Stereoscopic three-dimensional (3D) slit-lamp photography using a compact 3D digital camera

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We describe a novel method of stereoscopic 3D slit-lamp photography using a portable compact 3D digital camera. Thirteen eyes of 13 patients underwent slit-lamp photography using a Fujifilm 3D compact digital camera. We modified a universal smartphone microscope adapter to attach the camera to the slit-lamp. Photography was attempted on Zeiss and on HAAG-Streit slit-lamps. Success was defined as capturing a stereogram that consists of two simultaneous pictures, one from each slit-lamp ocular. Stereoscopic 3D slit-lamp photos could be captured in all 13 eyes in which they were attempted on Zeiss slit-lamps. Captured 3D media included external, eyelid, conjunctival, corneal, anterior chamber, lens, vitreous, and optic disc pathologies. Stereoscopic 3D photography could not be obtained using this Fujifilm 3D digital camera on Haag-Streit slit-lamps because of alignment incompatibility between the oculars of the slit-lamp and the camera. Digital stereoscopic 3D slit-lamp photography is feasible using a compact 3D digital camera and compatible slit-lamp design. Images obtained using this technique may be helpful in clinical education.

Key words: Slit-lamp photography, stereoscopic 3D, virtual reality clinical training

Binocular stereoscopic examination is one of the major advantages of slit-lamp use and allows for identification and characterization of various ocular pathologies. Photographic three-dimensional depiction of ophthalmic pathology provides additional information to the viewer when compared with standard two-dimensional (2D) photographs. Stereoscopic 3D slit-lamp photography was first described by Norton in 1964, using a twin-lens 3D camera attached to the slit-lamp oculars.[1] Stereoscopic 3D slit-lamp atlases along with 3D viewers have been used as educational tool for ophthalmology trainees.[2] More recently, digital cameras have been described for 2D slit-lamp photography and videography.[3,4] Stereoscopic 3D recording of intraocular and extraocular surgery using compact digital 3D cameras has been reported.[5,6] In this study we describe stereoscopic 3D slit-lamp photography using a compact 3D digital camera.

Methods

This is a prospective, noninterventional case series study approved by the Institutional Review Board of Johns Hopkins University School of Medicine. Thirteen eyes of thirteen patients underwent slit-lamp photography using a Fujifilm 3D compact digital camera that has two lenses and two sensors separated by 75mm and can capture still images as well as videos from both lenses simultaneously to generate 3D media. We used “Snapzoom” universal adapter” (http://snapzooms.com/) to attach the camera to the slit-lamp. Snapzoom adapter has the ability to hold to the two oculars of binocular devices (e.g. binocular telescopes and microscopes). Because this adapter comes with only one lens opening, we created another opening, in addition to widening the original opening of the adapter, to allow for alignment of the two camera lenses with the oculars of the slit-lamp [Fig. 1a]. After informed consent was obtained and the 3D camera was mounted on the slit-lamp oculars [Fig. 1b], images were captured by positioning the subject at the slit-lamp, focusing on the desired area of pathology as per normal slit-lamp use, and shooting the image

Figure 1: (a) A picture of the modified universal adapter with the camera attached. (b) A picture of the camera mounted on the slit-lamp using the modified adapter.

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Figure 2: Slit-lamp side-by-side stereogram of (a) Vitreous strand prolapsed in the anterior chamber in a pseudophakic patient. (b) Layered hyphema (c) Conjunctival granuloma with surface ulceration in a patient with inflammatory bowel disease (d) Complicated cataract with pigments on anterior lens capsule in a patient with recurrent anterior uveitis. (e) Right lower eyelid mass
through the oculars. Raw captured pictures were uploaded to a secure database. Stereo Photo Maker software (http://stereo.jpn.org/eng/) was used to convert the raw digital clinical slit-lamp picture files to side-by-side formats compatible with viewing by virtual reality set.

Results

Binocular stereoscopic external, eyelid, conjunctival, corneal, anterior chamber, lens, vitreous and optic disc pathologies 3D slit-lamp pictures [Fig. 2] were captured in all thirteen eyes in which 3D slit-lamp photography was attempted on Zeiss slit-lamps. Stereopsis effect could be appreciated when the 3D media were viewed by Google cardboard virtual reality viewer. Stereoscopic 3D photography could not be obtained using this 3D digital camera on Haag-Streit slit-lamps due inability to align the two lenses of the camera simultaneously with both oculars of the slit-lamp.

Discussion

We successfully obtained 3D slit-lamp pictures using the Zeiss slit-lamp, but we could not capture 3D media from Haag-Streit slit-lamps. While Zeiss slit-lamp oculars are parallel, Haag-Streit slit-lamp oculars diverge towards the objective end [Fig. 3]; so that only one lens of the camera could be aligned with one Haag-Streit slit-lamp ocular at a time. Viewing of 3D slit-lamp photos requires special virtual reality viewers or 3D glasses. Reflections from biomicroscopic lens used for posterior segment (vitreous and optic disc) photography degraded the quality of the images.

Stereoscopic 3D slit-lamp photography may provide a good educational resource for ophthalmology trainees and can be particularly helpful for overseas training. This technology can also be used in assessment and testing of medical trainees by providing virtually simulated exam stations. Further studies are required to improve 3D image quality, compatibility with different slit-lamp designs; to validate the effectiveness of this technique in medical education are required.

Conclusion

This study proves the concept of feasibility of digital stereoscopic 3D slit-lamp photography using compact 3D digital camera and compatible slit-lamp design. Images and videos obtained using this technique may be helpful in clinical education. Further study is required to address equipment design challenges and for further evaluation the types of ocular pathology that are most conducive to this imaging technique.

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Conflicts of interest
There are no conflicts of interest.

References

1. Norton HJ. Absolute stereophotography of the slit-lamp optical section: A new ophthalmic stereography. Am J Ophthalmol 1964;58:797-804.
2. Braley AE, Watzke RC, Allen L, Frazier O. Stereoscopic Atlas of Slit Lamp Biomicroscopy. Vols. 1 & 2. Mosby, ISBN 0801607302 Published 1970.
3. Fogla R, Rao SK. Ophthalmic photography using a digital camera. Indian J Ophthalmol 2003;51:269-72.
4. Yuan J, Jiang H, Mao X, Ke B, Yan W, Liu C, et al. Slit-lamp photography and videography with high magnifications. Eye Contact Lens 2015;41:391-7.
5. Ho DK. Stereoscopic microsurgical videography of phacoemulsification surgery. JAMA Ophthalmol 2018;136:432-3.
6. Birnbaum FA, Wang A, Brady CJ. Stereoscopic surgical recording using GoPro cameras: A low-cost means for capturing external eye surgery. JAMA Ophthalmol 2015;133:1483-4.

Figure 3: (a) Shows parallel orientation of Zeiss slit-lamp’s oculars which allows simultaneous alignment of each ocular with the corresponding lens of this 3D camera. (b) Haag-Streit slit-lamp oculars are slightly diverging so only one ocular of the slit-lamp can be aligned with a lens of this 3D camera at a time.