Kinetic Perimetry in Contemporary Ophthalmic Practice: A Critical Appraisal of Its Measurement Properties, Clinical Roles and Evidentiary Limits

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Abstract

Kinetic perimetry, in which a moving stimulus of fixed luminance and size is advanced from a non-seeing towards a seeing region to define an isopter, was the dominant method of visual field assessment for several decades before static threshold perimetry displaced it from routine practice. Its position in modern ophthalmology is unsettled. Manual instruments are increasingly scarce, the examiner-dependent technique is difficult to standardise, and quantitative analysis remains awkward, yet kinetic testing continues to be requested for advanced field loss, peripheral disease, paediatric assessment, neuro-ophthalmic localisation, oculoplastic documentation and disability certification, and it supplies endpoints in trials of gene-directed therapy for inherited retinal disease. This critical narrative review examines what the accessible evidence can and cannot support about that continuing role. Literature was identified through PubMed and Crossref Metadata Search for the period from January 1980 to 30 May 2026, supplemented by reference-list examination, and appraised for design adequacy, sample composition, measurement validity and analytical robustness rather than tabulated study by study. Four findings emerge with reasonable confidence: semi-automated kinetic perimetry reproduces Goldmann isopters closely for large, bright targets but diverges for smaller targets and for instruments with restricted bowl geometry; test-retest variability is acceptable for high-contrast isopters in experienced hands yet deteriorates sharply for dim targets, small residual fields and inexperienced observers; reaction-time handling is a principal and under-standardised determinant of isopter position; and statokinetic dissociation, long interpreted as a physiological or pathological signal, is largely abolished when static and kinetic psychophysical procedures are equated, which reframes it as a methodological artefact of criterion bias. Substantial uncertainty persists regarding longitudinal responsiveness, paediatric interpretability, normative reference limits and the equivalence of emerging virtual-reality implementations. Kinetic perimetry retains defensible, circumscribed indications, but its quantitative use as a progression or trial endpoint currently rests on a narrower evidentiary base than its clinical familiarity implies.

Keywords: Kinetic perimetry; goldmann perimetry; visual field; isopter; statokinetic dissociation; semi-automated kinetic perimetry; peripheral vision; inherited retinal disease.

1. Introduction

Static perimetry presents stationary stimuli of varying luminance at fixed locations and estimates a differential light sensitivity threshold at each point. Kinetic perimetry moves a stimulus of fixed size and luminance from a region where it is not perceived towards a region where it is, and records the eccentricity at which the patient first responds; joining these points across meridians yields an isopter, a contour of equal sensitivity. Repeating the procedure with stimuli of differing size and luminance produces a set of nested isopters that approximate a two-dimensional map of the three-dimensional hill of vision.

Automated static threshold perimetry displaced kinetic testing from routine practice because it addressed exactly this weakness. Fixed test grids, standardised thresholding strategies, built-in reliability indices and numerical summary statistics made comparison across visits tractable and permitted the event-based and trend-based progression analyses now embedded in glaucoma management. Reviewing four decades of instrument development, Li and De Moraes (2025) describe the consequence as a reorientation of perimetric practice around the central 24 to 30 degrees, a restriction that leaves most of the seeing field unexamined and that Mönter et al. (2017) characterised as territory the discipline had effectively ceded.

The Goldmann projection perimeter, introduced in the mid-twentieth century, standardised kinetic testing sufficiently for it to become the reference method internationally.

The displacement has been documented empirically rather than merely asserted. Analysing a decade of national health insurance claims, S. Kim et al. (2022) found that static perimetry procedures for glaucoma and glaucoma-suspect patients in tertiary hospitals rose substantially between 2010 and 2019 while kinetic perimetry examinations declined, both in absolute number and in average examinations per patient. That trajectory is consistent with the wider observation that manual Goldmann instruments are no longer manufactured, that expertise in their use is concentrated in a shrinking pool of technicians, and that the technique is increasingly encountered by trainees as an historical curiosity rather than a working tool.

Against this trend runs a persistent clinical counter-current. Where the central field is extinguished or reduced to a small island, static perimetry within 30 degrees returns little interpretable information, whereas kinetic testing can delineate residual peripheral function relevant to orientation, mobility and legal status (Nowomiejska et al., 2015; Rowe et al., 2021). Where disease begins peripherally, as in retinitis pigmentosa and other inherited retinal degenerations, kinetic isopter area has served for decades as the principal index of functional retinal extent and now appears among the outcome measures of gene-directed therapy trials (Melillo et al., 2024; Weleber et al., 2016). Where cooperation is limited, as in young children, the adaptive and conversational character of kinetic testing may permit assessment when a fixed static grid cannot be completed (D. E. Patel et al., 2018; Wilscher et al., 2010). Where a defect must be localised anatomically rather than quantified statistically, the contour information of an isopter map remains diagnostically informative (Banc & Kedar, 2024). Kinetic perimetry has therefore not been abandoned; it has been displaced from the centre of practice to a set of peripheral but consequential indications, several of which carry high stakes for individual patients.
Existing reviews address parts of this picture but not its whole. Hepworth and Rowe (2018) systematically catalogued which perimetric programmes have been used in four neurological conditions and demonstrated the dominance of central static testing, but their remit was programme choice and defect pattern rather than the measurement properties of kinetic testing itself. Riaz et al. (2025) evaluated the diagnostic accuracy of non-standard paediatric visual field tests and judged risk of bias to be unclear or high in most included studies, yet manual kinetic perimetry functioned in that review as a comparator rather than as an object of appraisal. K. E. Kim and Ahn (2025) reviewed visual field examination in retinal disease and Phu et al. (2025) provided an extensive account of standard automated perimetry, in both cases treating kinetic methods peripherally. No accessible synthesis has taken the measurement properties, evidentiary quality and defensible clinical scope of kinetic perimetry as its central question, and none has confronted the tension between the technique's continuing clinical use and the comparative thinness of the evidence supporting its quantitative interpretation. More recent publications likewise address discrete applications rather than kinetic perimetry as a whole, including longitudinal assessment in inherited retinal degeneration, paediatric testing under constrained cooperation, afferent visual pathway localisation and oculoplastic documentation (Costello, 2026; Duncan et al., 2025; Rebollo et al., 2025; Thakur et al., 2026).

1.1 Scope, Research Gap and Objectives

This review concerns kinetic perimetry as performed in human clinical ophthalmology, encompassing manual Goldmann perimetry, semi-automated and automated kinetic programmes implemented on projection perimeters, tangent screen kinetic testing, and emerging kinetic implementations on head-mounted and computer-based displays. The evidence considered relates to adults and children with ocular, neuro-ophthalmic and adnexal disease, and to healthy participants in whom normative or psychophysical questions have been addressed. Attention is directed at four linked questions: how kinetic measurements behave as measurements, in terms of repeatability, reproducibility, learning, fatigue and instrument dependence; whether the relationship between kinetic and static findings is best understood as physiological or as methodological; in which clinical domains kinetic testing supplies information that static testing demonstrably does not; and how kinetic output can be quantified in a manner adequate for longitudinal and interventional use.

The identified gap is specific. Kinetic perimetry continues to generate decisions of high individual consequence, including certification of visual impairment, determination of fitness to drive, authorisation of functional eyelid surgery and adjudication of response in gene-therapy cohorts, while the psychometric evidence underpinning those uses is fragmentary, dominated by small single-centre studies, concentrated in a limited number of research groups, and rarely designed to establish longitudinal responsiveness. The discrepancy between the weight placed on kinetic findings and the strength of the evidence supporting their quantitative interpretation has not been examined systematically in a single synthesis.

The objectives are accordingly to appraise the measurement properties of kinetic perimetry against the standards ordinarily applied to clinical outcome measures; to re-examine statokinetic dissociation in the light of experimental work that equates the psychophysical procedures underlying static and kinetic testing; to define the clinical domains in which kinetic perimetry retains a defensible and evidence-supported role and to distinguish these from domains in which its use rests principally on convention; to evaluate the analytical methods used to convert isopter contours into quantitative indices; and to specify research priorities capable of resolving the principal uncertainties. The intended contribution is an integrated critical account that separates well-supported conclusions from those that are plausible but inadequately demonstrated, and that clarifies where the technique should be preserved, where it should be replaced and where the evidence is insufficient to say.

Several matters are deliberately excluded. Animal and purely computational studies without human validation are excluded, as is the extensive engineering literature on perimeter hardware that does not report human performance data.

2. Methods for Literature Selection

2.1 Review Design and Rationale

A critical narrative synthesis was selected because the review question concerns the interpretation, coherence and evidentiary adequacy of a heterogeneous body of work rather than the estimation of a single effect. The relevant literature spans psychophysical experiments in healthy volunteers, instrument-comparison studies, retrospective clinical series, prospective observational cohorts, methodological developments in field quantification and secondary outcome data from interventional trials. Narrative synthesis is the appropriate form when the analytical task is to reconcile divergent bodies of evidence and expose the assumptions on which their interpretation depends, provided that the review remains transparent about how sources were located and appraised (Greenhalgh et al., 2018; Sukhera, 2022).

The absence of a formal protocol and of duplicate independent screening does not license informal conduct. The reporting standards articulated in the Scale for the Assessment of Narrative Review Articles were used as an internal reference for the justification of importance, statement of aims, description of literature searching, referencing of evidence, evidence-level differentiation and data presentation (Baethge et al., 2019). Every substantive claim is attributed to an identified source, disagreements between studies are represented rather than smoothed, and the strength of the evidence supporting each conclusion is stated explicitly in the text.

2.2 Information Sources

Two sources were searched directly. PubMed, which indexes MEDLINE, served as the primary bibliographic database and was queried programmatically through the Entrez Programming Utilities, permitting structured field-limited searching and retrieval of complete bibliographic records and abstracts. Crossref Metadata Search was queried through its public application programming interface and was used both to identify additional records and to verify bibliographic metadata, including author order, journal title, volume, issue, pagination and Digital Object Identifiers.

