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Original Article/นิพนธ์ต้นฉบับ

# A Prospective Study on the Outcomes of Manual Small Incision Cataract Surgery (MSICS) Using the Modified Ruit Technique at Nan Hospital

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## Abstract

**Objective:** To study the visual outcomes, post-operative astigmatism, and complications of manual small incision cataract surgery (MSICS) using the Modified Ruit technique in the treatment of cataract patients.

**Design:** Prospective study

**Methods:** The medical records of 91 patients (91 eyes) with cataracts who underwent MSICS using a temporal scleral tunnel incision (Ruit's technique) at Nan Hospital between October 2023 and February 2024 were analyzed. All 91 surgeries were performed by a single surgeon. Out of these 20 eyes (20 patients), four eyes missed the six-week follow-up, one eye was subject to incomplete data, seven eyes underwent combined ocular procedures, and eight eyes had pre-operative vision impairing pathology or previous ocular surgery. Records of 71 patients (71 eyes) with pre-operative, post-operative visual acuity (VA), operative time, intraoperative difficulties, intraoperative complication, post-operative complications, and astigmatism were analyzed in the second and sixth week after surgery.

**Results:** Seventy-one eyes of 71 patients were treated by MSICS using the Modified Ruit technique. Patients achieved excellent surgical outcomes with low complication rates. The post-operative best-corrected visual acuity (BCVA) results at the sixth-week follow-up were 20/20 to 20/40 in 95.8% (68/71) and 20/50 to 20/70 in 4.2% (3/71). At the sixth week after treatment, the mean post-operative astigmatism was -1.14 ± 0.91D. The findings revealed a small risk of surgical complications, with hyphema being the most frequent intraoperative complication in 12.7% (9/71) of patients. No major surgical complications were found.

**Conclusion:** MSICS using the Modified Ruit technique is a high-quality procedure that achieves excellent clinical outcomes with a low rate of complications.

***Keywords:*** Modified Ruit technique, Manual small incision cataract surgery

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## Introduction

Cataracts are the main cause of blindness worldwide (52.6%)[1] as well as in Thailand (51.9%)[2]. Both phacoemulsification and manual small incision cataract surgery (MSICS) achieve excellent visual outcomes with low complication rates, but MSICS is less expensive and requires less technology. Phacoemulsification is the preferred technique for cataract surgery in developed countries. MSICS is a safe technique for cataract extraction, gives excellent visual outcomes with low complication rates, and requires a short operation time. It can be performed in all cataract stages[3], is less technology-dependent and cost effective[4-6], and is often used as an alternative to phacoemulsification. Since its development, MSICS has undergone many changes and modifications. The basic technique involves a sutureless and self-sealing incision, with the main procedural change being lens removal. Various methods of lens removal have been reported. In 1999, Ruit et al. described a new technique for MSICS[4]. More than 85% of post-operative patients receiving treatment with Ruit's technique for MSICS attained visual acuity of better than or equal to 20/60, meeting the quality target recommended by the World Health Organization (WHO)[4,7,8]. The Modified MSICS technique used in the present study has been adapted from the conventional Ruit technique previously described[4].

Details retrieved from the database for the patients under study were analyzed. These included demographics such as age, gender, pre-operative and post-operative visual acuity, operative time, intraoperative difficulties, intraoperative complications, post-operative complications, and post-operative astigmatism in the second and sixth week after surgery. The purpose of this study was to evaluate the visual outcomes and post-operative astigmatism of patients treated by MSICS using the Modified Ruit technique.

## Materials and Methods

This was a prospective study. The medical records were analyzed of all patients diagnosed with cataracts at Nan Hospital, Nan Province, Thailand, between October 1, 2023, and February 29, 2024, who underwent MSICS using the Modified Ruit technique with the implantation of an IOL. Patients with a history of ocular surgery or any other pre-operative ocular pathology that could reduce vision (traumatic cataract, lens subluxation, age-related macular degeneration, other retinal conditions, severe glaucoma, optic atrophy, corneal scarring, large pterygium, amblyopia, etc.) or underwent combined ocular procedures were excluded from the study. Similarly, those patients who failed to attend the six-week follow-up were excluded from the study. The study was approved by the Research Ethics Committee (COA No. 079 Nan Hos. REC 079/2566). Data analysis was performed with the IBM SPSS Statistics for Windows, version 21.0 (IBM Corp., Armonk, NY, USA). Statistical analysis was performed with the IBM SPSS Statistics for Windows, version 21.0 (IBM Corp., Armonk, NY, USA). A frequency table with numbers and percentages is included in the descriptive statistics [range, mean, and standard deviation (SD)].

