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Evaluation of the Clinical Efficacy of Full Femtosecond Laser Surgery in the Treatment of Myopia

Zhigang Ma, Jingwei Zhang, Ning Ma, Wanqiu Jiao*

Harbin Eye Hospital, Harbin 150010, Heilongjiang Province, China

***Corresponding author:** Wanqiu Jiao, xx853334@126.com

Abstract: *Objective:* To evaluate the clinical effect of full femtosecond laser surgery in the treatment of myopia patients. *Methods:* 120 myopia patients admitted to our hospital from January 2022 to June 2023 were selected. According to the random number table method, 60 patients in the observation group underwent full femtosecond laser surgery, and 60 patients in the control group underwent femtosecond laser-assisted in situ keratomileusis (FS-LASIK) surgery. The clinical effects of the two groups were compared. *Results:* 10 days postoperatively and 6 months after operation, the visual acuity level of the observation group was higher than that of the control group, the postoperative corneal asphericity coefficient and corneal full-thickness were lower than those of the control group, and the total effective rate 6 months after operation was higher than that of the control group ($P < 0.05$). *Conclusion:* Full femtosecond laser surgical treatment can improve the postoperative visual acuity of patients with myopia, enhance the corneal asphericity coefficient (Q) and corneal full-thickness, and exert significant clinical effects.

Keywords: Full femtosecond laser surgery; Myopia; Visual acuity level; Clinical effect

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1. Introduction

Myopia is defined as blurred vision caused by light entering the glasses parallel to the visual axis being focused in front of the retina when the eyes are relaxed. In recent years, people have overused their eyes due to the widespread use of electronic products, and the rate of myopia has increased year by year. There is currently no cure for myopia, but it is controllable and correctable [1]. Surgical treatment can improve patient symptoms and correct vision. Femtosecond laser-assisted in situ keratomileusis (FS-LASIK) has the advantages of mild intraoperative pain and rapid postoperative visual recovery. The instantaneous power of full femtosecond laser surgery is relatively high. This surgery can focus on a small space area and is widely used in clinical ophthalmic treatment [2]. The full femtosecond laser operates in the form of pulses to promote the improvement of the patient's corneal refractive power, correct the refractive state, and restore emmetropia with good correction effects. This study selected 120 myopia patients to evaluate the therapeutic effect of full femtosecond laser surgery.

2. Materials and methods

2.1. General information

120 myopia patients admitted to our hospital from January 2022 to June 2023 were selected. They were grouped according to the random number table method, with 60 cases in each group. Inclusion criteria: patients diagnosed with myopia [3]; myopia has lasted for over 2 years; the consent form has been signed. Exclusion criteria: patients with severe dry eye syndrome; patients with autoimmune diseases or other severe systemic diseases; patients with other eye lesions or a history of eye surgery. The control group had 35 males and 25 females; aged 18–31 (25.27 ± 3.29) years old; weighed 50–74 (62.09 ± 10.27) kg; eye axis was 23.63 ± 0.58 mm. The observation group had 32 males and females 28 cases; aged 18–32 (25.32 ± 3.27) years old; weighed 50–75 (62.12 ± 10.25) kg; eye axis was 23.59 ± 0.56 mm. There was no statistical significance between the two groups of data ($P > 0.05$).

2.2. Methods

The control group underwent FS-LASIK surgery treatment. The eyes were cleaned with normal saline before surgery, and the eye skin was routinely disinfected to prevent infection. The patient was supine, and topical anesthetic was applied to the operative eye area. An eye speculum was used to open the eyelids, the conjunctival sac was disinfected and cleaned, and a negative pressure suction ring was placed on the eye to adsorb the eyeball. Subsequently, a femtosecond laser machine was used to make the corneal flap reasonably. Specific parameters were: the lower limit of thickness was set to 90 μm, the upper limit was set to 110 μm, the diameter and length were 9.0 mm, the pedicle angle and direction were set at 45° and 12 points, respectively, the flap edge cutting angle was set at 70°. After 10 minutes of corneal flap production, a lens separator was used to open the corneal flap and an excimer laser machine was used to cut the corneal bed based on actual data. The cutting diameter was set to 6.5 mm. After the patient's corneal flap was completely covered, normal saline was used to rinse the corneal flap and the stromal layer. During this period, the corneal flap must be reset, flushed again, and the eye speculum removed. After completion, a slit lamp was used to observe the corneal flap apposition to confirm that the apposition was appropriate and there were no wrinkles, defects, flap displacement, or other undesirable conditions.

The observation group received full femtosecond laser surgical treatment. The conjunctival sac was first flushed, then the eye skin was disinfected. The patient was supine, and the head position was adjusted appropriately. Physiological saline was used to disinfect and clean the eyes, and 0.5% concentration of proparacaine hydrochloride eye drops was used for topical anesthesia. After completion, the eyelids were opened with an eye speculum, and the negative pressure suction ring was placed on the femtosecond laser head. It was installed correctly to adsorb the eyeball and stay in a static state. A femtosecond laser was used to cut the cornea. The frequency and energy parameters were 500 kHz and 110–150 nJ, respectively. The optical zone was set to 6.5 mm. The diameter and thickness of the corneal cap were set, respectively. The cutting ratio was recorded according to the settings of 7.5 mm and 110–120 μm. In addition to scanning the lens surface, scanning the peripheral small incisions was necessary, separating the corneal lens, carefully rinsing the corneal stromal bag, and restoring it to flatness. The operation was completed when there was no abnormality in the corneal (repositioning) condition using a slit lamp. Both groups used tobramycin and dexamethasone eye drops 4 times on the first day after surgery, then reduced to 1 every 3 days, and continued for 10 days; levofloxacin and sodium hyaluronate eye drops were administered 4 times/day, and continued for 14 days.

2.3. Observation indicators

(1) 10 days postoperatively and 6 months after surgery, the ophthalmic technician used an electronic vision tester to measure the patient's uncorrected visual acuity (UCVA) and best corrected visual acuity (BCVA).

(2) The Pentacam anterior segment analysis system was used to measure the patient's postoperative corneal asphericity. The coefficient Q and corneal full-thickness were measured and repeated three times to obtain the average.

(3) Surgical effect [1] was assessed. The postoperative follow-up was for 6 months, and the treatment effect was evaluated based on the patient's uncorrected visual acuity improvement before and after surgery. Markedly effective: the improvement range is > 75%; Effective: the improvement range is 50% to 75%; Ineffective: the improvement range is < 50%. Total efficiency = markedly effective + effective.

2.4. Statistical analysis

SPSS28.0 was selected as the data analysis software, measurement data were expressed as mean ± standard deviation (SD), *t*-test was performed; count data were expressed as n (%), χ^2 test was performed, and $P < 0.05$ indicated statistically significant difference.

3. Results

3.1. Comparison of postoperative visual acuity levels between the two groups

The visual acuity level of the observation group was higher than that of the control group 10 days after operation and 6 months after surgery ($P < 0.05$). The details are presented in **Table 1**.

Table 1. Comparison of postoperative visual acuity levels between the two groups (mean ± SD)

Group	*n*	UCVA		BCVA	
		10 days after surgery	6 months after surgery	10 days after surgery	6 months after surgery
Observation group	60	1.21 ± 0.19	1.21 ± 0.24	1.18 ± 0.15	1.21 ± 0.23
Control group	60	1.11 ± 0.15	1.13 ± 0.16	1.13 ± 0.12	1.14 ± 0.13
t	-	3.199	2.148	2.016	2.052
P	-	0.002	0.034	0.046	0.042

3.2. Comparison of postoperative corneal asphericity coefficient Q and corneal full-thickness between the two groups

The postoperative corneal asphericity coefficient (Q) and corneal full-thickness of the observation group were lower than those of the control group ($P < 0.05$), as shown in **Table 2**.

