



Clinical Application of the Amsler Grid in the Assessment of Macular Disorders

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Abstract

Background: The Amsler Grid is a simple, standardized tool for detecting central visual field disturbances, particularly metamorphopsia and scotoma, associated with macular pathology. Despite its simplicity, it remains clinically relevant for early detection and home monitoring of macular disease.

Aim: To review the clinical applications, limitations, and adjunctive role of the Amsler Grid in assessing macular disorders and related visual field defects.

Methods: A comprehensive literature-based analysis was conducted, examining the anatomical basis of central vision, mechanisms underlying metamorphopsia, and the diagnostic utility of the Amsler Grid across various retinal and optic nerve conditions. The review also explored alternative psychophysical and perimetric techniques for enhanced sensitivity and quantification.

Results: The Amsler Grid effectively identifies functional changes in conditions such as neovascular age-related macular degeneration, central serous chorioretinopathy, epiretinal membrane, and cystoid macular edema. It provides a practical home-monitoring option, though its sensitivity for early disease detection is limited. Modified charts and advanced technologies, including hyperacuity-based tests and microperimetry, offer improved precision and quantification.

Conclusion: The Amsler Grid remains a valuable adjunct for screening and monitoring macular disorders due to its accessibility and ease of use. However, its limitations—restricted field coverage, lack of fixation control, and poor repeatability—necessitate integration with advanced imaging and functional tests for comprehensive assessment.

Keywords: Amsler Grid, metamorphopsia, scotoma, macular disorders, visual field, hyperacuity, microperimetry.

Introduction

The Amsler Grid is a standardized, square lattice chart designed for the clinical detection and longitudinal surveillance of central visual field disturbances, particularly metamorphopsia and scotoma, that arise in association with pathology affecting the macula and, in certain contexts, the optic nerve head. By providing a simple yet functionally informative assessment of macular integrity, the grid enables patients and clinicians to identify subtle distortions in perceived line geometry or interruptions within the central field that may signify evolving retinal dysfunction. Its practical value is especially evident in settings where frequent in-clinic imaging is impractical, as the Amsler Grid offers an accessible method for repeated self-assessment. In contemporary ophthalmic practice, it is widely recognized as an inexpensive home-monitoring tool that may facilitate the earlier recognition of metamorphopsia attributable to neovascular (“wet”) age-related macular

degeneration, thereby supporting timely clinical evaluation and intervention. In addition to its role in disease detection and monitoring, the Amsler Grid may serve as a preoperative macular function screening instrument prior to cataract surgery, helping to differentiate reduced visual performance attributable to lenticular opacity from that resulting from underlying macular compromise. Historically, the test derives its name from Marc Amsler (1891–1968), a Swiss ophthalmologist who formally described the chart in 1947.[1] Amsler’s formative training included mentorship under Jules Gonin (1870–1935), a figure influential in shaping early modern retinal diagnostics and therapeutics. The conceptual origins of the grid may also reflect earlier methodological precedents. In particular, Edmund Landolt (1846–1926) devised a comparable small card incorporating a grid-like pattern intended to be maintained at the center of the visual field, suggesting a prototype for systematic distortion detection.[1] The broader scientific foundation for

detecting scotoma and metamorphopsia predates Amsler's publication. Jacob Hermann Knapp (1832–1911) documented these phenomena in traumatic maculopathy with choroidal rupture using horizontal line stimuli in 1869, and Richard Forster (1825–1902) later demonstrated metamorphopsia with a square grid in 1874.[1] Collectively, these contributions contextualize the Amsler Grid as the culmination of progressive refinements in central field assessment [1].

Anatomy and Physiology:

The fovea occupies a precisely localized position within the posterior pole and is classically situated approximately two optic disc diameters temporal to the temporal edge of the optic disc, corresponding to roughly 3 mm on average. This topographic relationship is clinically important because it anchors the interpretation of central visual function and the mapping of central field defects. In parallel, the physiological blind spot observed on perimetric testing represents the functional correlate of the optic disc, a region devoid of photoreceptors due to the convergence and exit of retinal ganglion cell axons. On standard visual field coordinates, the blind spot is typically located about 15 degrees temporal to the point of fixation, the latter being anatomically aligned with the fovea.[2] Its contour is characteristically vertically oval, measuring approximately 7.5 degrees in the vertical meridian and 5.5 degrees horizontally, a configuration that reflects the anatomical dimensions and orientation of the optic disc.[2] These spatial correspondences between retinal anatomy and visual field representation are fundamental to understanding why certain pathologies produce predictable perceptual disturbances and why tests that probe central fixation are diagnostically informative. Equally pivotal to foveal physiology is the exceptional specialization of its photoreceptor mosaic. The foveal center contains the highest cone density within the retina, with estimates extrapolated to approximately 150,000 to 180,000 cones per square millimeter, a concentration that supports maximal spatial sampling and, consequently, the finest levels of visual acuity.[3] This density declines steeply with eccentricity, reaching roughly 6,000 cones per square millimeter at approximately 1.5 mm from the fovea.[3] The rapid reduction in cone packing away from the foveal pit provides a biological explanation for the pronounced gradient between central and paracentral acuity and underscores why even subtle macular structural alterations can have disproportionate effects on tasks requiring high-resolution vision. Within this anatomical and physiological framework, disturbances affecting photoreceptor alignment, retinal layer architecture, or fixation stability can readily manifest as distortions or interruptions in the perceived visual scene, particularly when the central field is challenged by patterned stimuli [2][3].

