

Five-in-one: a novel, cost-effective yet simple use of micro needle holder

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Abstract

● **AIM:** To achieve a balance between efficiency and cost in the management of medical instrument by the use of micro needle holder.

● **METHODS:** In this study, the novel multifunctional use of micro needle holders was performed between 2018 and 2019 at the Department of Ophthalmology in the 4 hospitals in Shaanxi Province. In this innovation, the micro needle holders were initially used as micro forceps to remove sutures, as eye spud to safely extract foreign body from cornea, as ciliary forceps to remove trichiasis, as well as punctal dilator to dilate most small puncta.

● **RESULTS:** Using this technique, the medical costs of both procurement and sterilization were cut off in the selected 4 hospitals. The purchase cost has dropped by roughly 50%. The sterilization cost was decreased by about 30%.

● **CONCLUSION:** The innovation in the five-in-one multifunctional use of micro needle holders saves the medical costs.

● **KEYWORDS:** micro needle holder; medical instrument; ocular surgical instruments

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INTRODUCTION

The cleaning and sterilization of ocular surgical instruments are widely concerned by the surgeons and various academies of ophthalmology around the world^[1]. A newly published study supported the safety of common short-cycle instrument processing practices for sequential same-day anterior segment surgery. In an online survey, 78% cataract surgeons and nurses believed that more supplies should be reused by short-cycle processing^[2]. A reduced instrument tray can also be successfully implemented for vitrectomy surgery and can result in significant indirect benefits as well as direct cost savings from reduced sterilization costs^[3]. A variety of operating room protocols that may increase cost and waste without any actual safety benefit, should be critically evaluated.

Some procedures such as removal of suture, extraction of foreign body from cornea, removal of trichiasis^[4] and punctal dilation are the daily routine treatments in the ophthalmology outpatients' clinics and wards. Most procedures, especially micromanipulations, need various fine ophthalmic instrument, of which most are easily damaged and waste of time for classification managements^[5]. Effectiveness yet cost-saving is crucial to meet this increasing demand^[6], especially in the limited budget practice.

Herein, we briefly report a novel multifunctional yet simple use of micro needle holder as micro forceps, eye spud, ciliary forceps and punctal dilator while saving the medical costs in northwest China.

SUBJECTS AND METHODS

Ethical Approval The study was conducted in accordance with the Declaration of Helsinki and was approved by the Medical Ethics Committee of First Affiliated Hospital of Xi'an Jiaotong University (XJTU; 2018-W11). All patients had been fully informed of the purpose and methods of the present study and provided written informed consent from themselves.

Multifunctional Use of a Micro Needle Holder A micro needle holder is often used to hold a needle to suture the cornea, sclera, and conjunctiva with the assistance of micro forceps under a surgical microscope (Figure 1A) in the operating rooms. Further, there will be some procedures such as removal of suture, extraction of foreign body from cornea,

