

Macular Buckle in Myopia

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Introduction

Pathologic myopia is one of the leading cause of secondary visual impairment worldwide and the most frequent cause in Asian subcontinent. Visual impairment in these eyes with pathologic myopia is mainly due to the development of different types of myopic maculopathies, closely associated with the type and grade of the staphyloma.¹ Various authors have classified them into tessellated fundus, lacquer cracks and patchy atrophy, diffuse chorioretinal atrophy, lacquer cracks, patchy chorioretinal atrophy, CNV, macular atrophy and posterior staphyloma.² Macular hole with or without macular retinal detachments, myopic foveal schisis are established associations of the posterior staphyloma.¹ These complications are managed surgically by pars plana vitrectomy (PPV) with internal limiting membrane (ILM) peeling with intraocular tamponade. Scleral shortening procedures, episcleral buckling are some of the additional procedures performed to take care of the posterior staphyloma component pathological myopia with variable surgical success.³

Pathophysiology

The pathogenesis of RD secondary to macular hole and retinoschisis in high myopia with posterior staphyloma are^{4,5}

- 1 Posterior staphyloma leading to disparity in the length of the sclera and retina (mismatch).
- 2 Anteroposterior traction caused by the vitreous.
- 3 Tangential traction due to abnormal rigid ILM, stretched retinal vessels or epiretinal membrane.

Other possible explanations were weak adhesion between the neurosensory retina and retinal pigment epithelium due to the severe myopic chorioretinal atrophy and an incomplete detachment of the posterior hyaloid that will increase the anteroposterior and tangential traction on the retina.

The macular buckle is proposed to support the posterior globe to counteract all the mechanisms involved in such cases. Buckle changes the configuration of the posterior pole from the concave profile of posterior staphyloma to a plano/convex protruding contour thereby relieving anteroposterior traction, tangential traction and sclero retinal mismatch (Fig. 1).

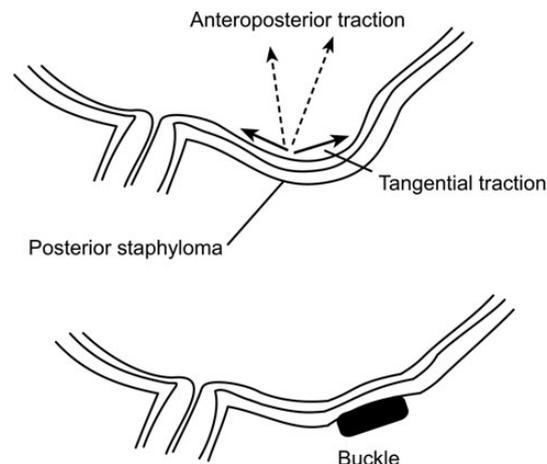


Fig. 1.

History of macular buckle

1957: Macular buckling was described for the first time by Charles L. Schepens, the father of modern retinal surgery, using a radially placed polyethylene tube.⁶

1966: Rosengren B described a silver ring and plomb technique to indent the macula. The ring is attached to the limbus and an arm fixed to the ring has a terminal ball, which was made to indent the macula. Photocoagulation is done after a day or two once the fluid is absorbed. The ring and plomb are removed after 4 weeks.^{7,8}

1974: Theodossiadis used a silastic sponge rod placed between the inferior oblique insertion and the optic nerve. The rod was stretched vertically across the macula by fixing sutures to produce the required indentation. He followed his patients for upto 15 years.⁹

1980: Ando introduced the Ando plombe which is described in detail later.^{10, 11}