Metamorphopsia, defined in the Oxford dictionary as a “defective visual perception in which objects appear distorted in shape, size, etc.,” represents a clinically meaningful symptom arising from disruptions in the orderly relationship between retinal structure and visual percepts. Several mechanisms have been proposed to account for the emergence of metamorphopsia in macular disease.[4][5][6] A primary explanatory model emphasizes the displacement or misregistration of photoreceptors, which can produce inaccurate spatial localization of the retinal image. When photoreceptor positions are altered relative to their normal retinotopic arrangement, the brain's reconstruction of spatial relationships may become warped, yielding perceived bending of lines, irregular spacing, or altered proportions. This concept aligns with observations in disorders that impose tangential traction on the retinal surface, in which retinal elements are mechanically shifted rather than simply rendered less sensitive. Advances in retinal imaging, particularly optical coherence tomography (OCT), have strengthened structure–symptom correlations by allowing clinicians to relate subjective distortion to quantifiable microanatomical changes. In the context of epiretinal membrane, OCT-based findings indicate that thickening of the inner nuclear layer (INL) is associated with metamorphopsia, whereas the status of the inner segment–outer segment junction is more closely related to visual acuity outcomes.[4][5][6] This distinction is clinically salient because it suggests that the perceptual phenomenon of distortion may not be solely a function of photoreceptor integrity, but may also reflect alterations in inner retinal architecture that perturb signal integration. The INL comprises the cell bodies and elements of horizontal, bipolar, and amacrine neurons, along with Müller glial components; therefore, structural remodeling within this layer could plausibly disrupt synaptic connectivity and retinal circuitry. The hypothesis that changes within these cellular assemblies may inhibit synaptic junction function and reduce effective photoreceptor sensitivity provides a mechanistic bridge between OCT-visible thickening and the patient's subjective complaint of distortion.[4][5][6]

Moreover, thickening of the ganglion cell layer (GCL) and INL has been proposed to induce optical or geometrical aberrations within the retina itself, thereby degrading the quality of vision beyond what might be predicted by acuity measurements alone.[4][5][6] Such changes may affect not only the fidelity of retinal encoding but also the consistency of spatial sampling across adjacent receptive fields, leading to a perceptual “deterioration” that patients describe as waviness or irregularity. Importantly, metamorphopsia may not arise exclusively from retinal factors; higher-order visual processing is also thought to contribute. Cortical mechanisms involved in integrating local features into coherent shapes, as

well as the specific characteristics of the stimulus and broader scene context, may modulate how distortion is perceived and reported.[4][5][6] Taken together, these perspectives support the view that metamorphopsia is a multidimensional symptom emerging from an interplay between retinal microstructure, neural connectivity, and downstream perceptual interpretation, thereby explaining its variability across diseases and between individuals with similar anatomical findings.

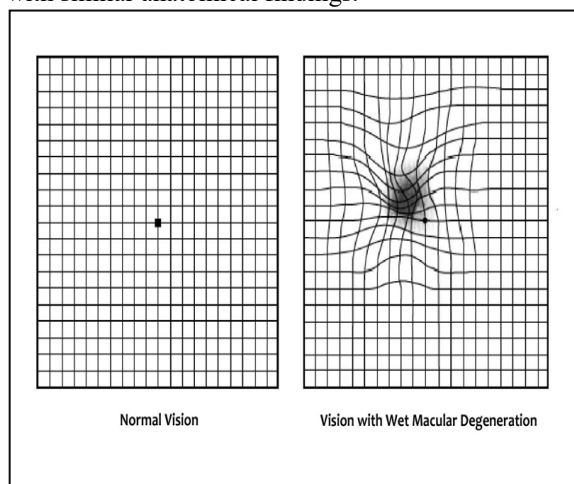


Fig. 1: Amsler Grid, normal vision Vs. Macular degeneration.

Indications

The Amsler Grid constitutes a pragmatic, low-cost, and readily deployable functional assessment tool for identifying and tracking disturbances within the central visual field, particularly metamorphopsia and scotoma. Its principal clinical value lies in its capacity to render subjective central visual symptoms observable and reproducible, thereby supporting early recognition of macular dysfunction and facilitating longitudinal monitoring in both clinical and home-based settings. Within this scope, the grid has established validity across several diagnostic contexts in which central retinal architecture, photoreceptor alignment, or post-retinal visual pathway integrity is disrupted.[7] By interrogating the fidelity of perceived linearity, continuity, and spatial uniformity within the fixation area, the Amsler Grid can help corroborate patient-reported distortion and provide a functional correlate to anatomical abnormalities detected through ophthalmoscopy or multimodal imaging. Among its most consequential indications is neovascular or “wet” age-related macular degeneration (wAMD), wherein the development of a choroidal neovascular membrane (CNVM) may precipitate acute or progressive metamorphopsia and the emergence of new central scotomas. In this setting, the Amsler Grid is frequently employed as an accessible surveillance measure to detect symptom evolution that may signify exudation, hemorrhage, or expansion of neovascular complexes, all of which can threaten

central vision. Because the perceived onset or worsening of line distortion can precede overt declines in measured visual acuity, the grid can function as an early warning mechanism prompting expedited ophthalmic evaluation and imaging confirmation.[7]

Central serous chorioretinopathy (CSCR) represents another disorder in which the Amsler Grid may yield clinically informative findings.[7] CSCR commonly produces a central scotoma attributable to localized neurosensory retinal detachment; the scotoma’s contour may be round or oval, reflecting the geometric configuration of the subretinal fluid accumulation and the associated detachment. The grid’s structured pattern provides a stable reference against which patients can identify missing regions or areas of distortion, thereby offering a functional depiction of the central field compromise that aligns with the anatomical distribution of detachment seen on OCT. The grid is similarly pertinent in epiretinal membrane and other vitreoretinal interface disorders, conditions in which tangential tractional forces distort the macular surface and can displace photoreceptors, culminating in metamorphopsia.[7] In these cases, Amsler testing helps to capture the patient’s experiential quality of distortion—such as waviness, kinking, or non-uniform spacing of lines—which may inform clinical decision-making and surgical counseling, particularly when evaluating symptom burden relative to measured acuity. In acute macular neuroretinopathy, the Amsler Grid may assist in revealing characteristic scotomas that correspond to fundus lesions.[7] Patients may describe paracentral or central blind spots, sometimes with a distinctive “flower petal” configuration, and these functional deficits can map to lesions that often become more conspicuous on near-infrared (NIR) or multicolor imaging. In this regard, the grid serves as a functional adjunct to multimodal imaging by helping delineate the perceptual footprint of structural pathology within the macular region.

