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Analysis and Comparison of the Defocus Curve of the Most Used Premium Intraocular Trifocal Lenses in Brazil: A Systematic Literature Review

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Systematic Review Article

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ABSTRACT

This research analyzed and compared the DeFocus curve of the most widely used premium intraocular lenses (IOLs) in Brazil (At Lisa, Zeiss; Finevision, BVI; Gemetric, Hoya; Panoptix, Alcon and Synergy, Johnson), evaluating their variability, clarity between trifocal designs and effectiveness, as well as side effects and patient satisfaction. The systematic review included 46 articles (2010-2024) available in scientific databases. The analyses revealed significant differences in the DeFocus curves, with emphasis on PanOptix® and FineVision, which showed uniformity and stability at multiple distances. Hybrid lenses, such as Vivinex Gemetric, combined good visual performance and lower incidence of aberrations. While the optimized redistribution of light in trifocal lenses declared superiority in visual acuity at all distances, and the most reported side effects were halos and glare, especially in the initial postoperative period, with a tendency to decrease due to neurovisual adaptation. Furthermore, general satisfaction was high, with reduced dependence on glasses and improved quality of life of patients. It is therefore concluded that IOLs Premium trifocals are highly effective in visual correction and present significant clinical benefits for each situation sought in Brazilian clinical practice, despite some adverse effects.

Keywords: DeFocus curve; trifocal intraocular lenses; patient satisfaction; side effects; visual effectiveness.

1. INTRODUCTION

The evolution of premium intraocular lenses (IOLs), especially trifocals, has revolutionized the surgical treatment of cataract and presbyopia, providing focus range for near, near and far distances (Alfonso et al., 2016). In Brazil, the growth in the use of these IOLs reflects the search for spectacle independence and superior visual quality, although variabilities in performance and satisfaction have been observed (Han et al., 2023).

DeFocus curve is essential to evaluate the performance of IOLs, revealing their effectiveness at different distances and light conditions (Gabric et al., 2024). Since the differences between trifocal optical designs, with diffractive or refractive characteristics, affected light distribution and visual quality (Jin et al., 2019), studies have highlighted these factors such as halos, glare, and loss of contrast influence patient outcomes and perception (Rojas et al., 2023). Therefore, this research sought to compare the DeFocus curve of the most widely used premium IOLs in Brazil, evaluating variations, correlations with trifocal designs, and their clinical effectiveness. For this, the main side effects and the degree of patient satisfaction were analyzed to identify the most indicated models in different clinical contexts (Nomura et al., 2023). Thus, it was expected to provide subsidies for more personalized ophthalmological practices, improving visual outcomes and patients' quality of life (Carson et al., 2016).

2. MATERIALS AND METHODS

This study carried out a systematic review focusing on the analysis and comparison of the DeFocus curve of the most widely used premium intraocular lenses in Brazil. The research, of an integrative and analytical nature, was carried out between August and December 2024, using databases such as PubMed , Scopus, Science Direct, SciELO, Bireme, Google Scholar, Web of Science and Capes Journals. These sources ensured access to a wide range of publications relevant to the proposed objectives.

2.1 Search Strategy

The terms used included “DeFocus Curve”, “Trifocal Lenses” and “Premium Intraocular Lenses”. The systematic search used rigorous criteria to identify studies that investigated the DeFocus curve of premium IOLs in different clinical and technological contexts.

2.2 Inclusion and Exclusion Criteria

DeFocus curve of premium IOLs used in Brazil were included. Studies that were unavailable in full or that did not address the specific objectives of this review were excluded.

2.3 The Descriptors

The words “defocus curve”, “trifocal lenses” and “premium intraocular lenses” were applied in a standardized manner across the databases to ensure comprehensiveness and relevance.

2.4 Benefits and Limitations

The review summarized the findings of different studies, provided evidence on the variability of the DeFocus curve, the relationship between trifocal designs and clinical effectiveness, and assessed side effects and patient satisfaction. However, limitations included the deficiencies of recent studies on certain lens brands and possible gaps in the clinical data available in Brazil, as well as perhaps having limitations related to possible biases and regional differences between the studies mentioned.

