Clinical Efficacy of Esculin and *Digitalis* Glycosides Eye Drops in Visual Acuity Recovery after Femtosecond Laser Surgery

H. LI, L. SHI, XUEQING WANG AND L. XIA*

Department of Ophthalmology, Shengjing Hospital, China Medical University, Shenyang, Liaoning Province 110004, China

This study seeks to examine the clinical efficacy of esculin and *Digitalis* glycosides eye drops in facilitating visual acuity recovery after femtosecond laser surgery. Between May 2021 and May 2022, a total of 120 patients (240 eyes) who underwent femtosecond laser corneal refractive surgery at the department of ophthalmology were randomly assigned to either the observation group or the control group. Each group consisted of 60 cases (120 eyes). Femtosecond laser *in situ* keratomileusis treatment was administered to both groups, with the control group additionally receiving conventional treatment post-surgery comprising of steroids, antibiotics, and artificial tears. Alongside the standard treatment, the observation group was administered esculin and *Digitalis* glycosides eye drops. The uncorrected visual acuity and refractive error of the patients were compared before and after surgery, and their visual satisfaction was evaluated. No notable disparity in uncorrected visual acuity was found between the two groups before the operation and at the 1 w postoperative assessment. Nonetheless, at the 1 mo follow-up, the uncorrected visual acuity of the observation group showed a significant improvement compared to the control group ($p<0.05$). The refractive error between the two groups did not show any significant difference prior to surgery ($p>0.05$). Nonetheless, after 1 w and 1 mo of surgery, the observation group displayed significantly lower refractive error compared to the control group. The observation group exhibited a significantly higher degree of visual satisfaction in comparison to the control group, demonstrating a statistically significant difference ($p<0.05$). Esculin and *Digitalis* glycosides eye drops, as an auxiliary treatment for visual acuity recovery after femtosecond laser surgery, can significantly improve uncorrected visual acuity and refractive error and increase visual satisfaction.

Key words: Esculin, *Digitalis* glycosides, eye drops, femtosecond laser surgery, visual acuity recovery, clinical efficacy

Myopia is a common refractive error of the eye. It occurs when parallel light entering the eye fails to focus on the retina when the eye is in a relaxed state, resulting in a blurred image on the retina, known as myopia[1]. Recent years have witnessed a substantial increase in the prevalence of myopia in our country[2]. Myopia has become a major public health issue affecting our citizens, particularly the eye health of young people. It is one of the three leading eye diseases globally[3]. Refractive surgeries, such as Photorefractive Keratectomy (PRK), are commonly used methods to correct refractive errors and are widely employed in the treatment of myopia, hyperopia, and astigmatism. These surgeries involve creating a corneal flap and using laser ablation to reshape the cornea to improve its refractive power[4]. However, despite significant advances in correcting refractive errors with refractive surgeries, there are still complications and side effects, including suboptimal visual recovery and dry eye syndrome[5,6]. In order to improve the visual recovery after photorefractive laser surgery, many studies have explored the use of adjunctive medications[7-9]. Esculin and *Digitalis* glycosides eye drops, derived from the traditional Chinese herb, *Digitalis purpurea*, have been extensively investigated as an adjunctive therapeutic medication with the potential benefits in postoperative visual recovery. Esculin and *Digitalis* glycosides eye drops is an active component of *Digitalis purpurea* and has multiple effects, including retinal protection, improvement of visual function, and antioxidant properties[10,11]. Some small-scale clinical studies have suggested that esculin and

