

An innovative external drainage device for suprachoroidal fluid: the puncture needle with drainage groove

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Dear Editor,

We introduce a novel surgical instrument designed to overcome the challenges in draining fluid from the suprachoroidal space in patients with choroidal detachment. In the evolving landscape of ophthalmic surgeries, procedures that were once considered complex, such as those for choroidal detachment, are becoming increasingly common. Drainage of subchoroidal fluid was derived from 1985^[1] with indirect visualization during scleral buckle surgery^[2-4]. This technique has also been recognized as an important technique to assist with pars plana vitrectomy^[5]. Some studies have documented the use of scleral buckle with external needle drainage and vitrectomy in the treatment of rhegmatogenous retinal detachment and choroidal detachment^[6]. In these cases, effective drainage^[7] of fluid from the subchoroidal cavity is a critical step in the surgical process. Additionally, intraocular surgeries can occasionally lead to postoperative choroidal hemorrhage^[8] which requires prompt and efficient drainage to salvage the patient's vision. The absence of a convenient surgical instrument for this purpose underscores the need for innovative solutions^[8]. We introduce a novel device for external drainage technique, which could be used in choroidal fluid effusion. In the era of minimally invasive vitreoretinal surgery, the use of trocar makes it challenging to drain the subchoroidal fluid from patient's suprachoroidal space. The

subchoroidal fluid drainage needle that we have invented effectively addresses this issue.

All the authors were grateful of the patient who agreed to participate in this letter, which was approved by The Medical Ethics Committees of Tianjin Eye Hospital. All of the authors had permission to access patients' records and confirmed that all written consent was obtained.

Traditional puncture needles solely possess the ability to puncture, requiring surgeons to switch to a different instrument to achieve drainage step. This lack of integration in surgical tools poses an inconvenience during surgery, potentially increasing operative time and compromising surgical outcomes.

The proposed instrument, as illustrated in Figure 1, constitute with three main components.

Figure captions towards the surgery were in Figure 2.

The device's unique design ingeniously incorporates a drainage groove into a 25-gauge puncture needle, enabling both puncturing and drainage *via* a single instrument. This dual functionality not only expedites the surgical procedure but also reduces potential complications associated with instrument exchanges. The semi-circular drainage groove is the hallmark feature of this device. By allowing for continuous and rapid drainage while simultaneously supporting the scleral puncture site, the groove ensures efficient removal of subchoroidal fluid.

This instrument heralds a significant advancement in micro-ophthalmic surgery, addressing an unmet clinical need. Its introduction involves the removal of subchoroidal fluid could lead to enhanced surgical outcomes and a potential reduction in complications associated with the drainage of subchoroidal fluids. Since the axial length is approximately 24 mm, the needle diameter is set to 4 mm to reach the depth of the choroidal detachment cavity. Furthermore, the reason why chose 14 mm as the length of the groove is aim to facilitate convenient handling for the surgeon. The semi-circular design has two main advantages: on one hand, it mimics the shape of a puncture blade; on the other hand, the hollow semi-circular groove design facilitates the outflow of fluid from the eye through its cavity. This technique using novel device is critical in managing conditions such as choroidal detachment and

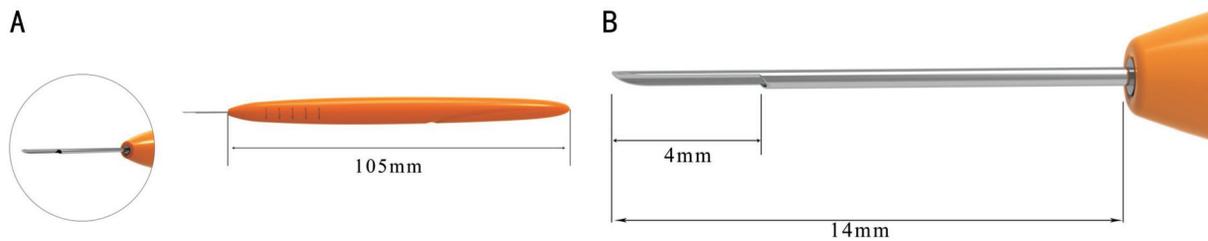


Figure 1 Animated illustrations of the device A: The needle combines semi-circular channel in the needle itself, 105 mm of whole length, designed for rapid and continuous drainage of fluid from the suprachoroidal cavity. B: Puncture head is 4 mm and groove is 14 mm, which allows precise penetration into ocular tissues and effective drainage through the groove.

