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Comment on: "Astigmatism in Duane Retraction Syndrome"

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Abstract

A recent article provides valuable insights into different aspects of astigmatism in the Duane Retraction Syndrome (DRS) subtypes. The differing underlying pathophysiology in type II DRS and its higher prevalence in the mentioned study, along with possible age variations among different DRS subtypes, complicates the interpretation of the results. The mechanical forces generated by the co-contraction of the horizontal rectus muscles in patients with Duane Retraction Syndrome (DRS) may contribute to changes in the shape of the cornea, potentially leading to astigmatism. However, the exact mechanism needs further scrutiny, considering all possible contributing factors.

Keywords Duane Retraction syndrome, Astigmatism, Co-contraction

Dear Editor,

I read with great interest the recent article by Khorrami-Nejad et al. titled *"Astigmatism in Duane Retraction Syndrome"* published in *BMC Ophthalmology* [https://doi.org/10.1186/s12886-025-03855-w] [1]. The study provides valuable insights into the association between different types of astigmatism and Duane Retraction Syndrome (DRS). Previous research has revealed inconsistent findings regarding the refractive error components in DRS patients [2–5], highlighting the need for further investigation in this area. The authors reported a series of 280 unilateral and 32 bilateral DRS cases with an average cylindrical power of -1.12 Diopter in the DRS eyes of the unilateral group which was significantly higher than the non-DRS eyes [1]. With-the-rule (WTR) astigmatism was the most common pattern in both groups (56.8% in unilateral and 60% in bilateral cases) and against-the-rule (ATR) astigmatism was the least common pattern in DRS cases (19.6% in unilateral and 17.9% in bilateral cases). Subgroup analysis of the refractive error component in various types of unilateral DRS cases revealed a trend toward myopia as the classification progressed from type I DRS to type II and subsequently to type III. The mean cylindrical power did not differ among different subtypes, but J0 vector values became increasingly negative as the classification progressed from type I to type III shifting from a predominance of WTR astigmatism in type I DRS-affected eyes toward a more pronounced ATR astigmatism in type III DRS affected eyes [1].

I would like to highlight some key points discussing the main outcomes and conclusions of the above-mentioned study. Huber classification is a system used to categorize DRS cases based on the pattern of eye movement abnormalities and electromyographic (EMG) findings that were previously considered to correspond to each other [6–11]. However, more recent investigations showed a discrepancy between the clinical and EMG subtypes of Huber classification and other variations in EMG patterns highlighting more complex neural and muscular behavior in Duane Retraction Syndrome [6, 10]. Type I DRS cases show limitation of abduction due to 6th cranial nerve agenesis or hypoplasia, combined with

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aberrant innervation of the lateral rectus (LR) muscle by the 3rd cranial nerve [10, 12, 13]. The abducens nerve splits to innervate both the medial rectus (MR) and LR muscles, with most of the nerve going to the MR, resulting in intact adduction. In type III DRS, the abducens nerve splits equally to innervate both MR and LR muscle and therefore the eye shows both limitations in abduction and adduction [12–14]. Type II DRS holds the least common subtype of DRS in most of the previously published epidemiologic studies [8–11, 15], and different underlying pathophysiology was proposed in these cases due to preserved ocular abduction. Magnetic Resonance Imaging (MRI)-based studies have confirmed the dual innervation of lateral rectus muscle in type II DRS patients [13, 14]. Partial innervation by the 6th cranial nerve results in full abduction, along with aberrant innervation of the LR by the branches of the 3rd cranial nerve during attempted adduction. Co-contraction is a prominent characteristic seen in individuals with DRS, which refers to the simultaneous activation of MR and LR muscles during eye movements [11]. This results in globe retraction, narrowing of the palpebral fissure, and overshoot when adducting the eye. Khorrami-Nejad and colleagues categorized type I cases as having highly asymmetric co-contraction, type II DRS cases as having less asymmetric co-contraction, and type III DRS patients as having more balanced forces that result in symmetric co-contraction [1]. In my opinion, given the unequal division of the abducens nerve in type I cases compared to the equal division in type III cases, it is reasonable to conclude that the degree of co-contraction is more pronounced in type III DRS individuals than in type I. However, the dual innervation of the lateral rectus (LR) muscle in type II DRS cases complicates comparisons of co-contraction levels between type II and the other types [13, 14]. In the referenced study, type II DRS cases are the second most common subtype, accounting for 81 individuals, which is more than twice the number compared to type III DRS. This finding is also inconsistent with the previous literature on DRS [8–11].

Khorrami-Nejad and colleagues noticed a myopic shift in both the spherical power and the spherical equivalent power as they progressed from type I to type II and then to type III [1]. These changes were observed in both DRS and non-DRS eyes. Therefore, it is important to consider the average age of individuals within each category. This will help determine if the differences among DRS subtypes are significant or merely the result of age differences in these categories [8].

