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Technical Note

3D-Printed Placido Disc for Intraoperative Keratoscopy

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Introduction

The cornea, similar to all non-ideal refracting surfaces, reflects some of the light rays that strike it. The Placido disk reflection principle has its roots in this (1). Placido described this principle in 1880, and he designed the first photokeratoscope. The quality and dimensions of the projected image can be improved using cylindrical, hemispherical, and ellipsoidal targets. This obtained image can be quantitatively evaluated for corneal astigmatism by employing computer software calculations. On the basis of this concept, numerous sophisticated technological devices have since been developed (2). Despite many revolutionary advances in this field, practical methods based on the most fundamental principle of Placido disk reflection, primarily in the rapid and qualitative evaluation of the cornea, still remain relevant.

To obtain good visual acuity, it is essential to lessen surgically induced astigmatism. For this purpose, surgeons should track astigmatism during ocular operations. There are technologically advanced instruments built into the operating microscope. However, many surgeons may not have access to these high costing devices. On the other hand, a more affordable and useful option is to use qualitative keratometry instruments based on the Placido disk reflection principle (3,4). This kind of intraoperative qualitative keratometry is essential in corneal surgery. It helps in making decisions regarding applications like the replacement of a suture during a simple interrupted suture and adjusting the suture tightness during a continuous suture.

Herein, a Placido disk that was produced using a 3D printer is presented (Fig. 1). This 3D-printed Placido disk is very inexpensive to manufacture and reproduce. It was aimed to provide a cost-effective and practical qualitative intraoperative evaluation of corneal astigmatism with this device.

The disk, which is very simple to use, is held in front of the cornea perpendicular to the visual axis (Fig. 2). There

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Figure 1. Illustration of the Placido disk's design.

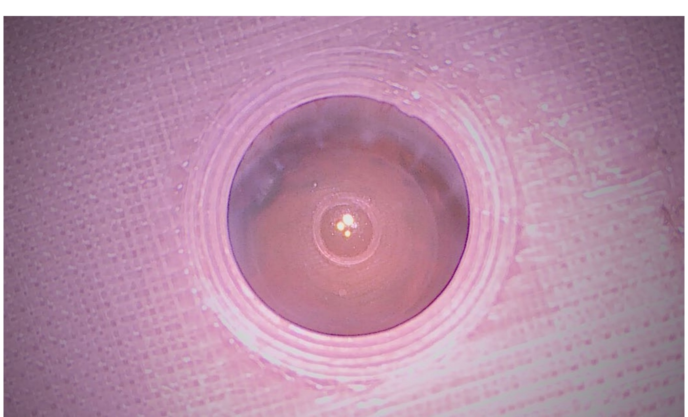

Figure 2. Image of the corneal disk being used under the operating microscope.

are concentrically spaced grooves on a translucent circle. Under the operating microscope, a visual inspection is done through the disk's center opening. The rings are assessed qualitatively, just as in a standard keratoscope, to detect astigmatism. The distance between the rings is reflected equally when reflected from the center of the cornea in the absence of significant astigmatism. Based on the distortion of the rings, the estimated degree and axis of astigmatism are determined. This qualitative evaluation establishes whether or not to perform any additional intervention for experienced surgeons. It is important to keep the cornea constantly wet during this process so that the evaluation is not impaired. It does not need to be assembled since it is used in the surgeon's hand, which adds to its convenience.

Modern 3D printing technology offers up novel opportunities. Tools made with a 3D printer no longer require any logistical support. It is sufficient to transfer the model's design to reproduce the product in different locations. Placido disk keratoscopy was defined over a century ago, and numerous alternatives have been described in different contexts. This device can be modified and calibrated as needed for use in different setups thanks to 3 printing technology.

Although the design of the disk produced is not new, a 3D printed version is a practical and affordable tool for worldwide use.

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