Salzmann's Nodular Degeneration in a Pilot Applicant

Joelle L. Thorgrimson; David D. Hessert

BACKGROUND: This report presents a unique case that illustrates the importance of ocular history and photo documentation of ophthalmologic pathology when waivers are granted.

CASE REPORT: A United States Navy pilot applicant was granted a waiver for a corneal scar of unknown etiology. He chose not to pursue Navy pilot training and reenrolled as a United States Marine Corps pilot applicant. He did not mention the previous waiver or subsequent civilian surgical corneal treatment for Salzmann's nodular degeneration and was diagnosed with gelatinous drop-like corneal dystrophy. Eventually all information was disclosed, and the diagnosis was changed to postoperative changes from previous Salzmann's nodule removal, which is disqualifying for Marine Corps pilot applicants.

DISCUSSION: Corneal dystrophy and degeneration are disqualifying conditions for military pilot applicants. A detailed history, to include surgical history, must be disclosed by the applicant. Photo documentation and appropriate topographic studies should also be completed and reviewed when waivers for corneal pathology are considered.

KEYWORDS: corneal degeneration, aeromedical standards, aerospace ophthalmology.

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Salzmann's nodular degeneration (SND) is an uncommon, typically unilateral, noninflammatory condition characterized by smooth, bluish-gray elevated nodular stroma opacities with bases potentially surrounded by epithelial iron deposits; they generally appear in a circular array located in the midperiphery in the central edge of the pannus.[4,5] The authors of the *Clinical Eye Atlas*[4] state that these lesions may increase in size, elevation, and number with no tendency to regress. Most patients' visual acuity is retained unless growth invades visual axis or nodules induce astigmatism; however, there is an association with recurrent corneal erosions, which can cause severe pain or irritation. Epidemiologically, SND appears in a 2:3 ratio of females:males and across all races with varied age presentations, albeit with increasing incidence in the elderly. The etiology of this condition is unclear, but it seems to develop following a history of inflammation (specifically phlyctenular keratoconjunctivitis), as well as epithelial basement dystrophy, keratoconus, postop corneal surgery, and wearing hard contact lenses.[4,5] Removal is only required if the visual axis is disturbed, which is uncommon, but SND can recur.

Gelatinous drop-like corneal dystrophy, also known as subepithelial amyloidosis or primary familial amyloidosis, is a rare autosomal recessive trait on locus 1p32 of the tumor-associated calcium signal transducer 2 gene.[8] Subepithelial and stromal amyloid deposits, which are seen under light microscopy, disrupt the epithelial tight junctions leading to abnormally high epithelial permeability.[1] The American Academy of Ophthalmology[8] describes subepithelial lesions as similar to band keratopathy, or groups of multiple small nodules that appear in the first and second years of life. Eventually there is a decrease in vision, in addition to increased photophobia, irritation, tearing, and the progression of protruding subepithelial lesions. Superficial vascularization, stromal opacification, or larger nodular kumquat-like lesions may develop. Treatment includes superficial keratectomy, lamellar keratoplasty, or penetrating keratoplasty, but there will be recurrences within a few years. Soft contact lenses are effective in managing the abnormal epithelial permeability to decrease recurrences.

We present a case of medical disqualification of a pilot applicant who previously had an approved waiver for a corneal scar of unknown etiology. Following the review of a more thorough

From the Naval Aerospace Medical Institute, Pensacola, FL.

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Address correspondence to: Joelle Thorgrimson, Naval Aerospace Medical Institute, 340 Hulse Road, Pensacola, FL 32508; jthorgrimson@nosm.ca.

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history, appropriate corneal imaging studies, and further information disclosure from the applicant, it was determined that SND was the original cause of his corneal pathology.

CASE REPORT

A 32-yr-old male civilian private pilot is seen for an initial United States Marine Corps (USMC) pilot medical exam. He denies any previous ocular history, medication use, substance use, or family history of ocular diseases. He also denies photophobia, irritation, tearing, previous infections, trauma, ocular surgery, or changes in visual acuity. He has a normal screening exam with visual acuity 20/20 bilaterally (OU); however, the file is reviewed by an aerospace medicine ophthalmologist who notes that the right (OD) OCULUS Pentacam®, which is a slit illumination system and a Scheimpflug tomography camera,[7] reveals a prominent anterior flattened nasal area measuring 5 × 9 mm (blue area in **Fig. 1A**). Upon further slit lamp examination of this area, there appears to be an obvious corneal dystrophy, with iron deposits extending into the visual axis and without corneal blood vessels (red arrow in **Fig. 1B**).

