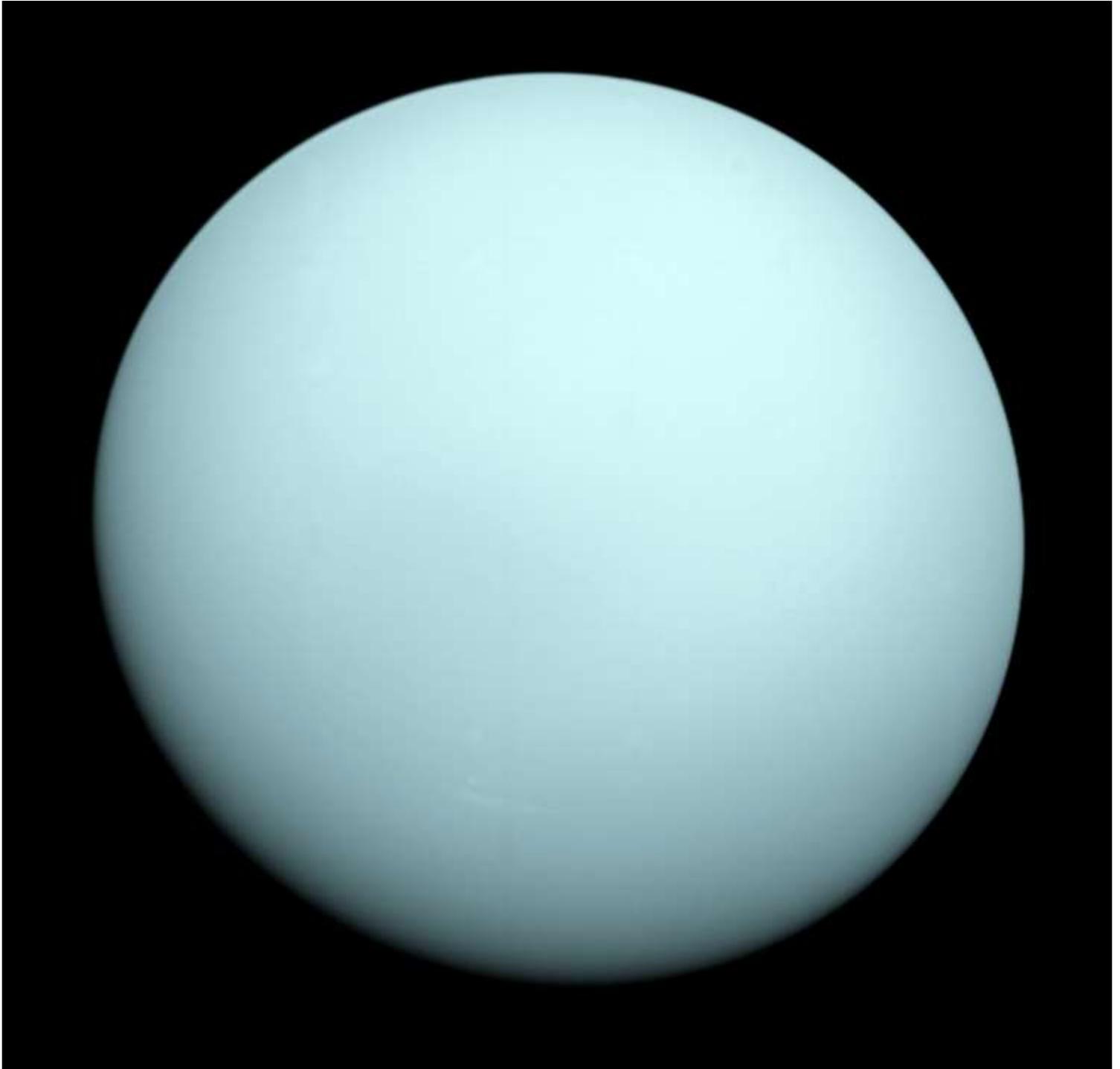


**ORBITAL BLOW OUT FRACTURE**



*Uranus, as seen by Voyager 2 from a distance of 18 million kilometres,  
January 10, 1986, (NASA)*

