

# **DIPLOPIA**

## **Background**

1. Definition: Diplopia, commonly called double vision, is simultaneous perception of two images of a single object.
  - Term derived from 2 Greek words: *diplous*, meaning double, and *ops*, meaning eye.
2. General Information: Two most common mechanisms: ocular misalignment and ophthalmic aberrations (defects of cornea, lens, iris and retina).
  - Diplopia is often first manifestation of many systemic disorders, especially muscular or neurologic processes<sup>1</sup>

## **Pathophysiology**

1. Pathology of Disease
  - Binocular diplopia (true diplopia): Breakdown in fusional capacity of binocular system.
    - Normal neuromuscular coordination cannot maintain correspondence of visual objects on retinas of both eyes.
    - Rarely, fusion cannot occur because of dissimilar image size such as after cataract and refractive surgery.
  - Monocular diplopia: May occur from abnormal ocular media (e.g., corneal distortion or scarring, multiple openings in the iris, cataract or subluxation of the natural lens or pseudophakic lens implant, vitreous abnormalities, retinal conditions).
  - Temporary diplopia can result from:
    - Intoxication from alcohol or head injuries, such as concussion.
    - Side effect of the anti-epileptic drugs phenytoin and lamotrigine, hypnotic drug zolpidem and the dissociative drugs ketamine and dextrometorphan.
    - Tired and/or strained eye muscles, or by one crossing own eyes at will.
2. Incidence, Prevalence: Not many studies are available. In an ophthalmic facility, diplopia accounted for 1.4% of chief presenting complaint<sup>2</sup>
3. Risk Factors
  - Neuromuscular disorders, ocular and orbital surgery, orbital blowout fractures, orbital tumors and parasitic infections.
4. Morbidity / Mortality
  - Significant morbidity
    - Difficulty with depth perception and confusion with orientation of objects, especially when performing visually demanding tasks, such as driving or operating tools.

## **Diagnostics**

Careful history and physical examination may reveal relatively benign etiology or may compel rapid diagnostic studies to evaluate patient for neurological catastrophe<sup>3</sup>

1. History - clear and comprehensive history is most useful for evaluation of diplopia.  
Inquire regarding:
  - Onset,

- Progression, aggravating and relieving factors,
  - Variability with head posture or gaze direction,
  - Previous similar episodes (especially if associated with other neurologic symptoms) and/or spontaneous resolution.
  - Does covering either eye make the diplopia disappear? Helps rule out monocular diplopia, which persists in one eye even if other eye is covered
  - Is deviation the same in all directions of gaze or by tilting and rotating the head into different positions? Change in extent of deviation with gaze suggests problem with innervation, most likely a paretic muscle.
2. Is the second object displaced horizontally (side-by-side images) or vertically (images above each other)?
- Review of systems:
- History of diabetes, vascular disease, or hypertension.
  - Headache and other neurologic complaints.
  - Muscle fatigue or weakness.
  - Medications and drugs being used.
  - Recent trauma to face and head.
  - Past medical and surgical history.
3. Physical Examination
- Does covering each eye in turn alleviate the problem?
  - Visual acuity in each eye.
  - Evaluate how gaze and head tilt alters diplopia.
  - Cranial nerves integrity.
  - Ocular movements.
  - Inspect head position, eyes, eyelids, orbits, and face for symmetry or displacement (upward, downward; proptosis, enophthalmos).
  - Ptosis of the upper eyelid (third nerve lesions), while eyelid retraction (thyroid ophthalmopathy).
  - Inflammation or vascular congestion (orbital cellulitis, orbital tumors, thyroid ophthalmopathy).
  - Palpate orbital rim for fractures and soft tissues surrounding eye for tumors.
  - Percuss for focal tenderness from sinus inflammation.
  - Auscultate closed eye for bruit of carotid cavernous fistula.
4. Diagnostic Testing
- Laboratory evaluation: As indicated based on history
  - Diagnostic imaging:
    - CT scan or MRI (with contrast) of the skull and orbits to rule out intracranial masses or other pathologic processes like:
      - Blow-out fracture,
      - Bhyroid ophthalmopathy (enlarged muscles),
      - Tumor of orbit,
      - Cranial nerve pathway tumor,
      - Increased intracranial pressure,
      - Aneurysm of intracranial carotid artery,
      - Carotid cavernous fistula,
      - Disease of sinuses (e.g., infection, tumor) or
      - Bony disorders (e.g., dysostoses, encephalocele)

- Other studies
  - Old photographs for head posture to determine if diplopia is long- standing.
  - Tensilon test to exclude myasthenia gravis.
  - Forced duction test: fibrotic/tethered muscle.
  - Lee screen (highly specialized): separates field of vision for both eyes.
  - Park's 3 step test.