Cystoid macular edema constitutes another important indication because intraretinal fluid accumulation can alter the spatial relationship among photoreceptors and disrupt normal retinal signal sampling.[7] This change may manifest not only as blurred central vision but also as micropsia, in which objects are perceived as smaller than their true size, plausibly reflecting altered photoreceptor spacing and retinal image scaling. Cystoid macular edema may arise in diverse etiologies, including diabetic maculopathy, retinal vein occlusion, intermediate uveitis, CNVM, and other inflammatory or vascular retinal disorders. The Amsler Grid can help detect and monitor the presence and progression of such central distortions and scotomas, complementing anatomical assessment with OCT. Although most commonly associated with macular pathology, Amsler Grid testing may also demonstrate defects

stemming from optic nerve and chiasmal disease. In non-arteritic anterior ischemic optic neuropathy, the grid may reveal an altitudinal pattern of field loss, reflecting the segmental ischemic injury typical of this condition.[7] Similarly, in the presence of a pituitary tumor compressing the optic chiasm, the grid may be used to illustrate bitemporal hemianopia, thereby providing a simple demonstration of chiasmal field compromise that can be clinically suggestive and useful for patient education.[7] While formal perimetry remains the standard for characterizing such defects, the Amsler Grid can offer a rapid, bedside-oriented functional screen. Finally, hydroxychloroquine retinopathy is acknowledged as a condition in which central scotoma may occur; however, despite this theoretical relevance, the Amsler Grid is presently not recommended as a screening instrument for hydroxychloroquine-induced retinal toxicity.[7] This limitation reflects the need for more sensitive and standardized modalities—such as automated visual field testing and objective structural imaging—to detect early toxicity before symptomatic central vision loss develops. Consequently, the Amsler Grid's role in this domain is best understood as ancillary rather than primary, reinforcing the broader principle that its utility is strongest when integrated with disease-specific diagnostic standards and imaging-based confirmation.[7]

Contraindications:

Although the Amsler Grid is widely regarded as a safe, noninvasive, and easily administered tool for the assessment of central visual field disturbances, it is important to recognize its practical limitations and contextual constraints, even in the absence of absolute contraindications. From a strictly clinical standpoint, there are no medical or procedural conditions that preclude the use of the Amsler Grid, as it involves no pharmacologic agents, instrumentation, or exposure that could pose risk to the patient. Consequently, it may be employed across a broad range of patient populations and clinical settings without concern for adverse effects. Nevertheless, its effective application presupposes a minimum threshold of visual function, as the individual must possess sufficient visual acuity and contrast sensitivity to reliably discern the grid lines and fixation point. In patients with profoundly reduced vision, dense media opacities, or severe central vision loss, the interpretability of the test may be compromised, limiting its diagnostic usefulness. A further consideration pertains to the sensitivity of the Amsler Grid in detecting subtle or early pathological changes, particularly in the context of neovascular or “wet” age-related macular degeneration. Although the grid is commonly advocated for home monitoring and early symptom detection, evidence suggests that its sensitivity for identifying early or incremental changes in wAMD may be relatively low. As a result, a normal or unchanged Amsler Grid result cannot be

interpreted as definitive evidence of disease stability. This limitation underscores the principle that the Amsler Grid should not be regarded as a substitute for comprehensive ophthalmic examination, advanced retinal imaging, or formal functional testing. Rather, it functions most appropriately as an adjunctive screening or monitoring tool, the findings of which must be contextualized within a broader diagnostic framework [7][8].

The restricted spatial extent of the Amsler Grid further constrains its applicability. By design, the grid assesses only the central 10 degrees of the visual field temporal to fixation, thereby excluding peripheral and paracentral regions from evaluation. Consequently, physiological landmarks such as the blind spot, which is located approximately 15 degrees temporal to fixation, are not represented within the test area. This inherent limitation diminishes the grid's utility in detecting visual field defects that lie outside the immediate central field. In diseases such as glaucoma, where early damage typically manifests as arcuate or paracentral defects that spare central fixation, the Amsler Grid is notably insensitive. Glaucomatous visual field loss may therefore go undetected until the disease has progressed substantially and the defect encroaches upon the fixation area. In such cases, reliance on the Amsler Grid alone may provide false reassurance and delay diagnosis. In summary, while the Amsler Grid has no formal contraindications and remains a valuable, patient-friendly tool for central field assessment, its use must be tempered by an appreciation of its functional requirements, limited sensitivity, and restricted field coverage. Its findings should always be interpreted in conjunction with comprehensive clinical evaluation and disease-specific diagnostic modalities to ensure accurate assessment and timely management [7][8].

Equipment

The Amsler Grid is a compact, standardized chart designed to provide a structured stimulus for the functional assessment of the central visual field. In its conventional format, the grid measures 10 cm × 10 cm and is intended to be viewed at a working distance of approximately 33 cm from the eye. When deployed under these conditions, the chart samples a central visual field extent of roughly 20 degrees, encompassing approximately 10 degrees in every direction around the fixation point, including superior, inferior, nasal, and temporal meridians. This carefully defined geometry is not incidental; rather, it ensures that alterations in perception—such as missing segments of lines, focal interruptions, waviness, or displacement—can be interpreted with reference to a predictable angular subtense. Consequently, the Amsler Grid constitutes a practical instrument for detecting and monitoring central scotomas and metamorphopsia by translating subjective visual symptoms into a reproducible spatial framework. Within the Amsler system, seven

distinct chart variants are traditionally described, each maintaining the same overall dimensions of 10 cm × 10 cm while differing in pattern design to emphasize particular aspects of central visual function. The foundational version, commonly referred to as Chart 1, consists of white orthogonal grid lines on a black background. The grid is subdivided into 20 equal small squares per side, yielding 400 small squares in total. Given the 10 cm chart width, each small square measures 5 mm (10 cm/20), and at the standard viewing distance of 33 cm, each 5 mm interval subtends approximately 1 degree of visual angle (20°/20). This proportionality is clinically useful, as it allows clinicians and patients to approximate the angular size of perceived defects and to monitor changes over time with reasonable consistency. The high-contrast design of white-on-black lines facilitates clear detection of distortions and interruptions in individuals with sufficient visual acuity and contrast sensitivity [7][8][9].

