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Visual outcome of manual small-incision cataract surgery: comparison of modified Blumenthal and Ruit techniques

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Abstract

• AIM: To compare the efficacy and visual results of the modified Blumenthal and Ruit techniques for manual small-incision cataract surgery (MSICS).

• METHODS: This was a prospective, non-randomized comparison of 129 patients with senile cataracts scheduled to undergo routine cataract surgery *via* either a superior scleral tunnel incision, *i. e.*, the Blumenthal technique (group 1, $n=64$) or a temporal scleral tunnel incision, *i. e.*, the Ruit technique (group 2, $n=65$). MSICS and intraocular lens implantation were performed through an unsutured 6.5- to 7.0-mm scleral tunnel incision. Uncorrected and corrected visual acuity, intraoperative and postoperative complications, and surgically induced astigmatism calculated by simple subtraction were compared. Patients were examined 1 day, 1 week, 1 month, and 3 months after surgery.

• RESULTS: Both groups achieved good visual outcomes with minor complications. Three months after surgery, the corrected visual acuity was 0.73 in the Blumenthal group and 0.69 in the Ruit group ($P=0.29$). The average (SD) postoperative astigmatism was 0.87 (0.62) diopter (D) for the Blumenthal group and 0.86 (0.62) D for the Ruit group. The mean (SD) surgically induced astigmatism was 0.55 (0.45) D and 0.50 (0.44) D for the Blumenthal and Ruit groups, respectively ($P=0.52$). Common complications were minimal hyphema and corneal edema. There was no statistically significant difference in the complication rate between the groups ($P>0.05$).

• CONCLUSION: In MSICS, both the Blumenthal and Ruit techniques achieve good visual outcomes, with low complication rates.

• KEYWORDS: cataract surgery; small-incision cataract surgery; astigmatism; complication; visual acuity; Blumenthal technique; Ruit technique
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INTRODUCTION

Manual small-incision cataract surgery (MSICS) is a cost-saving procedure and is suitable for developing countries[1]. In most cases, a phacoemulsification machine is not required, and the cost of surgery can thus be reduced further. Blumenthal elegantly described the use of an anterior chamber maintainer (ACM) in extracapsular cataract extraction and MSICS. This technique was developed in 1987 and is highly effective and reproducible for all grades of cataracts[2-4]. The Ruit technique, developed in 1999, is also a well-known surgical procedure for the treatment of cataract in developing countries[5,6]. The surgical time for the Ruit technique is much shorter than that for phacoemulsification. Overall, MSICS is significantly faster, less expensive, and less dependent on technology than phacoemulsification[1]. In general, patients with senile cataracts have an against-the-rule astigmatism[7,8]. Surgical techniques that decrease postoperative against-the-rule astigmatisms have good outcomes. The Ruit technique (temporal scleral tunnel incision) should result in better visual acuity in patients than the Blumenthal technique (superior scleral tunnel incision), although there has been no reported comparative study about the visual outcome of these two surgical techniques. I performed a prospective, non-randomized clinical trial to compare the visual results and complications of MSICS performed using the Blumenthal technique versus the Ruit technique.

MATERIALS AND METHODS

Materials A non-randomized, prospective study of 129 consecutive patients with senile cataracts was performed. Patients who could participate in the study for 3 months were enrolled from Jul. 2007 to May, 2010. Initial screening examinations consisted of tests for uncorrected visual acuity (UCVA) and best-corrected visual acuity (BCVA), pupil and slit-lamp examination, fundus examination, and intraocular pressure measurements. Patients were scheduled to undergo routine MSICS and intraocular lens (IOL) implantation. For group 1 (64 patients), surgery was performed using the Blumenthal technique, while for group 2 (65 patients), it was performed using the Ruit technique. The average (SD) age of patients was 66.6 ± 8.9 (range, 49-89) years. Patients

with a history of ocular surgery or disease that affected visual results, such as glaucoma or corneal or retinal disorders, were excluded from the study. The research protocol had Institutional Review Board approval, and written informed consent was obtained from each patient. Baseline characteristics of the 64 patients in group 1 and 65 patients in group 2 were comparable. The sample size of 129 corresponded to the number of patients who met the inclusion criteria and participated in the study. No patients withdrew from the trial.