The authors interestingly reported a more negative J0 in DRS type III cases showing a tendency toward ATR astigmatism in this subtype of Duane syndrome. They attributed this finding to the more severe and symmetric co-contraction in these patients [1]. Since the MR and LR muscles are horizontally oriented, their co-contraction primarily exerts horizontal forces on the globe and compresses the cornea horizontally. The horizontal meridian therefore becomes steeper than the vertical meridian leading to ATR astigmatism. However, the potential effect of the resultant globe retraction and palpebral fissure narrowing may lead to paradoxical results. Similar to conditions like upper eyelid ptosis and blepharophimosis [16, 17], the mechanical pressure on the cornea from palpebral fissure narrowing might paradoxically steepen the vertical meridian, resulting in with-the-rule and oblique astigmatism. The influence of the mentioned mechanical forces on corneal curvature may be better understood by evaluating these parameters using keratometry and corneal topographic data [5].

A few minor points need to be addressed as well. While the authors interestingly explained the significant differences in J0 among different DRS subtypes, the variations observed in the non-DRS eyes (shown in Table 2 in the article https://doi.org/10.1186/s12886-025-03855-w) remained unexplained. The refractive error components of bilateral DRS cases presented in Table 3 (in the article https://doi.org/10.1186/s12886-025-03855-w) showed that the average cylindrical power was 3.26 diopters in the right eye and 1.20 diopters in the left eye. However, given the minimum cylindrical power reported for the right eye, there appeared to be a data error that affected the results. Additionally, the symbol "α," denoting the meridian of the minus cylinder, was missing from the formulas for J0 and J45. The corrected formulas are: $J0 = (-C/2)\cos(2\alpha)$ and $J45 = (-C/2)\sin(2\alpha)$.

Abbreviations

DRS	Duane Retraction Syndrome
WTR	With-the-rule
ATR	Against-the-rule
EMG	Electromyography
LR	Lateral Rectus
MR	Medial Rectus
MRI	Magnetic Resonance Imaging

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H.F: study design and manuscript preparation. M.F: study design and critical revision of the manuscript.

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Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
This study was conducted in accordance with the Declaration of Helsinki. The study received approval from the Institutional Review Board of Shiraz University of Medical Sciences.

Consent for publication
Not applicable.

Competing interests
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References

1. Khorrami-Nejad M, et al. Astigmatism in Duane Retraction syndrome. BMC Ophthalmol. 2025;25(1):15.
2. Khorrami-Nejad M, et al. Refractive features and amblyopia in Duane's Retraction syndrome: A review of the 582 patients. J Optom. 2024;17(3):100508.
3. Yuzbasıoglu S, et al. Relationship between Retraction and refraction values in patients with Duane's Retraction syndrome. J Fr Ophtalmol. 2024;47(7):104214.
4. Young MP, et al. Refractive error in unilateral Duane syndrome. J Aapos. 2022;26(5):247.e1-247.e5
5. Yeniad B, Gezer A. Corneal topography changes in cases with Duane Retraction syndrome in different gaze positions. Turkiye Klinikleri J Med Sci. 2011;31:641–5.
6. Mizukawa K, et al. Classification of Duane's Retraction syndrome: two additional electromyogram types. Jpn J Ophthalmol. 2004;48(2):148–53.
7. Mohan K, Saroha V, Sharma A. Factors predicting upshoots and downshoots in Duane's Retraction syndrome. J Pediatr Ophthalmol Strabismus. 2003;40(3):147–51.
8. Mohan K, Sharma A, Pandav SS. Differences in epidemiological and clinical characteristics between various types of Duane Retraction syndrome in 331 patients. J Aapos. 2008;12(6):576–80.
9. Khan AO, et al. Duane Retraction syndrome on the Arabian Peninsula. Strabismus. 2007;15(4):205–8.
10. Kekunnaya R, et al. Duane Retraction syndrome: series of 441 cases. J Pediatr Ophthalmol Strabismus. 2012;49(3):164–9.
11. Kekunnaya R, Negalur M. Duane Retraction syndrome: causes, effects and management strategies. Clin Ophthalmol. 2017;11:1917–30.
12. Yüksel D, Orban de JJ, Xivry, Lefèvre P. Review of the major findings about Duane Retraction syndrome (DRS) leading to an updated form of classification. Vis Res. 2010;50(23):2334–47.
13. Guo Y, et al. Magnetic resonance imaging findings in patients with Duane Retraction syndrome. J Neuroophthalmol. 2024;44(1):101–6.
14. Xia S, et al. MRI findings in Duane's ocular Retraction syndrome. Clin Radiol. 2014;69(5):e191–8.
15. Gaballah KA, Shawky D. Treatment modalities in Duane's Retraction syndrome. Int J Ophthalmol. 2020;13(2):278–83.
16. Paik JS, et al. Refractive error characteristics in patients with congenital blepharoptosis before and after ptosis repair surgery. BMC Ophthalmol. 2016;16(1):177.
17. Read SA, Collins MJ, Carney LG. The influence of eyelid morphology on normal corneal shape. Invest Ophthalmol Vis Sci. 2007;48(1):112–9.

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