Chart 2 builds directly on the first chart by superimposing four diagonal white lines across the same white-on-black grid. The primary intent of these diagonals is to provide enhanced fixation guidance in individuals who have a central scotoma, in whom the usual central fixation point may be difficult to perceive or maintain. By offering additional linear cues that converge toward the center, Chart 2 can assist the patient in stabilizing gaze and thereby improve the reliability of the subjective report. In this way, it adapts the standard grid to a clinical reality in which central fixation may be compromised precisely in the conditions being evaluated. Chart 3 retains the grid configuration of Chart 1 but replaces the white lines with red lines on a black background. This modification is grounded in the physiological property that red stimuli preferentially engage the long-wavelength-sensitive cone pathways, enabling detection of subtle red desaturation phenomena that may reflect optic nerve or macular dysfunction. As a result, Chart 3 is employed to enhance sensitivity to chromatic deficits in conditions such as bitemporal hemianopia associated with pituitary tumors, toxic optic neuropathy, and toxic maculopathy, in which color perception changes may precede or accompany other functional deficits. By shifting the stimulus chromaticity, the chart offers an alternative functional probe that may reveal abnormalities not as readily evident on the standard achromatic grid [7][8][9].

Chart 4 departs more substantially from the classical lattice design by eliminating linear structure altogether. Against a black background, it presents a prominent central round white dot for fixation, while the remaining field contains multiple small, randomly distributed white dots. This pattern is intentionally devoid of continuous forms, thereby reducing the opportunity for perceived line bending or geometric distortion. Accordingly, Chart 4 is particularly useful for distinguishing scotoma from metamorphopsia: a

true scotoma may manifest as an absence of dots in a localized region, whereas metamorphopsia—defined by distortion of form—cannot be readily expressed when no coherent form is present to be deformed. In this manner, Chart 4 serves as a complementary tool for clarifying the nature of a patient's subjective complaint. Chart 5 is designed to interrogate distortion along specific axes by presenting a bounded square containing 21 horizontal white lines on a black background, spaced 5 mm apart, with a central fixation dot. This emphasis on horizontal linearity can be advantageous when evaluating patients who report reading-related difficulties, as reading relies heavily on the integrity of horizontal scanning and alignment. The chart can therefore help determine whether metamorphopsia is preferentially expressed along a particular meridian, supporting a more nuanced functional characterization of the distortion. Chart 6 represents a further refinement of the horizontal-line paradigm and is notable as the only chart in the seven-chart series that features black lines on a white background. This inversion of contrast may improve visibility for some individuals and reduce glare-related discomfort in others. Additionally, the central lines in Chart 6 are closer together than those in Chart 5, thereby increasing spatial sampling density near fixation. This design facilitates the detection of finer degrees of metamorphopsia in the parafoveal region, where subtle distortions may meaningfully affect tasks requiring high-resolution vision. Chart 7 modifies the standard orthogonal grid by incorporating a central zone composed of smaller squares, each subtending approximately 0.5 degrees of visual angle. This increased granularity near fixation enhances sensitivity to small scotomas or minute areas of distortion in the immediate central field. By offering a finer metric scale at the point of maximal visual importance, Chart 7 is particularly suited to demonstrating subtle abnormalities that might otherwise be obscured by the coarser 1-degree spacing of Chart 1. Collectively, these chart variations illustrate how the Amsler Grid system uses controlled alterations in pattern structure, contrast polarity, and spatial resolution to extend its utility across diverse clinical scenarios while preserving the simplicity and portability that underpin its widespread use [8][9].

Technique or Treatment

The Amsler Grid is typically administered as a near-vision functional assessment and, when performed under standardized conditions, can yield clinically meaningful information regarding central visual field integrity, particularly with respect to metamorphopsia and scotoma. The chart is conventionally positioned at a viewing distance of approximately 33 cm from the tested eye, a distance selected to ensure that the grid subtends an appropriate central field angle while remaining within

the patient's comfortable near-working range. Adequate and uniform illumination of the chart is essential, as insufficient lighting can reduce contrast sensitivity and confound the interpretation of subtle defects, whereas glare or uneven illumination may introduce artefactual distortions. In addition, it is advisable to avoid intense light exposure directed into the eye immediately before testing, including exposure associated with slit-lamp biomicroscopy, indirect ophthalmoscopy, or other high-intensity examination lights, because such exposure can induce transient photostress. Photostress may temporarily alter macular function and contrast perception, thereby diminishing test reliability and potentially producing spurious reports of blur or scotoma that do not reflect baseline retinal performance. To optimize accuracy, the patient should wear appropriate near correction if prescribed, including reading spectacles or multifocal lenses, so that the grid lines can be clearly resolved at the intended distance. Pupillary dilation is generally avoided for routine Amsler testing because mydriasis may increase light scatter and glare, alter depth of focus, and reduce the comparability of serial home assessments. The test is performed monocularly to prevent binocular compensation, as the fellow eye may mask a central defect in the tested eye. Accordingly, the patient is instructed to occlude one eye while viewing the chart with the other eye through the near correction. The patient is then directed to fixate steadily on the central dot, which serves as a reference point for the assessment of line integrity and field completeness. In individuals with reduced fixation stability or ambiguous foveal fixation—often encountered in macular disease—the instruction may be broadened to emphasize focusing attention at the center of the grid while maintaining awareness of the four corners simultaneously. This approach promotes a stable gaze orientation and assists in ensuring that the examined field extends across the intended test area rather than collapsing into an unmonitored central region due to eccentric fixation [8].