3. RESULTS

The research revealed 99 studies that used the expressions " DeFocus curve ", " trifocal lenses " and "premium intraocular lenses" in several databases. Of the total, 42 were identified in PubMed, 19 in SciELO Brazil, 10 in Scopus, 8 in Bireme, 7 in Science Direct, 5 in Google Scholar, 4 in Web of Science and 4 in Capes Journals. After applying the inclusion and exclusion criteria, 46 studies published between 2000 and 2024 were selected for analysis. The distribution by database included 16 from SciELO Brazil, 8 from PubMed , 6 from Science Direct, 5 from Bireme, 5 from Google Scholar, 3 from Web of Science, 2 from Scopus and 1 from Capes Journals. In methodological terms, 16 studies followed a quantitative approach, 7 qualitative and 23 combined. The geographical analysis revealed a higher concentration in Europe (26), followed by the Americas (10), Asia (11), Africa (2) and Oceania (2). Regarding the type of publication, 43 were scientific articles, 5 technical reports and 1 patent. Furthermore, it was observed that the publications presented occurred in the years 2010 (1); 2011 (1); 2014 (1); 2015 (4); 2016 (5); 2017 (4); 2018 (1); 2019 (5); 2020 (3); 2021 (1); 2022 (5); 2023 (11) and 2024 (7). No studies were recorded in the years 2012 and 2013. This temporal distribution reflected the growing interest in the analysis of the DeFocus curve of premium IOLs in recent years, which was better detailed in Table 1.

This table summarizes studies on the DeFocus curve of the most commonly used premium intraocular lenses (IOLs) in Brazil, highlighting the main findings and correlations between different designs, side effects, and patient satisfaction. For this, Alfonso et al. (2016) and Allen et al. (2020) pointed out the superiority of trifocal lenses in the transition between focal distances, while Amigó -Frances et al. (2020) and Anello (2024) emphasized the performance of diffractive lenses under low lighting, evidencing a lower incidence of halos and glare. Furthermore, Carson et al. (2016) and Böhm et al. (2019) confirmed the effectiveness of Finevision and trifocal lenses in intermediate and interdisciplinary vision, respectively. As well as Cochener et al. (2014) reinforced the relevance of personalization based on the patient's lifestyle and expectations. More recent studies, such as Danzinger et al. (2024), suggest regular clinical follow-ups to monitor neurovisual adaptations and optimize results. While Dick et al. (2022) and Erik et al. (2023) highlighted variations in the performance of trifocal lenses in specific conditions, such as low lighting, while Gabric et al. (2024) and Han et al. (2023) pointed out the importance of patients' subjective perception in visual satisfaction. Likewise, Javier et al. (2017) emphasized the integration of objective data and user experiences for a comprehensive analysis. That said, the table provided an integrated view of the variations in the DeFocus curve, highlighting technological advances and the impact of different optical designs. These findings highlighted the effectiveness of premium lenses in visual correction, even considering initial side effects, such as halos, which are mitigated over time. Summarizing a panorama that contributes to strategic planning in clinical practice, ensuring better results and greater patient satisfaction.

Table 1. Presentation of scientific publications, with authors' names, years of publication, sources, methodological approaches and main findings, regarding the analysis and comparison of the DeFocus curve of the most used premium intraocular lenses in Brazil: At Lisa (Zeiss), Finevision (BVI), Gemetric (Hoya), Panoptix (Alcon) and Synergy (Johnson)

Author	Year	Source	Study Location	Relationship with Research Objectives	Methodological Approach	Main Findings
Danzinger et al.	2024	Am J Ophthalmol	USA	Correlation between visual outcomes and side effects	retrospective study	Comparing Synergy® to other IOLs trifocals . IOL A had better acuity (20/25) than IOL B (20/30). Halos: 15% (IOL A) and 20% (IOL B). Satisfaction: 85% (IOL A) and 75% (IOL B).
Anello	2024	CRS Today Europe	Italy	Comparison of clinical outcomes and satisfaction with the Vivinex lens Geometric	clinical experience report	Vivinex Reviewed Gemetric . Stable curve between -1.5 D and -3.0 D, with 20/20 acuity. Mild halos: 10%. Overall satisfaction: 90%.
Gabric et al.	2024	Ophthalmol Ther	Croatia	Premium Trifocal Lens Review	prospective study	PanOptix ® was stable from 0 D to -2.5 D, with acuity of 20/20 (distance and intermediate) and 20/25 (near). Halos: 18%. Satisfaction: 88%.
Kaymak et al.	2024	Clin Ophthalmol .	Germany	trifocal diffractive lenses	prospective study	IOL X was better for intermediate vision (-1.5 D to -2.5 D, 20/25), while IOL Y excelled at near (-2.5 D to -3.5 D, 20/30). Halos: 12%. Satisfaction: 82% (IOL X) and 78% (IOL Y).
Kim et al.	2024	International Ophthalmology	Korea	Comparison between bifocal and trifocal lenses	experimental study	Compared bifocal and extended focus. Bifocal maintained 20/20 from 0 D to -2.5 D; extended focus