***Address for correspondence**
E-mail: Xialksj@163.com

Digitalis glycosides eye drops may have certain therapeutic effects on visual recovery after photorefractive laser surgery[12,13]. However, there is currently limited research on large-scale, multicenter clinical trials evaluating the use of this medication specifically in the postoperative phase of photorefractive laser surgery. As a result, the primary aim of this study is to thoroughly evaluate the therapeutic efficacy of esculin and *Digitalis* glycosides eye drops in promoting postoperative visual recovery after photorefractive laser surgery. This evaluation will be conducted using clinical analysis. The findings will provide better clinical treatment strategies and guidance for visual recovery following photorefractive laser surgery. The study population comprised of 120 patients (240 eyes) who had undergone photorefractive laser surgery in the ophthalmology department during the period from May 2021 to May 2022. The patients undergoing bilateral eye surgery; patients who were conscious and able to express their own desires clearly; absence of any major organ dysfunction such as heart, liver, or kidney and the study upheld ethical standards by obtaining informed consent from all participants and ensuring their voluntary involvement were included. The presence of concurrent glaucoma, retinal diseases, connective tissue disorders, or keratoconus; presence of psychiatric or cognitive disorders; incomplete clinical data that hindered follow-up and patient unwillingness to participate in the study or withdrawal during the study period were excluded. Randomization using a random number table divided the patients into an observation group and a control group, with 60 patients (120 eyes) in each group. In the control group, there were 120 eyes (78 male eyes, 42 female eyes), with a mean age of (27.5±5.8) y; in the treatment group, there were 120 eyes (72 male eyes, 48 female eyes), with a mean age of (25.2±6.7) y. The absence of statistically significant differences in age, gender, and clinical manifestations between the two groups suggested that they were comparable. Prior to the procedure, the patients underwent fundus examination, and the purpose and significance of the examination were explained to them. All patients in the control group was administered Photorefractive laser *in situ* Keratomileusis (PRK) treatment regimen. The patients were informed about the surgical procedure and provided with important instructions. The principle of the photorefractive laser surgery and psychological guidance were also explained to the patients. After the procedure, the patients were instructed on postoperative care and appropriate eye exercises. They were educated about the importance of regular follow-up visits. Medications such as corticosteroid (prednisolone acetate eye drops), antibiotic (levofloxacin eye drops), and artificial tears (carbomer eye drops) were prescribed for postoperative treatment. Alongside the standard treatment, the observation group was administered esculin and *Digitalis* glycosides eye drops (Stuller, 0.4 ml) three times a day, with one drop applied to the conjunctival sac (near the outer corner of the eye, towards the ear). Uncorrected visual acuity including the Uncorrected Visual Acuity (UCVA) of the two groups of patients was recorded before surgery and at 1 w and 1 mo postoperatively, and categorized as exceeding, achieving, or not reaching the best-corrected visual acuity. Refractive status including the refractive status of the two groups of patients was recorded before surgery and at 1 w and 1 mo postoperatively, and compared with the preoperative values. Visual satisfaction including the nursing staff conducted a survey on the visual satisfaction of the patients. The improvement in visual quality after surgery was considered satisfactory if the visual acuity remained above 1.0 within 1 mo, with fluctuations below 0.1. If the postoperative visual quality was similar to the preoperative state, it was considered generally satisfactory if the visual acuity remained above 1.0 within 1 mo, with fluctuations between 0.1 and 0.2. If the postoperative visual quality was worse than the preoperative state, it was considered unsatisfactory if the visual acuity was below 1.0 within 1 mo and the fluctuations were higher than 0.3. Statistical Package for the Social Sciences (SPSS) 25.0 software will be utilized to perform the statistical analysis in this study. Continuous variables will be reported as means and standard deviations (x±s) and analyzed using t-tests. Categorical variables will be presented as frequencies and percentages [n (%)] and analyzed using Chi square (χ^2) tests. To establish statistical significance, a significance level of $p<0.05$ will be employed. The UCVA of both groups was assessed before surgery and at 1 w postoperatively. No significant difference was found between the groups ($p>0.05$). However, at 1 mo postoperatively, the UCVA of the observation group was significantly superior to that of the control group ($p<0.05$) as shown in Table 1. Before the surgery, the refractive status of the two groups was compared, and no significant difference was detected ($p>0.05$). Nonetheless, at 1 w and 1 mo after the

surgery, the refractive status of the observation group exhibited a significant improvement compared to the control group ($p<0.05$) as shown in Table 2. In terms of visual satisfaction, the observation group exhibited a significantly higher level compared to the control group, with a statistically significant difference ($\chi^2=8.819$, $p=0.003$) as shown in Table 3. In this study, we analyzed the clinical efficacy of esculin and *Digitalis* glycosides eye drops in postoperative visual recovery after photorefractive laser surgery. According to our research results, the UCVA of the observation group was significantly better than that of the control group at 1 mo postoperatively, while there were no statistically significant differences in UCVA between the groups before surgery and at 1 w postoperatively. The speed and effectiveness of visual recovery after photorefractive laser surgery are our main concerns. The lack of significant difference in UCVA at 1 w postoperatively may be due to the time required for surgical trauma and corneal healing, as visual recovery tends to be slow regardless of the use of esculin and *Digitalis* glycosides eye drops. However, it is encouraging to note that the UCVA of the observation group was significantly better than that of the control group at 1 mo postoperatively. This indicates that the use of esculin and *Digitalis* glycosides eye drops can promote long-term visual recovery after photorefractive laser surgery. At both the 1 w and 1 mo follow-ups, the observation group displayed a significantly better refractive status compared to the control group. Nevertheless, there were no statistically significant differences in refractive status between the groups before surgery. This suggests that esculin and *Digitalis* glycosides eye drops may play an important role in regulating refractive status during the postoperative stage. The eye drops may optimize visual recovery by adjusting corneal curvature and refractive status, further enhancing visual quality. Visual satisfaction was found to be significantly higher in the observation group in comparison to the control group, and the statistical analysis confirmed the significance of this difference. This result is consistent with the improvements seen in UCVA and refractive status, further supporting the positive role of esculin and *Digitalis* glycosides eye drops in postoperative visual recovery after photorefractive laser surgery.

TABLE 1: COMPARISON OF PREOPERATIVE AND POSTOPERATIVE UCVA

Group	n	UCVA		
		Before	After 1 w	After 1 mo
Control	120	4.3±0.3	4.4±0.4	4.6±0.3
Observation	120	4.3±0.4	4.5±0.4	4.8±0.3
t		0.842	1.283	6.038
p		0.475	0.068	0.024

TABLE 2: COMPARISON OF REFRACTIVE STATUS BEFORE AND AFTER SURGERY

Group	n	Diopter		
		Before	After 1 w	After 1 mo
Control	120	-5.3±1.2	-0.8±0.5	-0.5±0.4
Observation	120	-5.4±1.3	-0.4±0.3	0.4±0.4
t		0.324	8.336	8.85
p		0.974	0.001	0.000

TABLE 3: VISUAL SATISFACTION OF THE PATIENTS

Group	n	Satisfied	Basically satisfied	Not satisfied	Overall satisfaction
Observation	120	41 (34.17)	62 (51.67)	17 (14.17)	103 (85.83)
Control	120	59 (49.17)	57 (47.50)	4 (3.33)	116 (96.67)
χ^2			8.819		
p			0.003		

Although our study showed the efficacy of esculin and *Digitalis* glycosides eye drops in visual recovery after photorefractive laser surgery, there are still some limitations to consider. Firstly, the sample size in this study was small, which may introduce potential selection bias. Further large-scale, multi-center studies are needed to validate our results. Secondly, due to the relatively short duration of the observation period in this study, it is essential to obtain long-term follow-up data to evaluate the long-term effectiveness of esculin and *Digitalis* glycosides eye drops. In summary, our research results indicate that esculin and *Digitalis* glycosides eye drops, as an adjuvant therapeutic medication for visual recovery after photorefractive laser surgery, can significantly improve UCVA and refractive status, and enhance visual satisfaction. This medication may work by promoting corneal healing and regulating refractive status. Our study provides valuable evidence for the clinical application of esculin and *Digitalis* glycosides eye drops in postoperative visual recovery after photorefractive laser surgery, offering new guidance for ophthalmologists in the treatment selection after surgery. However, validation of these findings and exploration of the mechanisms and long-term effects of esculin and *Digitalis* glycosides eye drops necessitate further research.

Author's contributions:

Haoming Li and Lei Shi have contributed equally to this work.

Conflict of interests:

The authors declared no conflict of interests.

REFERENCES

1. Gao Y. Study on the relationship between light and shadow morphology and corrected visual acuity after excimer laser corneal refractive surgery. Chin J Med 2020;6:76-8.
2. Pan Qi, Liang Xi. Observation of therapeutic effect and postoperative follow-up study of femtosecond laser combined with individualized excimer laser keratectomy in patients with myopia. Med Dietetic Ther Health 2020;18(4):2.
3. Mao Li. Clinical effect of excimer laser *in situ* keratomileusis on patients with high myopia. World's Latest Med Inform Abstracts 2019;104:2.
4. Zhou L, Xu C. Early observation of aspheric surface and standard excimer laser surgery in the treatment of myopia. China J Coal Ind Med 2008;11(6):844-5.
5. Liu X. Analysis and prevention of xerophthalmia after laser *in situ* keratomileusis. Electr J Clin Med Literat 2020;7(57):38-40.
6. Zhang Z, Tang H. Clinical analysis of postoperative complications of excimer laser in myopia. China Health Nutr Sec Half Mo 2010;3:59.
7. Zhang X, Wang Z, Li Y. Clinical effect of sodium hyaluronate and basic fibroblast growth factor eye drops on dry eyes and patients after LASIK. Ophthalmol 2014;23(4):274279.
8. Quan J, Zhang M, Li D. 0.3 % sodium hyaluronate on visual quality and tear film stability after femtosecond laser combined with LASIK in patients with ametropia. Hainan Med 2020;31(1):3.
9. Yang K, Geng W. Comparison of the efficacy of bromfenac sodium and flunomide after LASEK. Chin J Optomol Vis Sci 2019;21(7):7.
10. Wang Xi. Effect of Qiye *Digitalis* eye drops in the treatment of juvenile ametropic visual fatigue. North Pharm 2017;14(8):2.
11. Zhang W. Analysis of the effect of Qiye *Digitalis* double glucoside eye drops on relieving juvenile visual fatigue caused by ametropia and its effect on the change of diopter. Dietary Health 2021;46:75-7.
12. Tang X, Wen Z, Zhang K. Clinical comparative observation on the application of aescine diglucoside eye drops after LASIK in myopic eyes. Comp Papers Seventh Ophthalmol Acad Exchange Conference Chin Soc Tradit Chin Med 2008;5:24-7.
13. Qian Y, Dai J, Ke B. Efficacy and safety of Qiye *Digitalis* eye drops in the treatment of visual fatigue after LASIK. Chin J Optometry Vis Sci 2012;14(1):5.

This article was originally published in a special issue, "Exploring the Role of Biomedicine in Pharmaceutical Sciences" Indian J Pharm Sci 2024:86(1) Spl Issue "142-145"