

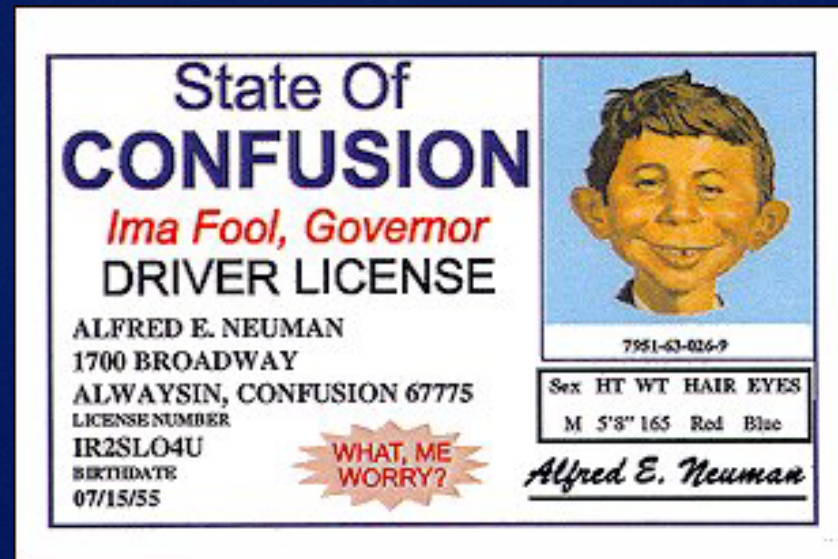
Pediatric Traumatic Brain Injury

A fall from a bunk bed

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Disclosures

- ▶ No conflicts of interest
- ▶ No financial relationship with any products or devices discussed
- ▶ No problem!



Pediatric Traumatic Brain Injury





Injury During Little League World series (Source: [NBC News](#))

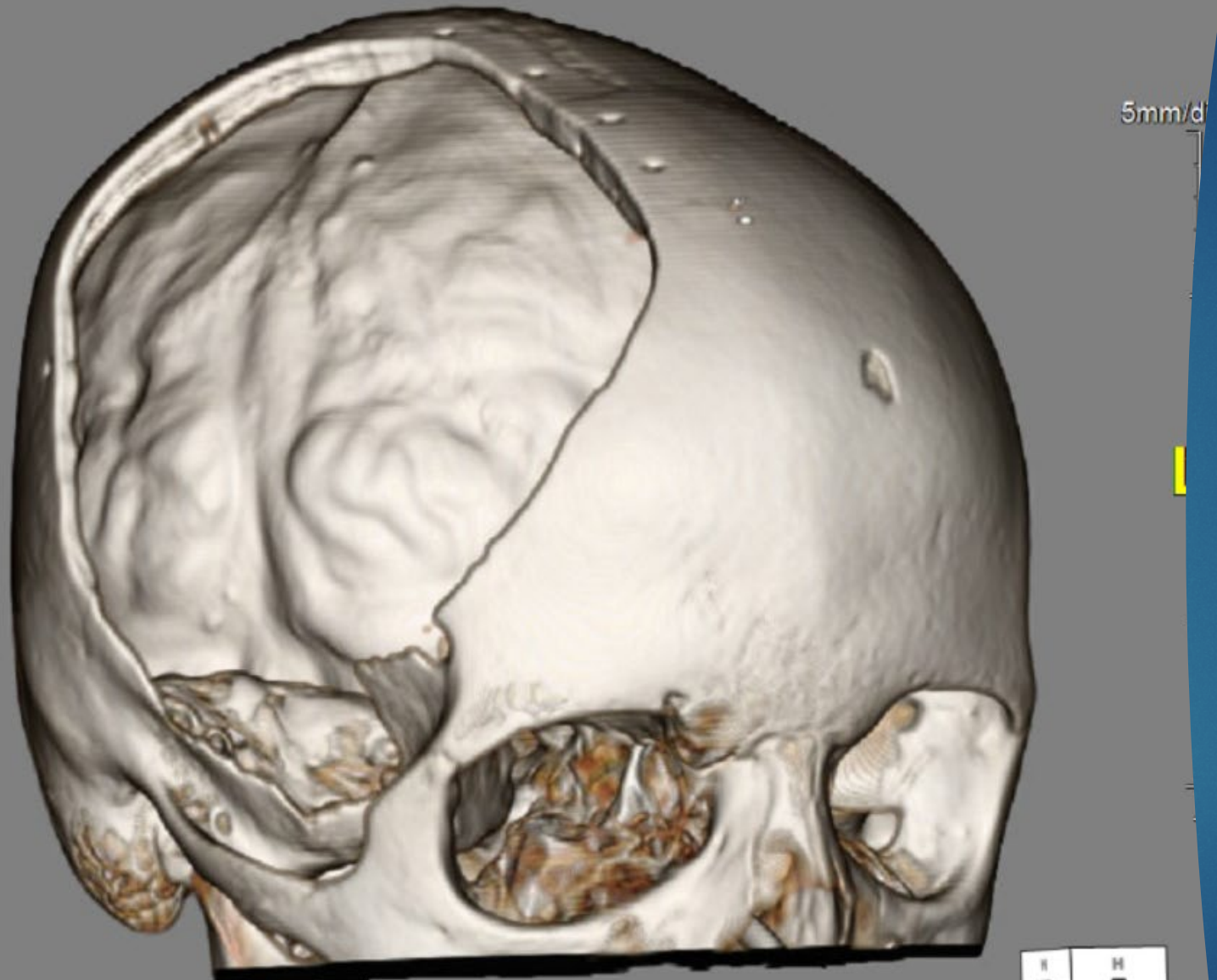
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Sequence from Injury to Operation

- ▶ Fall from bunk bed 0200, stood, was nauseated, fell unconscious
- ▶ Heard by a peer, EMS activated, transported to local hospital
- ▶ ED assessment, C-collar, intubated, given Levetiracetam, hypertonic saline
- ▶ Pediatric trauma center contacted, Life Flight transfer, Level I trauma response
- ▶ 0345 arrival, ATLS resuscitation, GCS 3T, blown R pupil, FAST (-)
- ▶ CT head shows 2.5 cm EDH with midline shift, skull fx, posturing
- ▶ 0404 to operating room for decompressive craniotomy



Epidural Hematoma



Craniectomy

Geisinger

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Children's Hospital

Pediatric Severe Traumatic Brain Injury

Mechanism consistent with **severe** TBI

Proceed with initial resuscitation using ATLS/PALS guidelines. Maintain C-Spine precautions

Confounding drug effect¹ altering neurological exam
Obtain STAT non-contrast CT

No confounding drug effect
Obtain neurological exam and follow with CT

GCS \leq 8

GCS $>$ 8

CT: no early evidence of severe TBI

CT: + severe nonsurgical TBI

CT: + severe TBI and mass effect

CT: + severe TBI and mass effect

CT: + severe nonsurgical TBI

CT: no early evidence of severe TBI

Placement of ICP monitor³

To OR for decompression and ICP monitor⁴

Placement of ICP monitor³

See footnote 2

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Primary Neuroprotective Strategies

Avoid hypoxia/hypercarbia: Maintain PaO₂ > 90 mmHg and PaCO₂ 36 to 40 mmHg

Avoid hypotension: Maintain age appropriate MAP and euvolemia

Avoid hyperthermia: Maintain temperature < 37.5°

Head of bed @ 30°

Judicious use of analgesics and sedatives⁵

Correct coagulopathy


Maintain electrolytes and euglycemia⁶

Severe TBI

Seizure prophylaxis with phenytoin, may consider phenobarbital in infants⁷

If + ICP monitor: Maintain ICP ≤ 20 mm Hg, CPP in age appropriate range⁸

Maintain osmotic gradient: 3% saline to maintain Na 145-155 meq/L or may use mannitol if acute increased ICP suspected⁹



Every five seconds, a man, woman, or child suffers a traumatic brain injury (TBI) in the U.S. In fact, TBI is the leading cause of death among adolescents.

Whether from a fall, a car accident, or a sports injury, traumatic brain injuries can produce persistent problems.

Let's do something about it.



**Brain
Trauma**
FOUNDATION

Hospital course

- ▶ PICU care postoperatively
- ▶ NGT and tube feeding
- ▶ Physical therapy
- ▶ Cranioplasty
- ▶ Walking and eating
- ▶ Transfer to TBI rehabilitation inpatient near home
- ▶ Staphylococcal infection and seizure
- ▶ Physical therapy



Fear of Bunk beds: Bunkatopiphobia

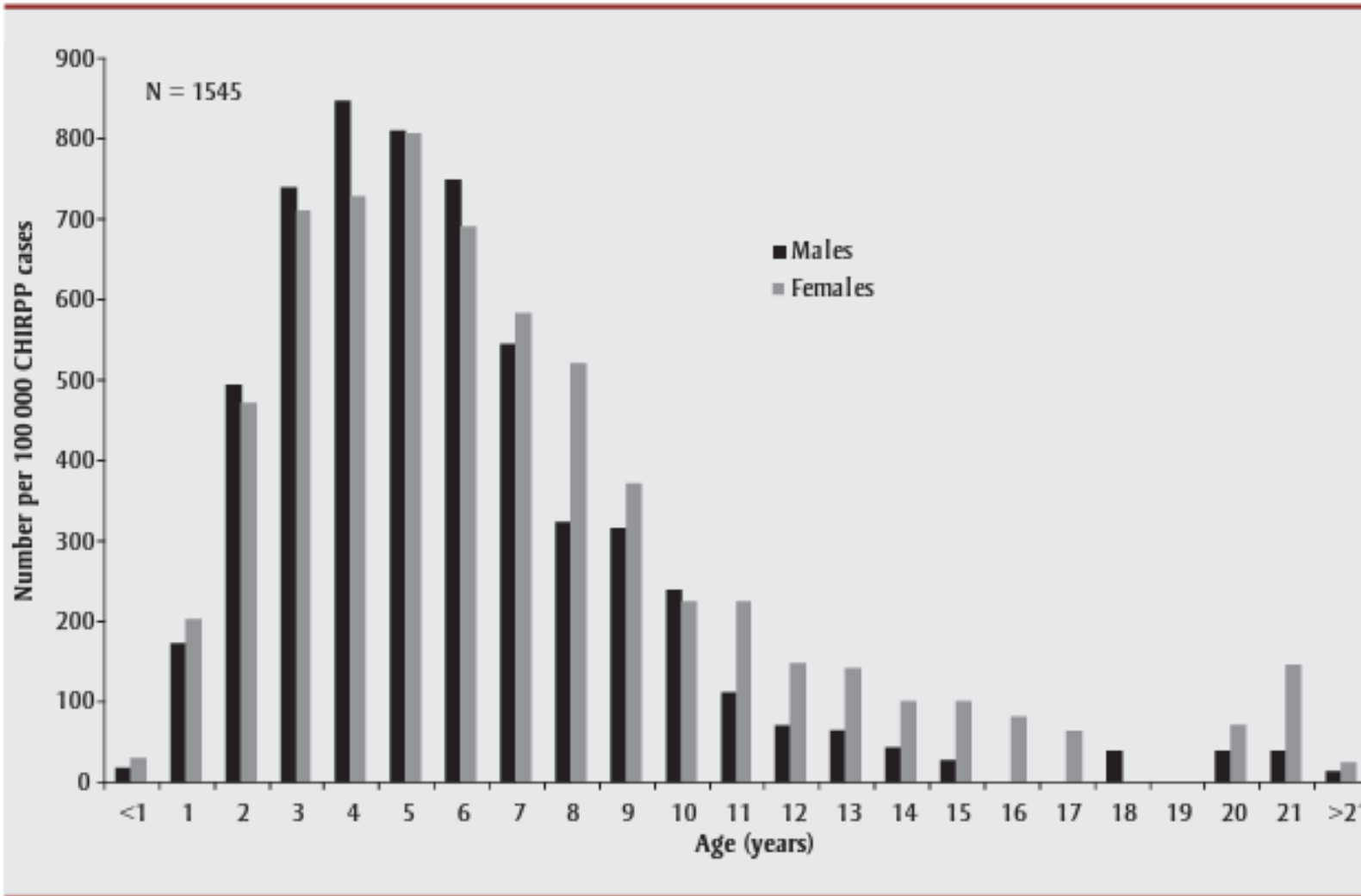
D'Souza, Pediatrics, 2008

- ▶ 36000 bunk bed injuries / yr in US, 3% hospitalized
- ▶ Injuries: laceration (30%), contusion (24%), fracture (20%)
- ▶ Region: head/neck (28%)
- ