Medial wall and orbital floor blow-out fractures

Current management: Intervention and timing

Indications repair:

• Diplopia w mechanical restriction:
  – Imaging
  – Urgent repair

• Enophthalmus
  – Most do not develop
  – Size of fracture does not predict
  – Delayed repair equally effective
  – Wait until develops
Enophthalmus rare at presentation

Globe luxation into maxillary sinus

Proptosis more often

Edema, hemorrhage, emphysema

Blow-out initial management

- Treat ocular injuries
- Coronal C.T.
- No blowing nose, no ASA
- ATBs if medial wall or sinusitis
- Systemic steroids if diplopia
- Urgent exploration if “frozen globe”, entrapped EOMs (kids)
Internal Orbital Fractures
Traditional thinking

• Minority of fractures require repair

• Surgery - within 2 weeks of injury for persistent diplopia due to restriction, or significant enophthalmos or “large” fracture

New thinking

• Tightly entrapped EOMs need urgent repair

• Diplopia often takes longer than 2 weeks to clear

• Delayed repair equally efficacious (unless tightly entrapped)
5 y.o female
s/p “butting heads” with playmate
Head C.T. in E.D.- wnl
5 d later returns with L. head turn

R. XT in primary

- 4 limitation adduction O.D.

Abduction overshoot
11/7/2013

Head C.T. day of trauma

"Normal"

Repeat head C.T. 6 d later

Ethmoid sinus disease
Release I.O. origin

Complete exposure floor and medial wall

3 d p-op
XT, paretic M.R.

? mgmnt
3 weeks p/op

Adduction deficit diminishing

6 wks post-op: resolved
Forced ductions markedly restricted abduction

Medial wall fx.
Limited adduction

Moderately restricted adduction
Diplopia in blow-out fx

- Restriction- entrapment, impingement
  - Floor fracture- limited upgaze
  - Medial wall – limited abduction

- Paresis- entrapment or edema, trauma
  - Floor fracture- limited downgaze
  - Medial wall- limited adduction

- Entrapment may cause paresis 2ary to mechanical compression, ischemia or moving muscle origin anterior to fracture edge
Non-surgical management of blow-out fractures of the orbital floor

Putterman et al. A.J.O.-1974

- Prospective study
- 29 consecutive pts with blow out fx
  - Diplopia
    - Initial: 41%
    - At 1-6 mos: 19%
    - Beyond 6 mos: 0%
  - Enophthalmos
    - Initial: 0%
    - At 1-6 mos: 13%
    - Beyond 6 mos: 36%
  - (none "objectionable")

Diplopia

- 40-70% of blowout fx at presentation
  - Less common with ZMC fx
- Reversible- large majority
  - Contusion/Edema
  - Paresis (III, IV, VI n.)
- Irreversible- small minority
  - Entrapment/impingement
- Differentiate reversible/irreversible
- Timing of intervention

Contusion/edema
Diffuse orbital swelling
Often global, partial limitation

Very rarely need surgery for diplopia
2 weeks post-injury
Essentially full motility
1 mm enophthalmos

Marked limitation
Identify patient at risk for persistent, symptomatic diplopia

- Patient age
  - Large majority children <17 y.o.

- Imaging
  - Mechanical restriction of E.O.M.

- Clinical exam
  - Marked, fixed limitation excursions
  - Forced ductions (yeah, right...)
    - IOP increase in field restriction
    - Ductions vs versions

White Eyed Blowout Fracture
Jordan et al. OPRS 1998
- Children <17 yrs
  - Little evidence of soft tissue trauma
  - Severe restriction of vertical gaze
  - Minimal radiologic signs of floor displacement
Why children?

- Thicker, immature bone: bends and breaks in a linear pattern—“snaps back”
- “Trapdoor” fractures most common
  - 21 out of 34 cases
    - Egbert, Kersten Ophthalmol, 2001

Adult fx.