*“Forever invisible to the unaided eye of man, a sister-globe to our Earth was shown to circulate, in frozen exile at 30 times its distance from the Sun. Nay, the possibility was made apparent that the limits of our system were not even thus reached, but that yet profounder abysses of space might shelter obedient, though little favoured members of the solar family, by future astronomers to be recognised through the tell-tale deviations of Uranus”.*

*Agnes Clerke,  
“A Popular History of Astronomy in the Nineteenth Century”, 1886.*

*Almost since the beginning of recorded human history the heavens were known to contain five planets, Mercury, Venus, Mars, Jupiter and Saturn. They were known to the ancients by direct observation with the naked eye. The identities of the original discoverers have been lost to us in the mists of deep antiquity. For millennia, apart from the occasional “portentous” comet, this was thought to be the fixed order of the universe, eternal, unchanging, without vestige of a beginning nor prospect of an end.*

*Then on a cold night sometime between ten and eleven o’clock in the evening on Tuesday, March the 13<sup>th</sup> 1781 a young English amateur astronomer named William Herschel made one of the most stunningly fortuitous celestial discoveries in history. Whilst sweeping the heavens with his homemade telescope, with incredible acuity he noticed something unusual in the constellation of Gemini. One of the “stars” looked somewhat like a disc. He observed it closely over the ensuing nights and realized that it was moving relative to the “fixed” stars, just as the planets were known to do. A new planet had been discovered and ideas of a “fixed” universe became seriously challenged. The new planet was named Uranus. In the previous century Newton had described the laws of gravity. This revolutionary new science was able to predict with incredible accuracy the orbital pathways of the 5 “classical” planets, yet when these laws came to be applied to Uranus there seemed to be minor but definite discrepancies between the “Newtonian” universe and what was actually observed. Could Newton have been incorrect?*

*Uranus’s orbital irregularities seemed to deviate ever more with the passage of time since its discovery and why it did this remained a complete mystery. Then in 1846 an ingenious and inspirational theory was independently put forward by two men. John Couch Adams a little known but brilliant twenty four year Scottish mathematician and Urbain Le Verrier a well known French mathematician both surmised that Newton’s laws were entirely correct and that the orbital irregularities of Uranus could only be explained by the gravitational influences of another vast, but unseen planet even further out from the Sun. In addition to this prediction their calculations were further able to show precisely in the sky where this unseen planet should lie. Then in one of the most stunning triumphs of human reasoning Newton’s work was powerfully vindicated when two German astronomers Johann Gottfried Galle and Heinrich Louis d’Arrest diligently scanned the heavens with the powerful telescope of the Fraunhofer Observatory for the predicted planet and discovered it exactly where Adams and Le Verrier had said it should be. The new planet would later be named Neptune. For the first time in history a new world was discovered purely on the basis of scientific and mathematical reasoning. This electrified the astronomical world and indeed the wider public of the time. It revolutionized astronomy and changed forever the way in which the heavens would be studied.*

*Progress in astronomy became exponential over the course of the 20<sup>th</sup> century until finally on 6<sup>th</sup> October 1995 the Swiss planet hunting team of Michel Mayor and Didier Queloz announced to the world the discovery of the first extra solar planet orbiting the star Pegasi 51. The planet was not directly seen but detected by mathematical prediction by way of the gravitational effects that were observed on its parent sun. Since this time some hundreds of new worlds have been discovered orbiting other stars. All this has been achieved by the legacy of Adams and Le Verrier as the joint founders of the 21<sup>st</sup> century methodologies of a new golden age of planet hunting, not seen since the anonymous ancient astronomers observed the first 5 planets of our own solar system. The orbital irregularities of Uranus pointed the way to Neptune which in turn has pointed us onward to the stars in our quest to answer the ultimate profound question that the discovery of these new worlds implies. Johannes Kepler himself articulated these implications in the Seventeenth century and H. G Wells would popularize them to the general public in the opening lines of his immortal 1898 classic “The War of the Worlds”*