Subscription databases including Web of Science Core Collection, Scopus and Embase were not accessible during the preparation of this review and were not searched; no claim of coverage of those indexes is made, and the implications of this restriction are addressed among the limitations. All bibliographic details reported in the reference list were confirmed against at least one authoritative record, and every Digital Object Identifier was checked to resolve to the cited article. Sources whose metadata could not be confirmed completely were not cited.

2.3 Search Strategy and Search Period

Search concepts were constructed around five domains and combined with Boolean operators. The technique domain combined the phrases kinetic perimetry, semi-automated kinetic perimetry, automated kinetic perimetry, Goldmann perimetry, Goldmann visual field, kinetic visual field, isopter and tangent screen perimetry. The measurement domain combined reliability, reproducibility, repeatability, variability, agreement, test-retest, normative, learning effect, fatigue and reaction time. The comparator domain combined static perimetry, standard automated perimetry, statokinetic dissociation and Riddoch. The clinical domain combined glaucoma, retinitis pigmentosa, inherited retinal disease, optic neuropathy, chiasmal compression, idiopathic intracranial hypertension, hemianopia, ptosis, dermatochalasis, blepharoplasty, vigabatrin, epilepsy, children and functional visual loss. The translational domain combined outcome measure, endpoint, clinical trial, gene therapy, quantification, digitisation, visual field volume, driving, disability, virtual reality and portable perimetry.

A representative PubMed string took the form: ("kinetic perimetry"[Title/Abstract] OR "semi-automated kinetic perimetry"[Title/Abstract] OR "Goldmann perimetry"[Title/Abstract] OR "Goldmann visual field"[Title/Abstract] OR isopter[Title/Abstract]) AND (reliability OR reproducibility OR variability OR agreement OR "test-retest" OR normative OR "outcome measure" OR endpoint). Analogous strings substituted the clinical and translational concept blocks. Crossref was queried with bibliographic free-text strings matching the same concepts.

The search period extended from 1 January 1980 to 30 May 2026. The starting year reflects the point at which the modern critical literature on kinetic perimetry begins: the reappraisal of statokinetic dissociation using standardised Goldmann technique and the near-contemporaneous development of computerised quantitative analysis of kinetic fields together mark the transition from descriptive to analytical treatment of the method, and they coincide with the period in which automated static perimetry began to displace kinetic testing from routine use. Foundational earlier work is discussed narratively where necessary to explain the origin of concepts but is not counted among the appraised evidence.

2.4 Eligibility Criteria

Records were eligible if they reported original human data or constituted a systematic, scoping or methodological review bearing on the conduct, measurement properties, interpretation or clinical application of kinetic perimetry, and were published in English within the search period. Studies in which kinetic perimetry served only as an incidental descriptor, without reported field data or comparison, were excluded.

Case reports and small case series were excluded from the appraised evidence base, with the single exception of sources establishing a conceptual or historical point that is not disputed. Conference abstracts, non-peer-reviewed preprints, commercial material, editorials without original data and publications whose bibliographic identity could not be verified were excluded. Non-English publications were excluded because translation could not be assured, and the consequences of this restriction are addressed among the limitations.

2.5 Screening, Duplicate Handling and Study Selection

Titles and abstracts retrieved from the database searches were read in full and assessed against the eligibility criteria. Records judged potentially relevant were examined against their complete abstract and, where accessible, their full text. Duplicates arising between PubMed and Crossref retrievals were identified by Digital Object Identifier and, where absent, by matching of title, first author and publication year, and were merged into single records before appraisal.

Selection was performed by a single author, and no formal count of screened, excluded or included records is reported, since the process was iterative and thematically driven rather than sequential and protocol-bound. No flow diagram is presented, because presenting one would misrepresent a narrative selection process as a systematic one. Where a source appeared potentially important but its full text was not accessible, the record was retained only if its abstract supplied sufficient methodological detail to support the specific claim for which it is cited; otherwise it was not used.

2.6 Critical Appraisal and Evidence Synthesis

No formal risk-of-bias instrument was applied, since the included designs are too heterogeneous for a single tool and the reporting in many older studies is insufficient to support reliable scoring. Instead, each source was appraised against criteria appropriate to its design: adequacy and justification of sample size; representativeness of the sample with respect to the clinical population to which inference is drawn; whether healthy volunteers or patients were studied; presence and appropriateness of a comparator; explicit specification of stimulus size, luminance, velocity and meridian sampling; whether reaction time was measured and how it was handled; masking of graders where subjective interpretation was involved; adequacy of the statistical approach to repeated and clustered measurements, including whether inter-eye correlation was accommodated; the interval and completeness of longitudinal follow-up; declared funding and potential conflicts; and the geographical and demographic concentration of the evidence.

Where an apparent conflict could be attributed to methodology, that attribution is stated and its basis given. Where it could not, the disagreement is reported as unresolved.

3. Psychophysical Foundations and the Transition from Manual to Automated Kinetic Testing

Kinetic and static perimetry differ in more than the trajectory of the stimulus. A moving target is detected under conditions of temporal uncertainty resolved by the participant, whereas a stationary target presented at a known location is judged against a criterion the examiner has fixed in advance. The distinction propagates into every property examined in the sections that follow, and the transition from manual to computer-assisted implementation altered which of these determinants remained under human control.

3.1 Stimulus Parameters as Determinants of Isopter Position

Stimulus velocity exerts a systematic and measurable influence. In a within-subject experiment on healthy young participants, Hirasawa et al. (2014) tested velocities of 2, 3, 4, 5 and 10 degrees per second across five Goldmann stimuli and found that test duration fell as velocity rose, as expected, while kinetic sensitivity declined significantly at 5 and 10 degrees per second for all stimuli and at 4 degrees per second for several. Sensitivities at 2 and 3 degrees per second did not differ significantly. The variability of kinetic sensitivity did not differ across velocities, which is analytically important: faster presentation does not make the measurement noisier so much as it makes it systematically smaller.

Pupil size also perturbs the isopter, and does so in a direction that depends on stimulus intensity. Hirasawa et al. (2015) induced mydriasis with tropicamide and miosis with pilocarpine in healthy participants and found that dilation left the III4e isopter area unchanged but significantly reduced the areas obtained with the dimmer I4e, I3e, I2e and I1e stimuli, whereas constriction reduced the III4e area and increased the I3e and I2e areas.

Reaction time is the parameter with the greatest practical consequence. Because the stimulus continues to move during the interval between perception and response, the recorded eccentricity systematically overestimates the true sensitivity boundary by the product of velocity and latency. Nowomiejska et al. (2010) measured reaction

time during semi-automated kinetic perimetry in patients with advanced field loss and established that latency is substantially prolonged in this group, so that uncorrected isopters are correspondingly displaced. In a later series spanning glaucoma, retinitis pigmentosa and postchiasmal lesions, Nowomiejska et al. (2012) showed by regression that variability of isopter position increased as reaction time increased, and proposed that reaction time be adopted as a reliability index analogous to the fixation and catch-trial indices of static perimetry. Rowe et al. (2021) independently observed in advanced glaucoma that longer kinetic reaction time was associated with poorer fields.

Whether reaction-time correction should be applied at all is unresolved and the disagreement is consequential. Bevers et al. (2019) compared Goldmann perimetry with the Octopus 900 and the Humphrey Field Analyzer 3 and found that Octopus testing performed with a reaction-time vector produced a significantly larger mean isopter radius for V4e stimuli than Goldmann perimetry, whereas the same instrument without the reaction-time vector agreed closely with Goldmann. That result is capable of two readings. It may indicate that the correction overcompensates, or it may indicate that the Goldmann reference is itself systematically displaced inward by uncorrected latency and that the corrected measurement is the more accurate one. The literature has not resolved which reading is correct, and the ambiguity matters because it determines whether historical Goldmann series and contemporary semi-automated series can be compared.

3.2 From Manual Technique to Semi-Automated and Supervised Automated Implementations

Semi-automated kinetic perimetry retains examiner control over which vectors are tested and in what order, while delegating stimulus movement, velocity control, reaction-time estimation and data capture to the instrument. This division preserves the adaptive character that gives kinetic testing its clinical value while removing the largest sources of examiner-generated variability, namely inconsistent velocity and manual plotting. The evidence that this transfer succeeds is reasonably strong for large targets and weaker for small ones. Barnes et al. (2019) tested children and adults with inherited retinal degenerations on Goldmann and Octopus perimeters at two visits approximately one week apart and found no significant difference in isopter solid angle between instruments or between visits, with comparable between-visit test-retest variability. Bevers et al. (2019) found no significant difference in mean isopter radius between Goldmann and either the Humphrey Field Analyzer 3 or the Octopus 900 without reaction-time vector for V4e stimuli, but reported significantly larger field areas for both automated instruments than for Goldmann with the dimmer I4e stimulus.

That asymmetry between bright and dim targets recurs across the comparative literature and has a plausible explanation. The practical inference is that inter-instrument substitution is defensible for gross field extent but not for the dim isopters on which sensitive detection of early or subtle loss depends.

Instrument geometry imposes a further and less widely appreciated constraint. Rowe et al. (2019) compared kinetic testing on the Humphrey 850 and the Octopus 900 in participants with normal visual function and found that horizontal boundaries were similar, but that Humphrey measurements were significantly smaller superiorly and inferiorly, with ceiling effects at approximately 40 and 50 degrees respectively, attributable to the aspheric bowl. The clinical corollary is that conditions preferentially affecting the superior field, including chiasmal compression and restrictive orbitopathy, are precisely those in which this ceiling is most likely to mislead.
The simulation design is a genuine strength for isolating instrument behaviour from patient variability, and simultaneously its principal limitation, since simulated fields do not reproduce fluctuating attention, fatigue or prolonged latency.

Trained and evaluated on digitised simulated fields of varying origin and severity, the algorithm achieved a median accuracy of 0.93 with a median examination duration of 7.0 minutes, performing best for altitudinal and hemianopic patterns with macular sparing and least well for superior wedge-shaped defects. This is a genuinely promising development, but it has not yet been evaluated prospectively in patients, and simulated data cannot test the behaviour of an adaptive algorithm when confronted with unreliable responses.