While maintaining fixation centrally, the patient is asked to evaluate the grid for deviations from expected geometry. A primary aspect of the assessment is the perception of line linearity and parallelism: straight lines should appear straight, and the grid should retain a consistent pattern of orthogonal intersections. Any waviness, bending, kinking, or irregularity is suggestive of metamorphopsia, typically reflecting macular structural disturbance that perturbs photoreceptor alignment or retinal signal mapping. In parallel, the patient is asked to note whether any grid segments appear missing, faded, blurred, or obscured, which may indicate the presence of a scotoma or relative depression in central sensitivity. Importantly, patients should be encouraged to distinguish between general blur attributable to refractive issues and localized or patterned deficits that remain despite appropriate near

correction. To facilitate longitudinal comparison, the patient should document areas of perceived abnormality by marking the affected region directly on the chart, thereby creating a visual record that can be compared across time points to infer progression, stability, or recovery. This documentation is particularly valuable in chronic conditions where symptom evolution may be gradual and difficult to recall reliably without contemporaneous records. A practical checkpoint during Amsler testing is the ability to appreciate the grid boundaries and corners at the specified viewing distance. If the patient cannot perceive the corners of the chart despite proper refractive correction and adequate lighting, broader visual field constriction should be considered. In such circumstances, conditions characterized by peripheral field loss, such as glaucoma or retinitis pigmentosa, merit exclusion through formal perimetry and comprehensive ophthalmic evaluation. Although the Amsler Grid is not designed to interrogate peripheral field integrity, the inability to perceive the chart extent may serve as a clinically relevant prompt for further investigation. For home monitoring purposes, the Amsler Grid is often recommended at least weekly, providing an interval that balances practicality with the need for timely recognition of meaningful change, particularly for individuals at risk of developing or worsening neovascular macular pathology [8].

Notwithstanding its simplicity and accessibility, the Amsler Grid is not the sole method for documenting metamorphopsia, and several alternative psychophysical techniques have been developed to quantify distortion with greater precision. The M chart, also known as the metamorphopsia chart, provides a structured approach to estimating distortion magnitude.[8] This test uses a series of 19 dotted lines in which the dot separation progressively increases from approximately 0.2 degrees, representing fine spacing, to about 2 degrees, representing coarse spacing. The psychophysical principle underlying the M chart is that as the stimulus becomes coarser, the perceptual impact of local distortion tends to diminish, such that metamorphopsia may become less noticeable or disappear. The test quantifies metamorphopsia by identifying the minimum visual angle of dot separation required for the distortion to no longer be perceived. In practical terms, the patient's threshold is recorded separately for horizontal and vertical orientations, enabling characterization along orthogonal meridians. However, although the M chart provides a measurable index of distortion magnitude, it does not capture the morphological features of the distortion, such as its shape, spatial extent, or precise location within the central field, thereby limiting its descriptive granularity in comparison with mapping-based techniques. Preferential hyperacuity perimetry (PHP) represents a more sophisticated approach grounded in the visual system's hyperacuity

capabilities. Hyperacuity, also termed Vernier acuity, refers to a cortically mediated ability to detect extremely small misalignments, sometimes as subtle as 3–6 seconds of arc.[9] It is commonly defined as the capacity to perceive differences in the relative spatial localization of two or more visual stimuli.[10] Because hyperacuity sensitivity can remain comparatively preserved even when conventional acuity is compromised, PHP-based systems can detect early or subtle distortions resulting from retinal displacement. A widely used home-based implementation is Foresee Home (Notal Vision, Tel Aviv, Israel), a PHP device that has received FDA approval for the detection and characterization of central and paracentral metamorphopsia in patients with age-related macular degeneration, and for aiding in monitoring the progression of disease factors associated with metamorphopsia, including but not limited to choroidal neovascularization, in individuals with stable fixation. This system evaluates the central 14 degrees of the visual field and samples approximately 500 data points, each tested multiple times, thereby generating a dense functional dataset that can enhance sensitivity to change. Nevertheless, the method has practical constraints: it may be unsuitable for individuals with cognitive impairment, such as those with Alzheimer's disease, and it may also be limited when a stable baseline cannot be established within two attempts, circumstances that can undermine longitudinal interpretability [9].

Additional hyperacuity-based methods include the Macular Computerized Psychophysical Test (MCPT), which similarly leverages hyperacuity principles to detect metamorphopsia.[11] In parallel, PreView PHP (Carl Zeiss Meditec, Dublin, CA) applies PHP concepts and has been evaluated for its ability to identify recent-onset choroidal neovascularization secondary to age-related macular degeneration and to discriminate this from intermediate AMD with high sensitivity and specificity.[10] These approaches reflect an emphasis on quantification and early detection, particularly in macular disorders where timely treatment may preserve central vision. Shape discrimination hyperacuity (SDH) provides another psychophysical paradigm based on the human visual system's remarkable sensitivity to minimal deviations from geometric regularity. Humans can detect very small sinusoidal departures from circularity, with reported SDH thresholds below 10 seconds of arc.[12] Notably, SDH performance is described as relatively resistant to the effects of aging and to reduced contrast at low radial frequencies, which supports its potential utility across a broad patient demographic.[9] Building on this principle, radial shape discrimination testing has been proposed as a means to detect new-onset neovascular AMD.[13] Technological translation of SDH into portable

platforms has produced handheld solutions such as myVisionTrack (Vital Art and Science, Inc., Richardson, TX), available for smartphone environments (iOS; Apple, Inc., Cupertino, CA).[14] This application has been cleared by the FDA for detecting and characterizing metamorphopsia within the central three degrees in patients with maculopathy, including age-related macular degeneration and diabetic eye disease, and for assisting in the monitoring of disease factors associated with metamorphopsia. The software is intended for individuals capable of performing regular self-testing at home, and its workflow typically involves twice-weekly testing with automated notification to the eye care professional when significant functional changes are detected. Such systems aim to bridge the gap between clinic-based monitoring and the need for frequent, sensitive surveillance in high-risk patients [12].