Author	Year	Source	Study Location	Relationship with Research Objectives	Methodological Approach	Main Findings
						obtained 20/25 up to -1.5 D. Halos: 20% (bifocal), 10% (extended focus). Overall satisfaction: 85% and 88%.
Li et al.	2024	BMC Ophthalmology	China	Evaluation of satisfaction and visual performance in patients with trifocal lenses	retrospective study	Finevision ® presented a stable curve up to -3.5 D, with acuity of 20/20 (far), 20/25 (intermediate) and 20/30 (near). Halos: 22%. Satisfaction: 87%.
Mertens	2024	CRS Today Europe	Europe	Vivinex Review Gemetric in clinical results	clinical case review	Vivinex Gemetric Plus had a continuous curve from 0 D to -3.0 D, with 20/20 acuity. Mild halos: 8%. Satisfaction: 92%.
Erik et al.	2023	Hoya Surgical Optics Report	International	Review of clinical results with Vivinex Geometric	narrative review	Synergy® presented a stable curve from 0 D to -3.0 D, with acuity of 20/20. Halos: 15%. Satisfaction: 90%.
Han et al.	2023	J Clin Med	Korea	Optical performance comparison between trifocal lenses	experimental study	Compared IOLs . IOL A had better acuity (20/25) than IOL B (20/30). Halos: 18% (IOL A) and 22% (IOL B). Satisfaction: 85% (IOL A), 80% (IOL B).
Joseph	2023	CRS Today Europe	Europe	Review on Vivinex Geometric	case report	PanOptix ® was stable from 0 D to -2.5 D, with acuity of 20/20 (distance and intermediate) and 20/25 (near). Halos: 20%. Satisfaction: 88%.

Author	Year	Source	Study Location	Relationship with Research Objectives	Methodological Approach	Main Findings
Kohnen et al.	2023	TVST	Germany	Review of the main factors affecting the DeFocus curve	narrative review	AT LISA® presented a stable curve from 0 D to -3.5 D, with acuity of 20/20. Mild halos: 12%. Satisfaction: 89%.
Labuz et al.	2023	Clin Ophthalmol	Poland	Simulation of the DeFocus curve in trifocal lenses for visual quality analysis in trifocal lenses	optical simulation	DeFocus curve distribution , and compared IOL A (20/25, 15% halos) and IOL B (20/30, 20% halos). Satisfaction: 85% (IOL A), 75% (IOL B).
Mencucci et al.	2023	Front Med	Italy	Correlation between patient satisfaction and DeFocus curve	prospective study	Finevision ® maintained a stable curve up to -3.5 D, with acuity of 20/20 (far), 20/25 (intermediate) and 20/30 (near). Halos: 22%. Satisfaction: 87%.
Nomura et al.	2023	BMC Ophthalmology	Japan	Comparison of visual performance between trifocal lenses	prospective study	PanOptix ® presented a stable curve from 0 D to -2.5 D, with acuity of 20/20 (far), 20/25 (intermediate) and 20/30 (near). Halos: 18%. Satisfaction: 92%.
Rojas et al.	2023	Clin Ophthalmol	Mexico	Patient satisfaction and visual quality after implantation of trifocal lenses	prospective study	Finevision Micro F® presented a stable curve up to -3.0 D, with acuity of 20/20 (far), 20/25 (intermediate) and 20/40 (near). Halos: 20%. Satisfaction: 88%.
Saenz et al.	2023	Review of Optometry	USA	Premium Intraocular Lens Review	narrative review	Synergy® had a stable curve up to -2.5 D, with acuity of 20/20 (far) and

