

# Sutureless contact lens-type amniotic membrane for persistent epithelial defects after infectious keratitis

Jung Hye Shin<sup>1</sup>, Young-Ho Jung<sup>1,2,3</sup>, Hyun Beom Song<sup>4</sup>, Mee Kum Kim<sup>1,2,3</sup>, Chang Ho Yoon<sup>1,2,3</sup>

<sup>1</sup>Department of Ophthalmology, Seoul National University Hospital, 101 Daehak-ro, Jongno-gu, Seoul 03080, Republic of Korea

<sup>2</sup>Department of Ophthalmology, Seoul National University College of Medicine, 103 Daehak-ro, Jongno-gu, Seoul 03080, Republic of Korea

<sup>3</sup>Laboratory of Ocular Regenerative Medicine and Immunology, Biomedical Research Institute, Seoul National University Hospital, 101 Daehak-ro, Jongno-gu, Seoul 03080, Republic of Korea

<sup>4</sup>Department of Medical Science, Seoul National University College of Medicine, 103 Daehak-ro, Jongno-gu, Seoul 03080, Republic of Korea

**Correspondence to:** Chang Ho Yoon. Department of Ophthalmology, Seoul National University College of Medicine, 103 Daehak-ro, Jongno-gu, Seoul 03080, Republic of Korea. ifree7@gmail.com

Received: 2021-11-14 Accepted: 2021-12-09

**DOI:10.18240/ijo.2022.08.26**

**Citation:** Shin JH, Jung YH, Song HB, Kim MK, Yoon CH. Sutureless contact lens-type amniotic membrane for persistent epithelial defects after infectious keratitis. *Int J Ophthalmol* 2022;15(8):1404-1406

**Dear Editor,**

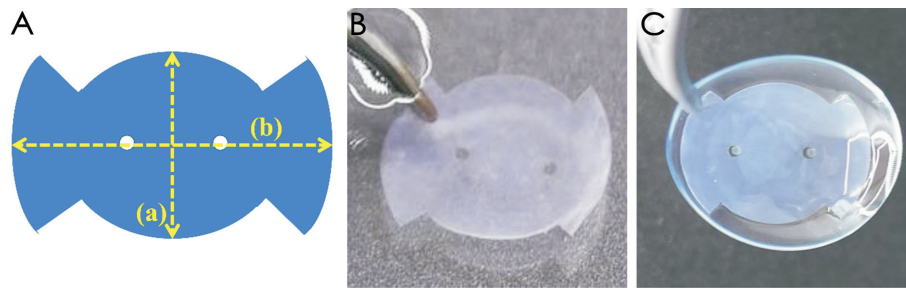
We are writing to present two case reports of persistent epithelial defect after infectious keratitis successfully treated with sutureless contact lens-type amniotic membrane (AM) transplantation. Infectious keratitis is one of the leading causes of corneal blindness. Infection disrupts the normal corneal healing process and induces inflammation, limbal cell dysfunction, and corneal surface irregularity, which can lead to corneal opacities or persistent epithelial defects (PEDs)<sup>[1]</sup>. Untreated PED can cause corneal thinning, resulting in corneal perforation.

The AM has been used successfully to treat PED and ulcers from different pathologies<sup>[2]</sup>. AM transplantation (AMT) has been shown to effectively suppress inflammation and promote epithelial healing in intractable infectious keratitis. Therefore,