The distinctions among these approaches are summarised in Table 1, which sets out how examiner control, stimulus regulation, reaction-time handling, quantitative output and the principal residual weakness differ across the main kinetic implementations. The table makes explicit that the shift from manual to automated testing has not removed examiner dependence so much as relocated it, from the execution of the test towards the selection

of vectors and the interpretation of the resulting map, and that no current implementation resolves the criterion-dependence intrinsic to the psychophysical task.

4. Measurement Properties: Repeatability, Reproducibility and Their Boundaries

Reproducibility determines whether a technique can support longitudinal monitoring or serve as a trial endpoint, and it is the property on which kinetic perimetry has most often been criticised. The evidence is more differentiated than the criticism implies: variability depends systematically on stimulus intensity, on the extent of residual field and on examiner experience, so that a single summary statement about kinetic repeatability is not defensible.

4.1 Within-Visit and Between-Visit Variability

The most informative within-visit data come from inherited retinal disease, where kinetic fields have the longest record as an outcome measure. Bittner et al. (2011) obtained two within-visit Goldmann fields from one eye each of 37 participants with retinitis pigmentosa, all tested by a single experienced operator, digitised the results and converted them to retinal areas. The 95 per cent coefficient of repeatability for percentage change in central retinal area averaged 23.7 per cent for the III4e target and 32.8 per cent for the V4e target. The distribution mattered more than the average: three of eight participants whose geometric mean retinal area was below 10 square millimetres, corresponding to a radius of approximately 7 degrees, showed variability between 50 and 100 per cent, and excluding those three reduced the V4e coefficient to 19.2 per cent. Variability was not significantly related to visual acuity, age, presence of cystoid macular oedema or self-reported stress.

Two conclusions follow, and they pull in opposite directions. The optimistic reading, advanced by the authors, is that repeatability can be held below 20 per cent with a single experienced operator, which makes the Goldmann field an acceptable measure of change in peripheral vision. The critical reading is that this bound was achieved by excluding precisely those participants whose fields were smallest, and that small residual fields are common in the advanced disease for which kinetic testing is most often requested. The evidence therefore supports the conclusion that kinetic isopter area is reproducible where the field is large and deteriorates where it is small, which is an unfortunate inversion of clinical need.

Between-visit data are broadly consistent. Barnes et al. (2019) reported median between-visit test-retest variability of approximately 9 to 13 per cent for both Goldmann and Octopus semi-automated fields in participants with inherited retinal degenerations, with lower overall variability in children than adults, a finding that runs contrary to expectation and merits replication. Mönter et al. (2017), studying automated kinetic perimetry of a single III1e isopter in patients with glaucoma tested twice on the same day, found that approximately 90 per cent of test-retest differences in mean isopter radius were within 4 degrees, and that retest variability relative to the range of measurements in the sample was similar to that of standard automated perimetry. That comparison is the more meaningful one, since it evaluates the signal-to-noise ratio rather than the absolute error, and it undermines the common assumption that kinetic testing is intrinsically the noisier method.

Table 1. Conceptual and technical distinctions among kinetic perimetric implementations, with the principal residual weakness of each

Implementation	Locus of examiner control	Regulation of stimulus velocity	Handling of reaction time	Quantitative output	Principal residual weakness	Supporting references
Manual Goldmann kinetic perimetry	Complete: vector choice, velocity, sequence, plotting	Manual and inherently variable within and between examiners	Not measured; isopter systematically displaced outward by latency	Planimetric tracing requiring subsequent digitisation	Not standardisable; instruments no longer manufactured and expertise contracting	Hashimoto et al. (2017); Talib et al. (2018); Wilscher et al. (2010)
Tangent screen	Complete:	Manual	Not measured	Field extent	Restricted to the	Fuller et al.

kinetic perimetry	target, distance, meridian and pace			at two or more testing distances; tangent ratio	central field; low resolution; highly examiner dependent	(2017); Na et al. (2026); Thakur et al. (2025)
Semi-automated kinetic perimetry	Vector selection, target choice, sequencing and adaptive repetition	Instrument controlled at a specified constant velocity	Estimated from reaction-time vectors; correction optionally applied	Isopter area in square degrees, mean isopter radius, solid angle	Correction convention unstandardised; agreement with Goldmann deteriorates for dim targets	Bevers et al. (2019); Nowomiejska et al. (2010, 2012)
Automated kinetic perimetry, single or fixed isopter	Restricted to programme selection	Instrument controlled	Programme dependent	Mean isopter radius; isopter area	Fixed vector set cannot pursue unexpected scotomata; limited defect characterisation	Hashimoto et al. (2015); Ma et al. (2021); Mönter et al. (2017)
Supervised automated kinetic perimetry	Supervisory: algorithm places vectors adaptively under oversight	Instrument controlled	Incorporated within the algorithm	Interpolated three-dimensional hill of vision with accuracy metric	Validated only against simulated field data; no prospective patient evaluation reported	Schiefer et al. (2024)
Head-mounted and computer-based kinetic testing	Programme selection; limited adaptive control	Software controlled	Device dependent and often unreported	Isopter plots; scotoma dimensions in degrees	Limited peripheral coverage; calibration and fixation control less well established	Al-Nosairy et al. (2024); Greenfield et al. (2022); Terracciano et al. (2023)

Note. Goldmann stimulus notation designates size by Roman numeral (0 to V, each a fourfold increase in area) and luminance by an Arabic numeral and letter (for example V4e, III4e, I4e, I2e). Velocity is expressed in degrees per second and isopter area in square degrees. Entries describe the technique as characterised in the cited sources and are not exhaustive of all commercially available programme

Within-session repeated presentation reveals a systematic component that simple test-retest analysis conceals. Nowomiejska et al. (2012) repeated III4e presentations four times along identical vectors in 58 patients with severe field loss. Mean scatter of the kinetic threshold was 2.5 degrees in the glaucoma group, 1.5 degrees in retinitis pigmentosa and 1.7 degrees in postchiasmal lesions, and the difference in isopter area between a single examination and four repeated examinations was 656 square degrees in glaucoma, 104 square degrees in retinitis pigmentosa and 227 square degrees in postchiasmal disease. Both variability and fatigue were most pronounced in glaucoma.

4.2 Learning, Experience and Examiner Dependence

Learning effects are present but bounded. Hirasawa and Shoji (2014) tested inexperienced and experienced healthy young participants three times with automated kinetic perimetry and found a learning effect only in the inexperienced group and only between the first and second measurements, with kinetic sensitivity increasing by 1.5 degrees for III4e and 1.1 degrees for I4e and test duration falling. No learning effect was demonstrable between the second and third measurements in either group. Repeatability was better for the brighter III4e and I4e stimuli than for I3e, I2e and I1e, for which mean-square and coefficient-of-variance values were substantially higher. The practical implications are that a baseline kinetic field in a perimetrically naive patient should be treated as provisional, and that the dim isopters most sensitive to early change are also those least reproducible.

Examiner dependence persists even where the instrument controls stimulus movement, because the examiner still selects vectors, decides when to repeat and determines when the examination is complete. Hashimoto et al. (2017) noted explicitly that results across automated kinetic programmes were considerably influenced by examiner skill. Bittner et al. (2011) achieved their favourable repeatability with a single experienced operator, and it is not established that similar performance is attainable in routine departments where kinetic testing is

performed infrequently. This is a generalisability problem of the first order: the reproducibility literature has been generated predominantly in specialist centres with concentrated expertise, and its results may not transfer to settings where the technique is used occasionally. No study identified in this review has compared kinetic perimetric reproducibility across centres with differing volumes of kinetic testing, and this absence is a substantive gap.

Objective assessment of test reliability has been attempted for children. D. E. Patel et al. (2017) developed the kinetic perimetry reliability measure, a quantitative index of within-test reproducibility, and evaluated it in 103 children aged 5 to 15 years alongside a structured qualitative examiner-based assessment of reliability. Every child was able to complete the measure. Values increased as test quality fell and decreased with age, and discordance between the quantitative and qualitative assessments occurred in one child. This is the clearest attempt to supply kinetic perimetry with the reliability indices that static perimetry has long possessed, and the fact that it remains largely confined to the group that developed it, without independent external validation identified in this review, illustrates how thinly this methodological ground is occupied.

The evidence bearing on reproducibility and inter-instrument agreement is summarised in Table 2, which juxtaposes the population studied, the stimulus conditions, the quantitative finding and the principal methodological caveat for each of the main contributing studies. Reading the table as a whole discloses a pattern that individual studies do not: the favourable estimates cluster in healthy or moderately affected participants tested with bright targets by experienced operators, and the unfavourable estimates cluster in advanced disease, dim targets and small residual fields.

5. Statokinetic Dissociation Reconsidered

Few observations in clinical perimetry have been invested with as much interpretive weight as statokinetic dissociation, the finding that a moving stimulus may be detected within a region where an equivalent static stimulus is not. The evidence assembled over the past decade substantially complicates each of these claims.

The clinical tradition derives principally from Safran and Glaser (1980), who investigated dissociation of kinetic and static stimuli using standard Goldmann perimetry in 15 normal participants and 11 patients with compression of the anterior visual pathways. Variable degrees of dissociation occurred in normal participants for white and for achromatically perceived red targets but not for chromatic recognition of red, and dissociation was documented in the defective fields of all patients with tumours. Two features of this study are frequently overlooked. Dissociation was present in healthy participants as well as patients, which already indicates that it is not a specific marker of pathway disease. The authors also concluded that static presentation was the more sensitive technique for eliciting field defects, a conclusion contrary to the use to which the phenomenon has often subsequently been put.

The most direct challenge to the physiological interpretation comes from experiments that equate the psychophysical procedures. Phu et al. (2016) first demonstrated dissociation in normal observers using conventional clinical methods, comparing static contrast thresholds on a static perimeter with isopters obtained by manual Goldmann perimetry using a size II target, and confirmed that neither examiner technique nor instrument-specific differences accounted for the effect. The authors concluded that physiological dissociation is inherent to the differing methods of threshold measurement in conventional static and kinetic perimetry and to individual criterion bias.

