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LETTER TO THE EDITOR

Measurement inaccuracies in widefield imaging—a cautionary tale

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Key messages

What we know:

- Widefield and ultra-widefield fundus cameras have proved useful for early detection and monitoring of various retinal diseases such as diabetic retinopathy, retinal detachments, and peripheral retinal degenerations.

What is new:

- In this letter we highlighted measurement discrepancies with the Zeiss Clarus 500 fundus camera when comparing the area of a large peripheral atrophic retinal hole captured with a single shot and a multi-shot with semi-automatic montage.

Dear Editor,

Over the last decades, widefield devices have revolutionized retinal imaging, enabling high-resolution photographs beyond a field of view of 200 degrees [1]. Among its extensive range of clinical applications, widefield imaging is particularly useful in the detection of peripheral retinal lesions [2].

During a routine examination of a patient with a large peripheral atrophic retinal hole employing the Zeiss Clarus 500 fundus camera (software version 1.0, Carl Zeiss Meditec, Jena, Germany), we performed both a single shot of the retinal break and a 5-shot photograph with semi-automatic montage. Surprisingly, when measuring the hole with the in-built software of the device, discordant values were obtained for the two photographs. In the single shot, the hole presented an area of 10.33 mm^2 (Fig. 1), whereas in the multi-shot photograph, the software calculated a smaller area of 4.93 mm^2 (Fig. 2). The photographs and montage were repeated multiple times on the same day, by two distinct operators (A.L. and A.T.), confirming the contrasting results of the first assessment.

Interestingly, when the multi-shot photograph was reassembled by using automatic montage, instead of semi-automatic, the measurements were correct and consistent.

In order to obtain a control measurement, we performed additional photographs with a different widefield fundus camera (Nidek Mirante; Nidek, Gamagori, Japan). All measurements were comparable with those obtained with the single shot of the Zeiss Clarus 500.

We attempted at investigating other patients affected by peripheral retinal lesions using the above-mentioned techniques. However, in all cases, no significant differences were found in the measurements according to the technique employed. This finding might be due to the different anatomical location of the lesions investigated.

While there was no sufficient evidence to establish a definitive reason for the discrepancy, we hypothesized that the software could be affected by a bug in the processing of multi-shot images obtained by semi-automatic montage, limited to the measurements of lesions located in the extreme peripheral retina. After the release of a software update (1.1 version), we repeated the measurement of the retinal hole in the multi-shot photograph with the same

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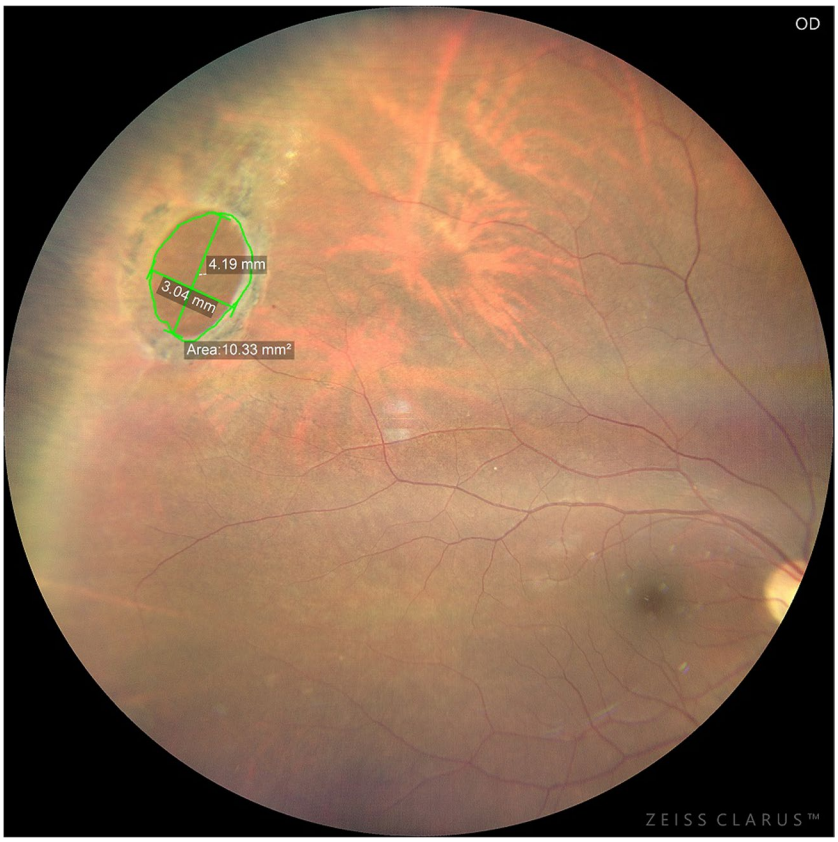