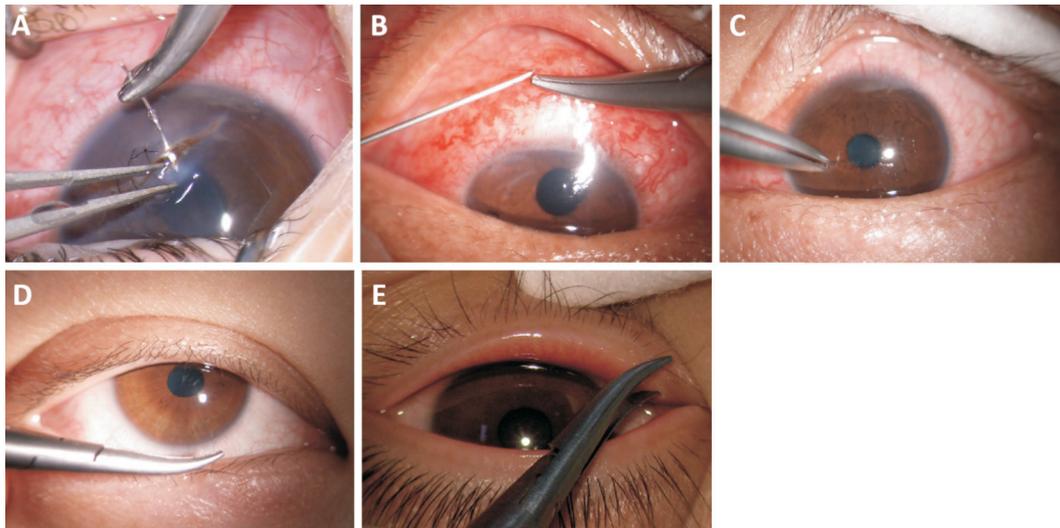


Figure 1 A novel five-in-one multifunctional yet simple use of micro needle holder A: Normal use of micro needle holder. A needle held by a micro needle holder suturing the cornea with the assistance of micro forceps. B: Micro needle holder used as micro forceps. Suture removal with a syringe needle with the assistance of a micro needle holder instead of micro forceps in front of the slit lamp microscope. C: Micro needle holder used as eye spud. Extraction of foreign body from cornea with a micro needle holder instead of an eye spud or a syringe needle in front of the slit lamp microscope. D: Micro needle holder used as ciliary forceps. Removal of trichiasis with a micro needle holder instead of ciliary forceps in front of the slit lamp microscope. E: Micro needle holder used as punctal dilator. Using one blade of a micro needle holder instead of a punctal dilator for dilating the lower puncta.

removal of trichiasis and punctal dilation in the treatment rooms of ophthalmology outpatients' clinics and wards. A micro needle holder instead of micro forceps can be used to remove corneal and conjunctival sutures with a syringe needle in front of the slit lamp microscope (Figure 1B). Moreover, a micro needle holder instead of an eye spud or a syringe needle can be used to extract foreign body from cornea in front of the slit lamp microscope (Figure 1C). In addition, a micro needle holder instead of ciliary forceps can be used to remove trichiasis in front of the slit lamp microscope (Figure 1D). Besides micromanipulation, we can use one blade of a micro needle holder instead of a punctal dilator to dilate the puncta (Figure 1E).

Medical Costs Comparison This study included 4 hospitals with the department of ophthalmology between 2018 and 2019. The selected representative hospitals are all located in the less-developed northwest China. The First Affiliated Hospital of XJTU is in Shaanxi Province as the general health center of northwest China. Yulin No.2 Hospital (Yulin) and Ankang Hospital of Traditional Chinese Medicine (Ankang) are the eye care centers of northern and southern Shaanxi respectively. Xi'an No.1 Hospital (Xi'an) is the eye care center of Xi'an City, which is the most populous city of northwest China. The cost components included purchase cost of micro needle holders, micro forcipes, eye spud, ciliary forcipes and punctal dilators, as well as sterilization cost of the above medical instruments in the whole year 2018. With the novel multifunctional yet simple use of micro needle holders, of

which purchase and sterilization costs were gathered for the year 2019.

RESULTS

Table 1 shows the cost components of medical instruments in the selected 4 hospitals between 2018 and 2019. With the novel multifunctional yet simple use of micro needle holders, both the purchase and sterilization costs were decreased. The purchase cost has dropped by roughly 50%. In the year 2019, the procurement costs of the only micro needle holders in the 4 hospitals were respectively 47.1% (US \$ 423/898, XJTU), 50.0% (US \$ 274/548, Yulin), 48.0% (US \$ 342/712, Ankang), and 48.9% (US \$ 4089/8369, Xi'an) of the medical instrument costs of the previous year. The sterilization cost was decreased by about 30%. The sterilization costs were respectively 68.4% (US \$ 386/564, XJTU), 72.3% (US \$ 298/412, Yulin), 70.1% (US \$ 345/492, Ankang), and 71.0% (US \$ 4105/5782, Xi'an) of the previous year. Moreover, both the treatment and preparation time was ultimately saved and shortened with the application of novel five-in-one micro needle holders. The average treatment time was respectively 30.0 % (1.5/5.0, XJTU), 43.8% (2.1/4.8, Yulin), 39.1% (1.8/4.6, Ankang), and 34.1% (1.4/4.1, Xi'an) of the previous year. The average preparation time was respectively 60.0% (24/40, XJTU), 61.5% (16/26, Yulin), 58.8% (20/34, Ankang), and 37.5% (18/48, Xi'an) of the previous year.

