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Long-term clinical Results after Cataract Surgery with and without capsular Tension Ring in Patients with Retinitis Pigmentosa: A Retrospective Study

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Article Summary: *Long-term clinical Results after Cataract Surgery with and without capsular Tension Ring in Patients with Retinitis Pigmentosa: A Retrospective Study*

Article Focus:

- Long-term clinical outcomes after cataract surgery with and without capsular tension ring in a group of retinitis pigmentosa patients

Key messages:

- Both surgical approaches were of benefit to retinitis pigmentosa patients
- Surgery with capsular tension ring implantation resulted in significantly fewer long-term postoperative complications
- These include secondary cataract and capsular contraction syndrome

Strength and limitations:

- Relatively small sample size of this special subset of cataract patients

ABSTRACT

Objectives: To describe the long-term clinical outcomes after cataract surgery with and without capsular tension ring (CTR) in a group of retinitis pigmentosa (RP) patients

Design: Retrospective study

Setting: Tertiary referral center

Participants: 88 eyes (59 patients) with RP

Interventions: Cataract surgery was undertaken between 10/2002 and 05/2010

Primary and secondary outcome measures: Visual acuity, secondary cataract, capsular contraction syndrome (CCS), intraocular pressure, cystoid macular edema (CME), intraocular lens dislocation and endophthalmitis

Results: The mean age at surgery was about 55 years and the overall mean follow-up 32 months (range 3-97 months). The mean preoperative LogMAR BCVA in the whole group was 1.35 +/-0.84 (95 % CI: 1.17-1.53) and increased to 1.19 +/-0.90 (95 % CI: 1.0-1.38) (p-value = 0.0006). The mean preoperative and the mean postoperative LogMAR BCVA in the non-CTR group (group one) improved from 1.17 +/- 0.82 (95 % CI: 0.97-1.38) to 0.99 +/- 0.83 (95 % CI: 0.78-1.2) (p-value = 0.0009) and in the CTR group (group two) from 1.74 +/- 0.81 (95 % CI: 1.42-2.1) to 1.66 +/-

0.90 (95 % CI: 1.3-2.03) (p-value = 0.31), respectively. Secondary cataract was observed in a total of 44 eyes (50%), of which 34 (38.6%) were of group one and 10 (8.8%) of group two. CCS was seen in a total of 6 eyes (7%) all of group one. CME was noted in 3 eyes (3.4%), of which 2 belonged to group one and a second 1 to group two. Endophthalmitis was not observed in any group.

Conclusions: Both surgical approaches were of benefit to the RP patients. Eyes of group two did significantly better in respect of long-term postoperative complications. This includes secondary cataract and CCS. Eyes of group one performed significantly better in respect of visual acuity. Further research would include insights into the genetic subsets.

Keywords:

Retinitis pigmentosa

Phacoemulsification

Capsular Tension Ring

Secondary cataract

Capsular Contraction Syndrome

INTRODUCTION: The development of cataract is a well-known complication seen in retinitis pigmentosa (RP) patients.[1-4] Treatment essentially involves phacoemulsification of the natural lens and the replacement by an artificial one. Relatively minor lens opacities may cause disproportionate functional symptoms, keeping in mind the inferior retinal function. In general, retinitis pigmentosa is an important causes of blindness among working-age people.[1] This elegant method leads to an increase of contrast and helps this patient group to gain visual acuity. Cut-off filters may be used to improve contrast sensitivity.[2] Although, a steady decrease is anticipated in the long-term prospective, surgical intervention is recommended and necessary to improve quality of life. Different surgical add-ons have been described in the literature to approach the potential postoperative complications, one of them being the capsular contraction syndrome (CCS).[5] Whether to utilize them remains to the surgeon's preference. This retrospective study tried to compare the development of short- and long-term postoperative complications and the best corrected visual acuity (BCVA) between two different kinds of cataract surgeries. Type 1 Surgery included phacoemulsification and the implantation of an intraocular lens (IOL). Type 2 Surgery adds a capsular tension ring (CTR) to the inserted IOL. Postoperative complications taken into consideration were intraocular pressure (IOP), cystoid macular edema (CME), secondary cataract and CCS. The former two may be treated medically, whereas the latter two ask for surgical intervention.

PATIENTS AND METHODS: The data of 59 patients with retinitis pigmentosa who had cataract removal by two different kinds of surgeries were retrospectively reviewed. Research was conducted according to the Tenets of the Declaration of Helsinki and with the approval of the ethics committee of Tuebingen. The first group (62 eyes) had phacoemulsification and IOL implantation. In the second group (26 eyes) a CTR was additionally inserted. Ophthalmological examinations were performed prior to surgery and at the follow-up visits. Examinations included the assessment of IOP by Goldmann tonometry, best corrected visual acuity (BCVA), anterior chamber, vitreal and retinal status. Surgeries took place between 10/2002 and 05/2010. Sex, age at surgery, preoperative findings, associated diseases, length of follow-up and postoperative complications were documented. Complications included IOP increase, CME, secondary cataract and CCS. BCVA was determined by the use of Early Treatment Diabetic Retinopathy Study (ETDRS) charts, converted into LogMAR units and recorded at the immediate preoperative visit and postoperative follow-up examinations.

PERIOPERATIVE MANAGEMENT: Preoperatively patients received antibiotics (fluoroquinolones four times daily) and corticosteroids (0.1 % dexamethasone gel four times daily) at least 24 hours prior to surgery. Postoperatively the medications were continued for up to 2 weeks or tapered, respectively.

STATISTICAL ANALYSIS: Analysis was undertaken using commercial software (JMP version 9.0). Results are presented with 95% confidence intervals (CIs). Nominal p values were calculated using *t*-test and the level of significance was set at 0.05.

RESULTS AND PATIENT CHARACTERISTICS: The mean age at surgery of our 32 male (54%) and 27 female (46%) patients was 55 years and ranged between 21 to 89 years. The overall mean follow-up time was 32 months (range 3 to 97 months). In group one the mean follow-up period was 37 months (range 3 to 97 months) and in group two 24 months (range 3 to 60 months). The most common complication was secondary cataract occurring in 50% (44 eyes) followed by increased IOP (requiring treatment) (10%) (9 eyes), CCS (7%) (6 eyes) and CME (3.4%) (3 eyes). Group one exhibited 34 (38.6%) eyes with secondary cataract, 8 (9%) eyes with IOP elevation, 6 (7%) eyes with CCS and 2 (2.3%) eyes with CME. Group two displayed 10 eyes (8.8%) with secondary cataract and 1 (1.1%) eye with CME and elevated IOP, respectively.