3.3. Comparison of clinical efficacy between the two groups

The surgical efficacy of the observation group was higher than that of the control group ($P < 0.05$), as displayed in **Table 3**.

Table 2. Comparison of corneal asphericity coefficient (Q) and corneal full-thickness between the two groups after surgery (mean ± SD)

Group	n	Postoperative corneal asphericity coefficient (Q)		Corneal full thickness (μm)	
		10 days after surgery	6 months after surgery	10 days after surgery	6 months after surgery
Observation group	60	0.75 ± 0.24	0.63 ± 0.19	403.48 ± 24.32	412.52 ± 26.65
Control group	60	1.25 ± 0.41	1.04 ± 0.33	442.18 ± 30.39	450.61 ± 42.42
t	-	8.152	8.340	7.048	5.889
P	-	0.000	0.000	0.000	0.000

Table 3. Comparison of clinical efficacy between two groups [n (%)]

Group	*n*	Markedly effective	Effective	Ineffective	Total effective rate
Observation group	60	42 (70.00)	16 (26.67)	2 (3.33)	58 (96.67)
Control group	60	35 (58.33)	15 (25.00)	10 (16.67)	50 (83.33)
χ^2	-	-	-	-	5.926
P	-	-	-	-	0.015

4. Discussion

Myopia can occur at any age and dramatically inconveniences patients' work and study, leading to a decline in their quality of life. Teenagers are a high-risk group for myopia, which is related to genetic factors, environmental factors, a lack of daily eye hygiene and protection, and poor habits for eye health. Treatment delay seriously affects their visual acuity, and it can easily be complicated by other eye disease symptoms, decreasing their quality of life [4].

Femtosecond laser can be quickly transmitted and focused. Full femtosecond laser surgical treatment can take advantage of the high-power and high-resolution characteristics of a femtosecond laser to completely remove the convex lens-shaped thin layer of corneal tissue in the corneal stroma. Removing the lens tissue using special instruments causes corneal curvature and thickness changes, which can effectively correct myopia [5]. Full femtosecond laser surgery has high resolution and precision advantages, is less invasive, and can improve corneal thickness. This study shows that the UCVA and BCVA levels and clinical efficacy of the observation group 10 days postoperatively and 6 months after surgery were higher than those of the control group ($P < 0.05$). It is suggested that patients with myopia receiving full femtosecond laser surgical treatment can significantly improve their vision. This may be because femtosecond laser has a short duration, an instantaneous power of up to one million watts, and a small, concentrated, and powerful focusing space, which can act on tiny space; each pulsed light blast can generate micro-plasma bubbles rich in CO_2 and H_2O. When they merge and get closer, they can reduce the tissue connections between the bubbles and significantly improve the accuracy of tissue separation. Femtosecond laser flap preparation can accurately adjust the diameter of the cornea and reasonably carve the edge angle and thickness. The safety of the operation is high. The femtosecond laser can quickly pass through transparent tissue during the operation. Due to its precise focusing advantage, the target tissue can be removed entirely [6]. This study shows that the postoperative corneal asphericity coefficient (Q) and corneal full-thickness of the observation group were lower than those of the control group ($P < 0.05$). It is suggested that full femtosecond laser surgery for the treatment of myopia can reduce the Q value of the patient's anterior corneal surface. This may be due to that the optical cutting range of the corneal stroma in this surgery is small, and it is an arc shape with a medium thickness and a thin edge. The full thickness of the cornea can directly reflect changes in the patient's corneal biomechanics and surface integrity. In full femtosecond laser surgery, near-infrared laser cuts stromal tissue, which may damage the corneal stromal tissue layer and affect the full thickness of the cornea [7].

5. Conclusion

In summary, full femtosecond laser surgical treatment has significant advantages in improving postoperative visual acuity, corneal asphericity coefficient (Q), and corneal full-thickness in patients with myopia, thus it has significant clinical efficacy.

Disclosure statement

The authors declare no conflict of interest.

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