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SICS – a cost effective alternative to phacoemulsification for developing countries in Nepal

Chirurgia małego cięcia (SICS) jako niskobudżetowa alternatywa dla fakoemulsyfikacji w rozwijających się krajach – na przykładzie z Nepalu

Rafał Nowak

From Eye Departament, City Hospital, ZOZ Poznań-Nowe Miasto,
Medical Director: Józef Szczypiński, MD

Summary: Millions of people worldwide are blind from mature cataracts. The developing countries cannot afford expensive modern technologies to treat these cases. A cost effective, fast, machine independent procedure is necessary. The purpose of this study is to describe such a technique, little known in Poland – manual small incision cataract surgery (SICS), where the whole nucleus is removed through a self-sealing sclero-corneal tunnel. Within the last several years SICS has become the main way of cataract removal in underserved populations of Asia, with Nepal as an example. Thus, the developing countries have developed a cost effective alternative to phacoemulsification with a very good clinical outcome.

Słowa kluczowe: chirurgia zaćmy, SICS, chirurgia małego cięcia, bezszwowe zewnątrztorebkowe usunięcie zaćmy, technika fish-hook.
Key words: cataract surgery, SICS, small incision cataract surgery, sutureless extracapsular cataract extraction, fish-hook technique.

Introduction

Despite all that modern technology has done to advance treatment of cataracts, our greatest challenge continues to be the large and increasing backlog of cataract blindness in developing countries. While in North America and Europe research and development have been directed primarily at new intraocular lens and phacoemulsification technology, millions with reversible blindness caused by cataracts go untreated in Asia and Africa (1,2).

Although the word trend is directed towards phaco surgery a bulk of cataracts in developing countries are operated by other procedures like SICS (small incision cataract surgery, manual small incision cataract surgery, sutureless surgery, sutureless extracapsular cataract extraction, manual phaco) and the old-aged standard ECCE ([3],[4]). The reason why the poorer part of the world does not utilize the latest machine-dependant techniques is very simple. Modern phacoemulsification devices are very expensive to purchase and maintain, have relatively high disposable costs (foldable IOLs, injectors etc.) and require extensive surgical training. Furthermore, for the more advanced and mature cataracts, typical for underserved populations, performing phacoemulsification becomes more difficult and complication prone (1,2,5,6).

In Nepal phacoemulsification as well as sutured ECCE are practiced rarely. Most of cataracts are operated with the manual SICS procedure, where the whole nucleus is removed through a self-sealing sclero-corneal tunnel. It induces a small amount of astigmatism, quick rehabilitation, requires no stitches and is cost effective (4,5,[7],[8]). Sanduk Ruit and associates have recently reported that the clinical outcome of SICS and phacoemulsification is comparable (1). This fact can be also confirmed by my own experience of several months spent in Nepalese hospitals.

Nepal has two schools of sutureless surgery: Lahan Eye Hospital and Tilganga Eye Center. The first one, located in Lahan (south-eastern part of the country) is run by Albrecht Henning. In 1997 he created his own modification of SICS. Its core is the fish-hook technique. Within 5,5 years (1997-2003) more than 170 000 cataracts were operated with this method (4). Currently the annual number of sutureless surgeries at Lahan Eye Hospital is up to 50 000.

In Kathmandu, there is another significant example of the efficient eye care system – Tilganga Eye Center. Its founder, Sanduk Ruit also has developed his own variation of SICS. Thus, most of eye surgeons in Nepal practice the above mentioned methods. However, those trained in India use another one, designed by Michael Blumenthal.

Techniques

Lahan method (the Fish-hook technique)

Before surgery an ophthalmic assistant performs a retrobulbar or peribulbar block (in some parts of Nepal it is combined with a facial block – O'Brien's method) outside operating theater. Next, orbital compression with a metal compressor (345g) is done for 10 minutes (Picture 1, Picture 2).

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Pict. 1. Metal compressor.
Ryc. 1. Metalowy kompresor.

Pict. 2. Orbital compression.
Ryc. 2. Kompresja oczodołu.

Then the patient walks into the operating theater. A trained assistant makes the eye ready for surgery by placing the superior rectus suture, preparing a fornix based conjunctival flap at 12 o'clock position and cauterizing scleral blood vessels. It happens so in the superior approach. If the surgeon chooses the temporal one, the operating field is prepared at the lateral side of the eye.

A central frown 6-8 mm incision is made 2 mm behind the limbus (Figure 1).