*“But who shall dwell in these worlds if they be inhabited?...  
Are we or they Lords of the World?...  
And how are all things made for man?” (Johannes Kepler)*

*When we detect irregularities in the orbital movements of the globe in our patients with facial trauma we must, like Adams and Le Verrier be alert to the unseen influences that give rise to this observation. Our radiological search like the astronomical search of Galle and d’Arrest must be diligent, as the underlying implications may be profound.*



*Friedrich Wilhelm Herschel, oil on canvas, 1785, Lemuel Francis Abbott  
(National Portrait Gallery, London).*

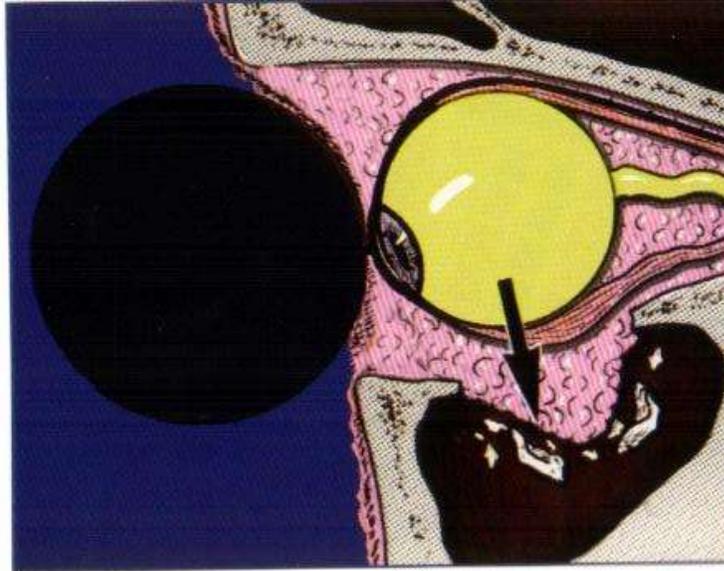
## ORBITAL BLOW OUT FRACTURE

### Introduction

**Orbital blow out fractures** are an uncommon, but potentially serious injury.

It is important to fully assess the eye, due to the high association of injury to the globe with these types of fractures.

### Mechanism



*Mechanism of blow out fracture as demonstrated by a squash ball hitting the eye. <sup>1</sup>*

**Blow out fractures may be “pure” or “impure”**

#### Pure Blow out Fracture

1. This results from a blunt A-P force directed against the globe. A squash ball injury is the classic mechanism.
2. The intraocular pressure of the globe is markedly increased and exerted in all directions. There is often associated ocular trauma.
3. The infra-orbital floor, being the weakest part of the bony orbit, fractures, with protrusion of orbital fat and occasionally extra-ocular muscle into the maxillary antrum. The medial wall (into ethmoid sinus) is occasionally affected.

#### Impure Blow out Fracture

1. This results from a blunt A-P force directed against the infra-orbital rim, in addition to the globe. A punch with a fist is a classic mechanism.

2. The infra-orbital rims fractures, which partly dissipates the force that would otherwise be entirely directed against the globe.
3. Because the force is partly dissipated there is generally less associated ocular trauma than that seen with pure blow out fractures.
4. This form is *more* common than the pure blow out fracture.

### Complications

#### 1. **Associated ocular injury:**

- This is the most important initial consideration.
  - Ocular injury is more commonly associated with pure blow out fractures
  - Injuries may include, traumatic mydriasis, hyphema, lens dislocation, corneal abrasions and retinal detachments.
2. Untreated these fractures may lead to permanent diplopia due to impairment of ocular movements.
    - The inferior rectus / inferior oblique muscles may become entrapped through the orbital floor.
  3. Disfiguring enophthalmos.
  4. Infraorbital nerve injury is common in both pure and impure blow out fractures.
  5. There may be associated epistaxis.