Visual outcome

The group exhibited 29 (33.0 %) eyes with unchanged BCVA, 12 (13.6 %) eyes with a decrease and 47 (53.4 %) with an increase of the BCVA. The mean preoperative LogMAR BCVA in the whole group was 1.35 +/-0.84 (95 % CI: 1.17-1.53) and increased to 1.19 +/-0.90 (95 % CI: 1.0-1.38) (p-value = 0.0006). The mean preoperative and the mean postoperative LogMAR BCVA in the non-CTR group

improved from 1.17 +/- 0.82 (95 % CI: 0.97-1.38) to 0.99 +/- 0.83 (95 % CI: 0.78-1.2) (p-value = 0.0009) and in the CTR group from 1.74 +/- 0.81 (95 % CI: 1.42-2.1) to 1.66 +/- 0.90 (95 % CI: 1.3-2.03) (p-value = 0.31), respectively. The pre-operative and post-operative overview is shown in Figure 1.

Complications

The postoperative complications included secondary cataract, increased IOP, CCS and CME in order of occurrence. An overview of the postoperative complications is given in Figure 2. One patient of group one developed during the follow-up period a subluxated IOL on her right eye. Explantation and implantation of a scleral-fixed lens was performed (Figure 3 & 4). CCS was only seen in the group which received Type 1 Surgery (Figure 5).

DISCUSSION: Cataract is a common complication in RP patients. The common form is the posterior subcapsular cataract found among all genetic subtypes.[3,4] Fortunately treatment is straightforward and involves lens exchange surgery. This procedure may be of great benefit to the patient, keeping in mind the inferior retinal function (Figure 6). An improvement of the quality of life is the consequence. Nevertheless, the potential postoperative complications may be frustrating.[6] To address these, additional implantable devices were conceived.[5] Whether to utilize them remains up to the surgeon's preference. This retrospective study tried to compare BCVA and the development of short- and long-term postoperative complications between two different kinds of cataract surgeries. Type 1 Surgery

included phacoemulsification and the implantation of an IOL. Type 2 Surgery adds a CTR to the inserted IOL. Postoperative complications taken into consideration were IOP, CME, secondary cataract and CCS.[3,4,7-14] The most common complication was secondary cataract occurring in 50% (44 eyes) followed by increased IOP (10%) (9 eyes), CCS (7%) (6 eyes) and CME (3.4%) (3 eyes). Comparing both groups a significant reduction of secondary cataract and CCS could be observed in group two. The mean preoperative and mean postoperative LogMAR BCVA improved in both groups. Though in group two insignificance was noted. Thus, both surgical approaches had beneficial outcomes for our patients in terms of decreased postoperative complications or increased visual acuity. The decreased number of eyes requiring IOP-lowering therapy in group two was considered a coincidence. We had no straightforward explanation for this observation. One patient developed during the follow-up a subluxated IOL in her right eye and several years later in her left eye.[14,15] Bilateral severe zonular insufficiency, noted intraoperatively, was suspected as the cause for both events.[14-16]

The additional implantation of a CTR may prevent IOL decentralization/ subluxation, posterior capsule opacification and anterior capsular phimosis as reported by other groups.[15,17,18] A decrease of posterior capsular opacification was also observed. Rapid capsular phimosis may especially occur in RP patients.[19] Precautions like CTRs should therefore be considered.[5,18] Ahmed et al reported improvements in CTR technology enhancing the safety and efficiency in eyes with profound zonular instability. In addition scleral-fixed devices may aid even more in decreasing intraoperative and postoperative risks.[5]

The limitations of the current study may be the relatively small sample size of this special subset of cataract patients. The prospective may be a future analysis of the genetic make-up. It may be concluded that a significant reduction of secondary

cataract and CCS could be observed in group two and that both surgical approaches had beneficial outcomes for our patients in terms of increased visual acuity or decreased postoperative complications.

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FIGURES:

Figure 1:

Preoperative and postoperative Visus in LogMAR for the total group, Type 2 and Type 1 Surgery.

Figure 2:

Figure 3 & 4:

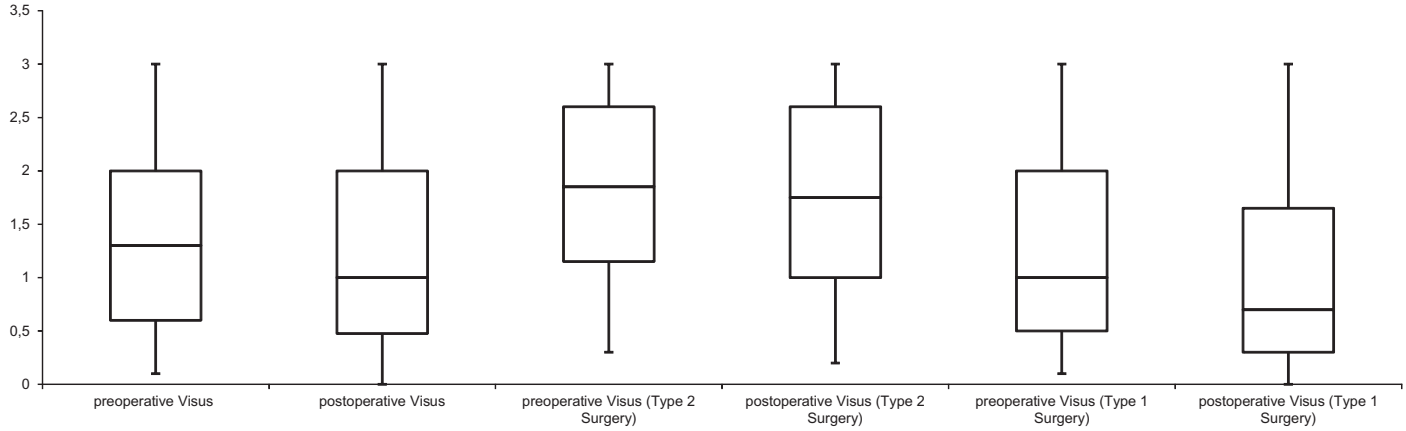
Demonstrate the IOL dislocation of the one patient with bilateral severe zonular insufficiency and the scleral-fixed IOL of the fellow eye.

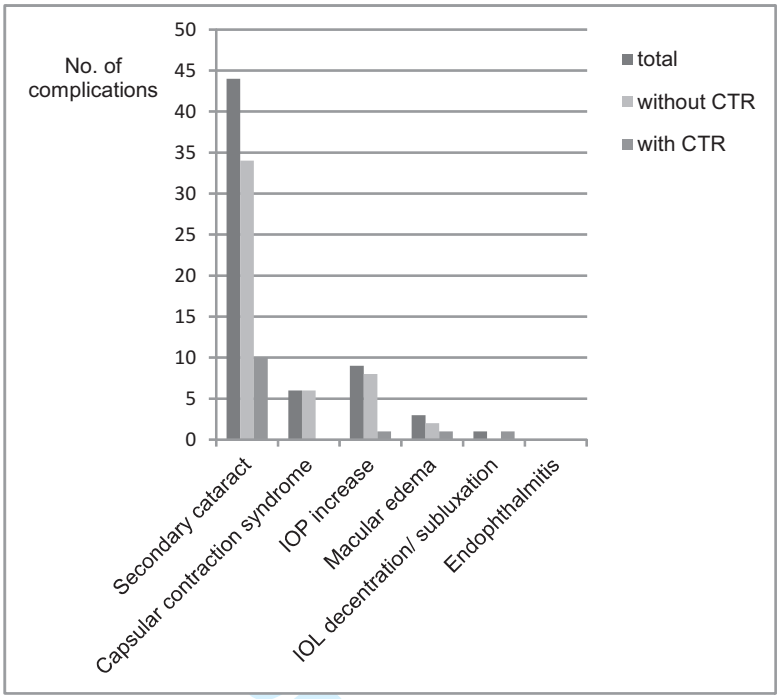
Figure 5:

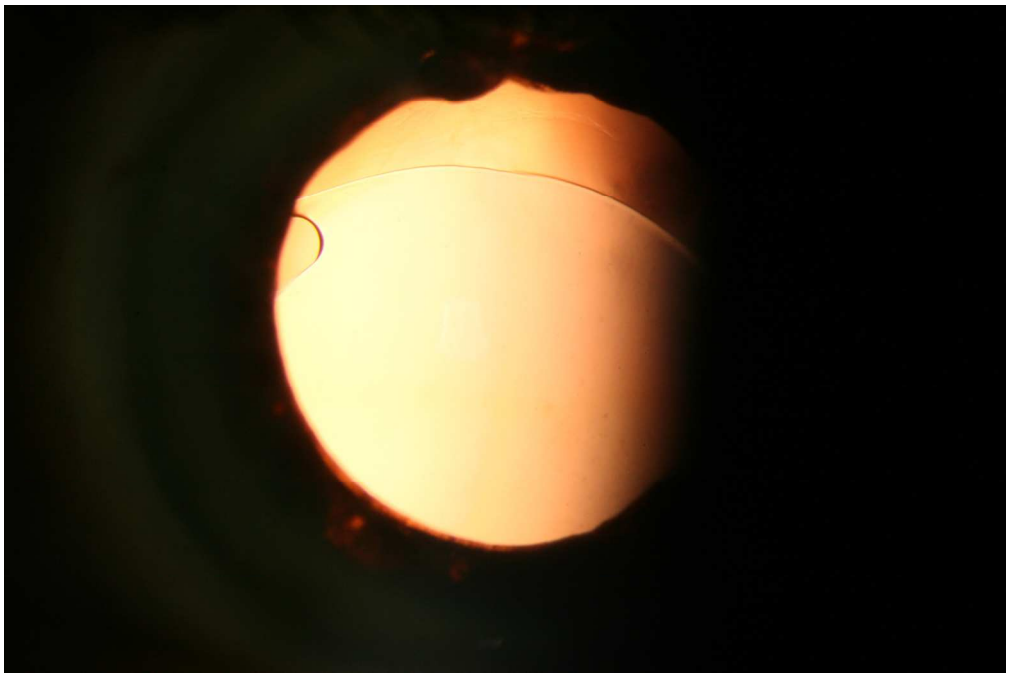
Depicts the developed capsular phimosis in a patient belonging to group one, which did not receive additional CTR insertion.

Figure 6:

Pathognomic retinal changes in a retinitis pigmentosa patient.

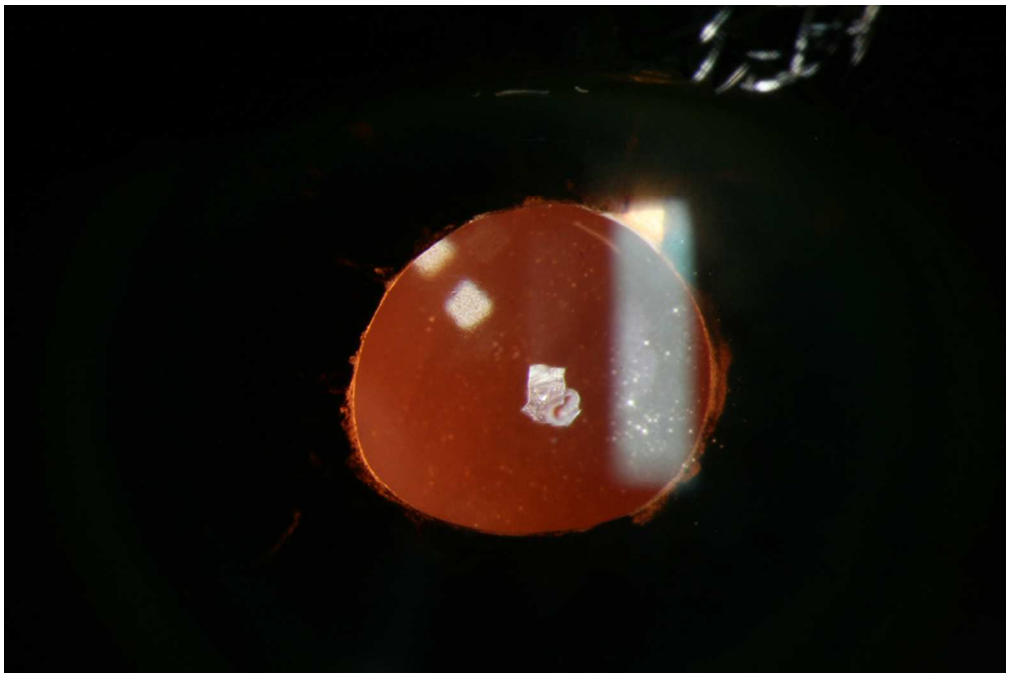




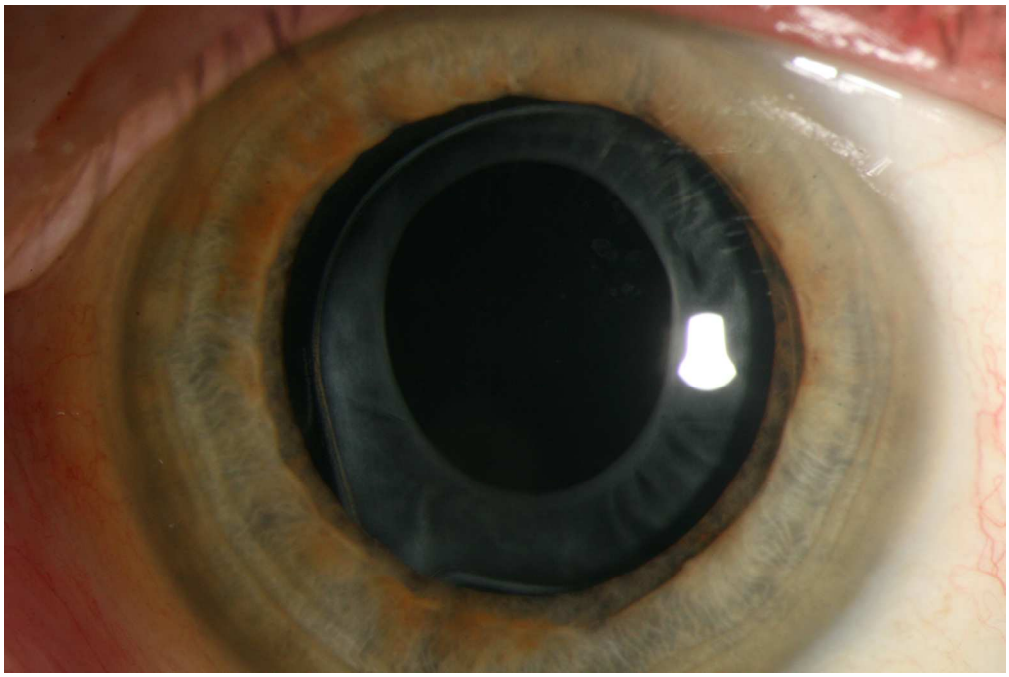


Demonstrates the IOL dislocation of the one patient with bilateral severe zonular insufficiency.