A partial thickness ($^1/_2$) scleral tunnel is dissected 2 mm into the clear cornea with a crescent knife. A side port paracentesis can be made to facilitate intraocular manipulation (optional). The anterior chamber is entered with a keratome and the internal lip of the incision is extended only to one side. Then, viscoelastic is injected into the anterior chamber. Again, the other side of the internal lip is extended with a keratome. The keratome stays in the anterior chamber and makes the envelope capsulotomy – a horizontal linear incision in the anterior capsule (Figure 1). After hydrodissection the nucleus is mobilized within the capsular bag. Viscoelastic material is injected between the posterior capsule and the nucleus as well as into the anterior chamber. The fish-hook (a 30 gauge needle with a bent tip) (Picture 3) is inserted between the nucleus and the posterior capsule with the sharp tip horizontal. Then the tip is turned upwards. As the hook is being withdrawn it engages the nucleus and delivers it from the eye (Figure 2, Picture 4).

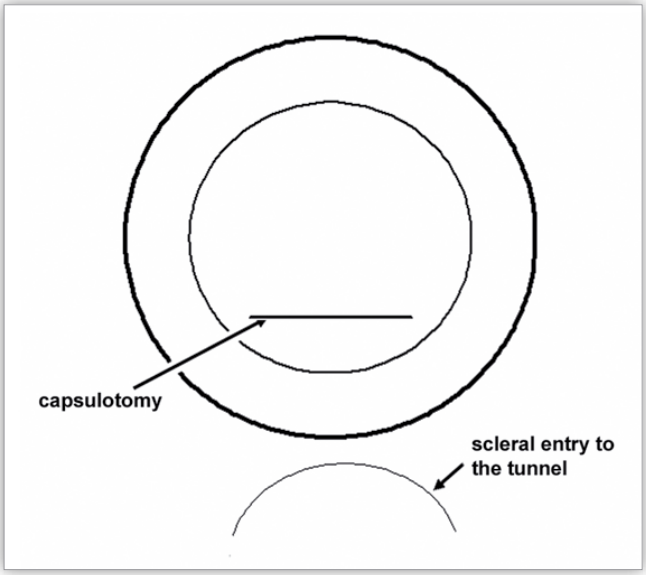


Fig. 1. Scleral groove and capsulotomy.
Fig. 1. Bruzda w twardówce i kapsulotomia.

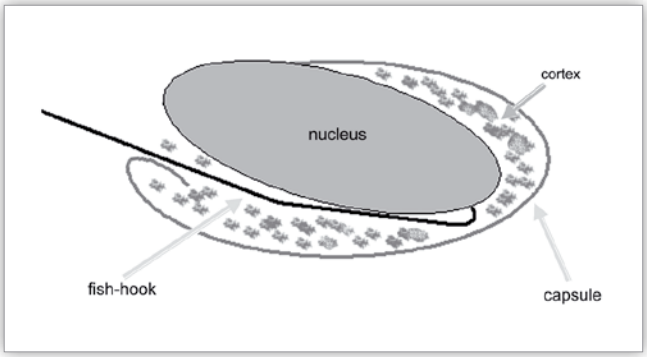
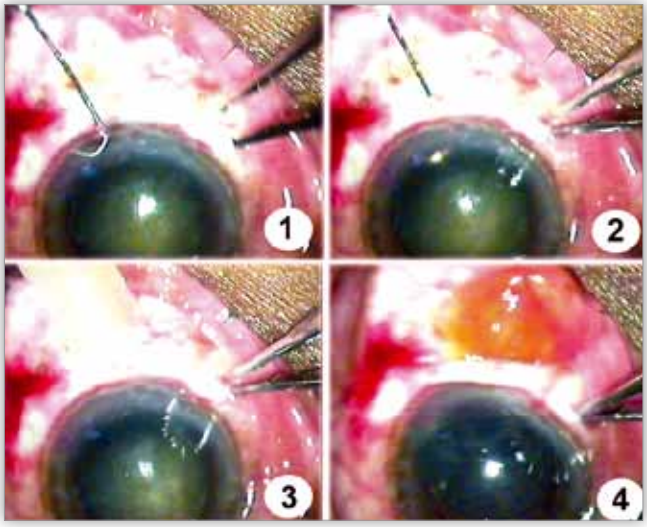


Fig. 2 Fish–hook extraction.
Fig. 2. Usuwanie techniką fish-hook.