Upon discussion of this disqualifying condition, the patient notes that he previously had an approved waiver when he applied to the United States Navy (USN) as a pilot 2 yr prior. Indeed, he does have an approved waiver with written documentation of an OD nasal corneal scar extending from 1–5 o'clock 2.5 mm from the limbus that does not meet the pupil edge unless dilated. Additionally, there is no decreased visual acuity with brightness acuity tester. A Zeiss ATLAS corneal topography was completed in April 2020 (**Fig. 2**). During a Zeiss ATLAS examination, the axial curvature is measured in relation to the visual axis; the tangential curvature is measured in relation to a perpendicular line at each spot on the surface, which tends to exaggerate changes in the peripheral cornea. Due to the different imaging modalities in the exams performed by the USN in 2020 and the USMC in 2022, the comparison has limitations; however, the OD nasal changes were noted in blue during the initial exam in 2020. The patient ultimately decided to switch his application to the USMC and states that he has not been seen for vision care until this USMC flight physical.

He later submits documentation disclosing that after the corneal scar was found during his initial USN eye exam, he sought a second ophthalmologic opinion and was diagnosed with SND, which was treated with superficial keratectomy without complications.

DISCUSSION

As per the USN and USMC waiver guide,[6] corneal dystrophies and degenerations are generally bilateral and negatively impact vision due to opacification; they also increase the risk of painful recurrent corneal erosions. They adversely affect flight performance and safety and thus are considered disqualifying for applicants. The most common corneal dystrophy is epithelial basement membrane dystrophy, or map dot fingerprint dystrophy, which gets its name from the characteristic pattern of redundant basement membrane under the epithelium. Recurrent corneal erosion may occur, but this is highly variable among patients. It can be treated with hypertonic sodium solution or ointment, anterior stromal puncture, diamond burr, or phototherapeutic keratectomy. Each treatment is variably beneficial, and the last two require significant healing time. This is the only corneal dystrophy for which a USN waiver would be considered in applicants. As is the case for this applicant, corneal degenerations tend to have less impact on ocular function and vision, as they tend to involve the peripheral cornea and are typically triggered by inflammation and environmental conditions; however, the prevalence increases with age. Waivers will typically not be considered for applicants with a history of corneal surgery treatment, long-standing secondary recurrent corneal erosions, or a diagnosis of a progressive type of dystrophy or degeneration. Waivers will be considered for designated aviators who meet vision standards with manageable symptoms.

The Canadian Medical Standards for Canadian Armed Forces Aircrew states that corneal dystrophy of any type is disqualifying,[2] but does not comment on corneal degeneration. Similarly, the Federal Aviation Administration states that corneal dystrophy requires a Federal Aviation Administration decision, but they do not comment on corneal degeneration.[3]

Retrospectively, during the initial USN eye exam, the documented "corneal scar" with associated corneal topography was actually SND, as diagnosed and treated in the subsequent second opinion assessment. The initial USMC eye exam suggested that this was a corneal dystrophy. However, with further information, it was determined that these corneal opacities were postoperative changes resulting from removal of a Salzmann's nodule. This applicant does not meet the minimum USMC medical standards for a pilot and likely would have had his corneal scar waiver revoked during a more thorough review if he decided to pursue USN flight training.

This case outlines the importance of photo documentation of pathology when waivers are granted. It is possible that the initial waiver granted by the USN would not have been given if the corneal topography was reviewed with imaging of the "corneal scar," especially in light of disclosed relevant ocular history of postoperative changes from SND. It also outlines the importance of reviewing applicant files to ensure that waivers were not previously granted, as aircrew applicants may not think this information is important to the aerospace optometrist or ophthalmologist.

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Authors and Affiliations: Joelle L. Thorgrimson, M.D., M.Sc., Naval Aerospace Medical Institute, Pensacola, FL, and David D. Hessert, M.D., B.S., Naval Aerospace Medical Institute, Pensacola, FL.