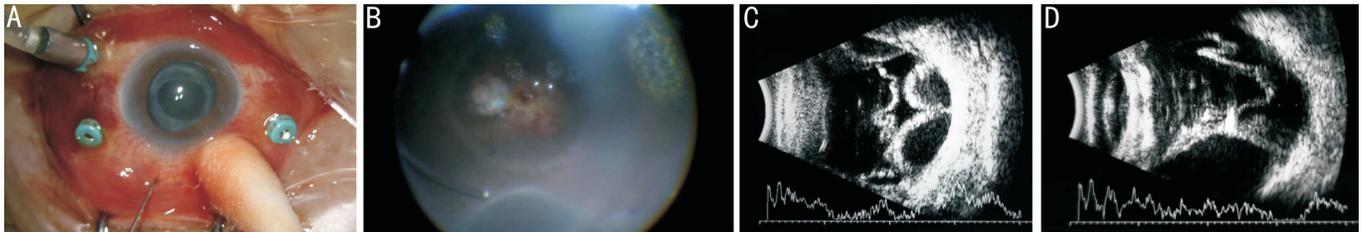


Figure 2 Intraoperative surgery photos and B-scan pictures before the surgery Intraoperative image of the guarded-needle external drainage technique using our device. A: The needle is used in the surgery of vitrectomy and external drainage is performed in a transconjunctival, transscleral lesion; B: The choroid is observed attached to the sclera immediately through scleral depressor; C, D: B-scan is shown choroidal detachment before the surgery.

choroidal hemorrhage. After the drainage needle enters the eye through the flat portion of the ciliary body, it is retracted to expose a groove, allowing for the drainage of subchoroidal fluid. Simultaneously, taking advantage of the viscous nature of the vitreous base, it prevents the outflow of intraocular fluid. At the same time of draining subchoroidal fluid, surgeon promptly elevates the intraocular perfusion pressure in order to remain stability of intraocular pressure within the eye.

Furthermore, the technique of subchoroidal fluid drainage extends to addressing choroidal effusion, a condition marked by the accumulation of fluid between the choroid and the sclera. Choroidal effusion can arise due to trauma, surgery, or underlying contexts. By safely draining the accumulated fluid, suprachoroidal drainage alleviates the pressure on the choroid and sclera, preventing potential complications such as scleral thinning and subsequent visual impairment.

The device usage of subchoroidal fluid effusion also can be applied to choroidal hemorrhage. In rare cases, choroidal hemorrhage, or bleeding within the choroid, can cause subchoroidal fluid accumulation. The applications of suprachoroidal fluid drainage also encompass managing choroidal hemorrhage, a critical condition characterized by the accumulation of blood beneath the retina and choroid. Suprachoroidal fluid drainage helps remove the blood congestion, relieving the pressure immediately.

The clinical presentation of subchoroidal fluid accumulation can vary depending on its severity and the underlying causes. Symptoms may include blurred vision, eye discomfort, and changes in intraocular pressure. Prompt diagnosis and

management are essential to address the above condition and prevent potential complications associated with subchoroidal fluid accumulation.

In conclusion, the puncture needle with a drainage groove offers a novel solution to a longstanding challenge in ophthalmic surgery. By integrating puncture and drainage functionalities into a single 25-gauge instrument, it promises to streamline surgeries and improve postoperative visual outcomes. By facilitating retinal reattachment, alleviating macular pressure, and restoring normal ocular anatomy, this technique contributes significantly to preserving and restoring visual function.

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