Pict. 3. Fish-hook.
Ryc. 3. Haczyk.



Pict. 4. Fish-hook extraction.
Ryc. 4. Usuwanie techniką fish-hook.

The residual cortex is removed from within the bag with a Simcoe cannula. Here the surgeon is aspirating with a 5 ml syringe in his left hand and is infusing fluid into the anterior chamber through the cannula held in his right hand. Again viscoelastic substance is injected into the anterior chamber as well as into the bag. An intraocular lens is inserted directly into the bag and dialed if needed with a Sinskey hook under the still existing anterior capsular flap. A side incision in the anterior capsule is made and the flap is removed with a forceps or a Simcoe cannula (Figure 3). Viscoelastic material is washed out. As the last tool is withdrawn from the anterior chamber the sclero-corneal tunnel seals itself. The conjunctiva over the external wound is neither sutured nor cauterized.

Tilganga method

Only differences in comparison to the above mentioned method will be mentioned below.

The groove behind the limbus is linear (straight) (Figure 4), The sclero-corneal tunnel is extended 2-3 mm into the clear cornea. At this point the anterior chamber is entered through the tunnel with a 27 – gauge needle attached to a syringe containing Ringer's fluid. Its bevel is used like a knife to make 2 incisions with fine chopping motions in the anterior capsule. Thus, a triangular flap of the still remaining anterior capsule is created. The apex of the capsulotomy is stripped inferiorly with the tip of the needle.

After the anterior chamber is entered with a keratome, hydrodissection and nucleus delivery into the anterior chamber is carried out with a Simcoe cannula. Then the nucleus is extracted with a corrugated irrigating toothed nuclear extractor. After removing cortex debris, the anterior chamber is filled with air and an IOL is implanted into the capsular bag. The capsular flap is removed with a Simcoe cannula. The conjunctiva over the external wound is closed with cauterization at both edges.

Blumenthal's method (the Mini – Nuc technique)

At the beginning a capsulorhexis is made through a side paracentesis with a cystotome. The initial scleral groove has a different shape and is started 1 mm behind the limbus (Figure 5). The sclero-corneal tunnel penetrates 2 mm into the clear cornea. The nucleus is usually extracted with an irrigating vectis

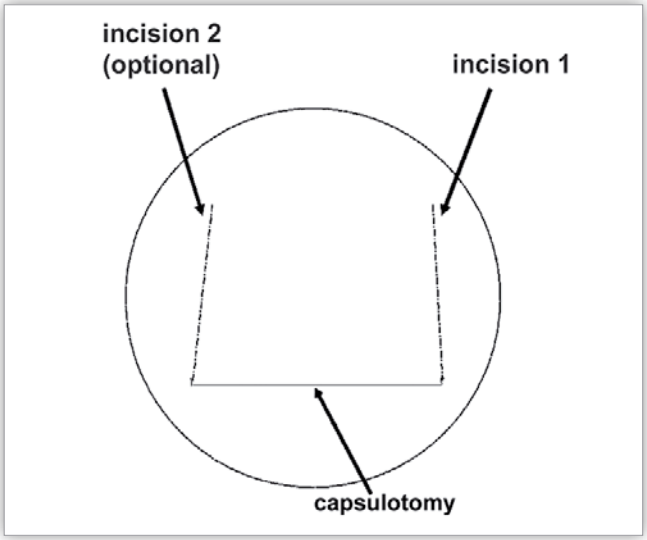


Fig. 3. Incisions in the anterior capsule.
Fig. 3. Nacięcie przedniej torebki.

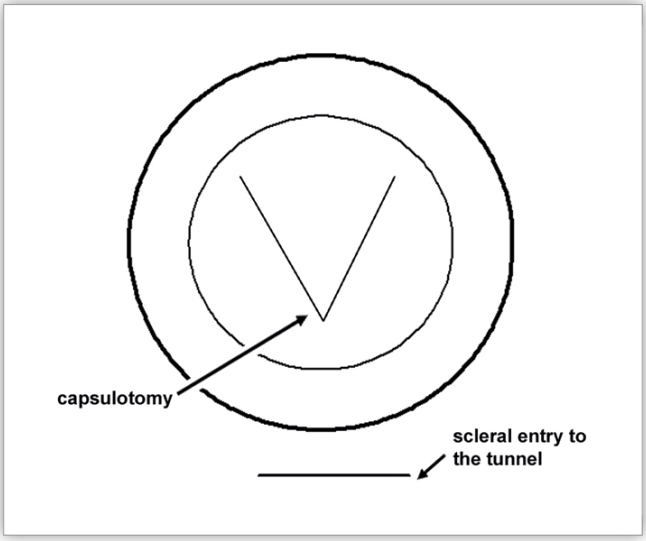


Fig. 4. Scleral groove and capsulotomy.
Fig. 4. Bruzda twardówki i kapsulotomia.