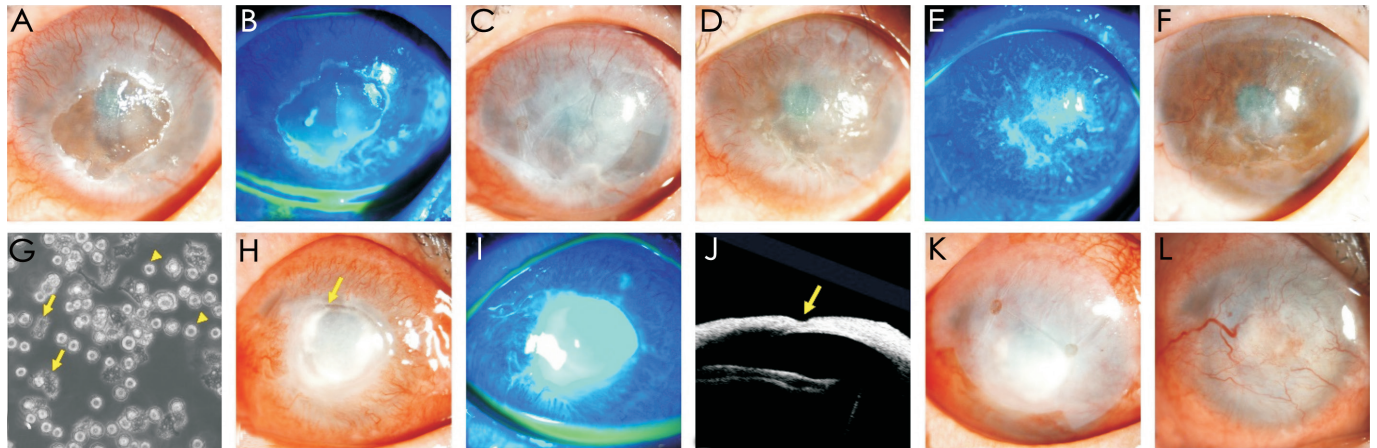
performing AMT can prevent perforation and reduce the possibility of further surgical procedures, such as tectonic keratoplasty. However, AM is generally secured with surgical suturing. The disadvantages of sutures include prolonged surgical time, postoperative discomfort, and the risk of inflammation or infection<sup>[3]</sup>. Recently, sutureless contact lens-type AM has been introduced to overcome these drawbacks. Here, we report two infectious keratitis patients who had PED treated with the sutureless contact lens type of AMT. This study was conducted following the tenets set forth in the Declaration of Helsinki and was approved by the Institutional Review Board of Seoul National University Hospital (No. 2012-138-118).

**Case Report** In this case report, we used a newly developed 2MD10 (MS Bio Inc., Seongnam, Republic of Korea) consisting of two or three layers of AM. It is physically molded and non-chemically crosslinked to obtain a similar base curvature of a bandage soft contact lens and requires cryopreservation (Figure 1). Two patients with PED due to bacterial and neurotrophic keratopathy or *Acanthamoeba* keratitis (AK) were treated with 2MD10 in 2020. Both patients achieved complete re-epithelialization without additional complications due to AMT.

**Case 1** A 70-year-old male was referred to our clinic with an intractable corneal ulcer that lasted more than 1mo. The patient reported left ocular pain with decreased vision that had developed 3mo previously. On initial examination, his visual acuity was a finger count in his left eye. The left eye showed a 6 (horizontal) ×3.5 (vertical) mm<sup>2</sup> corneal epithelial defect with inferior stromal infiltration, 360-degree corneal neovascularization, and mild anterior chamber reaction. PED secondary to infectious keratitis with neurotrophic keratopathy was suspected. Cultures of corneal scrapings were performed. The patient was subsequently started on empirical antibiotic therapy, including topical fortified vancomycin (2.5%) and ceftazidime (5%) every 2h. Corneal scrape cultures were positive for *Bacillus* species. Five days after treatment, the left ocular pain subsided, and corneal stromal infiltration and anterior chamber reaction decreased. However, corneal epithelial defects remained unchanged (Figure 2A and 2B). Topical medications were tapered four times a day, and



**Figure 1 Newly developed 2MD10** A, B: Sutureless contact lens type of amniotic membrane that has a base curvature similar to that of a normal cornea with a length of 10.7 mm (a) on the vertical axis and 14.2 mm (b) on the horizontal axis; C: Amniotic membrane placed on bandage soft lens. Figures were provided by MS bio Inc (Seongnam, Republic of Korea) with permission.