## Differential Diagnosis

### Key Differential Diagnoses<sup>4,5,6,7</sup>

1. Monocular diplopia:
  - Refractive error, Astigmatism
  - Corneal defect: Keratoconus, refractive Surgery
  - Iris injury: polycoria
  - Contact lens complications
  - Cataract, Ectopia lentis
  - Macular defects
  - Media opacities
  - Cerebral cortical dysfunction
2. Binocular Diplopia
  - Orbital disorders: trauma, mass or tumor, infection, thyroid ophthalmopathy.
  - Extraocular muscle restriction: mass or tumor, infection, thyroid ophthalmopathy, muscle entrapment, muscle injury or hematoma.
  - Extraocular muscle weakness: congenital myopathies, mitochondrial myopathies, muscular dystrophy.
  - Neuromuscular Junction Dysfunction: Myasthenia Gravis, Botulism.
  - Palsies of third, fourth and sixth cranial nerves: ischemia, hemorrhage, tumor or mass, vascular malformation, aneurysm, trauma, meningitis, Multiple Sclerosis.
  - Brain stem injury to cranial nerve nuclei: Stroke, hemorrhage, tumor or mass, trauma, vascular malformation.
  - Supranuclear injury (pathways to and between cranial nerve nuclei): stroke, hemorrhage, tumor or mass, trauma, hydrocephalus, syphilis, Wernicke's encephalopathy, neurodegenerative disorders.
3. Others:
  - Malingering/ hysteria
  - Middle ear disease with vertigo

## Therapeutics:<sup>8</sup>

1. Acute Treatment
  - Patching one eye while awaiting resolution or intervention.
  - Stick-on occlusive lenses: cosmetically better than patching.
  - Fresnel prisms: can be stuck to glasses - appropriate if stable deviation is present across all gaze directions
  - Treat underlying cause.
2. Further Management (24 hrs)
  - Watch for worsening of underlying condition

3. Long-Term Care
  - Strabismus surgery occasionally necessary.
  - Chemodenervation : Botulinum injections prevent muscle contracture
  - Watch for development of amblyopia in children
4. Recommendations: Evidence based recommendations are available for blow out fractures<sup>9, 10</sup>
  - Immediate repair (within 24-48 h):
    - Diplopia with computed tomography (CT scan) evidence of muscle or soft tissue entrapment and a nonresolving oculocardiac reflex.<sup>9,10</sup>
    - "White-eyed blowout fractures" in patients less than 18 years of age, history of periocular trauma, minimal ecchymosis or edema, marked vertical extraocular motility restriction, and CT-scan findings of an orbital floor fracture with muscle or peri-muscular soft tissue entrapment.
  - Early repair within 2 weeks:
    - Symptomatic diplopia with positive forced ductions and CT-scan documentation of inferior rectus muscle or peri-muscular soft tissue entrapment and minimal clinical improvement.
    - Fractures resulting in significant hypoglobus..
    - Large floor fractures (typically greater than 50% of floor) causing latent enophthalmos.<sup>9,10</sup>
    - Early repair of floor fractures recommended for progressive infraorbital hypoesthesia.<sup>9,10</sup>
  - Observation recommended if minimal diplopia, not present in primary or down-gaze, good ocular motility, and no significant enophthalmos or hypoglobus.

### **Follow-Up**

1. Return to Office
  - Time frame for return visit depends on the cause and treatment initiated
  - No specific recommendations for earlier follow-up
2. Refer to Specialist
  - Diabetologist: Isolated cranial nerve weakness (eg, typically third or sixth cranial nerve) indicates microangiopathy of diabetes. Diabetic control should be evaluated
  - Endocrinologist: for Grave's disease treatment.
  - Ears, nose, and throat: Sinus disease and blow out fracture.
  - Neurology/ Neurosurgery: Cranial Nerve palsies.
  - / urgency
3. Admit to Hospital
  - Dependent on severity of underlying condition / urgency

### **Prognosis**

1. Depends on underlying condition:
  - Patients with diabetic mononeuritis multiplex recover spontaneously in approximately 6 weeks,
  - Optical causes (e.g., lens dislocation, corneal disorders) can be surgically repaired.

- Neurological causes like tumors have worse prognosis

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