Differential perimetry offers a distinct conceptual approach rooted in the retinotopic mapping of visual space. When photoreceptors are displaced, the projection of the visual field onto the retina is altered, potentially disrupting correspondence between the affected eye and the normal fellow eye. This interocular mismatch can be exploited to document metamorphopsia through binocular perimetric comparison, including techniques using the Goldmann perimeter.[15] By highlighting discrepancies in spatial localization rather than solely sensitivity loss, differential perimetry provides a functional signature of retinal displacement that complements structural imaging. More advanced adaptations of Amsler-based testing have also been described, including the three-dimensional computer-automated threshold Amsler grid test (3D CTAG). This method, attributed to Fink and Sadun of the Doheny Eye Institute in California, is designed to characterize scotomas in three dimensions, capturing attributes such as location, extent, slope, depth, and shape with fine detail.[16] By quantifying not only whether a defect exists but also its contour characteristics, 3D CTAG seeks to enhance the descriptive precision of traditional grid testing and to support a more nuanced understanding of functional loss patterns. Beyond metamorphopsia-focused approaches, a range of established instruments can be used to document scotoma with greater standardization and broader field coverage. Conventional perimetry remains central in this regard, whether performed as static automated threshold testing—such as the Humphrey Field Analyzer using a 10-2 protocol suited to detecting central scotomas—or as kinetic perimetry using devices such as the Goldmann perimeter or tangent screen. Hybrid systems capable of both static and kinetic assessment, including Octopus perimetry, also contribute to comprehensive scotoma characterization. Each perimetric modality provides

complementary insights into sensitivity loss, defect boundaries, and field topography, often with higher reproducibility and quantification than the Amsler Grid [15][16]. Microperimetry represents a particularly valuable modality because it offers pointwise retinal sensitivity measurement directly overlaid on a fundus image, enabling a direct structure–function correlation in a visually intuitive format.[17] This capability is especially important in macular disease, where localized structural changes may correspond to focal sensitivity depressions that can be missed by broader field testing. Microperimetry also identifies preferred retinal loci, which are alternative fixation points adopted when foveal fixation is impaired, thereby informing both prognosis and rehabilitative strategies. Among the available platforms are the Nidek MP-3 (Nidek Co. Ltd., Aichi, Japan) and the Macular Integrity Assessment microperimeter (MAIA, CentreVue, Padova, Italy).[17] Collectively, these technologies underscore that while the Amsler Grid remains an accessible and clinically useful screening and monitoring tool, a spectrum of more quantitative psychophysical and perimetric methods exists to document metamorphopsia and scotoma with enhanced sensitivity, spatial precision, and reproducibility when clinical circumstances demand more detailed assessment [17].

Clinical Significance

The Amsler Grid remains a widely utilized clinical instrument because it provides an immediately accessible, low-cost, and conceptually intuitive method for detecting and monitoring functional disturbances arising from macular pathology. Its enduring relevance in ophthalmic practice derives from the fact that many macular disorders manifest initially not as dramatic decrements in high-contrast visual acuity, but rather as qualitative abnormalities in central vision such as distortion, waviness, localized blurring, or missing areas within the field of fixation. By presenting a highly structured visual stimulus with predictable geometry, the grid converts a patient's subjective visual complaint into an observable and documentable phenomenon, thereby supporting early clinical recognition, aiding longitudinal follow-up, and offering a practical means of home surveillance for individuals at elevated risk of macular change. In this sense, the Amsler Grid functions as a bridge between symptom perception and clinical decision-making, particularly in conditions characterized by fluctuating or progressive involvement of the fovea and parafovea. A principal symptom that the Amsler Grid is designed to reveal is metamorphopsia, a perceptual distortion in which straight lines are seen as bent, warped, or irregular, typically reflecting disruption of macular microstructure and photoreceptor topography. Within the grid framework, metamorphopsia can manifest as localized bending of the otherwise parallel lines or as

unequal spacing between adjacent squares. Clinically, the grid can also provide phenomenological cues suggesting whether the distortion is accompanied by changes in perceived image scale. Macropsia may be inferred when small squares appear widened relative to surrounding squares, with adjacent parallel lines seeming to bow away from one another within the affected region. Conversely, micropsia may be suggested when the same parallel lines appear to be drawn toward each other, implying a local compression of perceived space. Such patterns, while not inherently quantitative, can be valuable for characterizing patient experience, tracking the evolution of distortion over time, and prompting further structural evaluation with modalities such as optical coherence tomography when functional change is reported [15].

In addition to distortion, the Amsler Grid can reveal scotomas—localized defects in the visual field in which vision is reduced or absent. The Merriam-Webster dictionary defines scotoma as “a spot in the visual field in which vision is absent or deficient.” A scotoma is typically bounded by surrounding areas of normal visual function, and its functional severity can range from partial sensitivity loss to complete absence of perception. Conceptually, scotomas may be absolute, meaning that the region remains non-perceptible even when stimulus intensity is increased, or relative, meaning that perception can be elicited if the stimulus is sufficiently intensified. In the context of Amsler testing, relative scotomas often present as regions in which the grid appears partially veiled, faded, or blurred, as though a translucent obscuration were overlying the pattern. The scotoma may adopt variable shapes and boundaries, and in practice it may be more readily appreciated when the chart illumination is modestly reduced, as lower luminance can accentuate contrast-dependent sensitivity loss and bring partially suppressed areas into subjective awareness. Clinically, scotomas can also be described as positive or negative: positive scotomas are experienced as an intrusive percept, such as a spot, haze, smoke-like opacity, or cloud that actively obscures central vision, whereas negative scotomas may not be consciously noticed by the patient and are only revealed through structured testing. The Amsler Grid is particularly well suited to uncovering negative scotomas that might otherwise be compensated for through cortical “filling-in” or through binocular viewing with the fellow eye. Despite its practicality and widespread adoption, Amsler Grid home monitoring is accompanied by important methodological limitations that constrain sensitivity, reliability, and interpretive precision. A fundamental constraint is that the grid operates as a suprathreshold stimulus: the lines and squares are typically high-contrast and readily visible under standard conditions, which means the test is not designed to systematically measure threshold sensitivity across the central field.