101x67mm (300 x 300 DPI)



Demonstrates the scleral-fixed IOL of the fellow eye in the one patient with bilateral severe zonular insufficiency.
101x67mm (300 x 300 DPI)



Depicts the developed capsular phimosis in a patient belonging to group one, which did not receive additional CTR insertion.
101x67mm (300 x 300 DPI)

Pathognomic retinal changes in a retinitis pigmentosa patient.
101x91mm (300 x 300 DPI)

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Contributorship statement: Contributors: Bayyoud acquisition of data, cleaned and analysed the data, wrote the statistical analysis plan, drafted and revised the paper and was involved in final approval. Yoeruek conceptualized the project, monitored data collection, drafted and revised the paper and was involved in final approval. Bartz-Schmidt contributed to conception, revised the draft paper and was involved in final approval.

Competing Interests

None

Data sharing

No additional unpublished data

Word count: 1817

ARTICLE SUMMARY

Article Summary: *Long-term clinical Results after Cataract Surgery with and without capsular Tension Ring in Patients with Retinitis Pigmentosa: A retrospective Study*

Article Focus:

- Long-term clinical outcomes after cataract surgery with and without capsular tension ring in a group of retinitis pigmentosa patients

Key messages:

- Both surgical approaches were of benefit to retinitis pigmentosa patients
- Surgery with capsular tension ring implantation resulted in fewer long-term postoperative complications including secondary cataract and capsular contraction syndrome

Strength and limitations:

- Relatively small sample size of this special subset of cataract patients

ABSTRACT

Objectives: To describe the long-term clinical outcomes after cataract surgery with and without capsular tension ring (CTR) in a group of retinitis pigmentosa (RP) patients

Design: Retrospective study

Setting: Tertiary referral center

Participants: **52** eyes (**46** patients) with RP

Interventions: Cataract surgery was undertaken between 10/2002 and 05/2010

Primary and secondary outcome measures: Visual acuity, secondary cataract, capsular contraction syndrome (CCS), intraocular pressure, cystoid macular edema (CME), intraocular lens dislocation and endophthalmitis

Results: The mean age at surgery was about 53 years and the overall mean follow-up 26 months (range 3-60 months). The mean preoperative LogMAR BCVA in the whole group was 1.45 +/-0.85 (95 % CI: 1.21-1.69) and increased to 1.32 +/-0.95 (95 % CI: 1.06-1.58) (p-value = 0.02). The mean preoperative and the mean postoperative LogMAR BCVA in the non-CTR group (group one) improved from 1.16 +/- 0.8 (95 % CI: 0.83-1.48) to 0.98 +/- 0.88 (95 % CI: 0.62-1.33) (p-value = 0.02) and in the CTR group (group two) from 1.74 +/- 0.81 (95 % CI: 1.42-2.07) to 1.66 +/- 0.90 (95 % CI: 1.3-2.03) (p-value = 0.31), respectively. Secondary cataract was observed in a total of 23 eyes (44%), of which 13 (50%) were of group one and 10 (38%) of group two. CCS was seen in a total of 2 eyes (4%) all of group one. CME was noted in 2 eyes (4%), of which 1 belonged to group one and a second 1 to group two. Endophthalmitis was not observed in any group.

Conclusions: Both surgical approaches were of benefit to the RP patients. Eyes of group two showed less long-term postoperative complications. This includes secondary cataract and CCS. Eyes of group one performed significantly better in respect of visual acuity. Further research would include insights into the genetic subsets.

Keywords:

Retinitis pigmentosa

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Secondary cataract

Capsular Contraction Syndrome

INTRODUCTION: The development of cataract is a well-known complication seen in retinitis pigmentosa (RP) patients.[1-4] Treatment essentially involves phacoemulsification of the natural lens and the replacement by an artificial one. Relatively minor lens opacities may cause disproportionate functional symptoms, keeping in mind the inferior retinal function. In general, retinitis pigmentosa is an important causes of blindness among working-age people.[1] Cataract surgery leads to an increase of contrast and helps this patient group to gain visual acuity. Cut-off filters may be used to improve contrast sensitivity.[2] Although, a steady decrease is anticipated in the long-term perspective, surgical intervention is recommended and necessary to improve quality of life. Different surgical add-ons have been described in the literature to approach the potential postoperative complications, one of them being the capsular contraction syndrome (CCS).[5] Whether to utilize them remains to the surgeon's preference. This retrospective study tried to compare the development of short- and long-term postoperative complications and the best corrected visual acuity (BCVA) between two different groups. Group one received phacoemulsification and the implantation of an intraocular lens (IOL) (Type 1 Surgery). In group two a capsular tension ring (CTR) was added to the inserted IOL (Type 2 Surgery). Postoperative complications taken into consideration were intraocular pressure (IOP), cystoid macular edema (CME), secondary cataract and CCS. The former two may be treated medically, whereas the latter two ask for surgical intervention.

PATIENTS AND METHODS: The data of 46 patients with retinitis pigmentosa who had cataract removal and phacoemulsification with or without subsequent capsular tension ring (CTR) implantation were retrospectively reviewed. Research was conducted according to the Tenets of the Declaration of Helsinki and with the approval of the ethics committee of Tuebingen. The first group (26 eyes) had phacoemulsification and IOL implantation. In the second group (26 eyes) a CTR was additionally inserted. The surgical technique involved temporally localized clear corneal incision with 2.75 mm of wound size. Experienced surgeons operated this kind of demanding cataract with the risk of zonulolysis using stop and chop technique in advanced nuclear opacity and chip and flip technique in soft cataracts. Excessive cleaning of the posterior capsule, the equatorial bag and the anterior undersurface was done in all cases. The IOL types used were all hydrophobic, acrylic lenses made of a single-piece or multi-piece. In group one 1 and 25 were 3-piece or 1-piece IOLs, respectively. In group two 10 and 16 were 3-piece or 1-piece IOLs, respectively. The CTR type was either a Croma-Pharma GmbH (Leobendorf, Austria) or Morcher GmbH (Stuttgart, Germany) fabricate of 11 mm. There were 19 emmetropic, 6 myopic and 27 hyperopic eyes. Ophthalmological examinations were performed prior to surgery and at the follow-up visits. Examinations included the assessment of IOP by Goldmann tonometry, best corrected visual acuity (BCVA), anterior chamber, vitreal and retinal status. Surgeries took place between 10/2002 and 05/2010. Sex, age at surgery, preoperative findings, associated diseases, length of follow-up and postoperative complications were documented. Complications included IOP increase, CME, secondary cataract and CCS. BCVA was determined by the use of Early Treatment Diabetic Retinopathy Study (ETDRS) charts, converted into LogMAR units and recorded at the immediate preoperative visit and postoperative follow-up examinations.