- Large, comminuted most common
- Thinner, less elastic bone: shatters and displaces

Imaging

- Look for mechanical impediment
  - Gilbard et al Ophthalmology 1985
- 19 pts with C.T.s
  - 18 initial diplopia
    - 6 ‘functionally diplopic’ @ 1 mo
    - 5 of 6 “entrapped” muscle on C.T.
      - (E.O.M. in contact with bone on both sides)
- Koorneef’s fascia probably not clinically relevant
  - Koorneef Eye 1988

- 2 days p injury
  - Limited elevation
  - “Large” fracture, no impingement
Followed s surgery
2 mo later, E.O.M.s full

“Trapdoor” fracture often missed on imaging report

C.T.- “no fracture”

“Missing” inferior rectus on left
E.O.M. impingement
15 y.o.- struck O.D. with “brass knuckles”

Ptosis
Infraplacement O.D.
Markedly limited elevation
Ultimately clinical dx.
Symptoms
• Marked restriction in vertical gaze
• Pain with ocular excursions
• Nausea, vomiting
• Oculo-cardiac reflex

Internal Orbital Fractures
Traditional thinking
• Minority of fractures require repair

Surgery- within 2 weeks of injury if:
  — Persistent diplopia
  — Visible enophthalmos or “large” fracture

“Early” (2 weeks) repair
• Persistent diplopia:
  — Unlikely resolve

• “Large” fracture
  — Enophthalmos inevitable

• Delaying repair
  — More difficult
  — Less successful
New paradigm

- Initial natural history studies
  - Spontaneous improvement in most
  - Most “large” fractures don’t develop enophthalmos

- Anecdotal experience with successful “late” repair

- Presentation of others restrospective series

Non-surgical series: Putterman

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- Presentation of others restrospective series
Resolution diplopia

- Vast majority
- Takes longer than 2 weeks

Marked limitation excursions

Nishida et al
Am. J. Ophthalmology 2004

31 patients
8 pts excursions less than 2/3rds normal eye on 15 and 30 degree Hess chart- surgery
23 pts excursions more than 2/3rds contralateral eye- no surgery

Many took more than 4 weeks
15 degree normalization- 18 days (3-98)
30 degree normalization- 49 days (19-143)

No non-surgical patient ultimate symptomatic diplopia
Surgical group more persistent diplopia
To keep both eyes aligned on object of regard, “yolk” muscles receive equal innervation.

Version - Both eyes tracking - “Normal” eye follows target, paretic eye lags behind.
Duction - Paretic eye only forced to fixate - additional innervation increases excursion.

Ductions vs versions
Diplopia in downgaze

Duction, limited excursion

Version better excursion
Paretic, not entrapped

“Bone spicule into I.R.”
(residents hot to operate)
3 mos later, no repair

-½ in extreme downgaze
-No c/o functional diplopia

Duction=version
Entrapped
Posterior floor fragment within I.R.

Immediate c/o vertical diplopia

C.T.- "No fracture"

Referred 10 days later

Gaze evoked I.O.P. differential

16 y.o.- struck by brother O.D.

Immediate c/o vertical diplopia

I.O.P. O.D. - primary 15 mm
upgaze  23 mm
Limited elevation O.D.
IOP in primary = upgaze
Paresis resolved

Significant enophthalmos

- Rarely occurs

- Late Enophthalmos (Gilbard et al. Ophthalmol. 1986)
  - Grade I Fracture ("small")
    - 0 of 7
  - Grade II Fracture ("intermediate")
    - 0 of 5
  - Grade III Fracture ("large")
    - 3 of 7
    (one present initially)

Globe displacement only rarely produces persistent diplopia
Hard to predict enophthalmos, hypoglobus
Develops in less than 1/2 large fractures
Multiple walls more likely

Similar medial wall fractures, different enophthalmos
Diplopia

- Natural history resolution
- Good results with delayed repair

Early v delayed repair

- Soparkar and Patrinely
- Dal Canto and Linberg 2008
- Simon et al 2009
- Amrith et al 2010
- Shin et al 2011

- Multiple studies—over a thousand patients—multiple institutions, countries
- No difference in early (14 days) v late (30 days to many years)
  - Outcomes: persistent diplopia or enophthalmos
  - Complications

19 y.o. AA baseball player

5 mos s/p repair floor fx (? indications)
Persistent diplopia

Enophthalmos and marked restriction elevation
Enophthalmus

- Rarely develops
- Size of fracture poor predictor
- Delayed repair equally effective

s/p removal implant, release scar, restore free forced ductions

Hypoglobus, enophthalmos onset 4 mos post trauma R. orbit
Goal: 1-2 mm “overcorrection” of projection
Avoid supra-placement
Summary

• Vast majority diplopia clears
• Define risk persistent diplopia
  – Marked restriction
  – C.T.- entrapped/impinged
• Timing of repair
  – Urgent if obvious (young)
  – No harm in delay if uncertain