### Surgical technique

After dilating the pupil pre-operatively, a temporal limbal conjunctival peritomy, was performed with diathermy to achieve hemostasis. A scleral tunnel was fashioned with a 2.0 mm beveled-up crescent blade in the usual manner. A temporal scleral tunnel with a straight incision was created 1.5–2 mm posterior to the limbus, 7–9 mm in width, depending on the size of the nucleus, and advanced anteriorly along the plane of the sclera and mid-posterior corneal stroma until approximately 1–1.5 mm beyond the limbus without entering the anterior chamber. The scleral tunnel wound was then further enlarged internally within the cornea,

resulting in the inner wound being larger than the outer wound (a funnel-shaped wound). A paracentesis was created to facilitate intraocular manipulation at 90° from the scleral tunnel using a 22-gauze needle. An ophthalmic viscoelastic device (OVD) was injected through a paracentesis and v-capsulotomy or u-capsulotomy, then performed through the scleral tunnel wound by using a 25-gauze needle. The anterior chamber was entered, and the tunnel extended with a keratome of 3.0 mm. A 23-gauze irrigation-aspiration Simcoe cannula was used to hydrodissect, loosen, and prolapse the nucleus into the anterior chamber. In some difficult cases, after hydrodissection, viscodissection is performed to dislocate the nucleus from the capsular bag into the anterior chamber. After the ophthalmic viscoelastic device (OVD) was injected, the temporal scleral incision was passed over and under the nucleus to protect the corneal endothelium and depress the iris and posterior capsule, while the nucleus was delivered by a lens loop. Cortical cleanup was performed using Simcoe's cannula. A single-piece PMMA IOL was inserted into the capsular bag under an OVD. The base of the anterior capsule flap was transected with capsule scissors, and the flap was removed using fragment forceps. The OVD was removed. A watertight wound was confirmed by reinflating the eye with a balanced salt solution. After checking, an anterior chamber was formed with an air bubble. The conjunctiva was cauterized.

## Results

A significant number of patients were excluded from the study. Out of these 20 eyes (20 patients), four missed the six-week follow-up, one eye was subject to incomplete data, seven eyes underwent combined ocular procedures, and eight had pre-operative vision impairing pathology or previous ocular surgery. The remaining 71 eyes (71 patients) were eligible for inclusion. The demographic data and details of the pre-operative findings for both groups are summarized in Table 1. All participants were treated with MSICS using the Modified Ruit technique, a straight incision of the

**Table 1** Demographic characteristics of the study population

| Characteristics | Total (eyes) = 71 |
|---|---|
| Age (years) | |
| Min-max | 58-91 |
| Mean ± SD | 71.13 ± 7.66 |
| Gender; n (%) | |
| Male | 35 (49.3) |
| Female | 36 (50.7) |
| Pre-operative IOP (mm Hg) | |
| Min-max | 6-18 |
| Mean ± SD | 11.24 ± 2.73 |
| Type of cataracts ; n (%) | |
| Mature cataract | 38 (53.5) |
| Posterior subcapsular cataract | 30 (42.3) |
| Hypermature cataract | 2 (2.8) |
| Brunescent cataract | 1 (1.4) |
| Pre-operative uncorrected VA (UCVA); n (%) | |
| < 20/100 – 10/200 | 11 (15.5) |
| < 10/200 - PL | 60 (85.5) |

IOP = intraocular pressure; UCVA = uncorrected visual acuity; SD = standard deviation; PL = perception of light

temporal scleral approach; the nucleus was delivered using a lens loop with the implantation of a rigid PMMA PCIOL 6.0 mm, A constant = 118.3, under local anesthesia. All 71 surgeries were performed by a single surgeon. The IOL power was determined based on the immersion A-scan ultrasonography and automatic keratometry readings using the SRK II formula. The author aimed for a small degree of myopia ((-0.25D) to (-0.50D)) to offset possible biometric errors. Table 2 presents details of the surgical time, intraoperative difficulties, and intraoperative complications of the enrolled patients. Patients were examined on the first post-operative day (Table 2), then followed up at two weeks, and finally, at six weeks (Table 3).

**Table 2** Surgical times, intraoperative difficulties, intraoperative complications, and post-operative complications

| **Characteristics** | **Total (eyes) = 71** |
|---|---|
| Surgical time (minutes); n (%) | |
| < 10 minutes | 2 (2.8) |
| 10–15 minutes | 51 (71.8) |
| > 15–20 minutes | 12 (16.9) |
| > 20 minutes | 6 (8.5) |
| Min-max | 9-31 |
| Mean ± SD | 14.24 ± 3.83 |
| Intraoperative difficulties; n (%) | |
| Pupillary constriction | 12 (16.9) |
| Tight orbit /deep set eye | 6 (8.5) |
| Prolapsing nucleus difficulties | 6 (8.5) |
| Not full anesthetic effect | 4 (5.6) |
| Retrobulbar hemorrhage | 3 (4.2) |
| Poor corneal clarity | 1 (1.4) |
| Very shallow anterior chamber | 1 (1.4) |
| Intraoperative complications; n (%) | |
| Hyphema | 9 (12.7) |
| Incomplete cortex cleanup | 1 (1.4) |
| Post-operative complications first day; n (%) | |
| Corneal edema | 19 (26.8) |
| Hyphema | 6 (8.5) |

SD = standard deviation

**Table 3** Post-operative outcomes in the second and sixth week

| Outcomes | Total (eyes) = 71 |
|---|---|
| Post-operative UCVA 2 wk; n (%) | |
| 20/20 to 20/40 | 59 (83.1) |
| 20/50 to 20/70 | 8 (11.3) |
| < 20/70 to 20/100 | 4 (5.6) |
| Post-operative BCVA 2 wk; n (%) | |
| 20/20 to 20/40 | 66 (93) |
| 20/50 to 20/70 | 3 (4.2) |
| < 20/70 to 20/100 | 2 (2.5) |
| Post-operative UCVA 6 wk; n (%) | |
| 20/20 to 20/40 | 59 (83.1) |
| 20/50 to 20/70 | 10 (14.1) |
| < 20/70 to 20/100 | 2 (2.8) |
| Post-operative BCVA 6 wk; n (%) | |
| 20/20 to 20/40 | 68 (95.8) |
| 20/50 to 20/70 | 3 (4.2) |
| Post-operative astigmatism 2 wk (diopter); n (%) | |
| < -1.00 D | 30 (42.3) |
| -1.00 D to -2.00 D | 31 (43.7) |
| > -2.00 D | 10 (14.1) |
| Mean ± SD | -1.25±0.81 |
| Post-operative astigmatism 6 wk (diopter); n (%) | |
| < -1.00 D | 33 (46.5) |
| -1.00 D to -2.00 D | 28 (39.4) |
| > -2.00 D | 10 (14.1) |
| Mean ± SD | -1.14 ± 0.91 |

UCVA = uncorrected visual acuity; BCVA = best-corrected visual acuity; SD = standard deviation

The mean surgical time was 14.24 (±3.83) minutes. The study findings revealed that the incidence of intraoperative difficulty during surgery was 46.5% (33/71). Pupillary constriction was the most common intraoperative difficulty encountered in 16.9% (12/71) of patients. Hyphema was found to be the most common intraoperative complication in 12.7% (9/71) of patients, followed by incomplete cortical cleanup at 1.4% (1/71). There were no serious complications such as lens subluxation, posterior capsule rupture, or vitreous loss in this case series. There were a few transient minor immediate post-operative complications. On the first post-operative day, 26.8% of patients (19/71) had corneal edema, while 8.5% (6/71) experienced post-operative hyphema. None of the hyphema required intervention. No significant intraoperative

complications, such as posterior capsule rupture, vitreous loss or zonular dialysis, retinal detachment, corneal decompensation, or endophthalmitis, were observed during the study period. The surgical times, intraoperative difficulties, and complications, along with post-operative complications, are summarized in Table 2.

Patients achieved good visual results after MSICS. At two weeks, 94.4% (67/71) of patients had (UCVA) ≥ 20/70, while 97.2% (69/71) experienced (BCVA) ≥ 20/70. At the six-week follow-up, 97.2% (69/71) of patients with UCVA ≥ 20/70 and 100% (71/71) of patients with BCVA showed an improvement (Table 3). At the two-week follow-up, the mean post-operative astigmatism was -1.25 ± 0.81D. At the six-week follow-up, the mean keratometric astigmatism was -1.14 ± 0.91D (Table 3).

## Discussion

Modern-day cataract treatment comprises phaco-emulsification and MSICS. Both phacoemulsification and MSICS give excellent visual outcomes with low complication rates, but the cost of MSICS is substantially lower. The MSICS with Ruit's technique is a high-quality procedure that achieves excellent clinical outcomes with a low rate of cataract complications in developing countries. The present study demonstrates the favorable outcomes achieved with the modification of this technique.

A good surgical outcome after cataract surgery, according to the WHO, is a BCVA greater than or equal to 20/60 Snellen. In the present study, the patients achieved good visual results after MSICS. The findings revealed a BCVA ≥ 20/70 in 100% (71 /71) at the six-week follow-up. The results of visual outcomes in this study are similar to those reported in previous works. Vettorazzi reported that 96.4% of patients had a good outcome as defined by the WHO[9]. These results were similar to those reported by Waghmare (98%)[10], Gogate (98.36%)[11], Ruit (98%)[8], Venkatesh R (98.2%)[6], and Rathi (100%)[12].

At the six-week follow-up, the mean post-operative astigmatism was -1.14 ± 0.91D (Table 3). This is more than the 0.86 ± 0.62D reported by Kongsap P[13]. Mean surgical-induced astigmatism reported in the literature following MSICS ranges from 0.8D (Ruit et al.)[8], 1 D (Muralikrishnan et al.)[14], and 1.2 D (Gogate et al.)[11].

Besides the effectiveness of surgery for the improvement of visual acuity, the rate of complications in the perioperative and post-operative period in this study did not differ much from that reported in previous research. The present study found hyphema to be the most common intraoperative complication, with an incidence of 12.7% (9/71).

Common early post-operative complications were corneal edema and hyphema, which improved within two weeks. The findings reveal that corneal edema was encountered in 26.8% (19/71) of patients. Transient corneal edema has been reported in previous studies: 2.18% (Kamonporn et al.)[15], 4.5% (Gogate et al.)[11], 7% (Gogate et al.)[16], 10.2% (Venkatesh et al.)[17], and 29% (Cook et al.)[18]. The author suggests that the causes of this corneal edema were excessive nuclear manipulation, excessive irrigation-aspiration, and viscoelastic retention. Nucleus delivery techniques involving considerable manipulation in the anterior chamber, such as the lens loop method, require the repeated injection of ophthalmic viscosurgical devices (OVD) to maintain a distance from the corneal endothelium and prevent endothelium damage. All OVD should be completely removed at the end of the procedure.

In the present study, the incidence of post-

operative hyphema was 8.5% (6/71). Kamonporn et al.[15] reported 4.35% of hyphema, Sharma U et al. 5.5%[19], Kongsap 6.2%[13], while Ruit et al. reported a 29.6% incidence of minor post-operative hyphema[8]. One possible reason for the number of patients with intraoperative and post-operative hyphema in the present study compared to other studies could be due to the deep tunnel and scleral pocket incision. A proper depth of scleral tunnel, adequate treatment with an electric cauterization, and if a bleeding was identified intraoperatively, anterior chamber formation with a large air bubble and suturing of the wound may account for the low incidence of post-operative hyphema. In the present study, no serious surgical complications were found.

The advantage of this study is that it is prospective, involving one surgeon and a single surgical technique. However, one limitation is the absence of long-term follow-up to assess visual acuity and post-operative astigmatism. A prospective study with a larger sample size and the evaluation of long-term visual acuity and post-operative astigmatism is recommended.

## Conclusion

The present study demonstrates the favorable outcomes achieved with MSICS using the Modified Ruit technique. This high-quality procedure achieves excellent clinical outcomes with a low rate of complications and may be the preferred technique for cataract surgery in developing countries.

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## Conflicts of interest

The author declares no conflict of interest.

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# ผลการผ่าตัดต้อกระจกชนิดแผลเล็ก โดยใช้ Modified Ruit Technique ที่โรงพยาบาลน่าน

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## บทคัดย่อ:

**รูปแบบการศึกษา:** Prospective Study

**วัตถุประสงค์ของการวิจัย:** เพื่อศึกษาระดับการมองเห็น ภาวะสายตาเอียงหลังการผ่าตัดและภาวะแทรกซ้อนของการผ่าตัดจากการผ่าตัดต้อกระจกชนิดแผลเล็กด้วย Modified Ruit technique ในผู้ป่วยต้อกระจกจังหวัดน่าน

**วิธีการศึกษา:** ทบทวนข้อมูลเวชระเบียนผู้ป่วย ต้อกระจก จำนวน 91 ราย 91 ตา ที่ได้รับการรักษาด้วยการผ่าตัดต้อกระจกชนิดแผลเล็กด้วย Modified Ruit Technique Manual Small incision Cataract Surgery (MSICS) ในโรงพยาบาลน่าน ตั้งแต่วันที่ 15 ตุลาคม 2566 ถึง วันที่ 29 กุมภาพันธ์ 2567 ทั้งหมดได้รับการผ่าตัดโดยจักษุแพทย์คนเดียวกัน ผู้ป่วย 20 ราย จำนวน 20 ตา ถูกตัดออกจากการวิจัยเนื่องจากข้อมูลสำคัญไม่ครบถ้วนหรือมีโรคทางตาอยู่เดิม การผ่าตัดต้อกระจกชนิดแผลเล็กด้วย Modified Ruit technique ทุกรายลงแผลแนวตรง ที่ sclera ด้าน tempopral นำข้อมูลระดับการมองเห็นทั้งก่อนและหลังการผ่าตัด ปัจจัยความยากในการผ่าตัด ระยะเวลาในการทำการผ่าตัด ภาวะแทรกซ้อนในระหว่างการผ่าตัดและหลังผ่าตัด ค่าสายตาเอียงหลังผ่าตัดสัปดาห์ที่ 2 และสัปดาห์ที่ 6 มาวิเคราะห์

**ผลการศึกษา:** ผู้ป่วย 71 ตา 71 ราย ได้รับการผ่าตัดต้อกระจกชนิดแผลเล็กด้วย Modified Ruit technique หลังผ่าตัด6สัปดาห์ ผู้ป่วยมีbest-corrected visual acuity ระดับ 20/20 ถึง 20/40 อยู่ 95.8% (68 ราย/71 ราย) ที่ระดับ 20/50 ถึง 20/70 มีอยู่ 4.2% (3 ราย/71 ราย) และ ค่าเฉลี่ยสายตาเอียง -1.14 ± 0.91 diopter ภาวะแทรกซ้อนขณะทำผ่าตัดที่พบบ่อยที่สุดคือเลือดออกในช่องหน้าม่านตา พบร้อยละ 12.7 (9 ราย/71 ราย) ไม่พบภาวะแทรกซ้อนที่รุนแรง

**สรุป:** การผ่าตัดต้อกระจกชนิดแผลเล็กโดยใช้ Modified Ruit technique รักษาผู้ป่วยต้อกระจก ให้ผลการรักษาที่ดีและมีภาวะแทรกซ้อนต่ำ

***คำสำคัญ:*** Modified Ruit technique, การผ่าตัดต้อกระจกชนิดแผลเล็ก

*กลุ่มงานจักษุวิทยา โรงพยาบาลน่าน*

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