As a consequence, subtle depressions in sensitivity may remain undetected until they become sufficiently pronounced to disrupt suprathreshold perception. Another limitation is the absence of a mechanism to monitor fixation. Because stable central fixation is essential for the grid to probe the intended retinal locus, any instability, eccentric viewing, or poor compliance with the fixation instruction can lead to variability in reported findings and can obscure true change. Furthermore, the classic grid does not provide a formal means of quantifying metamorphopsia. While a patient may describe increased waviness or distortion, the test does not yield a numerical index of severity, and this restricts the ability to compare outcomes across time, across eyes, or across populations in a standardized manner. In addition, the traditional chart is non-interactive; it does not adapt stimulus placement, contrast, or sampling density in response to patient input, which limits its capacity to refine defect localization or distinguish between perceptual artefact and stable functional loss. Mapping and detection of scotomas may therefore be suboptimal, especially when defects are small, shallow, or irregular in boundary [16][17].

The test also presupposes adequate near visual function. Because reliable performance requires the patient to resolve fine grid elements at near distance, individuals with poor near acuity, significant uncorrected refractive error, or reduced contrast sensitivity may struggle to perceive the chart accurately, potentially generating false-positive reports of blur or false-negative reports of stability. Beyond these optical and methodological issues, repeatability represents a particularly salient challenge. It has been reported that scotoma size, shape, and location identified on the Amsler Grid can vary substantially even when the same patient is retested within a short period, including intervals as brief as 15 minutes, indicating poor repeatability of scotoma mapping.[18] This variability has been linked to the “perceptual completion phenomenon,” a neurovisual process by which the brain fills in missing information when part of a stimulus falls upon a blind or insensitive region of the visual field.[18][19] Such completion is thought to be mediated, at least in part, by cortical mechanisms that seek to preserve perceptual continuity, thereby reducing the subjective salience of field defects. This phenomenon helps explain why physiological blind spot perception, which corresponds anatomically to the optic disc, is typically not noticed in everyday vision and is likewise not usually appreciated during Amsler testing. In a similar vein, the capacity of the grid to detect small scotomas is limited; scotomas smaller than approximately 6 degrees may escape detection, which further constrains its sensitivity for early or focal macular changes.[20]

Additional limitations arise from the spatial characteristics of the grid itself. The Amsler Grid is

intrinsically focused on central field evaluation and is therefore poorly suited to detecting peripheral changes; moreover, the “crowding effect” of peripheral lines may decrease sensitivity to peripheral distortions or defects because visual processing in peripheral retina is less precise and more susceptible to interference from adjacent stimuli. In real-world settings, patient adherence further complicates the value of home monitoring. Even when provided with the chart and instructions, compliance may be inconsistent due to forgetfulness, limited motivation, misunderstanding of technique, or reduced confidence in interpreting subtle changes. These human factors can diminish the practical effectiveness of the grid as a surveillance tool, particularly for conditions that evolve insidiously and require consistent monitoring to detect meaningful change. Recognizing these constraints, multiple modifications of the traditional Amsler Chart have been developed to improve sensitivity and to introduce elements of quantification. One such adaptation is the threshold Amsler Chart, in which the effective luminance of the standard white-on-black grid is reduced by placing a cross-polarizing lens in front of the eye, thereby lowering stimulus visibility toward threshold conditions.[21] This reduction in luminance has been reported to enhance the detection of scotomas compared with the conventional suprathreshold chart, plausibly because sensitivity depressions become more apparent when the stimulus is closer to the detection threshold rather than being easily visible across the field.[18] Another widely discussed modification involves the use of red grids.[22] Red line stimuli may increase sensitivity to certain functional abnormalities, particularly those involving color perception or differential cone pathway involvement, and may thereby reveal defects that remain subtle or ambiguous on achromatic charts [21][22].

A further modification reported by Shinoda and colleagues involves a redesigned Amsler Chart consisting of black grid lines on a white background measuring 12 × 12 cm, with relatively large grid squares of 2 × 2 cm.[23] This configuration yields a 6 × 6 matrix, totaling 36 squares, and introduces a structured method for recording perceived distortion. In this approach, patients with metamorphopsia are asked to trace the lines as they perceive them, rather than merely describing distortion qualitatively. The total length of the distorted lines drawn by the patient is then measured in millimeters, excluding the outer margin of the chart. This method offers a semi-quantitative dimension by converting subjective distortion into a measurable physical parameter, thereby improving comparability and potentially enhancing the sensitivity of serial assessments. Other innovations have attempted to align the test stimulus more directly with the perceptual quality of distortion. The sine Amsler Chart uses a series of

eight modified Amsler grids in which straight lines are replaced by centrally positioned sine waves.[24] While the spatial frequency of the sine wave remains constant within each chart, the amplitude varies across charts. The patient first identifies metamorphopsia on a standard Amsler Grid and is then asked to match or corroborate the perceived magnitude of their distortion with the sine wave pattern that most closely resembles their experience. By providing graded distortion templates, this method aims to translate a patient's subjective metamorphopsia into an approximate magnitude category that can be tracked over time, thereby introducing a more structured quantification than simple descriptive reporting [22].