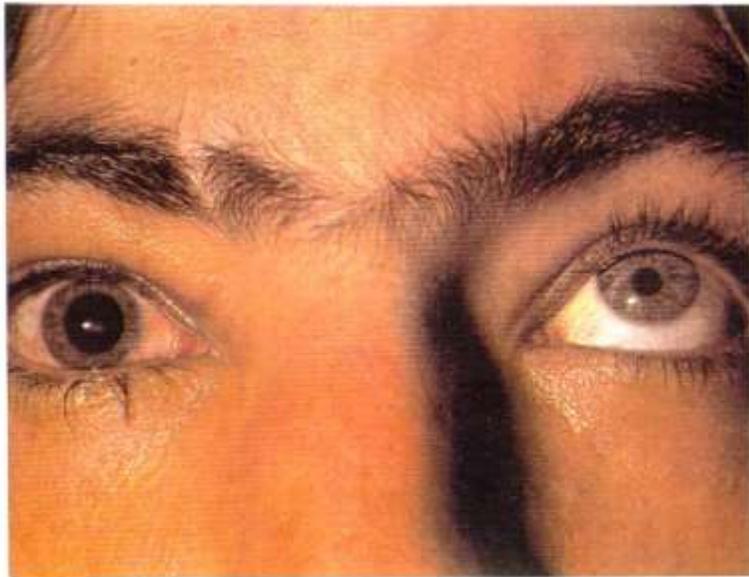
### Clinical Assessment

#### Important points of history:

1. Orbital blow out fractures should be suspected if there is a history of blunt ocular or peri-orbital trauma.
2. Note the mechanism of injury.
  - A (relatively) common cause is a direct blow due to a ball, in particular squash balls. Larger balls, such as a cricket ball will more commonly result in impure blow out fracture.
3. Pain:
  - Pain especially made worse on vertical movement is characteristic.

Important points of examination:

1. Enophthalmos.
  - Characterized by an apparent ptosis.
2. Epistaxis.
3. Infra-orbital nerve anaesthesia.
  - Numbness over the cheek.
  - Numbness over teeth and gums of the upper jaw.
4. Peri-ocular crepitus:
  - Subcutaneous (or conjunctival) emphysema, (due to communication with the maxillary or ethmoid sinuses)
  - This may be more apparent after forceful nose blowing, (which should be avoided).
5. Tenderness or a palpable bony defect along the orbital margins in impure fractures. In pure blow out fractures the infra-orbital rim is intact and tenderness may not be palpated on the face, *hence the fracture may go unsuspected.*
6. Any evidence of diplopia on eye movements



*Infra-orbital entrapment of the right ocular muscles, (the patient has been asked to look upward). The patient also has a traumatic mydriasis.*

- The classic finding is an inability to look upwards (or downwards) if there is infra-orbital entrapment of muscle.

7. Any evidence of ocular injury, (include slit lamp examination):

- Visual acuity should be checked.
  - ♥ Both eyes
- Hyphema.
- Corneal injury:
  - ♥ Abrasions, foreign bodies, check with *flourescein staining*.
- Traumatic mydriasis.
- Lens dislocations.
- Vitreous haemorrhage
- Retinal detachment.

### Investigations

#### Plain radiology:

Plain x-rays of the facial bones is not the preferred imaging option, but may show the following:

- Fluid level within the maxillary antrum, indicating haemorrhage, (a differential of this may be simple sinusitis). Occasionally this may be the only sign of injury.
- Fracture of the wall of the maxillary sinus.
- A “**tear drop**” **sign**, indicating herniation of orbital soft tissue contents into the maxillary antrum, (as shown below)
- Air may be seen within the orbit, indicating a communication between the orbit and maxillary sinus.