Table 2. Representative evidence on repeatability, reproducibility and inter-instrument agreement in kinetic perimetry

Study focus	Population and design	Stimulus conditions	Principal quantitative finding	Principal methodological caveat	Supporting references
Within-visit repeatability of Goldmann fields	37 participants with retinitis pigmentosa, one eye each, single experienced operator	III4e and V4e, planimetric digitisation to retinal area	95 per cent coefficient of repeatability 23.7 per cent (III4e) and 32.8 per cent (V4e); 19.2 per cent for V4e after	Favourable bound achieved only by excluding the smallest fields; single operator limits	Bittner et al. (2011)

Study focus	Population and design	Stimulus conditions	Principal quantitative finding	Principal methodological caveat	Supporting references
			excluding three participants with very small fields	generalisability	
Between-visit agreement of Goldmann and semi-automated fields	29 children and adults with inherited retinal degenerations, two visits about one week apart	V4e plus one smaller target, solid angle derived by digitisation	No significant difference in solid angle between instruments or visits; median between-visit variability about 9 to 13 per cent; lower variability in children than adults	Small sample; mixed diagnoses; counter-intuitive age effect not independently replicated	Barnes et al. (2019)
Same-day retest of automated kinetic perimetry	30 patients with glaucoma, central and peripheral fields measured twice on one day	Single automated III1e isopter	About 90 per cent of test-retest differences in mean isopter radius within 4 degrees; retest variability comparable to standard automated perimetry relative to sample range	Single isopter only; same-day retest excludes between-visit sources of variation	Mönter et al. (2017)
Within-session variability and fatigue	58 patients with severe field loss (glaucoma, retinitis pigmentosa, postchiasmal lesions)	III4e repeated four times along identical vectors	Threshold scatter 2.5, 1.5 and 1.7 degrees by group; isopter area difference after repetition 656, 104 and 227 square degrees; variability rose with reaction time	Cross-sectional single session; groups small and unmatched for severity	Nowomiejska et al. (2012)
Learning and stimulus-dependent repeatability	46 eyes of 46 healthy young participants, experienced and inexperienced groups, three sessions	III4e, I4e, I3e, I2e, I1e at 3 degrees per second	Learning effect only in inexperienced participants and only between first and second sessions; repeatability markedly worse for I3e, I2e and I1e than for III4e and I4e	Healthy young volunteers only; findings may not extend to elderly or diseased eyes	Hirasawa and Shoji (2014)
Agreement of semi-automated instruments with Goldmann	28 and 30 patients in two study groups, each tested across instruments	V4e and I4e, mean isopter radius and directional distances	No significant difference for V4e between Goldmann and Humphrey Field Analyzer 3 or Octopus without reaction-time vector; significantly larger areas for I4e on both automated instruments; reaction-time vector enlarged V4e radius	Modest sample; direction of the reaction-time discrepancy not resolvable from the design	Bevers et al. (2019)
Instrument geometry and ceiling effects	15 participants (30 eyes) with normal visual function, plus overlay analysis of 140 abnormal results	I4e and I2e on Humphrey 850 and Octopus 900	Similar horizontal boundaries; Humphrey significantly smaller superiorly and inferiorly with	Normative comparison in a small healthy sample; overlay analysis not a formal accuracy study	Rowe et al. (2019)

Study focus	Population and design	Stimulus conditions	Principal quantitative finding	Principal methodological caveat	Supporting references
			ceiling at about 40 and 50 degrees; high overall detection of known abnormality but failure for peripheral superior defects		
Objective reliability indexing in children	103 children aged 5 to 15 years without visual field-affecting disease	Two isopters with blind spot plotting, Goldmann perimetry	Reliability measure obtained in all children; values rose as test quality fell and fell with age; discordance with qualitative scoring in one child	Single-centre development study; no independent external validation identified	D. E. Patel et al. (2017)

Note. Isopter areas are expressed in square degrees and thresholds in degrees of visual angle unless otherwise stated. Goldmann stimulus notation is as defined in Table 1. The studies listed are representative of the principal lines of evidence and do not constitute a complete enumeration of all eligible reports

The critical test was whether the same explanation extends to disease. Phu et al. (2018) applied the equivalent design to six participants with glaucoma and six with retinitis pigmentosa. Clinical dissociation was demonstrable at the scotoma border in both groups, of variable magnitude between individuals but significantly exceeding expected measurement variability. When the psychophysical procedures were equated using the method of constant stimuli and a two-interval forced-choice task, sensitivity to static and kinetic targets was equal and dissociation was eliminated. The authors drew the conclusion that dissociation found using clinical techniques reflects methodological differences and criterion bias, and that it is therefore not useful for distinguishing normal from diseased fields.

The consequences for practice deserve careful statement, because they are easily overstated in either direction. The evidence does not show that kinetic perimetry detects nothing that static perimetry misses. Rowe et al. (2013), comparing semi-automated kinetic perimetry with a peripheral suprathreshold static programme in neuro-ophthalmic cases, found that combining I4e and I2e isopters matched the static result for normality or abnormality in 87 per cent of eyes and noted that dissociation may occur. What the evidence does show is that where kinetic testing detects function that static testing does not, the most parsimonious explanation is a difference in psychophysical procedure and response criterion rather than the engagement of a distinct visual pathway. The clinically defensible position is that kinetic and static perimetry sample the visual field differently, in space, in temporal structure and in the decision criterion they impose, and that the added value of kinetic testing lies chiefly in spatial coverage of the periphery rather than in privileged access to motion-specific residual function.

The competing explanations for statokinetic dissociation, and the evidence bearing on each, are set out in Table 3. Arranging them side by side clarifies that the explanations are not mutually exclusive and that the principal disagreement concerns which mechanism accounts for the routinely encountered clinical phenomenon rather than whether extrastriate motion processing exists.

Table 3. Competing explanations for statokinetic dissociation and the evidence bearing on each

Proposed explanation	Core claim	Supporting evidence and its design	Principal counter-evidence or limitation	Assessed strength of support	Supporting references
Criterion bias and procedural non-equivalence	Dissociation arises because conventional static and kinetic testing impose different decision criteria	Two-interval forced-choice psychophysics with method of constant stimuli eliminated dissociation in healthy observers	Small samples (six per diagnostic group in the disease study); testing confined to a region of interest; no	Moderate: strong design, limited scale and replication	Phu et al. (2016, 2018)

	and threshold-estimation procedures	and in glaucoma and retinitis pigmentosa	independent replication identified		
Extrastriate motion-selective processing	Preserved awareness of motion within a cortically blind field reflects a motion pathway capable of supporting conscious vision independently of primary visual cortex	Detailed psychophysical and functional imaging investigation of patients with extensive occipital damage	Derived from rare cases with large cortical lesions; does not establish the mechanism of dissociation at scotoma borders in ocular disease	Moderate for the specific syndrome; weak as an account of routine clinical dissociation	Beyh et al. (2023); Zeki and ffytche (1998)
Physiological dissociation in the normal visual system	Dissociation is a normal feature of the visual system and becomes exaggerated in disease	Goldmann-based comparison of static and kinetic presentation in healthy participants and patients with anterior pathway compression	Same study concluded that static presentation was the more sensitive method for eliciting defects, which conflicts with the clinical use of the phenomenon	Weak as currently interpreted; superseded by procedure-equating experiments	Safran and Glaser (1980)
Spatial sampling difference rather than dissociation	Apparent additional yield of kinetic testing reflects greater peripheral coverage rather than any dissociation of static and kinetic sensitivity	Comparative studies showing kinetic testing recovers peripheral information absent from central static grids in advanced glaucoma and neuro-ophthalmic disease	Does not address dissociation observed within the region sampled by both methods	Moderate and independently supported across groups	Ma et al. (2021); Nowomiejska et al. (2015); Rowe et al. (2013, 2021)

Note. Assessed strength of support reflects consistency across independent research groups, adequacy of design for the specific claim, and extent of replication, and is a qualitative judgement rather than a formal certainty rating. The explanations are not mutually exclusive

6. Clinical Domains in Which Kinetic Perimetry Retains a Distinct Role

The measurement properties described so far constrain rather than determine clinical utility. What matters in practice is whether the information a kinetic examination yields is unavailable by other means, and whether obtaining it changes a decision. The domains considered below differ substantially in how far the literature answers the second of these questions.

6.1 Advanced Field Loss in Glaucoma and Optic Neuropathy

Nowomiejska et al. (2015) examined 50 eyes of 44 patients with end-stage glaucoma, defined by cup-to-disc ratio worse than 0.9 and mean deviation worse than minus 20 decibels, first with static perimetry within the central 30 degrees and then with semi-automated kinetic perimetry within 90 degrees using III4e and V4e targets. Kinetic testing supplied additional information in 54 per cent of cases: it revealed islands of field beyond 30 degrees undetected by static testing in 32 per cent, demonstrated both central and peripheral islands in 16 per cent, and disclosed altitudinal loss not evident on static testing in 6 per cent. The cost was time, with a mean examination duration of approximately 9 minutes for kinetic testing against 4 minutes for static.

This finding has been corroborated in a substantially larger and independently conducted series. Rowe et al. (2021) recruited 126 patients (170 eyes) with advanced-stage glaucoma and performed both static and automated kinetic perimetry within a single clinic visit. The I4e isopter was plotted in 71 per cent of eyes and the I2e isopter in 53.5 per cent. The authors concluded that kinetic testing supplied clinically useful peripheral information in the presence of non-informative central fields.

The same argument extends to earlier disease, though with a different emphasis. Ma et al. (2021) examined 167 eyes of 89 patients with suspected or established primary open-angle glaucoma using static perimetry followed by a peripheral kinetic programme employing a III4e stimulus moving along 16 vectors at 5 degrees per second. Peripheral defects were found in 18 per cent of eyes with a normal central field, and 86 per cent of patients with moderate to severe central loss had corresponding peripheral defects. The peripheral test had a median duration of 71 seconds against 803 seconds for the central test.

Mönter et al. (2017) supplied the underlying rationale by demonstrating that peripheral and central fields were only moderately related in patients with glaucoma, with a Spearman correlation of 0.51, so that patients with similar central loss could have markedly different peripheral fields. Taken with the retest data reported in the same study, this supports a defensible conclusion: peripheral kinetic measurement contributes information that central static testing does not, and it does so with a signal-to-noise ratio comparable to that of static perimetry. What remains unestablished is whether that additional information changes management or predicts patient-relevant outcomes such as falls, mobility restriction or driving cessation. Peripheral field loss is associated with impairment of activities of daily living (Okrent Smolar et al., 2023; Sotimehin & Ramulu, 2018), which makes the hypothesis plausible, but no study identified in this review has demonstrated that adding kinetic peripheral testing to glaucoma follow-up improves any patient outcome. This is the central unresolved question in the glaucoma application and it is an outcome question, not a measurement question.

Comparable considerations apply to the optic neuropathies, although the supporting series are smaller and largely descriptive. Nowomiejska et al. (2009) compared static and semi-automated kinetic perimetry in patients with bilateral visible optic nerve head drusen, and follow-up of a comparable cohort combining both methods with optical coherence tomography angiography after 16 years indicated that each contributes to characterisation of the functional deficit (Koman-Wierdak et al., 2021). Semi-automated kinetic perimetry has also been used to delineate central scotomata in tobacco-alcohol toxic optic neuropathy (Nowomiejska et al., 2018). These reports establish feasibility and describe defect morphology; none was designed to determine whether kinetic testing alters diagnosis or management in these conditions.

A related monitoring application concerns iatrogenic peripheral field constriction, where the clinical question is whether a drug is producing progressive loss outside the central field. Nowomiejska et al. (2014) followed 14 patients with epilepsy from a pre-treatment baseline through five semi-automated kinetic examinations over two years during vigabatrin therapy, with six patients receiving other antiepileptic drugs as a comparison group. Reaction-time-corrected areas of the III4e, I4e and I2e isopters decreased significantly over the follow-up period in the vigabatrin group and did not change significantly in the comparison group, and the I2e isopter area correlated with both cumulative and mean daily dose. The finding nonetheless illustrates the specific circumstance in which kinetic testing is difficult to replace: progressive concentric constriction detected at the periphery, in a population in whom prolonged static testing is often impracticable.

6.2 Inherited Retinal Disease and Interventional Trial Endpoints

The natural history data are reasonably consistent in direction. Xu et al. (2020) analysed 275 kinetic fields from 52 participants with retinitis pigmentosa over follow-up extending to 29 years and calculated annual rates of decline in field area of 7.5 per cent for V4e, 10.7 per cent for III4e and 12.5 per cent for I4e, with all rates differing significantly from one another. Nowomiejska et al. (2016), following 16 patients with retinitis pigmentosa over two years with semi-automated kinetic perimetry using reaction-time-corrected isopter areas, found a significant decrease only in the I4e isopter area, amounting to 13 per cent of the initial area, with no significant change for V4e or III4e.

These two studies agree on an important methodological point and differ on an important practical one. Both indicate that dimmer targets decline proportionally faster, which is consistent with progressive loss of sensitivity at the isopter margin and makes dim isopters the more responsive measure. They differ in that a two-year interval sufficed to detect change only in the I4e isopter, whereas the longer series detected significant decline in all three targets.

The spatial pattern of residual function has been characterised in more detail. T. P. Patel et al. (2022) developed a computational platform to generate probability maps of retained peripheral field loci from the V4e isopter in

152 participants, with longitudinal data for 65. Retained loci were most likely to lie between the 50 and 80 degree isoeccentric meridians and between the 30 and 50 degree radial axes, and inferotemporal loci were most likely to be preserved over time, corresponding anatomically to the pre-equatorial superonasal retina.

The trial-endpoint application is where the measurement limitations become most consequential. Kinetic field area has been reported as an exploratory or supporting outcome in trials of gene-directed therapy. Weleber et al. (2016) reported that kinetic field area improved in three of twelve participants at two years after subretinal delivery of a recombinant adeno-associated viral vector expressing RPE65, while two participants showed a decrease, with longer follow-up subsequently reported by Pennesi et al. (2018). Melillo et al. (2024) found significant improvement in semi-automated kinetic field alongside best-corrected visual acuity and full-field stimulus threshold as early as 45 days after voretigene neparvovec treatment, maintained at twelve months, and Daruich et al. (2025) reported twelve-month outcomes in a paediatric cohort.

Against this stands the most methodologically pointed finding in the paediatric literature. Dedania et al. (2018) reviewed Goldmann fields in 29 children aged 5 to 16 years with mutation-proven retinal dystrophies and found that field area increased with age despite documented disease progression in 20 of the children, with mean annual increases of 333, 720 and 759 square millimetres for I4e, III4e and IV4e targets respectively and greater increases at younger ages. Repeatability coefficients were large. At 2.5 years after baseline, the field area had increased by at least 20 per cent, the criterion used in published therapeutic trials to define a positive treatment outcome, in 33 to 38 per cent of eyes depending on target. This is a direct and serious challenge to the use of kinetic field area as a paediatric trial endpoint, because it indicates that a substantial proportion of untreated children would meet the responder definition through developmental improvement in test performance alone.

The broader concern is that a measure with a coefficient of repeatability of 20 to 30 per cent in adults with retinitis pigmentosa (Bittner et al., 2011) and with an age-related upward drift in children is being used to adjudicate treatment effects of comparable magnitude. Confidence in kinetic field area as a natural-history descriptor is reasonable. Confidence in it as a stand-alone efficacy endpoint is not currently justified by the measurement evidence, and its use alongside static perimetry, full-field stimulus threshold testing and microperimetry, as in several of the cited trials, is the appropriate response to that limitation.

Static perimetry has begun to be characterised in the same populations, which will eventually permit a direct comparison that the current literature cannot support. Buckley et al. (2022) described visual fields in RPGR-related retinitis pigmentosa using static automated perimetry, and systematic review of natural history in X-linked disease has emphasised the heterogeneity of the biomarkers reported across studies and the resulting difficulty in comparing progression rates (Zada et al., 2021). Until kinetic and static measures are evaluated concurrently in the same cohorts with matched follow-up, the choice between them in trial design rests on convention rather than on comparative evidence.

6.3 Neuro-Ophthalmic Localisation and Neurosurgical Outcome Assessment

Neuro-ophthalmic diagnosis depends on the shape and boundaries of a defect rather than on its depth, since respect for the vertical or horizontal meridian, congruity between the eyes and the presence of a temporal crescent carry localising information that no summary index conveys (Banc & Kedar, 2024; Karowadia et al., 2025). Kinetic testing produces contour information directly, and this is the principal argument for its retention in this domain.

The evidence on whether that argument translates into superior detection is mixed. Rowe et al. (2013) compared semi-automated kinetic perimetry with a peripheral suprathreshold static programme in 64 patients (113 eyes) with neuro-ophthalmic disease. Agreement for the presence or absence of a defect was 80 per cent using I4e and 73.5 per cent using I2e, rising to 87 per cent when both isopters were combined. Kinetic testing was faster, with a mean of 4.54 minutes against 6.17 minutes. Bhaskaran et al. (2021) compared the Octopus kinetic module with Goldmann and Humphrey perimeters in 17 patients (26 eyes) with neuro-ophthalmic disorders and found 88 per cent agreement for normality or abnormality and 80 to 89 per cent agreement for quadrant involvement, but agreement on the specific pattern of defect was only 54 to 65 per cent depending on comparator and observer masking. Central and paracentral scotomata accounted for the discordance, and excluding those patients raised sensitivity to 95 per cent. The authors attributed this to the default protocol rather than to the technique, and proposed a customised protocol for central and centrocecal defects.

That conclusion is important and generalisable beyond the specific instrument. The default vector sets of semi-automated kinetic programmes are designed to define peripheral isopter boundaries, and they sample the central field too sparsely to characterise small central scotomata. A kinetic examination performed with a default protocol is therefore not a general-purpose field test, and the widespread assumption that a kinetic field can substitute for a static field in neuro-ophthalmic assessment is not supported. The complementary conclusion, that a static central field cannot substitute for a kinetic peripheral field where peripheral involvement is suspected, is equally supported. Hepworth and Rowe (2018), reviewing 330 studies across idiopathic intracranial hypertension, optic neuropathy, chiasmal compression and stroke, found that central static programmes predominated in the published literature and observed that little evidence supports their diagnostic accuracy in these conditions, particularly given that the peripheral field may be affected first.

Surgical outcome assessment provides the clearest demonstration of quantitative utility. Parikh et al. (2022) analysed kinetic field areas before and after endoscopic trans-sphenoidal pituitary adenectomy in 64 patients (128 eyes). Both I4e and I3e isopter areas increased significantly after surgery; of eyes with preoperative deficits, 80.7 per cent improved and 7.9 per cent worsened, with a median improvement of 60 per cent. Thirteen of fifteen patients with III4e data regained driving eligibility. Better preoperative field area predicted better postoperative area, yet the rate of improvement was greater in eyes with poorer preoperative vision.

Responsiveness is not uniform across neuro-ophthalmic conditions. Hickman et al. (2025) reviewed semi-automated kinetic fields in people with newly diagnosed idiopathic intracranial hypertension followed for up to one year. Baseline I4e and I2e isopter areas were significantly related to baseline visual acuity, and baseline blind spot area was significantly related to the modified Frisén grade of disc swelling. Over time, neither isopter area showed a significant linear relationship with time since diagnosis, whereas blind spot area decreased significantly. The authors concluded that the technique provided clinically meaningful information at presentation but was less useful for monitoring recovery. The dissociation between a responsive blind spot measure and unresponsive isopter areas is instructive: it suggests that isopter area is insensitive to the specific pathophysiology of resolving papilloedema, in which peripheral constriction may be a late and inconsistent feature, and it cautions against assuming that a measure responsive in one condition will be responsive in another.