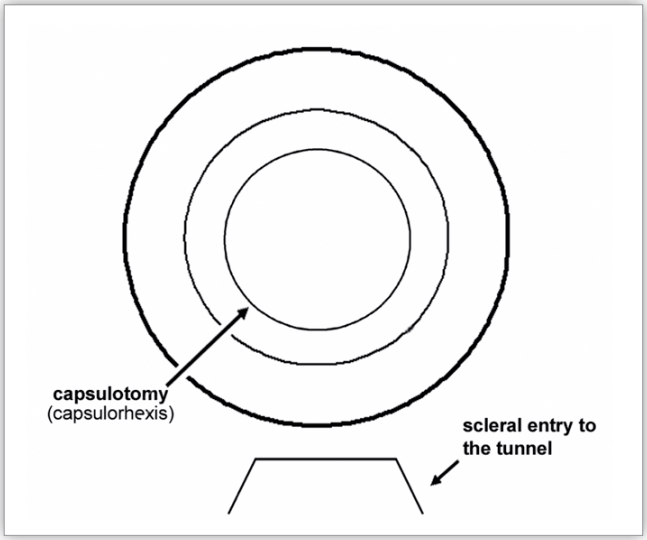


Fig. 5. Scleral groove and capsulotomy.
Fig. 5. Bruzda twardówki i kapsulotomia.

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(M. Blumenthal recommends using a glide as well as anterior chamber maintainer) (8)

Postoperative treatment

Within the first 2 postoperative days patients are administered frequent antibiotic-steroid eye drops (Table I). They are usually discharged on the second postoperative day and advised to use the medicine 4 times daily for one month on.

Parikshit Gogate (9) has confronted the complications of SICS and sutured ECCE. The study shows that the rates of intraoperative and postoperative complications were similar in the two groups, except for the transient postoperative corneal oedema, which was more common following SICS. However, in his research, during SICS the nucleus was delivered into the anterior chamber before its removal (9). It seems likely, that it might have been the cause of more frequent corneal oedema after surgery. Another study tends to confirm this hypothesis (5). Albrecht Henning reports corneal oedema as a minor problem in his analysis of 500 cases of SICS operated with the fish-hook

Name	Composition	Brand
CIPLOX-D	Ciprofloxacin 0.3 % Dexamethasone 0.1%	Cipla
BENTOR	Betamethasone Na Phosphate 0.1% Neomicin Sulphate 0.5%	Indoco Rem.
OFLOX-D	Ofloxacin 0.3% Dexamethasone 0.1%	Cipla
OFELDER-PA	Ofloxacin 0.3% Prednisolone 1%	Elder
CHLORMET-DM	Chloramphenicol 0.5% Dexamethasone Na Phosphate 0.1%	Milimet (Sun)

Tab. I. Example medicines used postoperatively.
Tab. I. Przykłady leków używanych po operacji.

Discussion

Complications

Table II shows possible complications after small incision cataract surgery.

Intraoperative complications
Premature entry to the anterior chamber while making the tunnel
Button hole formation while making the tunnel (when the dissection of the sclera is too superficial)
Too narrow tunnel
Bleeding from the tunnel into the anterior chamber
Descemet membrane injury or stripping
Iris trauma
Zonular dialysis
Endothelial damage
Posterior capsule rupture (with or without vitreous loss)
Postoperative complications
Wound leakage (with or without iris prolapse)
Hyphaema
Corneal oedema
Uveitis
Increased IOP
Macular oedema
IOL dislocation
Posterior capsule opacity
Endophthalmitis

Tab. II. Complications.
Tab. II. Powikłania.

technique. Here, the nucleus is extracted directly from the capsule, which reduces the endothelial damage significantly.

It is possible, that in procedures like the one from Tilgange Eye Center, where the IOL is implanted under air, there may be a higher probability of the endothelial damage. Therefore, it is recommended that the viscoelastic should be used.