Fig. 1 Single shot photograph of a large atrophic peripheral hole (area = 10.33 mm^2, maximum diameter = 4.19 mm, minimum diameter = 3.04 mm). The hole was manually marked, and its area was automatically calculated by the software device

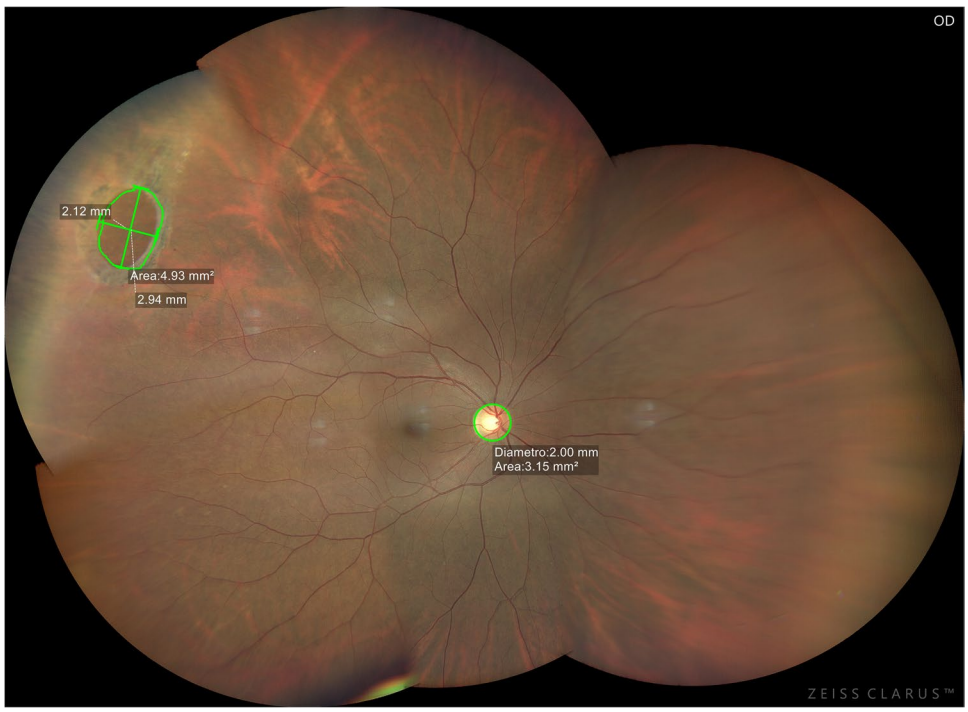

Fig. 2 Five shots, combined by semi-automatic montage (area = 4.93 mm^2, maximum diameter = 2.94 mm, minimum diameter = 2.12 mm). The hole was manually marked, and its area was automatically calculated by the software device. The difference in area exceeds the possible inaccuracy related to the manual input of the area to measure

semi-automatic montage technique performed in the initial assessment, obtaining similar values to those found in the single-shot photograph (area = 10.19 mm^2).

It is possible that the discrepancy we found was unique or limited to very few cases. However, linear and surface measurements are crucial in retinal imaging [3]. If unaware

clinicians relied on the measurements provided by software version 1.0, they might have reached incorrect assumptions regarding the possible evolution of certain retinal lesions. For instance, if a lesion appeared smaller in the initial measurement due to the software error and then larger in subsequent measurements after the release of a new software version, clinicians could mistakenly suspect that the lesion was enlarging over time. In conditions where the increase in size is a relevant factor for treatment decisions, such as choroidal nevi, measurement inaccuracies may lead to inappropriate interventions.

Widefield imaging is a rapidly evolving technology, and it is conceivable that despite extensive testing by manufacturers, software bugs may still occur. Clinicians should remain alerted about this possible but rare occurrence. It may be advisable to assess the progression of retinal lesions using the same photograph/montage techniques, especially when measurements are crucial to clinical decision-making.

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Declarations

Ethics approval No ethical approval was required.

Informed consent Informed consent was obtained for publication of medical images.

Competing interests The authors declare no competing interests.

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