6.4 Paediatric Assessment and Testing Under Constrained Cooperation

Wilscher et al. (2010) examined 50 children aged 5 to 14 years with automated kinetic perimetry at 2 degrees per second and completed the test in 49 of 50 children, with a duration of approximately 3.5 minutes per eye, faster than manual Goldmann testing despite the lower velocity. D. E. Patel et al. (2018) compared static and combined static-kinetic approaches in 65 children aged 5 to 15 years with glaucoma. Test quality improved with age for both strategies and was equivalent above the age of 10 years, but static testing yielded better-quality tests in younger children.

The interpretive problem is the age-related increase in measured field area described earlier (Dedania et al., 2018). Whether this represents genuine developmental change in peripheral sensitivity, improvement in test-taking capability, or a combination, is not resolved by the available data, and the distinction matters because only the first would justify treating the increase as a true biological signal. Normative reference data are correspondingly difficult to construct. D. E. Patel et al. (2016) addressed the statistical aspect of this problem by modelling normative isopters using linear quantile mixed models, which accommodate repeated measurements within individuals while requiring weaker distributional assumptions than mean-based approaches and permitting quantile-specific inference, and released an open-source implementation. This is a methodological advance rather than a normative dataset, and the absence of large, multi-ethnic, age-stratified normative kinetic reference limits remains a substantive obstacle to paediatric interpretation.

Alternative approaches designed for constrained cooperation illustrate both the demand and the current state of validation. Eye-tracking-based saccadic vector optokinetic perimetry has been evaluated in children with brain tumours, where 12 of 16 children completed testing and the technique showed high sensitivity with lower specificity against a consensus reference, with agreement with Goldmann fields in the six children able to perform both (Murray et al., 2018); its applicability across children with and without visual impairment has also been examined (Simkin et al., 2019). Tangent screen perimetry and a behavioural screening device permitted

quantification of field extent in patients with drug-resistant epilepsy in whom conventional perimetry was largely unachievable, with only 12 per cent able to complete standard automated testing against 87 to 91 per cent for the alternative methods (Thakur et al., 2025). These are small studies with limited reference standards, and the systematic review by Riaz et al. (2025) judged risk of bias to be unclear or high in most of the 30 studies it identified across 20 index tests, with sensitivities and specificities varying widely by method category. The honest summary is that feasibility in children is established for kinetic and several alternative approaches, and that diagnostic accuracy is not.

6.5 Oculoplastic, Certification and Medico-Legal Applications

A distinct group of applications concerns documentation rather than diagnosis, where the purpose of the test is to establish that a functional threshold has been crossed for administrative or surgical authorisation. The superior visual field in ptosis and dermatochalasis is the commonest instance. Riemann et al. (2000) compared Goldmann and Humphrey ptosis-protocol perimetry in 12 patients with bilateral aponeurogenic ptosis tested with lids ptotic and taped. Both methods documented field loss, but bilateral Goldmann examination required approximately 10 minutes against approximately 50 minutes for the Humphrey protocol, and the Goldmann protocol detected a larger mean field loss, suggesting that the automated protocol as performed was the less sensitive indicator.

The validity of preoperative kinetic testing as a predictor of postoperative benefit is more doubtful. Pemberton et al. (2018) prospectively compared preoperative taped and untaped Goldmann fields with postoperative fields in 46 eyelids of 23 patients undergoing upper eyelid blepharoplasty for dermatochalasis. Preoperative taped testing underestimated the eventual outcome in 76 per cent of cases by a mean of 61 per cent and overestimated it in 24 per cent by a mean of 23 per cent, with overall underestimation averaging 35 per cent. Since taped preoperative testing is used in many jurisdictions to determine whether surgery is functionally indicated, systematic underestimation has direct consequences for access to surgery. The study is small and single-centre and the finding requires replication, but it identifies a specific and testable deficiency in a widely applied administrative use of kinetic perimetry. Heterogeneity in the outcome measures used across blepharoplasty studies limits the scope for pooled comparison (Hollander et al., 2019), and virtual-reality superior field testing, with and without eye tracking, has been explored as an alternative that would remove the dependence on a bowl perimeter (A. J. Patel et al., 2023).

Certification and licensing applications rest on a different measurement question, namely whether binocular field extent meets a jurisdictional standard. Requirements differ substantially between jurisdictions and their empirical justification is uneven (Ahmed & Fraser, 2025). Instrument equivalence is therefore not a technicality. Yanagisawa et al. (2018) compared Esterman disability scores obtained with Goldmann perimetry and with the Humphrey Field Analyzer in 128 patients with low vision and found strong overall correlation, permitting estimation of one from the other, but scores obtained with Goldmann perimetry were significantly lower than those obtained with the Humphrey instrument in eyes with glaucoma and with retinitis pigmentosa, with no significant difference in age-related macular degeneration or other causes. A disease-dependent systematic difference in a score used to determine eligibility is a substantive finding, since it implies that the instrument used may affect certification outcome in exactly the conditions in which certification is most often at issue. Retinitis pigmentosa cohorts illustrate the practical stakes, both in relation to driving (Heath Jeffery et al., 2023) and in the age at which licensing standards are failed (Xu et al., 2020).

Kinetic and tangent screen testing also retain a role in the assessment of suspected functional visual loss, where the diagnostic logic depends on internal consistency rather than on absolute measurement. Na et al. (2026) reviewed tangent screen findings in 126 eyes of 76 patients with field constriction within 30 degrees and found clover-leaf and reversal patterns in 8.8 and 12.7 per cent of functional cases respectively and in no organic case, with a lower ratio of field extent at far to near testing distance in functional than organic loss. The finding that non-expanding fields also occur in organic disease is nonetheless a useful corrective to the assumption that tubular fields are pathognomonic of functional loss, an assumption long qualified in neuro-ophthalmic sources (Dattilo et al., 2016; Pula, 2012). Kinetic fields have similarly been used alongside electrophysiology to demonstrate organic macular dysfunction in children whose amblyopia responded incompletely to treatment (Beneish et al., 2021), and to characterise the peripheral field constriction associated with negative dysphotopsia after cataract surgery (Makhotkina et al., 2016).

The clinical domains, the evidence supporting each and the principal limitation of that evidence are summarised in Table 4. Comparing the rows discloses an asymmetry that is easily missed when the domains are considered individually: the applications with the strongest measurement evidence are not those with the highest individual stakes, and several of the highest-stakes uses, including certification, functional eyelid surgery authorisation and paediatric trial adjudication, rest on the thinnest evidentiary foundations.

Table 4. Clinical domains of kinetic perimetry: nature of the claimed advantage, supporting evidence, and principal limitation of that evidence

Clinical domain	Nature of the claimed advantage	Principal supporting evidence	Principal limitation of the evidence	Consequence of error	Supporting references
Advanced glaucoma and end-stage field loss	Recovers residual peripheral function where central static testing is at floor	Additional information in 54 per cent of end-stage eyes; independent series of 170 eyes showing only small to medium correlation between central and peripheral extent	No demonstration that the additional information changes management or predicts falls, mobility loss or driving cessation	Moderate	Mönter et al. (2017); Nowomiejska et al. (2015); Rowe et al. (2021)
Early and moderate glaucoma	Detects peripheral defects outside the central grid, rapidly	Peripheral defects in 18 per cent of eyes with normal central fields; peripheral test median duration 71 seconds	No independent reference standard for peripheral glaucomatous loss; false-positive rate not estimable from the design	Moderate	Ma et al. (2021); Mönter et al. (2017)
Inherited retinal disease, natural history	Quantifies extent of surviving peripheral retinal function	Consistent annual decline rates across targets over follow-up to 29 years; spatial mapping of retained peripheral loci	Retrospective designs; target-dependent responsiveness constrains usable follow-up interval	Moderate	Nowomiejska et al. (2016); T. P. Patel et al. (2022); Xu et al. (2020)
Inherited retinal disease, trial endpoint	Provides a functional efficacy measure sensitive to peripheral change	Kinetic field improvement reported alongside other measures after gene-directed therapy	Repeatability coefficient of similar magnitude to reported treatment effects; age-related upward drift in children can satisfy responder criteria without treatment	High	Calzetti et al. (2018); Dedania et al. (2018); Melillo et al. (2024); Weleber et al. (2016)
Neuro-ophthalmic localisation	Contour information supports anatomical localisation	80 to 88 per cent agreement with static testing for presence of defect; higher agreement when two isopters combined	Agreement on specific defect pattern only 54 to 65 per cent; default protocols sample the central field too sparsely for central and centrocecal scotomata	High	Bhaskaran et al. (2021); Hepworth and Rowe (2018); Rowe et al. (2013)
Neurosurgical outcome assessment	Quantifies field recovery against functionally meaningful thresholds	Significant increase in I4e and I3e areas after trans-sphenoidal surgery; median	Retrospective, unmasked grading; no comparison with static perimetric responsiveness	Moderate	Parikh et al. (2022)

Clinical domain	Nature of the claimed advantage	Principal supporting evidence	Principal limitation of the evidence	Consequence of error	Supporting references
		improvement 60 per cent; most eligible patients regained driving eligibility			
Idiopathic intracranial hypertension	Quantifies field loss and monitors recovery	Baseline isopter areas related to acuity and blind spot area to disc swelling grade	Isopter areas showed no significant change over time while blind spot area did; limited value for monitoring recovery	Moderate	Hickman et al. (2025)
Paediatric assessment	Feasible where fixed static grids cannot be completed	Completion in 49 of 50 children in about 3.5 minutes per eye; objective within-test reliability measure achievable in all children tested	Static testing gave better-quality tests below age 10 years; field area increases with age irrespective of disease course; normative reference limits scarce	High	Dedania et al. (2018); D. E. Patel et al. (2018); D. E. Patel et al. (2017); Wilscher et al. (2010)
Ptosis and dermatochalasis documentation	Rapid documentation of superior field loss for surgical authorisation	Shorter examination and larger detected loss than a dated automated protocol	Preoperative testing underestimated postoperative benefit by a mean of 35 per cent in a single small series	High	Hollander et al. (2019); Pemberton et al. (2018); Riemann et al. (2000)
Certification and licensing	Establishes binocular field extent against jurisdictional standards	Strong overall correlation of Esterman scores between instruments	Scores significantly lower with Goldmann than automated testing in glaucoma and retinitis pigmentosa; jurisdictional standards themselves unevenly justified	High	Ahmed and Fraser (2025); Yanagisawa et al. (2018)
Suspected functional visual loss	Detects internal inconsistency across testing distances	Clover-leaf and reversal patterns confined to functional cases; lower far-to-near field ratio in functional loss	Retrospective with clinically assigned reference diagnoses, risking incorporation bias	Moderate	Dattilo et al. (2016); Na et al. (2026); Pula (2012)

Note. Consequence of error denotes the potential impact on the individual patient of an incorrect result in that application, judged qualitatively as moderate or high, and does not indicate the frequency of error. Goldmann stimulus notation is as defined in Table 1

7. Quantification, Digitisation and Analytical Reproducibility

The earliest systematic approach treated the isopter set as samples from a three-dimensional surface. Weleber and Tobler (1986) described computerised quantitative analysis of kinetic fields, providing the conceptual basis for treating nested isopters as contours of a hill of vision whose volume can be estimated. Christoforidis (2011) subsequently examined the volume of the visual field assessed with kinetic perimetry and considered its relation to static perimetric measurement.

The most developed contemporary implementation was reported by DeLuca et al. (2023), who analysed 238 clinic visits from 56 molecularly confirmed male patients with choroideremia by tracing Goldmann records with a tablet-based application and interpolating a three-dimensional hill of vision for each trace. The approach accommodated data collected over decades under differing protocols, including incomplete or differing isopter sets, which is precisely the situation encountered in real archives. Using a delayed exponential mixed-effects

model, the authors estimated a mean field volume loss of 6.8 per cent per year and found that field volume was far more strongly correlated between eyes than best-corrected visual acuity, with coefficients of determination of 0.935 and 0.285 respectively. The strength of inter-ocular correlation is an indirect but persuasive argument for the measure's validity, since a measure dominated by noise would not show such correspondence between fellow eyes affected by the same genetic disorder.

The digitisation step introduces error of its own. Barry et al. (2016) had ten digitisers, each trained for one hour, digitise 23 Goldmann fields from patients with inherited retinal degeneration across three testing blocks. The standard deviation of isopter group area showed an approximately square-root relationship with total area, so the coefficient of variation fell from 68 per cent for the smallest isopter groups to 0.2 per cent for the largest. No significant effect of individual digitiser on isopter group area was detected.

The pattern here mirrors the perimetric findings and compounds them. Digitisation error is negligible for large isopters and severe for small ones, exactly as perimetric variability is low for large fields and high for small ones. The two sources of error therefore act in the same direction, so that a small residual field is measured imprecisely by the perimeter and then digitised imprecisely as well. Any longitudinal analysis of advanced disease that reports a single summary area without accounting for both sources is likely to be overconfident.

A related and less tractable problem concerns the comparability of derived units. Field area may be expressed in square degrees, converted to solid angle in steradians, projected to retinal area in square millimetres using an assumed schematic eye, or integrated to a volume. Each transformation embeds assumptions about ocular dimensions and the projection between visual and retinal space, and axial length varies substantially between individuals and between the ethnic groups represented in different studies. Retinal area measures are consequently not directly comparable across cohorts unless axial length is measured and incorporated, a step that is rarely described.

Anatomical factors external to the visual system further complicate normative comparison. Dogahe et al. (2025) compared far peripheral fields in 25 East Asian and 22 Caucasian healthy participants using both kinetic perimetry and static testing, with three-dimensional facial reconstructions generated from photographs to predict contour-dependent obstruction. East Asian participants showed significantly fewer predicted and observed facial contour-dependent defects, and kinetic testing revealed greater peripheral extent in the inferonasal quadrant at specified meridians. The principle is nonetheless secure and has been under-recognised: peripheral kinetic field extent is partly determined by facial and orbital anatomy rather than by retinal or neural function, and normative limits derived from one population may misclassify individuals from another. Related work has shown that colour vision status also alters the relationship between stimulus chromaticity and perimetric response, with quantifiable perimetric differences between red and white stimuli in protanopia (Wetzel et al., 2021), reinforcing that isopter position reflects the whole optical and perceptual chain rather than retinal sensitivity alone.

8. Emerging Technologies and the Prospect of Re-Automated Kinetic Testing

Two developments could alter the trajectory described so far: supervised automation capable of reproducing the adaptive behaviour of a skilled examiner, and head-mounted or computer-based displays that remove the dependence on a scarce and unsupported bowl perimeter. Successive reviews of perimetric development have identified the same gap between technical feasibility and clinical validation in each case (Camp & Weinreb, 2017; Prager et al., 2021).

The algorithmic development is the more consequential in principle, because it addresses the fundamental weakness of the technique. Schiefer et al. (2024) reported an algorithm that evaluates the outer angles of isopter segments, places examination vectors in response to deviations from expected values, and uses interpolation and local probing vectors to construct an individual hill of vision, achieving a median accuracy of 0.93 against digitised simulated fields with a median duration of 7.0 minutes. Prospective evaluation in patients is the necessary next step and has not been reported.

Hardware developments are further advanced in implementation and less advanced in validation. Terracciano et al. (2023) described a portable automatic kinetic perimeter implemented on a commercially available virtual-reality headset with an application generating stimuli moving centripetally along 24 or 12 vectors using three targets, with real-time isopter construction. Testing 42 eyes of 21 healthy participants, they reported Pearson

correlation coefficients above 0.83 against a commercial perimeter for each target. Greenfield et al. (2022) evaluated a virtual-reality oculokinetic test against conventional perimetry and optical coherence tomography, and repeatability of a headset perimeter has been examined in glaucoma and ocular hypertension (Nascimento e Silva et al., 2024), although both concern predominantly static or hybrid paradigms rather than peripheral isopter mapping.

A distinct kinetic approach implemented on standard computer hardware has been developed more thoroughly. Rapid campimetry uses kinetic presentation on any computer display to detect absolute scotomata, measuring the size of physiological and pathological scotomata in degrees rather than mapping isopters (Müller et al., 2022). Al-Nosairy et al. (2024) tested its robustness across varying room illumination, induced refractive error and media opacity in healthy participants, patients with glaucoma and patients with cataract, and found neither blind spot size nor defect size to differ significantly across conditions, with intraclass correlation coefficients of 0.86 to 0.93 for intra-session and 0.87 to 0.91 for inter-session assessment.

The systematic review literature on head-mounted perimetry supports a cautious overall reading. Selvan et al. (2024) reviewed virtual-reality headsets for perimetry and Hekmatjah et al. (2025) reviewed virtual-reality perimetry against standard automated perimetry in adults with glaucoma; both concern predominantly static implementations and both identify heterogeneity of devices, protocols and comparators as the principal obstacle to synthesis. Applied to kinetic implementations, where the published evidence is thinner still, the appropriate conclusion is that feasibility has been demonstrated and clinical equivalence has not. Adoption of a head-mounted kinetic device as a substitute for bowl perimetry in certification or trial contexts would at present be premature.

One structural consideration should temper optimism about hardware substitution. The applications for which kinetic perimetry remains most defensible require measurement out to 80 or 90 degrees of eccentricity, and the field of view of current head-mounted displays, together with facial and headset geometry, constrains peripheral coverage in ways that are seldom quantified in validation reports. The observation that facial contour alone measurably alters far peripheral field extent (Dogahe et al., 2025) implies that a device worn against the face introduces a further and device-specific obstruction that must be characterised before peripheral equivalence can be claimed.

9. Future Directions

The first immediate priority is a multicentre reproducibility study of semi-automated kinetic perimetry conducted across centres with differing volumes of kinetic testing. The unresolved problem is that the favourable repeatability estimates on which clinical confidence rests were generated in specialist centres, frequently with a single experienced operator (Barnes et al., 2019; Bittner et al., 2011), and no study identified in this review has quantified how reproducibility degrades where the technique is used infrequently.

The second immediate priority is standardisation and empirical resolution of reaction-time correction. The problem is defined: correction with a reaction-time vector produced significantly larger isopters than uncorrected Goldmann testing (Bevers et al., 2019), reaction time is prolonged in advanced disease and predicts isopter variability (Nowomiejska et al., 2010, 2012), and yet the literature contains no agreed convention. The resolving design is a study in which the true sensitivity boundary is established independently by forced-choice static threshold estimation at closely spaced eccentricities along the same meridians, against which corrected and uncorrected kinetic thresholds can be compared in the same participants across a range of latencies.

The third immediate priority concerns paediatric interpretation. The finding that field area increases with age despite disease progression, sufficiently often to satisfy trial responder criteria in a third of untreated eyes (Dedania et al., 2018), directly threatens the validity of paediatric efficacy conclusions and rests on a single retrospective single-centre series. The necessary study is a prospective multicentre longitudinal cohort of children with stable, non-progressive or absent retinal disease, tested annually with a standardised kinetic protocol from age 5 to at least age 14, with the trajectory of isopter area modelled by age using quantile mixed models of the kind developed for normative isopter analysis (Patel, Geraci & Cortina-Borja, 2016). The outcome is an age-referenced expected change in isopter area against which observed change in treated children can be interpreted.

A fifth priority concerns clinical utility rather than measurement. Whether adding peripheral kinetic testing to glaucoma follow-up improves outcomes that matter to patients has never been tested, although peripheral loss is associated with impairment of daily activities (Okrent Smolar et al., 2023). The design is a prospective cohort or pragmatic randomised comparison in which patients with moderate to advanced glaucoma receive either standard central static follow-up or the same follow-up supplemented by periodic peripheral kinetic assessment, with outcomes including falls, mobility restriction, driving cessation and patient-reported visual function over at least three years.

A sixth priority is prospective patient evaluation of supervised automated kinetic perimetry. The algorithm has been trained and evaluated only against simulated field data (Schiefer et al., 2024), and the essential unknown is its behaviour under genuine response unreliability. This is the pivotal study for the future of the technique: if adaptive automation can reproduce skilled examination without a skilled examiner, the principal practical objection to kinetic perimetry is removed and the accumulated clinical evidence becomes directly usable; if it cannot, the technique will continue to contract as expertise is lost.

An eighth priority, best pursued alongside the others, is independent replication of the procedure-equating experiments on statokinetic dissociation. The conclusion that clinical dissociation reflects criterion bias rather than distinct pathway function (Phu et al., 2016, 2018) revises accepted teaching and currently rests on two studies from one group with six participants per diagnostic group in the disease study.

These priorities and the reasoning behind their ordering are set out in Table 5, which links each unresolved problem to the inadequacy of current evidence, the design that would resolve it and the practical consequence of resolution.

Table 5. Prioritised research agenda for kinetic perimetry, linking unresolved problems to resolving designs and practical consequences

Priority and horizon	Unresolved problem	Why current evidence is inadequate	Resolving design and principal outcome	Consequence of resolution	Supporting references
1. Immediate	Reproducibility outside specialist centres is unknown	Favourable estimates derive from single experienced operators in specialist units; no multicentre variance-component study identified	Prospective multi-operator, multicentre repeated testing stratified by residual field size and target; coefficient of repeatability with variance partitioned by operator, centre and occasion	Establishes whether published repeatability limits apply in routine practice	Barnes et al. (2019); Bittner et al. (2011)
2. Immediate	No agreed convention for reaction-time correction	Corrected and uncorrected isopters differ significantly and the direction of bias cannot be resolved from existing comparative designs	Forced-choice static threshold estimation along matched meridians as an independent reference, across participants spanning clinically encountered latencies; systematic bias of each convention	Permits valid comparison of historical Goldmann archives with contemporary semi-automated data	Bevers et al. (2019); Nowomiejska et al. (2010, 2012)
3. Immediate	Paediatric field area increases with age irrespective of disease course	Single retrospective single-centre series; sufficient drift to satisfy trial responder criteria in about one third of untreated eyes	Prospective multicentre longitudinal cohort of children with stable or absent retinal disease, annual standardised testing, quantile mixed-model trajectory by age	Yields an age-referenced expected change against which treated children can be assessed	Dedania et al. (2018); D. E. Patel et al. (2016)

Priority and horizon	Unresolved problem	Why current evidence is inadequate	Resolving design and principal outcome	Consequence of resolution	Supporting references
4. Medium term	Normative reference limits are scarce and not population-representative	Existing normative work limited in scale; facial and orbital anatomy measurably alters far peripheral extent and differs between populations	Multicentre cross-sectional normative study with concurrent axial length, palpebral aperture and orbital contour measurement; quantile regression reference limits with covariates	Allows individual results to be interpreted against an appropriate rather than a generic comparison	Dogahe et al. (2025); Niederhauser and Mojon (2002)
5. Medium term	Clinical utility of peripheral kinetic testing in glaucoma is undemonstrated	Additional information is established; no study links it to falls, mobility, driving cessation or patient-reported function	Prospective cohort or pragmatic randomised comparison of standard versus supplemented follow-up over at least three years, with patient-relevant outcomes	Converts a measurement-level argument into a clinical indication or appropriately restricts it	Mönter et al. (2017); Okrent Smolar et al. (2023); Rowe et al. (2021)
6. Immediate	Supervised automated kinetic perimetry is unvalidated in patients	Algorithm trained and evaluated only against digitised simulated fields; behaviour under genuine response unreliability unknown	Prospective within-participant randomised-order comparison against experienced semi-automated examination, masked grading, repeat testing; agreement, duration and failure frequency	Determines whether adaptive automation can preserve the technique as expertise contracts	Schiefer et al. (2024)
7. Longer term	Head-mounted kinetic implementations lack agreement and accuracy data	Validation confined to correlation against a commercial perimeter in healthy participants; peripheral coverage limits unquantified	Staged programme: Bland-Altman agreement across the eccentricity range, explicit quantification of coverage and facial obstruction, then diagnostic accuracy in defined peripheral pathology	Establishes whether substitution is defensible in certification and trial contexts	Dogahe et al. (2025); Selvan et al. (2024); Terracciano et al. (2023)
8. Medium term	Criterion-bias account of statokinetic dissociation is unreplicated	Two studies from one group; six participants per diagnostic group in the disease study; occipital lesions not tested	Independent replication using criterion-free forced-choice procedures in a larger, severity-diverse sample including postchiasmal and occipital lesions, analysed by lesion location	Determines whether kinetic testing should be requested to detect function static testing is presumed to miss	Beyh et al. (2023); Phu et al. (2016, 2018)

Note. Horizon denotes the interval within which a study of the stated design could realistically be completed and reported, not the urgency of the clinical question. Priorities are numbered for reference and the numbering reflects the ordering discussed in the text

10. Conclusions

Four conclusions are reasonably well supported. Semi-automated implementations reproduce manual Goldmann isopters closely for large, bright targets, and this equivalence has been demonstrated by independent groups in different populations; the equivalence does not extend reliably to dim targets, where automated instruments record systematically larger field areas, nor to instruments whose bowl geometry imposes ceiling effects in the superior and inferior field. Repeatability of isopter area is adequate for large fields measured with bright targets

by experienced operators and deteriorates substantially for small residual fields, dim targets and inexperienced observers, which places the technique's precision in inverse relation to the severity of disease for which it is most often requested. Reaction time is a principal determinant of isopter position, is prolonged in advanced disease, predicts measurement variability, and is handled inconsistently across instruments and studies. Statokinetic dissociation, when tested under procedures that equate the psychophysical task and remove criterion bias, is largely abolished in healthy observers and in glaucoma and retinitis pigmentosa, which indicates that the routinely encountered clinical phenomenon is better understood as a methodological artefact than as evidence of distinct pathway function; the separate and well-documented preservation of motion awareness in extensive occipital damage is a different matter and should not be conflated with it.

Several further conclusions are supported but more tentatively. Kinetic testing recovers clinically relevant peripheral information in advanced glaucoma that central static testing cannot supply, and does so with a signal-to-noise ratio comparable to static perimetry, yet no evidence establishes that this additional information alters management or predicts outcomes that patients experience. Kinetic isopter area declines measurably in retinitis pigmentosa at rates that differ systematically by target, with dimmer targets more responsive, which constrains the follow-up interval over which any given target can serve as an endpoint.

Two areas warrant explicit caution because current practice appears to exceed the supporting evidence. The use of kinetic field area as a stand-alone efficacy endpoint in interventional trials is not justified by its measurement properties, since reported repeatability coefficients are of similar magnitude to the treatment effects being adjudicated and, in children, developmental drift alone can satisfy conventional responder criteria; its use alongside other functional measures is the appropriate response. The use of kinetic perimetry in certification, licensing and surgical authorisation rests on the assumption of instrument equivalence, and the evidence indicates that this assumption fails in a disease-dependent manner for binocular disability scoring and that preoperative superior field testing systematically underestimates the benefit of eyelid surgery. These are administrative decisions with substantial individual consequences and the evidence supporting the measurements on which they depend is unexpectedly thin.

The broader significance of this synthesis lies in the pattern that emerges when the domains are considered together rather than separately. The applications in which kinetic perimetry is best validated are not those in which the stakes for the individual patient are highest, and the inverse relationship between the precision of the measurement and the severity of the disease being measured runs directly counter to clinical need. The technique's future depends less on any refinement of its clinical indications than on whether adaptive automation can reproduce the behaviour of a skilled examiner, because the practitioner base capable of performing the examination to the standard on which the published evidence rests is contracting. Kinetic perimetry therefore retains defensible and in some cases irreplaceable roles, and the confidence with which its quantitative output is currently interpreted is not proportionate to the evidence that supports it.

11. Limitations

This review is a narrative synthesis and carries the limitations intrinsic to that form. Selection bias and interpretive bias cannot therefore be excluded, and a different reviewer applying the same criteria might reasonably assemble a somewhat different evidence base and reach different emphases, particularly in the weight given to small single-centre studies whose findings have not been replicated.

The literature search was restricted to two accessible sources. Subscription databases including Web of Science Core Collection, Scopus and Embase were not available, and no claim is made regarding coverage of those indexes. The restriction to English-language publications compounds this, since kinetic perimetry has a substantial German-language and Japanese-language clinical literature, and several methodologically relevant reports identified during searching were excluded on language grounds alone.

The evidence base itself imposes constraints that no review can overcome. Sample sizes across the appraised studies are consistently small, frequently fewer than fifty participants and in several instances fewer than twenty, so that individual estimates of repeatability, agreement and rate of change carry wide and usually unreported uncertainty.

Heterogeneity of design, stimulus specification and outcome definition prevented quantitative synthesis. Studies differ in the targets used, the velocities applied, the meridian sampling adopted, the treatment of reaction time

and the units in which field extent is expressed, so that repeatability coefficients, isopter areas and rates of change reported in different studies are not directly commensurable.

Geographical representation is uneven, with the evidence concentrated in European, North American and East Asian centres and very little from low-income and middle-income settings where the availability of perimetric equipment, the prevalence of advanced presenting disease and the certification frameworks all differ materially. Longitudinal evidence is scarce outside inherited retinal disease, and even there the studies with the longest follow-up are retrospective analyses of clinical archives rather than prospective cohorts with standardised protocols.

Finally, the field is developing in ways that will date parts of this synthesis. Automated and head-mounted kinetic implementations are advancing rapidly, and reports appearing after the search end date may substantially alter the assessment of their validation status. Conclusions concerning emerging technologies should therefore be regarded as provisional descriptions of the evidence available at the time of searching rather than as settled judgements.

Consent

It is not applicable.

Ethical Approval

It is not applicable.

Declaration of AI Use

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Competing Interests

Authors have declared that no competing interests exist.

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