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RESULTS AND PATIENT CHARACTERISTICS: The mean age at surgery of our 29 male and 23 female patients was 53 years and ranged between 21 to 89 years. The overall mean follow-up time was 26 months (range 3 to 60 months). In group one the mean follow-up period was 28 months (range 3 to 52 months) and in group two 24 months (range 3 to 60 months). The most common complication was secondary cataract occurring in 44% (23 eyes) followed by increased IOP (requiring treatment) (10%) (5 eyes), CCS (4%) (2 eyes) and CME (4%) (2 eyes). Group one exhibited 13 (50%) eyes with secondary cataract, 4 (15%) eyes with IOP elevation, 2 (8%) eyes with CCS and CME, respectively. Group two displayed 10 eyes (38%) with secondary cataract and 1 (4%) eye with CME and elevated IOP, respectively.

Visual outcome

The group exhibited 19 (37%) eyes with unchanged BCVA, 6 (12%) eyes with a decrease and 27 (52%) with an increase of the BCVA. The mean preoperative LogMAR BCVA in the whole group was 1.45 +/-0.85 (95 % CI: 1.21-1.69) and increased to 1.32 +/-0.95 (95 % CI: 1.06-1.58) (p-value = 0.02). The mean preoperative and the mean postoperative LogMAR BCVA in the non-CTR group

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Complications

The postoperative complications included secondary cataract, increased IOP, CCS and CME in order of occurrence. An overview of the postoperative complications is given in Figure 2. In comparison, secondary cataract was seen in 50% of cases in group 1 and in 38% of cases in group 2. Concerning CCS all cases were observed in group 1 and no cases in group 2. IOP increase was noted in 15 % of cases in group 1 and 4% of cases in group 2. One patient of group one developed during the follow-up period a subluxated IOL on her right eye and several years later of her left eye. Explantation and implantation of a scleral-fixed lens was performed (Figure 3 & 4). A decreased rate of secondary cataract and CCS was noted in group 2. Secondary cataract was seen in 10 eyes in group 2 and 13 eyes in group 1 (p-value = 0.4). CCS was only seen in the group which received Type 1 Surgery (Figure 5) (p-value = 0.15).

DISCUSSION: Cataract is a common complication in RP patients. The common form is the posterior subcapsular cataract found among all genetic subtypes.[3,4] Fortunately treatment is straightforward and involves cataract surgery. This procedure may be of great benefit to the patient, keeping in mind the inferior retinal function (Figure 6). An improvement of the quality of life is the consequence. Nevertheless, the potential postoperative complications may be frustrating.[6] To address these, additional implantable devices were conceived.[5] Whether to utilize them remains up to the surgeon's preference. This retrospective study tried to

compare BCVA and the development of short- and long-term postoperative complications after cataract surgery with and without the implantation of a CTR. Type 1 Surgery included phacoemulsification and the implantation of an IOL. Type 2 Surgery adds a CTR to the inserted IOL. Postoperative complications taken into consideration were IOP, CME, secondary cataract and CCS.[3,4,7-14] The most common complication was secondary cataract occurring in 44% (23 eyes) followed by increased IOP (10%) (6 eyes), CCS (4%) (2 eyes) and CME (4%) (2 eyes). Comparing both groups less cases of secondary cataract and CCS could be observed in group two. The mean preoperative and mean postoperative LogMAR BCVA improved in both groups, although in group two the difference was not statistically significant. Group one performed better in terms of final vision. This might be explained by the decreased, pre-operative visual acuity of group two. Thus, both surgical approaches had beneficial outcomes for our patients in terms of a low rate of postoperative complications or increased visual acuity. The decreased number of eyes requiring IOP-lowering therapy in group two was considered a coincidence. 5 eyes received anti-glaucoma therapy. We had no straightforward explanation for this observation. In the one case with bilateral subluxated IOL severe zonular insufficiency, noted intraoperatively, was suspected as the cause.[14-16]

The additional implantation of a CTR may prevent IOL decentralization/ subluxation, posterior capsule opacification and anterior capsular phimosis as reported by other groups.[15,17,18] A decrease of posterior capsular opacification was also observed. Rapid capsular phimosis may especially occur in RP patients.[19] Precautions like CTRs should therefore be considered.[5,18] Ahmed et al reported improvements in CTR technology enhancing the safety and efficiency in eyes with profound zonular instability. In addition scleral-fixed devices may aid even more in decreasing intraoperative and postoperative risks.[5] Nevertheless, there are also reports in the

literature stating fibrotic reactions, regarding PCO and CCS, and dislocations in patients with zonular weakness.[20-22]

The limitations of the current study may be the relatively small sample size of this special subset of cataract patients. Further studies may try to include more cases or an analysis of the different genetic subtypes of retinitis pigmentosa. It may be concluded that less cases of secondary cataract and CCS could be observed in group two and that both surgical approaches had beneficial outcomes for our patients in terms of increased visual acuity or decreased postoperative complications.

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FIGURES:

Figure 1:

Preoperative and postoperative Vision in LogMAR for the total group, Type 2 and Type 1 Surgery.

Figure 2:

Figure 3 & 4: **(may be supplemental)**

Demonstrate the IOL dislocation of the one patient with bilateral severe zonular insufficiency and the scleral-fixed IOL of the fellow eye.

Figure 5:

Depicts the developed capsular phimosis in a patient belonging to group one, which did not receive additional CTR insertion.

Figure 6: **(may be supplemental)**

Pathognomonic retinal changes in a retinitis pigmentosa patient.

Long-term clinical Results after Cataract Surgery with and without capsular Tension Ring in Patients with Retinitis Pigmentosa: A retrospective Study

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Contributorship statement: Contributors: Bayyoud acquisition of data, cleaned and analysed the data, wrote the statistical analysis plan, drafted and revised the paper and was involved in final approval. Yoeruek conceptualized the project, monitored data collection, drafted and revised the paper and was involved in final approval. Bartz-Schmidt contributed to conception, revised the draft paper and was involved in final approval.