Another complication – hyphaema is likely to occur within the postoperative period (1,5). It is the result of the wide sclero-corneal tunnel. Hence, it happens less often in techniques where the clear cornea incision is made. Sanduk Ruit (1) has compared phacoemulsification and SICS. 54 parients have been operated with each procedure (totally 108). Intra and postoperative complications were rare in both groups. In the phacoemulsification group there was one instance of posterior capsule rupture and none in the SICS group. There was one minor hyphaema caused by phacoemulsification and 16 by SICS. None of them required intervention, and all of them cleared spontaneously by the 5th postoperative day. No other significant complications were observed in the operative and postoperative period.

SICS – the learning curve

There is no doubt that sutureless cataract surgery is more difficult to learn than sutured ECCE. A self-sealing wound requires a very accurate tunnel construction as well as good surgical skills and experience to work inside the eye through a narrow tunnel (4). Lahan Eye Hospital has suggested the evaluation criteria for surgeons willing to learn SICS. The surgeon may be suitable if after at least 100 consecutive sutured ECCE the complications, especially posterior capsule rupture, are less than 5% and the number of patients with postoperative uncorrected visual acuity of less than 6/60 remains below 5% (4).

Surgically induced astigmatism

The surgically induced astigmatism (SIA) differs depending on the approach chosen by the surgeon. The superior approach makes about 1,4 D and the temporal approach creates around 0,4D (5,6). However, the Tilganga sources suggest higher levels of astigmatism – 1,7 D for the superior approach and 0,75 D for the temporal approach. Another study reports astigmatism of 0,88 D in the tempotal approach that makes it comparable with phacoemulsification (1). In general, the width of the tunnel as well as the distance of its external entry from the limbus influence the SIA.

Fast visual recovery

In comparison with sutured ECCE, sutureless surgery provides fast visual recovery (5). The self-sealing incision and no suture-related problems are two most important factors helping achieve that goal. Moreover, the Lahan method, which I personally recommend, provides even better results in terms of the postoperative condition of the cornea. The envelope capsulotomy and the fish-hook technique facilitate nucleus removal directly from the bag leaving the anterior capsule intact. It minimizes the risk of nucleus-endothelial touch which has a crucial impact on postoperative visual recovery (4,10,11). Fast visual recovery seems to be the advantage of not only phacoemulsification but also SICS (1).

Time of surgery

Thanks to the fact that no sutures are required time of surgery may be reduced to minimum in the hands of an experienced surgeon. Different sdudies show that the average time of surgery can reach even 3,75 min per case (2,12). Another study indicates the average duration of SICS at the level of 4 min.(5) Geoffrey Tabin has been able to perform more than 150 cases in one 9-hour stretch, which makes an average of 17 cases per hour and gives the average time of surgery of 3,6 min (1).

Costs

The cost of consumables per cataract operation, including an IOL, all medicines used before, during and after surgery, anesthesia, viscoelastic, irrigating solutions, disinfectants and eye pads can be reduced to 6.50 USD (5). In Kathmandu, Nepal, within the Tilganga Eye Center there is a local IOL factory. It is called the Fred Hollows Intraocular Lens Laboratory and produces high quality PMMA as well as foldable lenses under an Australian license. The commercial cost of one PMMA lens is 6 USD, one foldable lens with an injector is sold for 30 USD. The factory use lower rates for Nepalese hospitals. It holds ISO certificates guaranteeing high quality production standards (ISO 9001:2000, ISO 13485:2003, CE Mark – certified by SGS, UK).

Conclusios

Sutureless surgery appears to be a good alternative for phacoemulsification and an excellent solution for developing countries. It proves that high quality cataract surgery can be achieved at low cost on a large scale. It combines the advantages of expensive, modern, machine dependant procedures like phacoemulsification (low astigmatism, fast visual recovery, short rehabilitation) with cost effectiveness. There are studies (1) in which clinical results of both techniques are comparable – undeniably this subject needs more research. SICS is more difficult to learn than standard sutured ECCE and requires additional skills. However, the extensive and expensive surgical training necessary for phacoemulsification is hardly possible in countries where the majority of people suffers from poverty. Furthermore, the brunescent, hard cataracts typical for underserved populations make phacoemulsification more difficult, time consuming and prone to complications (1). For these reasons, manual small incision cataract surgery can be the answer to high needs for cataract surgery in the developing countries.

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Reprint requests to:
Rafał Nowak
Oddział Okulistyczny, Szpital ZOZ Poznań- Nowe Miasto
ul. Szwajcarska 3
61-285 Poznań,