DISCUSSION

Our technique is a five-in-one multifunctional yet simple use of a micro needle holder instead of micro forceps, an eye spud,

Table 1 Cost analysis of medical instruments with the novel multifunctional use of micro needle holder

Cost items	XJTU		Yulin		Ankang		Xi'an	
	2019	2018	2019	2018	2019	2018	2019	2018
Purchase cost (US \$)	423	898	274	548	342	712	4089	8369
Micro needle holder	423	267	274	168	342	213	4089	2543
Micro forceps	0	423	0	264	0	342	0	3978
Eye spud	0	72	0	44	0	52	0	526
Ciliary forceps	0	86	0	42	0	63	0	680
Punctal dilator	0	50	0	30	0	42	0	642
Sterilization cost (US \$)	386	564	298	412	345	492	4105	5782
Average treatment time (min)	1.5	5.0	2.1	4.8	1.8	4.6	1.4	4.1
Average preparation time (min)	24	40	16	26	20	34	18	48

XJTU: Xi'an Jiaotong University.

ciliary forceps and a punctal dilator. Furthermore, it can reduce the procurement and sterilization expenditures of medical instruments. In addition, it is possible to avoid wasting time on routine preparation and management of various instruments out of the operating rooms^[7].

A micro needle holder is often used to suture the tissue of an eyeball under the microscope^[8]. We found its multifunctional yet simple use in the clinics. The removal of sutures after keratoplasty, excision of pterygium, trabeculectomy^[9-10] and surgical repair of corneal or conjunctival laceration is a common issue. Instead of micro forceps, it is possible to remove the sutures using a micro needle holder with a syringe needle posterior to ocular surface anesthesia in front of the slit lamp microscope, which makes removal of sutures easier for both oculists and patients during the process and enhances the efficiency as well. As the fine tips of a micro forceps are easily damaged, it needs to be replaced more often than a micro needle holder, thus increasing expenses^[11]. The removal of a corneal foreign body is another procedure commonly performed in the emergency department^[12]. The eye spud is not widely used in the clinics, but a syringe needle is often used by surgeons to extract foreign body from cornea, while greatly increasing the risk of corneal penetrating injuries, especially for patients with poor cooperation^[13] and residents during their freshmen year. Safety is the outstanding advantage of the micro needle holder application for the extraction of foreign body from cornea^[14-15]. Moreover, the foreign body in cornea can be directly held by the micro needle holder, thus making extraction easier. In case of corneal foreign bodies not removed in a timely manner, they can cause prolonged pain and lead to microbial keratitis and even endophthalmitis^[16]. Trichiasis is another common eyelid problem. Eyelashes grow inwards toward the eye. The lashes rub against the cornea and the conjunctiva. Sometimes trichiasis affects only a few eyelashes, which maybe simply removed with a micro needle holder instead of ciliary forceps in front of the slit lamp microscope. For most patients with small puncta, it can also be dilated

by one blade of a micro needle holder instead of a punctal dilator^[17], which is easily damaged due to the fine tip and thus increases expenditure.

Economic evaluation in health care is still an evolving discipline^[18]. With the novel five-in-one multifunctional yet simple use of micro needle holders, it is amazing that both the purchase and sterilization costs were all decreased regardless of whether in a general hospital (XJTU) or an eye hospital (Xi'an), or a hospital with a large (Xi'an) or small (Ankang and Yulin) number of outpatients. The medical costs were cut off. A wide variety of ophthalmic instruments, which are easily damaged, is one of the key factors contributing to the medical costs^[19]. We found that reducing variety of instruments, especially those fine micro forceps and punctal dilators, is an effective way to save the medical costs. The costs of the other four instruments, however, were not cut off completely because the routine use of the instruments in the operation room was not changed. Nevertheless, the application of novel five-in-one micro needle holders makes oculists' clinical work easier and more effective.

Although over-range and non-standard use, our five-in-one multifunctional yet simple use of micro needle holders makes the clinical work simple and efficient, as well as saves the medical costs for hospitals. In addition, it could be applied to specific medical conditions such as poor and short of medical supplies^[20].

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