Word count: 1817

Objectives: To describe the long-term clinical outcomes after cataract surgery with and without capsular tension ring (CTR) in a group of retinitis pigmentosa (RP) patients

Design: Retrospective study

Setting: Tertiary referral center

Participants: **52** eyes (**46** patients) with RP

Interventions: Cataract surgery was undertaken between 10/2002 and 05/2010

Primary and secondary outcome measures: Visual acuity, secondary cataract, capsular contraction syndrome (CCS), intraocular pressure, cystoid macular edema (CME), intraocular lens dislocation and endophthalmitis

Results: The mean age at surgery was about **53** years and the overall mean follow-up **26** months (range **3-60** months). **The mean preoperative LogMAR BCVA in the whole group was 1.45 +/-0.85 (95 % CI: 1.21-1.69) and increased to 1.32 +/-0.95 (95 % CI: 1.06-1.58) (p-value = 0.02). The mean preoperative and the mean postoperative LogMAR BCVA in the non-CTR group (group one) improved from 1.16 +/- 0.8 (95 % CI: 0.83-1.48) to 0.98 +/- 0.88 (95 % CI: 0.62-1.33) (p-value = 0.02) and in the CTR group (group two) from 1.74 +/- 0.81 (95 % CI: 1.42-2.07) to 1.66 +/- 0.90 (95 % CI: 1.3-2.03) (p-value = 0.31), respectively. Secondary cataract was observed in a total of 23 eyes (44%), of which 13 (50%) were of group one and 10 (38%) of group two. CCS was seen in a total of 2 eyes (4%) all of group one. CME was noted in 2 eyes (4%), of which 1 belonged to group one and a second 1 to group two.** Endophthalmitis was not observed in any group.

Conclusions: Both surgical approaches were of benefit to the RP patients. Eyes of group two **showed less long-term postoperative complications**. This includes secondary cataract and CCS. Eyes of group one performed significantly better in respect of visual acuity. Further research would include insights into the genetic subsets.

Keywords:

Retinitis pigmentosa

Phacoemulsification

Capsular Tension Ring

Secondary cataract

Capsular Contraction Syndrome

INTRODUCTION: The development of cataract is a well-known complication seen in retinitis pigmentosa (RP) patients.[1-4] Treatment essentially involves phacoemulsification of the natural lens and the replacement by an artificial one. Relatively minor lens opacities may cause disproportionate functional symptoms, keeping in mind the inferior retinal function. In general, retinitis pigmentosa is an important causes of blindness among working-age people.[1] **Cataract surgery** leads to an increase of contrast and helps this patient group to gain visual acuity. Cut-off filters may be used to improve contrast sensitivity.[2] Although, a steady decrease is anticipated in the long-term **perspective**, surgical intervention is recommended and necessary to improve quality of life. Different surgical add-ons have been described in the literature to approach the potential postoperative complications, one of them being the capsular contraction syndrome (CCS).[5] Whether to utilize them remains to the surgeon's preference. This retrospective study tried to compare the development of short- and long-term postoperative complications and the best corrected visual acuity (BCVA) **between two different groups. Group one received** phacoemulsification and the implantation of an intraocular lens (IOL) **(Type 1 Surgery)**. **In group two a** capsular tension ring (CTR) **was added** to the inserted IOL **(Type 2 Surgery)**. Postoperative complications taken into consideration were intraocular pressure (IOP), cystoid macular edema (CME), secondary cataract and CCS. The former two may be treated medically, whereas the latter two ask for surgical intervention.

PATIENTS AND METHODS: The data of **46** patients with retinitis pigmentosa who had cataract removal **and phacoemulsification with or without subsequent capsular tension ring (CTR) implantation** were retrospectively reviewed. Research was conducted according to the Tenets of the Declaration of Helsinki and with the approval of the ethics committee of Tuebingen. The first group (**26** eyes) had phacoemulsification and IOL implantation. In the second group (26 eyes) a CTR was additionally inserted. **The surgical technique involved temporally localized clear corneal incision with 2.75 mm of wound size. Experienced surgeons operated this kind of demanding cataract with the risk of zonulolysis using stop and chop technique in advanced nuclear opacity and chip and flip technique in soft cataracts. Excessive cleaning of the posterior capsule, the equatorial bag and the anterior undersurface was done in all cases. The IOL types used were all hydrophobic, acrylic lenses made of a single-piece or multi-piece. In group one 1 and 25 were 3-piece or 1-piece IOLs, respectively. In group two 10 and 16 were 3-piece or 1-piece IOLs, respectively. The CTR type was either a Croma-Pharma GmbH (Leobendorf, Austria) or Morcher GmbH (Stuttgart, Germany) fabricate of 11 mm. There were 19 emmetropic, 6 myopic and 27 hyperopic eyes.** Ophthalmological examinations were performed prior to surgery and at the follow-up visits. Examinations included the assessment of IOP by Goldmann tonometry, best corrected visual acuity (BCVA), anterior chamber, vitreal and retinal status. Surgeries took place between 10/2002 and 05/2010. Sex, age at surgery, preoperative findings, associated diseases, length of follow-up and postoperative complications were documented. Complications included IOP increase, CME, secondary cataract and CCS. BCVA was determined by the use of Early Treatment Diabetic Retinopathy Study (ETDRS) charts, converted into LogMAR units and

recorded at the immediate preoperative visit and postoperative follow-up examinations.

PERIOPERATIVE MANAGEMENT: Preoperatively patients received antibiotics (fluoroquinolones four times daily) and corticosteroids (0.1 % dexamethasone gel four times daily) at least 24 hours prior to surgery. Postoperatively the medications were continued for up to 2 weeks or tapered, respectively.

STATISTICAL ANALYSIS: Analysis was undertaken using commercial software (JMP version 9.0). Results are presented with 95% confidence intervals (CIs). Nominal p values were calculated using *t*-test and the level of significance was set at 0.05.

RESULTS AND PATIENT CHARACTERISTICS: The mean age at surgery of our **29 male** and **23 female** patients was **53** years and ranged between **21 to 89 years**. The overall mean follow-up time was **26** months (**range 3 to 60 months**). In group one the mean follow-up period was **28 months** (**range 3 to 52 months**) and in group two 24 months (range 3 to 60 months). The most common complication was secondary cataract occurring in **44% (23 eyes)** followed by increased IOP (requiring treatment) **(10%) (5 eyes), CCS (4%) (2 eyes) and CME (4%) (2 eyes)**. Group one exhibited **13 (50%)** eyes with secondary cataract, **4 (15%)** eyes with IOP elevation, **2 (8%)** eyes with CCS and CME, respectively. Group two displayed 10 eyes (38%) with secondary cataract and 1 (4%) eye with CME and elevated IOP, respectively.

Visual outcome

The group exhibited **19 (37%)** eyes with unchanged BCVA, **6 (12%)** eyes with a decrease and **27 (52%)** with an increase of the BCVA. **The mean preoperative LogMAR BCVA in the whole group was 1.45 +/-0.85 (95 % CI: 1.21-1.69) and**

increased to 1.32 +/-0.95 (95 % CI: 1.06-1.58) (p-value = 0.02). The mean preoperative and the mean postoperative LogMAR BCVA in the non-CTR group improved from 1.16 +/- 0.8 (95 % CI: 0.83-1.48) to 0.98 +/-0.88 (95 % CI: 0.62-1.33) (p-value = 0.02) and in the CTR group from 1.74 +/- 0.81 (95 % CI: 1.42-2.07) to 1.66 +/- 0.90 (95 % CI: 1.3-2.03) (p-value = 0.31), respectively. The pre-operative and post-operative overview is shown in Figure 1.

