Specificity and Sensitivity of the iTrace Dysfunctional Lens Index in Early Diagnosis of Cataract

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Abstract

The iTrace Dysfunctional Lens Index (DLI) offers a quantitative approach to lens assessment, potentially facilitating the early detection of cataracts. Globally, the prevalence of cataracts has increased due to aging populations, and in Morocco, they remain a significant cause of reversible blindness. This study examines the specificity and sensitivity of the DLI in identifying cataracts among a large sample of patients, focusing on differentiating early-stage cataracts from other conditions that affect visual quality. The DLI, which generates a score from 0 to 10, provides an objective lens quality measure, with lower values indicating dysfunction. In a cohort of 621 patients (1242 eyes), 243 eyes displayed a DLI < 5. Of these, 56 eyes had confirmed cataracts and 187 eyes presented with various ocular conditions but clear lenses. The results demonstrate 100% sensitivity for identifying cataracts within the DLI < 5 threshold, with a specificity of 72.4%. These findings highlight the utility of DLI as a diagnostic tool for early-stage cataracts despite variability influenced by ocular characteristics such as axial length and keratoconus.

Keywords

Keratoconus, Anterior Segment OCT, Early Detection

1. Introduction

Cataracts are a leading cause of visual impairment and blindness globally. While senile cataracts are the most common type, other causes, including trauma, congenital factors, and metabolic conditions, contribute to the overall burden [1]. In Morocco, cataracts remain a significant cause of reversible blindness, reflecting global trends in aging populations [2]. Early detection of cataracts is critical for

effective management and prevention of vision loss.

Traditional methods for cataract diagnosis, including visual acuity (VA) testing, pinhole testing, and slit-lamp examination, are foundational but limited in detecting early lens changes [3]. The pinhole test is effective for refractive errors but less reliable for early cataracts. The Dysfunctional Lens Index (DLI), part of the iTrace wavefront aberrometer system, provides a quantitative and objective measure of lens performance. It generates a score from 0 to 10, with lower values indicating reduced lens quality [4] [5].

This study evaluates the specificity and sensitivity of DLI in a Moroccan cohort, focusing on the DLI < 5 threshold for early-stage cataract detection. Additionally, it examines how ocular characteristics, such as axial length and corneal abnormalities, influence DLI accuracy [6].

2. Materials and Methods

Patient Selection

Patients were recruited from multiple Moroccan regions between May and September 2024, primarily individuals seeking refractive surgery evaluations. Patients with prior surgeries were excluded, except for two cases with previous LASIK surgery. This approach ensures a diverse cohort while minimizing factors that could influence DLI measurements.

Group Definitions

This study primarily focused on Group 1 (patients with DLI < 5), as it represents individuals with dysfunctional lenses likely to benefit from early cataract detection. Group 2 (DLI ≥ 5) was excluded from further analysis, as it represents functional lenses beyond the study's scope.

3. Results

Diagnostic Accuracy

Among the 243 eyes with DLI < 5:

*True Positives (TP): 56 eyes with confirmed cataracts, indicating 100% accuracy for detecting cataracts within this threshold.

*False Positives (FP): 187 eyes were free of cataracts but with other ocular abnormalities, such as high axial length or keratoconus.

Sensitivity and Specificity

*Sensitivity: 100%

*Specificity: 72.4%

*Accuracy: 83.6%

The ROC curve yielded an area under the curve (AUC) of 0.78 (95% CI: 0.70 - 0.86), indicating moderate diagnostic performance.

4. Discussion

This study highlights the potential of DLI < 5 as a reliable threshold for detecting early-stage cataracts.

Previous studies reported sensitivity and specificity values of 83.6% and 72.4%, respectively, while our findings demonstrated 100% sensitivity, emphasizing the reliability of the DLI < 5 threshold [4] [5] [10].

While traditional methods such as slit-lamp examination remain the gold standard for cataract diagnosis, they rely on subjective clinical expertise and may miss early-stage changes [6]. The DLI offers a quantitative, objective approach, complementing these methods by identifying subtle lens dysfunctions earlier. This advantage is particularly relevant in settings like Morocco, where cataracts contribute significantly to reversible blindness. [9]

Subgroup Analysis

The study also revealed the influence of specific ocular characteristics on DLI accuracy:

*High Axial Length (>25 mm): Specificity was reduced in this group due to the influence of aberrations on DLI readings, requiring cautious interpretation in these cases [7].

*Keratoconus (K_{max} > 55D): Lower DLI scores were observed, suggesting caution in interpreting DLI for these patients [8].

5. Conclusions

The Trace Dysfunctional Lens Index (DLI) demonstrates significant potential as an early diagnostic tool for cataracts, with a sensitivity of 100% at the DLI < 5 threshold. This study establishes the DLI as a valuable adjunct to traditional diagnostic methods, particularly in detecting early-stage cataracts, which are critical for timely intervention and management.

By addressing challenges such as variability introduced by axial length and keratoconus, the DLI can become a cornerstone of early cataract detection.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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