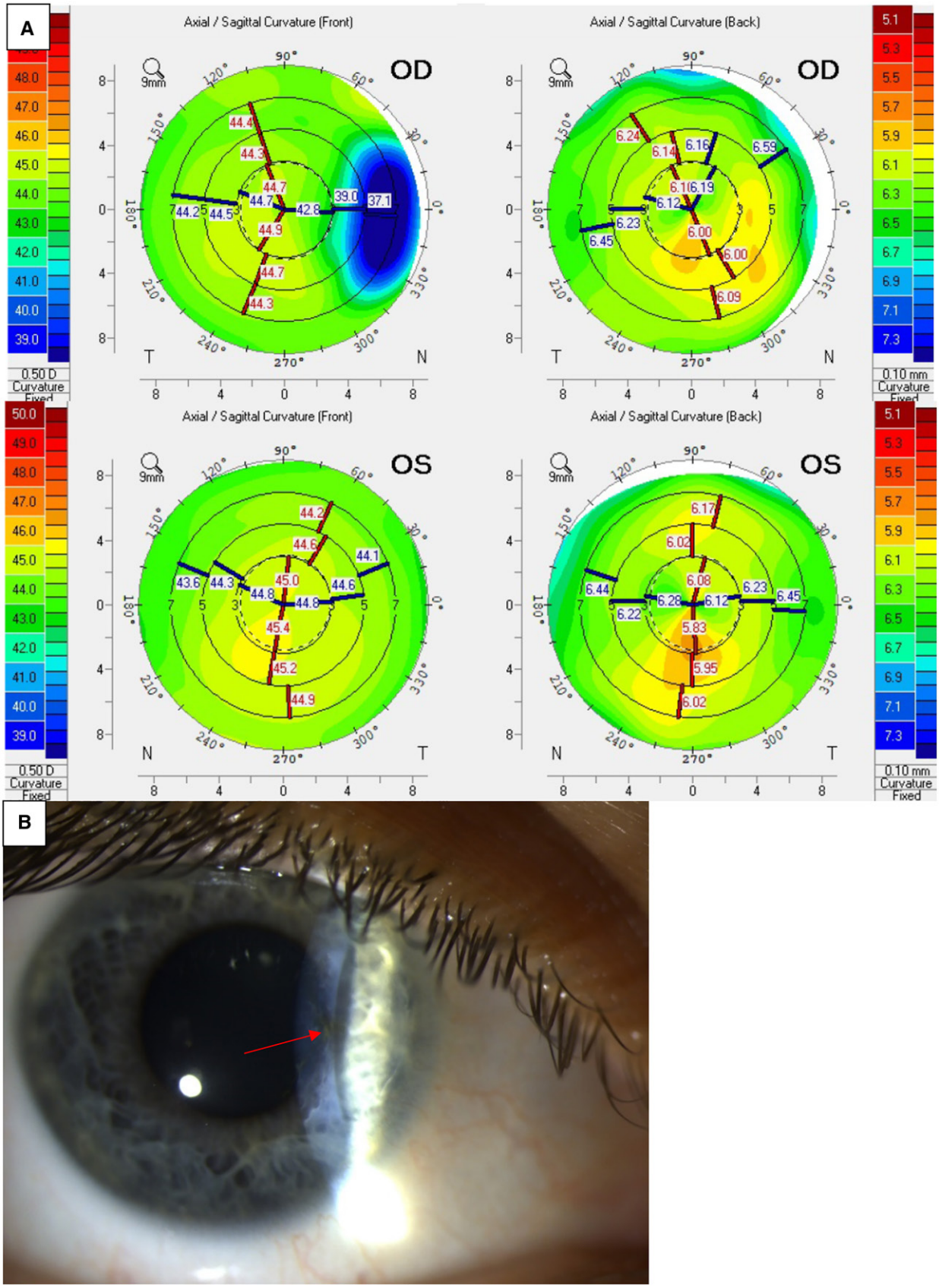

Fig. 1. Results from August 2022. a) OU OCULUS Pentacam® with OD changes including prominent anterior flattened nasal area in blue and minor posterior nasal changes in orange. The left eye is normal. b) OD optical microscopy image of presumed nasal corneal dystrophy with iron deposits, shown by red arrow, extending into the visual axis.

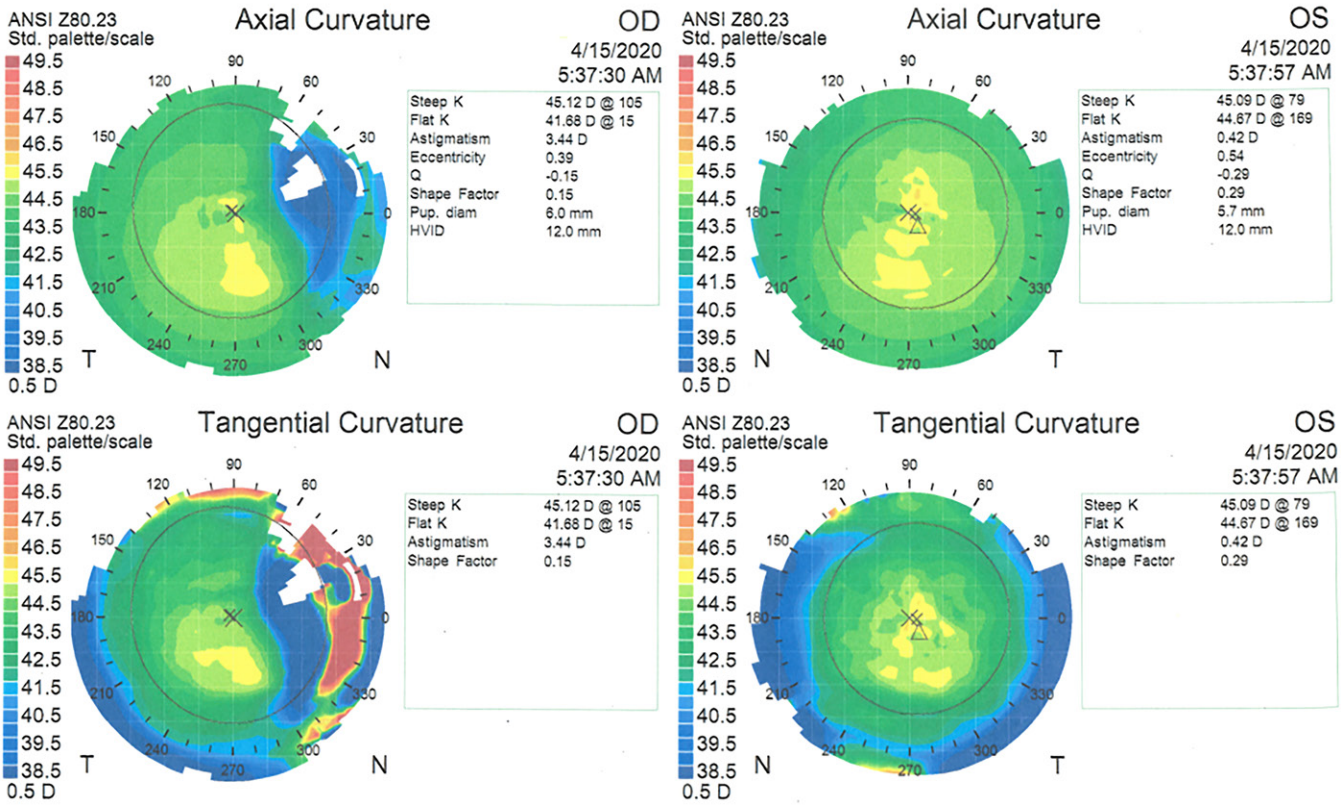

Fig. 2. OU Zeiss ATLAS imaging April 2020 showing OD nasal cornea changes axially in blue and tangentially in red.

REFERENCES

1. Akhtar S, Bron AJ, Qin X, Creer RC, Guggenheim JA, Meek KM. Gelatinous drop-like corneal dystrophy in a child with developmental delay: clinicopathological features and exclusion of the M1S1 gene. Eye. 2005; 19(2):198–204.
2. Department of National Defence. Annex A – Medical Standards: Potential causes for medical disqualification of aircrew. In: AMA Directive 100-01: Medical standards for CAF aircrew. Aerospace Medical Authority; 2021: Section 4.2.c. Accessed January 9, 2023. https://www.aerospacemedicine.ca/AMA100-01.pdf.
3. Federal Aviation Administration. Decision considerations – aerospace medical dispositions. In: Guide for aviation medical examiners. Federal Aviation Administration; 2022: Item 32. Ophthalmoscopic. Accessed January 9, 2023. https://www.faa.gov/about/office_org/headquarters_offices/avs/.
4. Gold DH, Lewis RA, eds. Degenerations and dystrophies of the cornea. In: Clinical Eye Atlas. 2nd ed. Oxford University Press; 2011. p. 236–257.
5. Kanski JJ. Corneal degenerations. In: Clinical Ophthalmology: A Systematic Approach. 5th ed. Butterworth-Heinemann; 2003.
6. Naval Aerospace Medical Institute. 12.21 Corneal dystrophies and degenerations. In: U.S. Navy aeromedical reference and waiver guide. Naval Aerospace Medical Institute; 2022. Accessed August 14, 2022. https://www.med.navy.mil/Navy-Medicine-Operational-Training-Command/.
7. Oculus, Inc. The measurement principle. OCULUS USA. (n.d.). Accessed January 9, 2023. https://www.pentacam.com/us/technology/.
8. Reidy JJ, American Academy of Ophthalmology, Bouchard CS, Florakis GJ, Goins KM. Salzmann nodular degeneration. In: External Disease and Cornea 2010-2011. American Academy of Ophthalmology; 2011.