Complications

The postoperative complications included secondary cataract, increased IOP, CCS and CME in order of occurrence. An overview of the postoperative complications is given in Figure 2**. In comparison, secondary cataract was seen in 50% of cases in group 1 and in 38% of cases in group 2. Concerning CCS all cases were observed in group 1 and no cases in group 2. IOP increase was noted in 15 % of cases in group 1 and 4% of cases in group 2. One patient of group one developed during the follow-up period a subluxated IOL on her right eye and several years later of her left eye**. Explantation and implantation of a scleral-fixed lens was performed (Figure 3 & 4). **A decreased rate of secondary cataract and CCS was noted in group 2. Secondary cataract was seen in 10 eyes in group 2 and 13 eyes in group 1 (p-value = 0.4)**. **CCS was only seen in the group which received Type 1 Surgery (Figure 5) (p-value = 0.15)**.

DISCUSSION: Cataract is a common complication in RP patients. The common form is the posterior subcapsular cataract found among all genetic subtypes.[3,4] Fortunately treatment is straightforward and involves **cataract surgery**. This procedure may be of great benefit to the patient, keeping in mind the inferior retinal function (Figure 6). An improvement of the quality of life is the consequence. Nevertheless, the potential postoperative complications may be frustrating.[6] To

address these, additional implantable devices were conceived.[5] Whether to utilize them remains up to the surgeon's preference. **This retrospective study tried to compare BCVA and the development of short- and long-term postoperative complications after cataract surgery with and without the implantation of a CTR**. Type 1 Surgery included phacoemulsification and the implantation of an IOL. Type 2 Surgery adds a CTR to the inserted IOL. Postoperative complications taken into consideration were IOP, CME, secondary cataract and CCS.[3,4,7-14] The most common complication was secondary cataract occurring in **44% (23 eyes)** followed by increased IOP **(10%) (6 eyes)**, CCS **(4%) (2 eyes)** and CME **(4%) (2 eyes).** Comparing both groups **less cases of** secondary cataract and CCS could be observed in group two. The mean preoperative and mean postoperative LogMAR BCVA improved in both groups, **although in group two the difference was not statistically significant. Group one performed better in terms of final vision. This might be explained by the decreased, pre-operative visual acuity of group two.** Thus, both surgical approaches had beneficial outcomes for our patients in terms of **a low rate of postoperative complications** or increased visual acuity. The decreased number of eyes requiring IOP-lowering therapy in group two was considered a coincidence. **5 eyes received anti-glaucoma therapy**. We had no straightforward explanation for this observation. **In the one case with bilateral subluxated IOL severe zonular insufficiency, noted intraoperatively, was suspected as the cause.**[14-16]

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The limitations of the current study may be the relatively small sample size of this special subset of cataract patients. **Further studies may try to include more cases or an analysis of the different genetic subtypes of retinitis pigmentosa**. It may be concluded that **less cases** of secondary cataract and CCS could be observed in group two and that both surgical approaches had beneficial outcomes for our patients in terms of increased visual acuity or decreased postoperative complications.

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Article Summary: *Long-term clinical Results after Cataract Surgery with and without capsular Tension Ring in Patients with Retinitis Pigmentosa: A retrospective Study*

Article Focus:

- Long-term clinical outcomes after cataract surgery with and without capsular tension ring in a group of retinitis pigmentosa patients

Key messages:

- Both surgical approaches were of benefit to retinitis pigmentosa patients
- **Surgery with capsular tension ring implantation resulted in fewer long-term postoperative complications including secondary cataract and capsular contraction syndrome**

Strength and limitations:

- Relatively small sample size of this special subset of cataract patients

FIGURES:

Figure 1:

Preoperative and postoperative **Vision** in LogMAR for the total group, Type 2 and Type 1 Surgery.

Figure 2:

Figure 3 & 4: **(may be supplemental)**

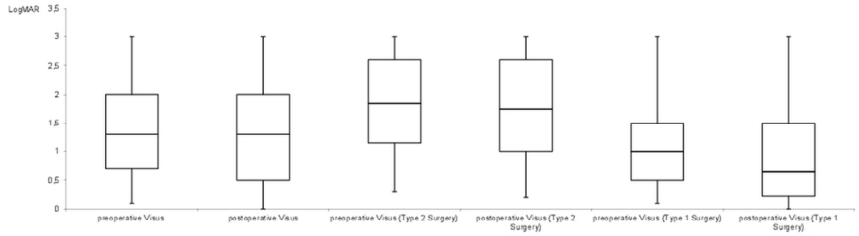
Demonstrate the IOL dislocation of **the one patient** with bilateral severe zonular insufficiency and the scleral-fixed IOL of the fellow eye.

Figure 5:

Depicts the developed capsular phimosis in a patient belonging to group one, which did not receive additional CTR insertion.

Figure 6: **(may be supplemental)**

Pathognomonic retinal changes in a retinitis pigmentosa patient.



Preoperative and postoperative Vision in LogMAR for the total group, Type 2 and Type 1 Surgery.
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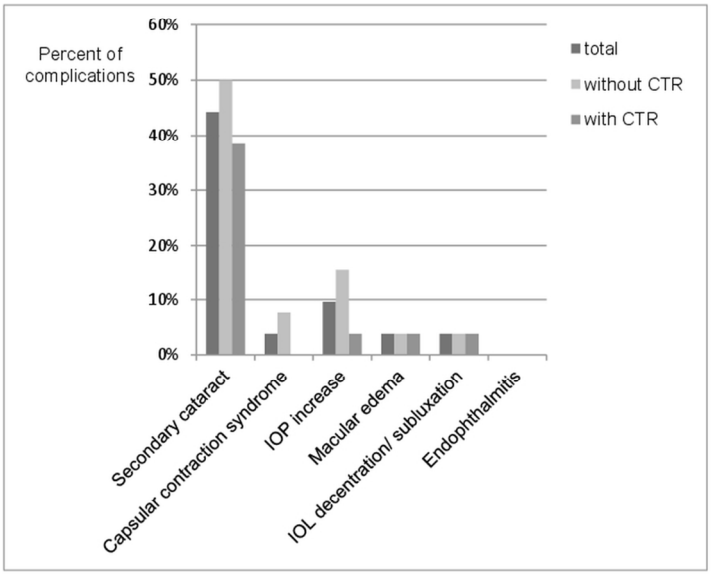