Evolution of surgical treatment for myopic macular schisis, macular hole and RD

PPV with ILM peeling has been effective in terms of anatomical and functional success in the treatment of macular schisis and macular holes associated with high myopia.¹²⁻¹⁴ Complications include formation or persistence of macular hole, macular hole retinal detachment (MHRD) and visual loss.¹⁵⁻¹⁶ Success of closure in these myopic macular holes following surgery is less than the idiopathic holes in emmetropia.¹⁷ Ikuno et al showed 25% of macular hole closure following surgery in myopia with macular hole and foveoschisis with posterior staphyloma.¹⁸ Failure

of vitrectomy with ILM peeling in such cases lead to think about the other causative factors responsible for the macular complications in myopic eyes with posterior staphyloma. Cases which had failures following vitrectomy led one to consider additional or supplemental procedures which could negate the mismatch between the staphyloma and retinal contour. This led to the surgical options of macular buckle in myopic eyes with posterior staphyloma

Indications

- Myopic macular retinoschisis with posterior pole staphyloma with recent decrease in visual acuity.
- Posterior pole detachment associated with myopic macular hole with posterior staphyloma.
- Failed and recurrent cases of macular hole with or without RD following vitrectomy with or without tamponade.
- Optic disc pit maculopathy.

Macular buckle types

- Ando plombe
- T-shaped macular buckle
- AJL macular buckle
- L-shaped macular buckle
- Adjustable macular buckle
- Wire-strengthened sponge explant

Ando's plombe (Ondeko Corp)



Ando plombe consists of a T-shaped semirigid silicone rubber rod internally reinforced with titanium wires and an indenting head at one end. The length of the plombe is either 25 or 27 mm from head to tail, selected according to the size of globe. The size of the head is 4–5 mm. Mateo et al. coupled Ando's plombe with an internal 30-G optical fiber to enhance the visualization to place the indenting head correctly under the fovea.¹⁹ Advantages include easy to insert the buckle, shape memory, customization of buckle with its embedded wire and eliminates the need for sutures on the staphylomatous sclera near macular area. Disadvantages include its stiffness, limitations in

adjustment of buckle height, a less accurate positioning. The long-term safety of metal wire which is embedded in the Ando's plombe is not known.

T-shaped macular buckle (France Chirurgie Instrumentation (FCI), Paris, France)



The T-shaped macular buckle²⁰ is created by threading a 4-mm-wide solid silicone band through a 7-mm solid silicone macular wedge (Morin-Devin 'T'-shaped macular wedge) with a biconvex end. Macular wedge is negotiated under the lateral rectus muscle, manoeuvred further to be placed posteriorly under the staphyloma area. The 4-mm solid silicone bands are mobilized under the vertical muscles, behind the obliques to secure on to the nasal aspect, either side of the medial rectus. Advantages of T-shaped macular buckle are that it allows the adjustment for lengthening or shortening the band anteriorly while sliding the macular plate in the coronal plane; it does not require posterior sutures or direct access to the posterior pole, no need for muscle disinsertion which carries the risk of post-operative pain and diplopia. Disadvantage includes possibility of improper alignment under the fovea.

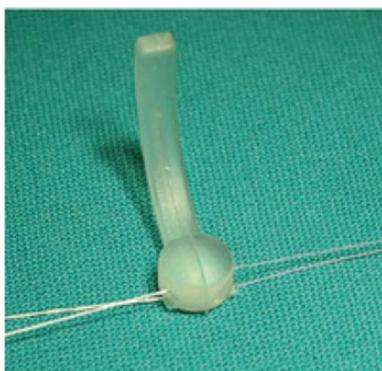
AJL macular buckle



AJL macular buckle is made up of PMMA material covered by silicone in order to increase its biocompatibility. It has an indentation area with a spherical helmet in its superior area to indent the macular area. The arm's length and curvature is customized depending on the patient's specific eye. It can be supplied with an optic fiber light probe for the accurate positioning of the head under the fovea.