A more expansive framework for characterization and quantification is represented by Morphision, which consists of a set of 50 modified Amsler grids compiled in an A5-sized booklet.[25] The system incorporates multiple functional layers: the first plate is intended to allow detection and localization of distortion; the second plate is designed to identify the pattern of distortion; and the remaining 48 plates are used to quantify metamorphopsia.[25] The plates include a range of modified stimuli, such as sine waves substituting for straight lines and patterns intended to elicit or approximate cushion-like or barrel-like distortions. By offering multiple stimulus configurations that correspond to different perceptual distortion profiles, Morphision seeks not only to detect metamorphopsia but also to refine its qualitative and quantitative characterization, thereby potentially increasing its clinical utility for longitudinal monitoring and for differentiating between distortion patterns associated with distinct vitreomacular interface or retinal pathologies. In aggregate, the clinical significance of the Amsler Grid can be understood as both enduring and context-dependent. Its strength lies in its simplicity: it is inexpensive, portable, easily explained to patients, and capable of highlighting central visual disturbances that are often subjectively prominent yet difficult to capture through conventional acuity testing alone. Its value is amplified when it is used as part of an integrated clinical strategy, serving as an initial screen or monitoring adjunct that prompts timely ophthalmic assessment when meaningful change is detected. However, its weaknesses—particularly its suprathreshold nature, lack of fixation monitoring, limited quantification, imperfect scotoma mapping, and variability driven by perceptual completion—require that results be interpreted cautiously and corroborated with more robust functional tests and imaging when clinical decisions hinge on precise characterization. The development of modified charts and alternative paradigms reflects an ongoing effort to preserve the practical advantages of the Amsler approach while addressing its psychophysical and methodological limitations. In contemporary practice, therefore, the Amsler Grid

remains most effective when deployed thoughtfully, with clear patient instruction, systematic documentation, and an appreciation of both the perceptual phenomena it reveals and the constraints inherent to the instrument itself.[18][19][20][21][22][23][24][25]

Enhancing Outcomes:

Enhancing outcomes through the effective use of the Amsler Grid depends fundamentally on coordinated interprofessional collaboration among healthcare professionals involved in eye care delivery. Although the grid itself is a simple and low-technology instrument, its clinical utility is highly contingent on correct handling, standardized administration, and accurate patient instruction. Ophthalmologists, optometrists, nurses, and allied eye care personnel each contribute distinct yet complementary roles in ensuring that the information derived from Amsler Grid testing is reliable, interpretable, and clinically meaningful. When these roles are aligned within a shared framework of education and communication, the likelihood of early detection of macular changes and timely clinical intervention is substantially enhanced. Nurses and optometrists who participate in patient care play a critical role in the proper handling and preservation of the Amsler Grid. Although the chart is physically robust, careless folding, soiling, or fading of printed lines can degrade contrast and alter stimulus integrity, thereby compromising test validity. Staff education should therefore emphasize appropriate storage, protection from excessive light exposure, and routine inspection of the grid to ensure that it remains undamaged and visually consistent. In clinical environments where repeated use occurs, standardized protocols for chart replacement and quality assurance can help maintain uniform testing conditions across patients and over time. Equally important is the role of nursing staff in supporting clinicians by reinforcing correct patient instruction. Clear, consistent explanations of test technique are essential to avoid ambiguity in patient responses. Nurses can assist by ensuring that patients understand the need for monocular testing, appropriate viewing distance, stable fixation on the central point, and the importance of reporting even subtle distortions or missing areas. By observing the patient during testing, nurses can identify common errors such as inadvertent peeking with the fellow eye, failure to wear near correction, or misunderstanding of what constitutes an abnormal finding. Early correction of these issues reduces variability and increases the reliability of the results communicated to the clinician. The interprofessional team's responsibilities extend beyond the clinic, as many patients are instructed to use the Amsler Grid for home monitoring. In this context, nurses often serve as the primary point of contact for assessing adherence and reinforcing appropriate use. Monitoring compliance is particularly important in

patients at risk for progressive macular disease, where inconsistent testing may delay recognition of clinically significant change. Nurses should be prepared to document patient-reported frequency of use, address barriers to adherence such as poor understanding or lack of motivation and communicate concerns to the supervising ophthalmologist or optometrist. Reporting inappropriate use, such as testing under poor lighting or without corrective lenses, is equally important, as such practices can lead to misleading results and unnecessary anxiety or false reassurance [25].

Attention to pharmacologic factors is another area in which interprofessional coordination is essential. Mydriatic agents should not be instilled prior to Amsler Grid testing, as pupillary dilation can increase glare, alter depth of focus, and affect contrast perception, thereby confounding interpretation. If a mydriatic is inadvertently administered by a nurse or clinician, transparent communication within the healthcare team is critical. The application should be documented, all relevant team members informed, and the test rescheduled to a later time when baseline visual conditions have been restored. Such communication safeguards test validity and reinforces a culture of patient safety and procedural accountability. Ultimately, the effective integration of the Amsler Grid into patient care exemplifies how even simple diagnostic tools benefit from structured interprofessional application. Through shared education, consistent patient instruction, vigilant monitoring of compliance, and clear intra-team communication, healthcare professionals can maximize the diagnostic and monitoring value of the Amsler Grid. This collaborative approach not only enhances the accuracy of clinical assessments but also empowers patients to participate meaningfully in the monitoring of their visual health, thereby contributing to improved outcomes and higher-quality ophthalmic care.

Conclusion:

The Amsler Grid continues to hold clinical significance as an inexpensive, portable, and patient-friendly tool for detecting central visual disturbances. Its primary strength lies in converting subjective symptoms such as distortion and scotoma into observable patterns, facilitating early recognition and timely referral. However, its suprathreshold nature, inability to monitor fixation, and limited sensitivity for subtle or peripheral changes restrict its standalone diagnostic value. Variability in patient compliance and perceptual completion further challenge reliability, particularly in home-monitoring contexts. Modern ophthalmic practice increasingly relies on multimodal strategies, combining Amsler testing with optical coherence tomography, microperimetry, and hyperacuity-based methods to achieve precise structure–function correlation and early disease

detection. Modified charts and digital adaptations aim to address traditional shortcomings by introducing quantification and interactive features. Ultimately, the Amsler Grid should be regarded as an adjunct rather than a substitute for comprehensive evaluation. When integrated thoughtfully within an interprofessional care framework and supported by patient education, it enhances monitoring, empowers patient participation, and contributes to improved visual outcomes in macular disease management.

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