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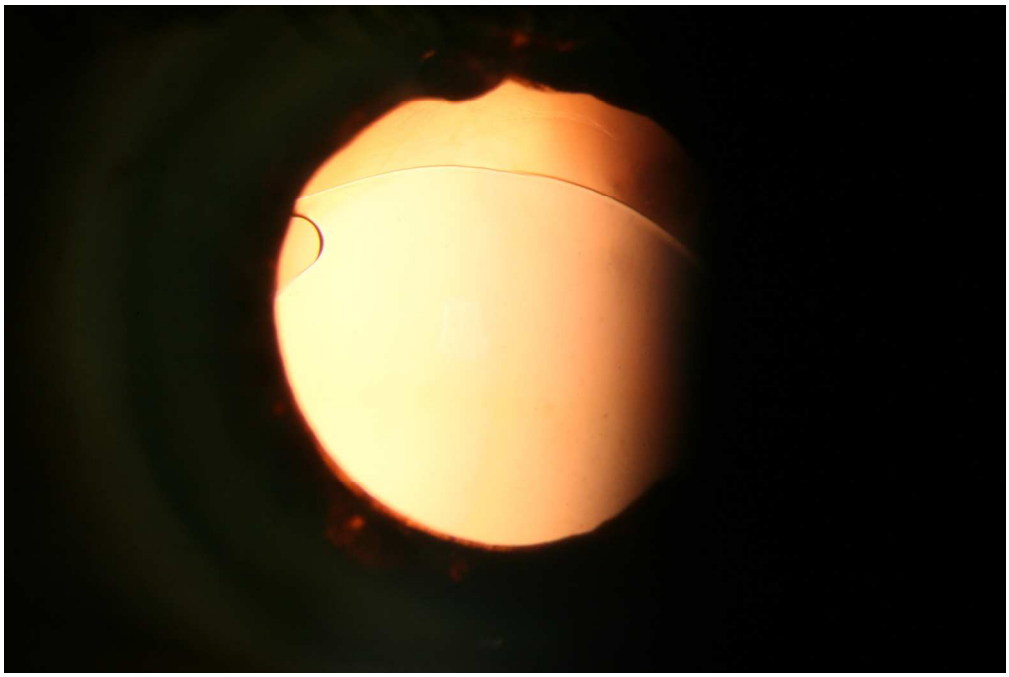
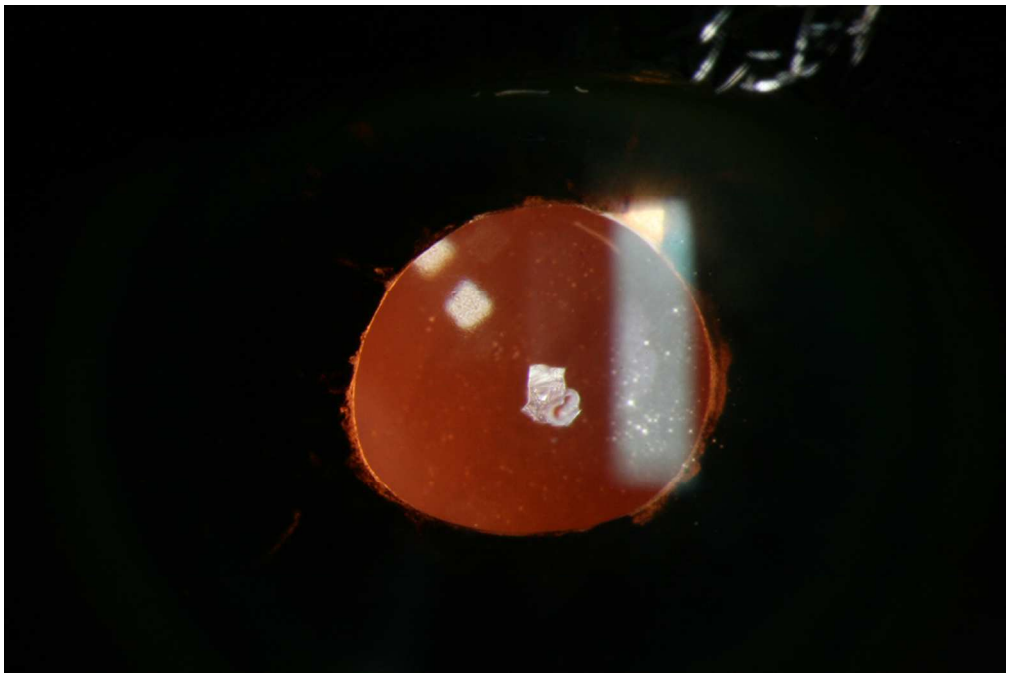
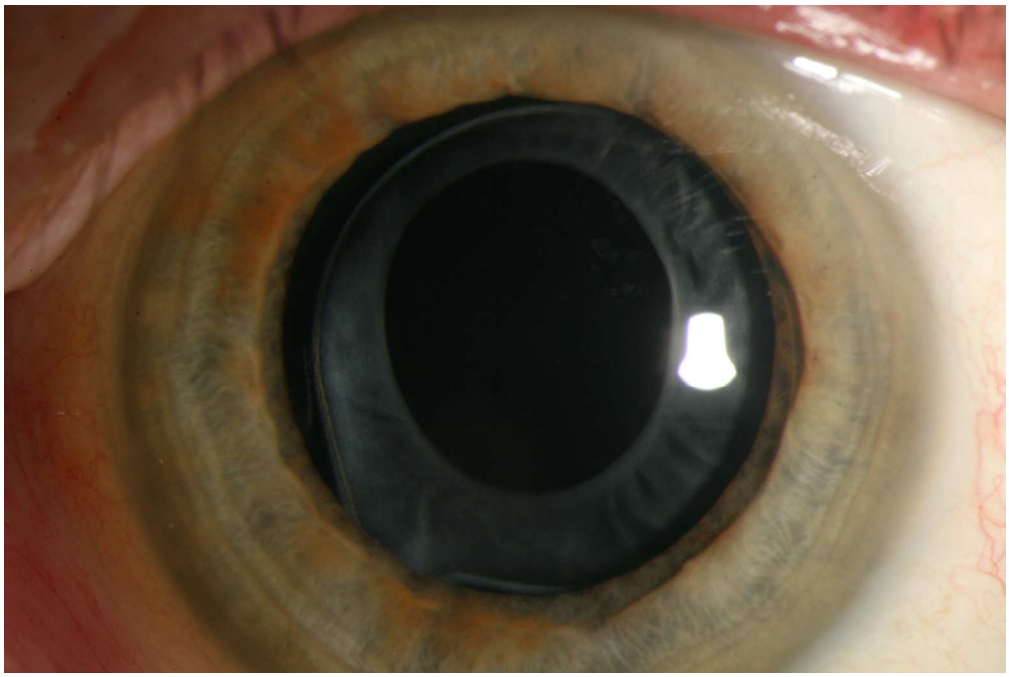


Demonstrates the IOL dislocation of the one patient with bilateral severe zonular insufficiency.

101x67mm (300 x 300 DPI)



Demonstrates the scleral-fixed IOL of the fellow eye in the one patient with bilateral severe zonular insufficiency.
101x67mm (300 x 300 DPI)



Depicts the developed capsular phimosis in a patient belonging to group one, which did not receive additional CTR insertion.
101x67mm (300 x 300 DPI)

Pathognomic retinal changes in a retinitis pigmentosa patient.
101x91mm (300 x 300 DPI)