L-shaped macular buckle

L-shaped buckle is prepared using a silicone sponge (Labtician 507 oval sponge), 7 mm large and 5 mm thick and 3 cm long. A malleable titanium stent (Mod MCP6TP, Tekka, Pesaro, Italy) 15 mm long, 2 mm wide and 0.5 mm was inserted and hidden into the tunnel. The sponge could then be bent to obtain an L-shaped buckle by creating a 90° angle to fashion the curvature accordingly. Advantages are that it can be easily prepared in the operation theatre and the technique can be performed without the need of specially designed buckles, which are not available easily in all countries. Disadvantages include the unknown long-term safety of the titanium inside the orbit.²¹

Adjustable macular buckle (AMB)

The AMB is made up of silicone rubber, consisting of a handle or stalk designed for radial positioning and a terminal plate intended to indent the macular area. Two lateral winglets at the terminal plate helps to pass suture through it. The two mersilene sutures are brought on either side of the medial rectus, fixed to the sclera anterior to the equator. This procedure requires lateral rectus disinsertion. Postoperatively the buckle effect can be adjusted using these sutures under local anaesthesia.²²

Wire-strengthened sponge explant

It consists of a 7 mm silicone sponge strengthened with a 0.5 mm orthodontic steel wire that is originally used for dental braces. First, the wire is bent into U shape at the middle with 2 mm separation between the 2 arms. Then, the wire is inserted inside the sponge and fed through its whole length. The distal end is bent according to the eyes which help to indent the macula.²³

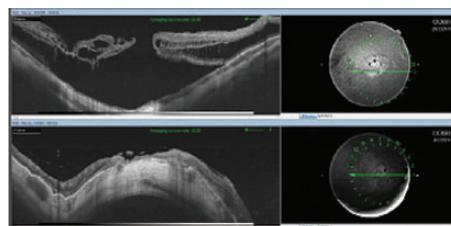
Limitations of macular buckle

- Possible damage to nerves and vessels in the posterior pole.
- Precised alignment of the buckle under the fovea is of concern.
- Thin sclera increases the risk of perforation and erosion is more.

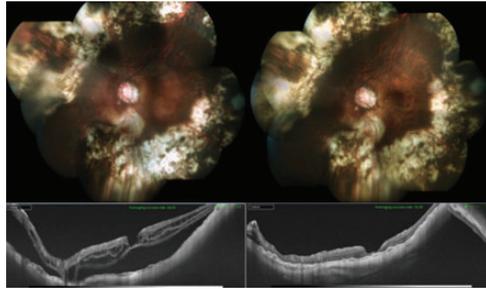
Precise alignment of the buckle under the fovea can be achieved by either

- External posterior landmarks.
- Trans illumination.
- Endo illumination.
- Using illuminated optical fiber along with the macular buckle.

We had an initial experience of three cases operated using the T-shaped macular wedge implants. Indications were recent central visual impairment due to progressive schisis, macular hole with macular detachment and persistent chorioretinal mismatch at the staphyloma in an oil filled eye. One patient operated for the staphyloma associated macular hole with localized detachment, had the macular buckle along with vitrectomy, ILM peeling and tamponade. We noted the anatomical closure of the macular hole and the foveal attachment as early as fourth post-operative period.



Another case had a persistent lamellar hole with a retinochoroidal mismatch post vitrectomy. This case was operated for the macular buckle alone in the oil filled eye. Patient had a progressive visual improvement with a gradual absorption of the subretinal fluid and the retinal apposition over a period of 5 months. Our initial short experience has been quite promising in terms of achieving anatomical restoration of the retina to match the contour of the ocular coats.



Complications

The intraoperative complications include inadvertent globe perforation, injury to vortex veins, ciliary vessels and nerves, malposition of the buckle, optic nerve abutting, subretinal hemorrhage, choroidal detachment and threatening suprachoroidal hemorrhage intraoperatively. Late complications include buckle displacement, exposure, infection, choroidal neovascular membrane progression, restriction of eye movements, diplopia, focal retinal pigment epithelium atrophy due to circulatory disturbances.²⁴

Conclusion

Macular buckle can be a good option for myopic posterior staphyloma-related macular conditions such as progressive macular schisis, macular hole and posterior pole RD. The technique requires appropriate case selection and has a good anatomical and functional success as reported in many of the studies. Detection and correction of the retinoscleral mismatch would help improve functional outcomes in these eyes with high myopia-related maculopathy.

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