#### CT Scan:

**CT scan of the facial bones and orbit will be necessary in all cases.**

It is the best imaging modality to assess orbital fractures.

### Orbital Ultrasound:

Orbital ultrasound is a very useful technique for examining the globe.

It can detect internal injuries such as retinal detachment or vitreous haemorrhage, and is particularly useful when direct ophthalmoscopy is difficult or impossible (due to a large hyphema for example) or when the clinician is inexperienced in the technique of direct ophthalmoscopy (frequently the case for non-Ophthalmologists).

### Management

1. **The most immediate consideration with these injuries is the possible associated ocular injury.**
  - **If a globe injury is suspected then urgent consultation with an ophthalmologist will be required.**
2. **Oral antibiotics should be commenced.** <sup>1</sup>
3. Analgesia as clinically indicated.
4. Nasal decongestants
  - Continue these for 7-10 days. <sup>1</sup>

### Disposition:

Consultations:

- Plastics consultation should occur in all cases
- Ophthalmological consultation should occur in all cases

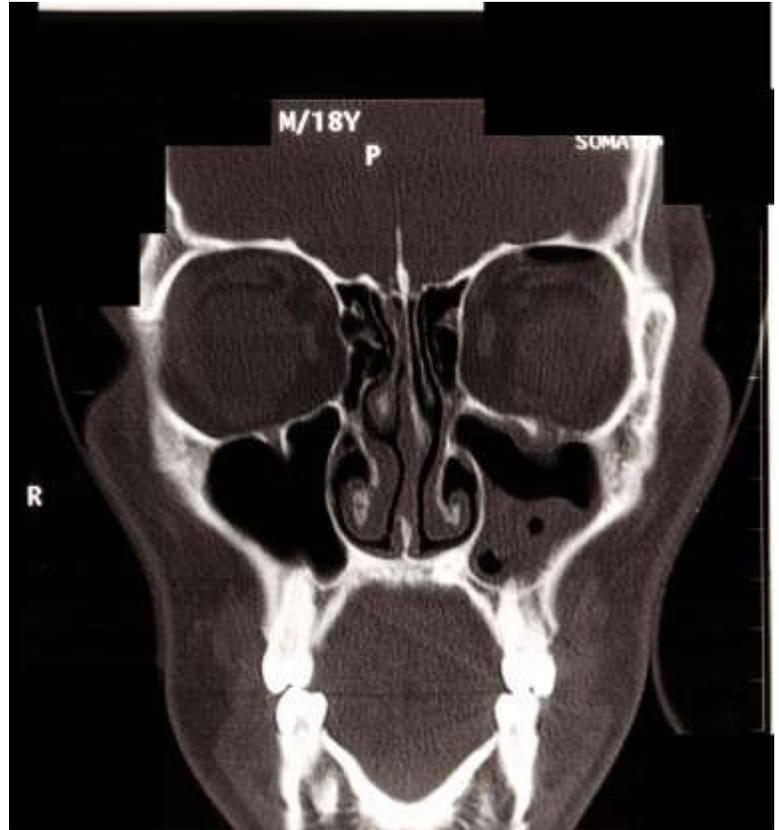
If there are no immediate concerns about the globe, and the eye is not entrapped, then immediate admission may not be necessary, but urgent follow-up (same/next week) must be organised for both **plastics** and **ophthalmological** review.

- Surgical repair is usually performed 7-14 days after injury.

Instructions to patient should include:

- Not blowing the nose.
- Avoidance of valsalva type manoeuvres.

## Appendix 1



*Left panel: The “tear drop” sign on plain radiograph.*

*Right panel: Coronal CT section, demonstrating, air in the left superior orbit, blood in the maxillary antrum and a positive tear drop sign.*

### References

1. Eye Emergency Manual, An Illustrated Guide NSW Health, 2007

Dr J. Hayes  
Reviewed August 2016.