Methods All surgeries were performed by a single surgeon [P. K.], using local anesthesia. The surgeon had previous experience in performing MSICS by both the Blumenthal and Ruit techniques. Local peribulbar anesthesia was administered with a mixture of 1mL of 20g/L lidocaine (Xylocaine®) and 1mL of 5g/L bupivacaine HCl (Marcaine®). A 6.5-mm PMMA lens was implanted in all cases.

In the modified Blumenthal technique (Mininuc), a 6.5- to 7-mm superior scleral tunnel incision was made with a straight incision, 2mm from the limbus. Two side ports were created at the 6 and 9 o'clock positions. An ACM was inserted through the 6 o'clock side port. The bottle height was maintained at least 90cm above the operating table to produce sufficient infusion pressure to assist in delivery of the nucleus. A continuous circular capsulorrhexis (CCC) was performed on the anterior capsule, followed by hydrodissection just below the capsular rim. Anterior cortical debris was removed, and viscoelastic was injected into the anterior chamber. The nucleus was dislocated into the anterior chamber using 2 Sinskey hooks. The lens glide was inserted below the nucleus[4]. Gentle pressure on the sclera with forceps allowed the wound to open so that hydrostatic pressure could push the nucleus through the scleral tunnel. The remaining cortex was removed with manual irrigation-aspiration; a PMMA lens was implanted in the capsular bag, and the ACM was removed. The incisions were left sutureless, and stromal hydration was performed. If wound leakage occurred, the wound was sutured with 1 stitch with prolene 10/0.

For the Ruit technique, a 6.5- to 7-mm temporal scleral tunnel was created with a straight incision, 2mm from the limbus. A side port was created to facilitate intraocular manipulation. Capsulorrhexis and hydrodissection were performed. Viscoelastic was injected around the nucleus, and the nucleus was then dislocated into the anterior chamber. An irrigating Simcoe cannula was inserted below the nucleus, and the nucleus was then extracted through the scleral tunnel. The remaining cortex was removed with manual irrigation-aspiration, and a PMMA lens was implanted in the capsular bag. Irrigation fluid was inserted through the side port to test the integrity of the tunnel.

Patients in both groups received the same postoperative medication regimen, beginning with 10g/L dexamethazone acetate and 10g/L neomycin sulfate, 4 times a day; the regimen was tapered over a month. Keratometric readings and visual acuity were recorded preoperatively and 1 day, 1 week, 1 month, and 3 months after the operation.

Table 1 Characteristics of 129 patients who had undergone manual small-incision cataract surgery $\bar{x} \pm s$

Variable	Group 1 (Blumenthal, $n=64$)	Group 2 (Ruit, $n=65$)
Age(yr)	64.47±8.29	68.71±9.06
Male(n,%)	32(50.0%)	36(55.4%)
Preoperative BCVA	0.06±0.06	0.05±0.06
UCVA 1wk	0.51±0.27	0.50±0.24
1mo	0.61±0.25	0.61±0.26
3mo	0.62±0.27	0.61±0.24
BCVA 1wk	0.64±0.22	0.63±0.22
1mo	0.71±0.23	0.66±0.23
3mo	0.73±0.21	0.69±0.22
Astigmatism		
Preoperative	0.59±0.46	1.05±0.73
1mo	0.85±0.70	0.81±0.60
3mo	0.87±0.62	0.86±0.62
Astigmatism(Diopters)		
After surgery		
0-0.75	32(50.0%)	36(55.4%)
1-1.75	27(42.2%)	24(36.9%)
2-2.75	5(7.8%)	5(7.7%)

The primary outcome measures were postoperative visual acuity and intraoperative and postoperative complications. The secondary outcome measure was astigmatism 3 months after cataract surgery. The Snellen visual acuity was converted to decimal values for statistical calculations. The amount of keratometric change was calculated by simple subtraction.