**Figure 2 Cases 1 (A-F) and 2 (G-L)** Represent photographs of case 1 before (A and B) and after (C) amniotic membrane transplantation. On day 7 after insertion, the amniotic membrane was dissolved, and complete epithelialization was observed (D-F). Corneal scraping culture showing *Acanthamoeba* trophozoites (arrow) and cysts (arrowhead) of case 2 (G). Photographs of case 2 with persistent epithelial defect after corneal thinning (arrow; H, I). Anterior segment optical coherence image of the corneal thinning area (arrow; J). After sutureless contact lens-type amniotic membrane transplantation (K). On day 8 after insertion, the amniotic membrane dissolved, and corneal epithelialization was progressed and complete epithelialized 28d after amniotic membrane transplantation (L).

sutureless contact lens-type AM (2MD10) was applied (Figure 2C). The AM was well positioned under the bandaged soft contact lens during the follow-up. Seven days later, the AM dissolved, and the corneal epithelial defect completely healed without the aggravation of infection (Figure 2D-2F).

**Case 2** A 69-year-old female was referred to our clinic for intractable infectious keratitis. The patient reported right ocular pain that developed after rubbing her eyes while gardening 15d prior. On initial presentation, the visual acuity was hand motion in the right eye. The right eye showed severe diffuse conjunctival injection, total corneal epithelial defect with paracentral ring infiltrates, severe corneal stromal edema, and a 3 mm hypopyon in the anterior chamber. Cultures from corneal scrapings showed *Acanthamoeba* trophozoites and cysts (Figure 2G). The polymerase chain reaction (PCR) results for *Acanthamoeba* were also positive. The patient was prescribed topical polyhexamethylene biguanide (PHMB; 0.02%) hourly and fortified voriconazole (1%) every 2h. After 50d, corneal stromal infiltration decreased and the hypopyon vanished. However, PED with progressive superotemporal

stromal thinning was observed despite the use of a pressure patch, soft contact lenses, application of a therapeutic bandage, and reduction of topical medication to six times per day (Figure 2H-2J). To prevent perforation, sutureless AMT using contact lens-type AM (2MD10) was performed (Figure 2K). The AM was well positioned under the bandaged soft contact lens, and there was no aggravation of the infection noted during the follow-up. Eight days later, AM dissolved, and corneal epithelialization progressed. After 4wk of AMT, corneal epithelialization was completed (Figure 2L).

#### DISCUSSION

AM has been used as a basement membrane substitute in patients with PEDs both with and without corneal ulceration<sup>[2]</sup>. It provides epidermal growth factor, bFGF, keratinocyte growth factor, TGF- $\alpha$  and TGF- $\beta$ , hepatocyte growth factor, and nerve growth factor to the ocular surface, and promotes epithelialization and suppresses corneal inflammation and neovascularization<sup>[4]</sup>.

Two types of AMs that do not require sutures have been previously introduced. One type is the AM surrounded by as

conformer ring, such as ProKera (Biotissue, Miami, FL, USA). The other type is the disc type AM, such as AmbioDisk (IOP Ophthalmics Inc., Costa Mesa, CA, USA) and BioDOPTIX (Labtician Ophthalmics, Oakville, Ontario, Canada). AM surrounded by as conformer ring consists of a concave polycarbonate dual-ring fastened with a sheet of cryopreserved AM that conforms to the corneal and limbal surfaces like a contact lens. The major drawbacks are the cost and discomfort in the form of foreign body sensations caused by the contact of a rigid polycarbonate ring with the eye<sup>[5]</sup>. Disc type AM is a freeze-dried AM that does not require cryopreservation<sup>[6]</sup>. It can be hydrated with a sterile solution and easily placed in the office. However, it is flat and is not always in place under a bandage soft contact lens<sup>[7]</sup>.

The 2MD10 has a trapezoidal shape and has a curvature similar to that of a normal cornea and is less likely to dislocate. Additionally, the two holes in AMT act as drainage holes to prevent tear and blood build-up between the cornea and AMT, which would cause dislocation of AMT. Indeed, the 2MD10 AM remained in place until it melted away in both patients in this study. Although cryopreservation is required, it is ready to use after resting at room temperature for approximately 30min. It is a cost-effective (approximately \$200), convenient, and effective office-based treatment that can be widely used to treat patients with PED.

We showed complete epithelialization in patients with PED due to infectious keratitis caused by sutureless AMT. Patient 1 (case 1) had bacterial keratitis combined with neurotrophic keratopathy, and patient 2 (case 2) had an *Acanthamoeba* infection. Since AMT is also effective in neurotrophic keratopathy, it seems that corneal epithelialization in case 1 was relatively faster than in case 2<sup>[8]</sup>. AK led to severe corneal inflammation and often presented a progressive chronic course with a long period of remission<sup>[9]</sup>. In addition, topical PHMB 0.02%, can induce cellular toxicity<sup>[10]</sup>. However, we could not discontinue PHMB because of the potential risk of AK reactivation. For these reasons, it seems that corneal epithelialization was slower in case 2 than in case 1. In summary, in both cases, corneal epithelialization was promoted after sutureless AMT, and side effects, such as exacerbation of infection, were not observed.

To the best of our knowledge, this is the first case report on

the use of a sutureless contact lens type of AM that retains its own curvature. The sutureless contact lens type of AM can be a convenient and effective office-based treatment for PED with infectious keratitis. In the future, an interventional randomized controlled trial is needed to determine whether the contact lens-type AM have significant effect on epithelial healing.

#### ACKNOWLEDGEMENTS

**Conflicts of Interest:** Shin JH, None; Jung YH, None; Song HB, None; Kim MK, None; Yoon CH, None.

#### REFERENCES

- 1 Eghrari AO, Riazuddin SA, Gottsch JD. Overview of the cornea. *Prog Mol Biol Transl Sci* 2015;134:7-23.
- 2 Dhillon HK, Bahadur H, Raj A. A comparative study of tarsorrhaphy and amniotic membrane transplantation in the healing of persistent corneal epithelial defects. *Indian J Ophthalmol* 2020;68(1):29-33.
- 3 Kassem RR, El-Mofty RMAM. Amniotic membrane transplantation in strabismus surgery. *Curr Eye Res* 2019;44(5):451-464.
- 4 Koizumi N, Inatomi T, Sotozono C, Fullwood NJ, Quantock AJ, Kinoshita S. Growth factor mRNA and protein in preserved human amniotic membrane. *Curr Eye Res* 2000;20(3):173-177.
- 5 Ijiri S, Kobayashi A, Sugiyama K, Tseng SCG. Evaluation of visual acuity and color vision in normal human eyes with a sutureless temporary amniotic membrane patch. *Am J Ophthalmol* 2007;144(6):938-942.e1.
- 6 Mimouni M, Trinh T, Sorkin N, Cohen E, Santaella G, Rootman DS, Slomovic AR, Chan CC. Sutureless dehydrated amniotic membrane for persistent epithelial defects. *Eur J Ophthalmol* 2021;11206721211011354.
- 7 Suri K, Kosker M, Raber IM, Hammersmith KM, Nagra PK, Ayres BD, Halfpenny CP, Rapuano CJ. Sutureless amniotic membrane ProKera for ocular surface disorders: short-term results. *Eye Contact Lens* 2013;39(5):341-347.
- 8 Dua HS, Said DG, Messmer EM, *et al.* Neurotrophic keratopathy. *Prog Retin Eye Res* 2018;66:107-131.
- 9 de Lacerda AG, Lira M. *Acanthamoeba* keratitis: a review of biology, pathophysiology and epidemiology. *Ophthalmic Physiol Opt* 2021;41(1):116-135.
- 10 Carrijo-Carvalho LC, Sant'ana VP, Foronda AS, de Freitas D, de Souza Carvalho FR. Therapeutic agents and biocides for ocular infections by free-living amoebae of *Acanthamoeba* genus. *Surv Ophthalmol* 2017;62(2):203-218.