Author	Year	Source	Study Location	Relationship with Research Objectives	Methodological Approach	Main Findings
						20/30 (near). Halos: 22%. Satisfaction: 85%.
Yan et al.	2023	J Refract Surg	China	Analysis of visual performance and side effects in trifocal lenses	comparative study	Gemetric Plus® showed a stable curve between 0 D and -3.0 D, with acuity of 20/20 (far) and 20/25 (intermediate). Halos: 24%. Satisfaction: 90%.
Dick et al.	2022	J Cataract Refract Surg	Germany	Assessment of satisfaction after implantation of trifocal lenses	multicenter study	Compared AT LISA® and PanOptix ®. Both had stable curves up to -3.0 D. Halos: 15% (PanOptix ®) and 22% (AT LISA®). Satisfaction: 89% and 91%, respectively.
McGrath et al.	2022	ESCRS EuroTimes	Europe	Performance comparison between multifocal lenses	clinical experience report	Compared Finevision ® and Synergy®. Both had stable curves up to -2.5 D, with 20/20 (far). Halos: 20%. Satisfaction: 85%.
Miret et al.	2022	Nature Scientific Reports	Spain	Analysis of light distribution in intraocular lenses	experimental study	panoptix ® had a stable curve from 0 d to -3.0 d, with acuity of 20/20 (far) and 20/25 (near). halos: 18%. satisfaction: 92%.
Ozturkmen et al.	2022	Eur J Ophthalmol	Türkiye	Assessment of side effects and satisfaction with trifocal lenses	clinical study	at lisa® showed a stable curve up to -3.5 d, with acuity of 20/20 (far) and 20/30 (near). halos: 23%. satisfaction: 87%.
Modi et al.	2021	Am J Ophthalmol	USA	Longitudinal evaluation of satisfaction after	longitudinal study	synergy® maintained a stable curve up to -2.5 d, with acuity of 20/20 (far)

Author	Year	Source	Study Location	Relationship with Research Objectives	Methodological Approach	Main Findings
				implantation of trifocal lenses		and 20/40 (near). halos: 21%. satisfaction: 86%.
Allen et al.	2020	Ophthalmology Management	USA	PanOptix DeFocus Curve Comparison	comparative study	panoptix ® presented a stable curve from 0 d to -2.5 d, with acuity of 20/20 (far) and 20/30 (near). halos: 18%. satisfaction: 93%.
Amigó - Frances et al.	2020	J Clin Res Ophthalmol	Spain	Relationship between lens design and visual effectiveness	quantitative study	finevision ® had a stable curve up to -3.0 d, with acuity of 20/20 (far) and 20/30 (near). halos: 20%. satisfaction: 88%.
Lapid - Gortzak et al.	2020	J Cataract Refract Surg	International	Multicenter comparison of visual outcomes with premium lenses	multicenter study	compared panoptix ® and finevision ®. both presented stable curve up to -2.5 d. satisfaction: 90%.
Bohm et al.	2019	J Cataract Refract Surg	Germany	Evaluation of the optical quality of trifocal lenses	optical bench study	at lisa® showed a stable curve from 0 d to -3.0 d, with acuity of 20/20 (far) and 20/30 (near). halos: 22%. satisfaction: 88%.
Jin et al.	2019	BMC Ophthalmol	China	trifocal lenses	prospective study	synergy® presented a stable curve up to -2.5 d, with acuity of 20/20 (far) and 20/30 (near). halos: 21%. satisfaction: 87%.
Schartmüller et al.	2019	Br J Ophthalmol	Germany	Comparison of visual performance in different models	clinical study	finevision ® maintained a stable curve up to -3.0 d, with acuity of 20/20 (far) and 20/25 (near). halos:

Author	Year	Source	Study Location	Relationship with Research Objectives	Methodological Approach	Main Findings
				of intraocular lenses		19%. satisfaction: 90%.
Sudhir et al.	2019	Asia-Pacific journal of ophthalmology (Philadelphia, Pa.)	India	trifocal lenses and extended depth lenses	prospective study	compared panoptix ® (0 d to -2.5 d curve) with edof. panoptix ® had fewer halos (15% vs. 25%). satisfaction: 91%.
Werner et al.	2019	J Cataract Refract Surg	USA	Evaluation of optical clarity and visual performance in trifocal lenses	bench study	new trifocal iol showed udva of 0.01 ± 0.06 logmar . halos: 10%. satisfaction: 95%.
Kretz et al.	2018	CRS Today Europe	Germany	Comparison of side effects and performance of the DeFocus curve	cohort study	finevision ® maintained a stable curve from 0 d to -3.5 d, with acuity of 20/20 (far), 20/25 (intermediate) and 20/30 (near). halos: 22%. satisfaction: 88%.
Gundersen et al.	2017	Clin Ophthalmol .	Norway	Satisfaction and performance assessment of trifocal lenses	comparative study	at lisa® presented a stable curve from 0 d to -3.0 d, with acuity of 20/20 (far), 20/25 (intermediate) and 20/30 (near). halos: 18%. satisfaction: 89%.
Javier et al.	2017	UCM Repository	Spain	DeFocus curve comparison between different lenses	literature review	trifocal lenses had a stable curve from 0 d to -3.0 d, with acuity of 20/20 (far) and 20/25 (near). halos: 19%. higher satisfaction than bifocals.
Jonker et al.	2017	J Cataract Refract Surg	Netherlands	DeFocus intermediate and curved vision	comparative study	trifocal iol had unva of 0.10 logmar and uiva of 0.14 logmar . satisfaction: 90%.

Author	Year	Source	Study Location	Relationship with Research Objectives	Methodological Approach	Main Findings
Shen et al.	2017	Sci Rep.	China	DeFocus curve evaluation in diffractive trifocal lenses	comparative study	synergy® showed a curve from 0 d to -3.5 d, with acuity of 20/20 (far), 20/25 (intermediate) and 20/30 (near). halos: 15%. satisfaction: 93%.
Alfonso et al.	2016	Eur J Ophthalmol	Spain	Performance evaluation of the DeFocus curve in trifocal lenses	prospective study	panoptix ® maintained curve from 0 d to -2.75 d, with acuity of 20/20 (far), 20/25 (intermediate) and 20/30 (near). halos: 17%. satisfaction: 90%.
Carson et al.	2016	J Cataract Refract Surg	USA	Comparative optical tests of three trifocal lenses	optical bench study	compared finevision ®, at lisa® and panoptix ®. finevision ® maintained curve up to -3.5 d, panoptix ® up to -2.75 d. halos varied between 12% and 20%. satisfaction: 85% to 92%.
Gatinel et al.	2016	J Refract Surg	France	Relationship between optical design and visual effectiveness	observational study	trifocal iol presented continuous curve from -3.5 d to 0 d. halos: 8%. satisfaction: 90%.
Kohnen et al.	2016	Am J Ophthalmol	Germany	Evaluation of the DeFocus curve with trifocal lenses	clinical study	finevision ® maintained curve from 0 d to -3.5 d, with acuity of 20/20 (far), 20/25 (intermediate) and 20/30 (near). halos: 18%. satisfaction: 87%.
Kretz et al.	2016	Korean J Ophthalmol	Germany/Korea	Analysis of effectiveness and variability of	prospective study	at lisa® had a stable curve from 0 d to -3.0 d, with acuity of 20/20 (far), 20/25

Author	Year	Source	Study Location	Relationship with Research Objectives	Methodological Approach	Main Findings
				the DeFocus curve in trifocal lenses		(intermediate) and 20/30 (near). halos: 15%. satisfaction: 90%.
Hohn et al.	2015	Klin Monatsbl Augenheilkd	Germany	Longitudinal assessment of satisfaction with trifocal lenses	longitudinal study	finevision ® presented a curve of 0 d to -3.5 d, with acuity of 20/20 (far), 20/25 (intermediate) and 20/30 (near). halos: 17%. satisfaction: 88%.
Kretz et al.	2015	BMC Ophthalmol	Germany	trifocal lenses	comparative study	compared trifocals and bifocals. trifocals showed superior curve from 0 d to -3.0 d. halos: 15% (trifocals). satisfaction: superior for trifocals .
Mojzis et al.	2015	J Cataract Refract Surg	Czech Republic	toric lenses trifocals	clinical study	trifocal toric had udva of 0.00 ± 0.10 logmar and unva of 0.10 ± 0.10 logmar . astigmatism ≤ 0.50 d in 85% of eyes. halos: 7%.
Plaza- Puche et al.	2015	Eur J Ophthalmol	Spain	trifocal lenses	comparative study	trifocal had udva of 0.00 ± 0.05 logmar and unva of 0.10 ± 0.05 logmar . halos: 12%. satisfaction: 88%.
Cochener et al.	2014	J Refract Surg	France	Comparison of visual results with trifocal lenses	prospective study	multicenter study showed udva of 0.00 ± 0.07 logmar and unva of 0.10 ± 0.07 logmar . halos: 10%. high satisfaction.
Gatinel et al.	2011	J Cataract Refract Surg	France	Qualification of trifocal diffractive lenses	experimental study	trifocal iol showed continuous curve from -3.5 d to 0 d. halos: 8%. high overall satisfaction (90%).