Statistical Analysis Numerical data were compared between groups using an unpaired, two-tailed Student's *t*-test and a *Chi-square*test; $P<0.05$ was considered significant.

RESULTS

The preoperative visual acuity was similar in both groups ($P=0.47$), and both groups achieved good visual outcomes (Table 1). The 2 groups showed no statistically significant difference in UCVA or BCVA at the 1-week, 1-month, and 3-month follow-up examinations. At 3 months, BCVA was 0.73 in group 1 patients and 0.69 in group 2 patients ($P=0.29$) The average ± SD preoperative keratometric astigmatism was 0.59±0.46 diopter (D) in the Blumenthal group and 1.05±0.73D in the Ruit group. The average postoperative astigmatism was 0.87±0.62D for the Blumenthal group and 0.86±0.62D for the Ruit group. The mean surgically induced astigmatism calculated by simple subtraction was 0.55±0.45D and 0.50±0.44D for the Blumenthal and Ruit groups, respectively ($P=0.52$). Thirty-two of 64 (50.0%) patients in the Blumenthal group and 36 of 65 (55.4%) patients in the Ruit group had astigmatism up to 0.75D ($P=0.81$). The type of astigmatism is shown in Table 2. Postoperatively, the Blumenthal group had slight against-the-rule astigmatism, whereas the Ruit group exhibited slight with-the-rule astigmatism.

Table 2 Types of astigmatism *n*(%)

	n	ATR	WTR	Neutral
Preoperation				
Group 1	64	43(67.2)	20(31.4)	1(1.6)
Group 2	65	56(86.2)	8(12.3)	1(1.6)
Postoperation 3 months				
Group 1	64	51(79.7)	8(12.5)	5(7.8)
Group 2	65	36(55.4)	28(43.1)	1(1.6)

ATR: Againt-the-rule astigmatism; WTR: With-the-rule astigmatism.

Intraoperative and postoperative complications were rare in both groups. There were no cases of posterior capsule rupture, dropped nucleus, or suprachoroidal hemorrhage in either group. The Blumenthal group had one case of a radial tear in the capsulorrhexis, and the Ruit group, 2 cases. Minimal postoperative corneal edema was observed in 3 cases in group 1 and 4 cases in group 2. With topical steroid treatment, corneal edema decreased by day 5 in both groups. There were 5 minor hyphemas in the Blumenthal group and 3 in the Ruit group, which spontaneously cleared within 4 postoperative days without intervention. Iris prolapse was seen in only 3 cases in group 2. There was no statistically significant difference in the complication rates between the groups ($P>0.05$).

DISCUSSION

In developing countries, MSICS using the Blumenthal or Ruit technique is well known as an appropriate surgical procedure for the treatment of cataracts[1-6]. These techniques are highly effective and reproducible for all grades of cataracts. A study has demonstrated that MSICS is significantly faster, less expensive, and less technologically dependent than phacoemulsification, but there has not been a study to compare the visual outcomes between these 2 surgical techniques[1]. In the present comparative study of 129 patients with senile cataracts, both the Blumenthal and Ruit techniques achieved good visual outcomes. The final BCVA of 0.73 in the Blumenthal group was slightly better than that of 0.69 in the Ruit group, but there was no statistical significance between the 2 groups ($P=0.29$). The average preoperative keratometric astigmatism was 0.59D in the Blumenthal group and 1.05D in the Ruit group. The average postoperative keratometric astigmatism was 0.87D in the Blumenthal group and 0.86D in the Ruit group. The mean surgically induced astigmatism was 0.55 and 0.50D for the Blumenthal and Ruit groups, respectively ($P=0.52$). These results are similar to those in a previous report showing that a superior scleral incision was associated with slight against-the-rule astigmatism, while a temporal scleral incision was associated with slight with-the-rule astigmatism[9,10]. The mean induced astigmatism calculated by simple subtraction was 0.12±0.51D, 0.16±0.98D, and 0.67±0.91D for the 6.0-, 6.5-, and 7.0-mm incisions, respectively[11]. The current results indicate that a superior scleral incision (Blumenthal technique) and a temporal scleral incision (Ruit technique) result in very stable and predictable astigmatic changes after surgery. A vector analysis was not performed because the axis of keratometric reading was not exactly recorded for each patient; further analysis may cause inaccurate conclusions about astigmatic changes.

Both groups had low complication rates without serious complications such as a dropped nucleus, suprachoroidal hemorrhage, or endophthalmitis. Common postoperative complications were minimal corneal edema and hyphema, which improved within 1 week without intervention. Ruit *et al*[1] reported 29.6% cases of minimal hyphema after MSICS; this percentage was 6.2% in our study. Another study showed a higher incidence of hyphema in the case of a deep scleral tunnel incision (34%) than in the case of a superficial scleral tunnel incision (6%)[12]. The superficial scleral tunnel (0.2mm) and adequate treatment with an electric cautery to stop bleeding may have been the reason for the low incidence of hyphema in this study. Iris prolapse is usually seen with the Ruit technique because of the hydrostatic pressure during nuclear removal. The lens glide used during hydroexpression prevents iris prolapse in the Blumenthal procedure. A major limitation of this study is that the results are from a 3-month follow-up; a 1-year follow-up is currently underway. Non-randomization was used in this study, and preoperative keratometric readings in the Ruit group were higher than those in the Blumenthal group. Although the incidence of surgically induced astigmatism was similar in both groups, this technical error or bias may result in a smaller number of patients with good postoperative visual acuity in the Ruit group. A further study with randomization should be used to balance the study groups in terms of the number of participants and the distribution of baseline variables known to predict the outcome.

MSICS is safe and effective for visual rehabilitation, as well as less expensive and less technologically dependent than phacoemulsification[1,13,14]. In contrast to the phacoemulsification system, equipment for MSICS does not require an initial capital investment or recurrent expenses. A randomized controlled trial in India also found MSICS to be more effective[15] and economical[16] than conventional ECCE. In conclusion, an experienced surgeon can perform MSICS by either the Blumenthal or Ruit technique to achieve excellent visual outcomes, with low complication rates. Both surgical techniques are appropriate for cataract surgery in developing countries.

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两种手法小切口白内障手术视觉结果比较

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摘要

目的:比较改良的 Blumenthal 和 Ruit 手法小切口白内障手术的效果。

方法:对 129 例预定行白内障手术的患者进行非随机分组的前瞻性比较分析。组一($n=64$)采用 Blumenthal 方法巩膜上方隧道切口,组二($n=65$)采用 Ruit 方法颞侧巩膜隧道切口。手法小切口白内障手术及人工晶状体植入术通过一个无缝合的 6.5~7.0mm 巩膜隧道切口。在术后 1d,1wk 和 3mo 检查患者。比较术后未矫正及矫正视力,术中及术后并发症以及手术引起的散光。

结果:两组患者都获得了很好的视觉结果,并发症很少。术后 3mo,Blumenthal 组的矫正视力是 0.73, Ruit 组的矫正视力是 0.69($P=0.29$)。术后平均散光:Blumenthal 组是 0.87(SD:0.62)D,Ruit 组是 0.86(SD:0.62)D。手术引起的平均散光 Blumenthal 组是 0.55(SD:0.45)D,Ruit 组是 0.50(SD:0.44)D($P=0.52$)。常见的并发症是少量的前房出血和角膜水肿。两组并发症的发生率无显著差别($P>0.05$)。

结论:Blumenthal 和 Ruit 手法小切口白内障手术都能获得很好的视觉结果,并发症很少。

关键词:白内障手术;小切口白内障手术;散光;并发症;视力;Blumenthal 方法;Ruit 方法