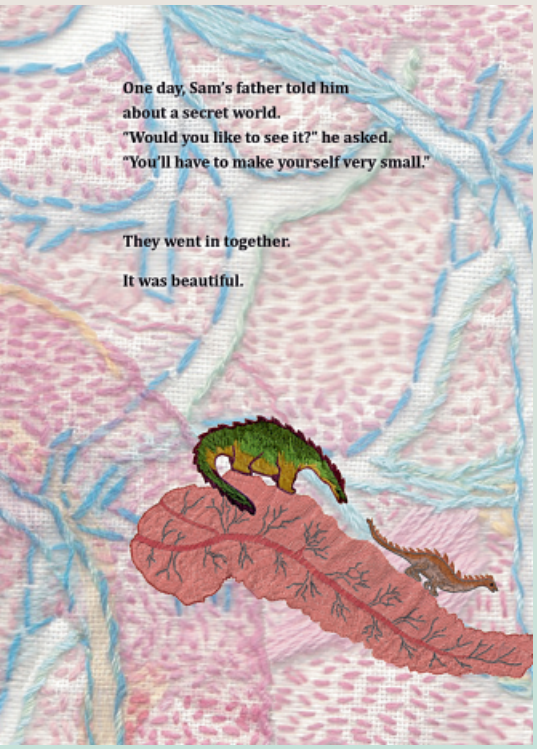
So that is what we did. We contacted Newham Public Health, who provided support, and the local community development teams based in libraries throughout Newham. We had a volunteer Diabetes researcher and the same children's editor and writer, Marilyn Watts, as for our oral health booklet. We created images around diabetes, using textile work done by women's groups in different parts of Newham (one of the most ethnically diverse boroughs in the country). An important part of the project was working with adults with learning disabilities and their carers. Slowly over a year we created sufficient images to make a book. The words and story were written entirely by Marilyn. Then I, with Marilyn's help, designed the embroideries into a children's picture book. There was a decision to make the characters in the book dinosaurs rather than people, because they could represent both sexes and all ethnicities. A draft then went to a literacy teacher at a Newham Primary school and to community health educators to check both images and texts. Some changes to the text were made, but none to the images. The final book was then distributed to all groups involved in the project and to libraries and health centres in Newham. Some remain to be sold at ELTA Open Days and exhibitions. We would like to get the book to a wider audience, but currently have no means of doing this.



Our participants felt proud and empowered by creating health literature rather than simply being consumers of it. This was particularly evident in the learning-disabled groups. The beneficial effect flowed out to carers and families. With our mainstream craft groups too, children were proud to see their grandmothers' work in booklets distributed to schools and libraries, and grandmothers humorously commented on the increased esteem with which they were viewed by their younger relatives.



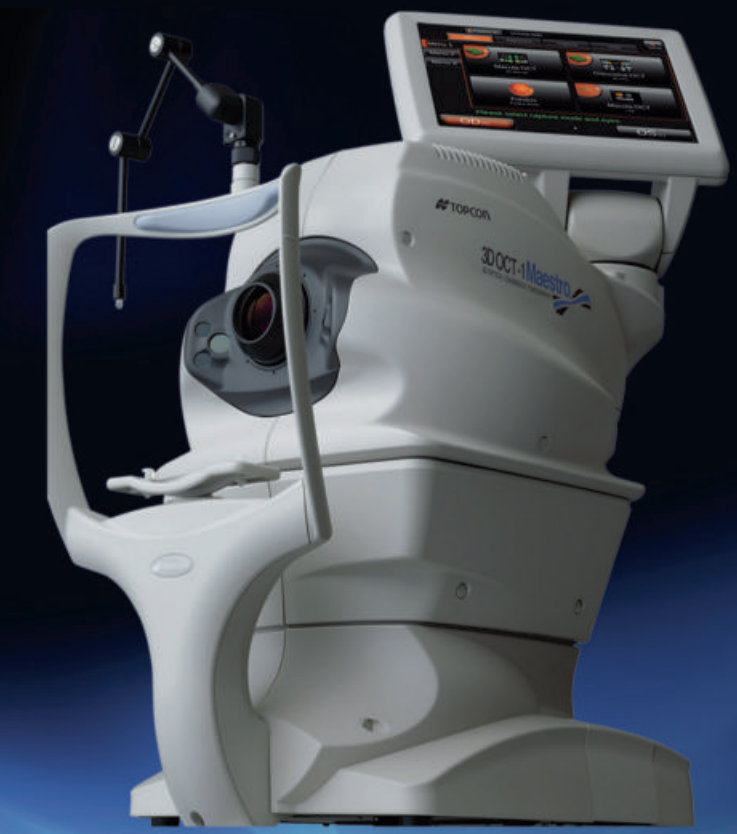
For the participants, it was an opportunity to learn about diabetes in a non-threatening way, while exploring the new and strange world of the inside of the body through creating intriguing and beautiful embroideries. A diet of exclusively medical subject matter would not work for our sewing groups, yet with this approach they are eager to tackle another health project.



Your choice is clear when it comes to a combined imaging system

3D OCT-1 Maestro

COMPACT. RELIABLE. ROBUST.



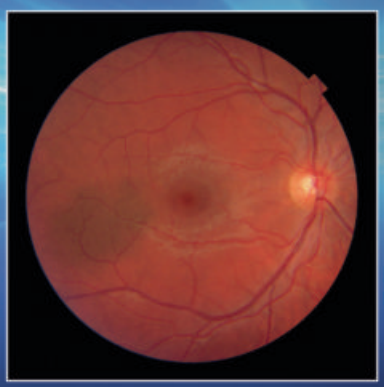
- Automatically captures full 3D OCT and Colour fundus of both eyes in under 60 seconds
- 50,000 A scans per second
- Pinpoint Registration™ for easy macular thickness analysis
- Linkable to any existing Topcon database
- Adjustable screen to maximise patient assistance
- Lightweight with small footprint
- 9 point adjustable internal fixation point matrix

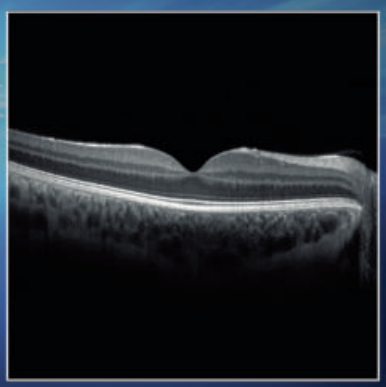
DRI OCT Triton

3D OCT-2000,
3D OCT-2000FA+

TRC-NW8, TRC-NW8FA+

TRC-NW400





All of our cameras are approved for diabetic screening by the NHS Diabetic Eye Screening (DES) programme

For more information, contact Topcon today

TOPCON GB Limited
- t: 01635 551120
- medical@topcon.co.uk
- www.topcon-medical.co.uk

TOPCON IRELAND
- t: +353 1 897 5900
- medical@topcon.ie
- www.topcon-medical.ie

TOPCON