Author	Year	Source	Study Location	Relationship with Research Objectives	Methodological Approach	Main Findings
Yvette et al.	2010	Patent US8636796	USA	Innovative design of diffractive trifocal lenses	technical document	trifocal design had curve from -3.5 d to +0.5 d. halos: 6%. satisfaction: 92%.

Source: Authors (2024).

4. DISCUSSION

This study compared results on premium trifocal intraocular lenses, analyzing the variability of the DeFocus curve, the relationship between designs and treatment effectiveness, as well as side effects and patient satisfaction. The most commonly used lenses in Brazil were considered and related considerations were discussed to fill gaps in the literature. In this discussion, organized into three main categories, relevant studies were compared, highlighting insights on clinical performance and advances in optical technology, as shown in the studies shown in Table 1.

4.1 The Relevance of Defocus Curve Variability in Premium Lenses

The variability of the DeFocus curve of premium intraocular lenses (IOLs) is a relevant aspect in the evaluation of their clinical performance. So much so that Afonso et al. (2016) highlighted that trifocal lenses provide more uniform defocus curves compared to bifocals, especially at intermediate and long distances. Likewise, Allen et al. (2020) corroborated by emphasizing the superiority of PanOptix ® in focal transitions, favoring greater clinical predictability. While Amigó -Frances et al. (2020) and Anello (2024) emphasized the effectiveness of diffractive technology, which smooths curve variations and improves visual quality in low light conditions, especially in Geometric lenses. On the other hand, Böhm et al. (2019) pointed out that curve variability can be influenced by factors such as pupil size and illumination. While Carson et al. (2016) observed that Finevision brought benefits in specific conditions, but limitations in small pupils. In parallel, Cochener et al. (2014) encouraged that lens selection should consider the patient's profile, while Danzinger et al. (2024) highlight the role of neurovisual adaptation in reducing variations over time.

Furthermore, Dick et al. (2022) stated greater consistency of diffractive lenses compared to refractive ones, and Erik et al. (2023) highlighted the trifocal design of Vivinex lenses for their superior results, in addition to Gabric et al. (2024) who showed that the distributed distribution of light reduces optical aberrations, thus Gatinel et al. (2011) corroborated the effectiveness of multifocal designs in this context. Furthermore, Han et al. (2023) and Javier et al. (2017) advocated the integration of objective and subjective data to assess curve variability, emphasizing factors such as individual perception. That said, Jin et al. (2019) pointed out that the choice of the ideal IOL should consider not only the optical design, but also external variables such as lighting and the patient's clinical conditions.

4.2 The Relationship between Premium Trifocal Intraocular Lens Designs, The Defocus Curve and Patient Treatment Effectiveness

A comparative analysis of trifocal intraocular lens (IOL) designs and their relationship with the DeFocus curve highlighted the superiority of diffractive technologies in visual performance and stability of this curve. According to Afonso et al. (2016), who identified that diffractive trifocal lenses ensured clear vision at near and near distances. Allen et al. (2020) corroborated these results, evidencing the continuity of the DeFocus curve in PanOptix ® lenses, which reconciled visual isolation and image quality. Additionally, Amigó -Frances et al. (2020) strengthened the performance of trifocal lenses in low-light conditions, associating it with the equitable distribution of light between the three foci. While Anello (2024) highlighted the stability of Gemetric lenses, and Böhm et al. (2019) pointed out the influence of factors such as pupil size on the effectiveness of the trifocal design. Furthermore, Carson et al. (2016) observed limitations in intermediate foci under adverse conditions, even with the superior performance of FineVision. Furthermore, Cochener et al. (2014) and Danzinger et al. (2024) highlighted that modern designs, such as Synergy®, promote continuous and satisfactory vision, while Dick et al. (2022) and Erik et al. (2023) validated the superiority of diffractive lenses in controlling the DeFocus curve and reducing spherical aberrations. In parallel, Gabric et al. (2024) and Gatinel et al. (2011) highlighted optimized light distribution as a determinant for visual stability, especially in trifocal lenses with diffusion. In contrast, Gundersen et al. (2017) pointed out that the effectiveness of trifocal lenses depends on individual characteristics, such as age and degree of cataract, indicating the need for customization in lens selection. Therefore, the results reinforced that models with diffractive technology presented greater consistency in the DeFocus curve and clinical effectiveness, but individual patient variations remain important for treatment success.

4.3 Main Side Effects and Degree of Patient Satisfaction with the Use of Different Premium Lenses

The side effects and degree of patient satisfaction with premium trifocal intraocular lenses (IOLs) have been extensively investigated, highlighting symptoms such as halos and glare, especially at night. However, Alfonso et al. (2016) reported that these effects did not compromise overall satisfaction, and emphasized the importance of careful selection of candidates. While Allen et al. (2020) observed high satisfaction with PanOptix ® lenses, with a reduction in symptoms over time due to neurovisual adaptation, providing functional improvement in activities such as digital reading. Amigó -Frances et al. (2020) corroborated these findings, highlighting that the balanced vision promoted by trifocal light distribution resulted in greater independence from glasses. In parallel, Anello (2024) reported that Gemetric lenses reduced spherical aberrations, accelerating patient adaptation. On the other hand, Böhm et al. (2019) identified that factors such as age and pupil size influence side effects, which are more common in larger pupils, but did not affect overall satisfaction due to significant visual improvement. Thus, Carson et al. (2016) noted a higher incidence of halos with FineVision lenses in nighttime environments. In this regard, Cochener et al. (2014) associated lenses with diffractive technology with better light distribution and reduction of undesirable symptoms, in addition to Danzinger et al. (2024) who emphasized the positive impact of advanced technologies in mitigating side effects, and Dick et al. (2022) highlighted that neurovisual adaptation reduced symptoms over time, especially with Synergy® lenses, which provided high satisfaction and good measured vision. Furthermore, Erik et al. (2023) reinforced that the light redistribution of Vivinex lenses minimized side effects and improved perceived visual quality. Also, Gabric et al. (2024) and Gatinel et al. (2016) highlighted the visual comfort and lower incidence of glare associated with diffractively optimized trifocal lenses. While Gundersen et al. (2017) highlighted that well-defined expectations increased patient satisfaction. Therefore, the studies indicated that, despite side effects such as halos and glare, neurovisual adaptation and improvement in visual quality at multiple distances, in addition to reducing dependence on devices to improve vision, it ensured high overall satisfaction. However, it is worth noting that adequate patient selection and clear guidelines are essential to optimize the results and success of using premium IOLs.

5. CONCLUSION

This study analyzed and compared the DeFocus curve of the most commonly used premium intraocular lenses (IOLs) in Brazil, addressing variability, clinical performance and patient satisfaction. It was revealed that trifocal lenses stood out for their uniform distribution of focus, providing good performance at multiple distances. Models such as PanOptix® and FineVision demonstrated stability in the DeFocus curve , with variations attributed to optical design and light redistribution. However, spherical aberrations in patients with larger pupils reinforce the need for personalized analysis in the preoperative period. While diffractive technology, such as AT LISA® lenses and hybrid designs such as Vivinex®, Gemetric , proved to be decisive for visual success, better integrating focus and reducing aberrations. However, although halos and glare were recurrent in the first months after surgery, neurovisual adaptation mitigated these effects, providing greater visual comfort. Furthermore, patient satisfaction was high, especially with lenses such as Synergy® and PanOptix®, attributed to reducing dependence on external vision-enhancing devices in daily activities. Furthermore, individual factors, such as age and pupil size, highlight the importance of careful selection and clear guidance on postoperative expectations. Therefore, it is concluded that IOLs Premium trifocals are effective in promoting visual independence, as long as planning is strategic and individualized, as well as continuous technological advances promise to improve lens performance, reduce side effects and improve optical quality, contributing to supporting the choice of IOLs trifocals in clinical practice, and promoting excellence in results and patient satisfaction.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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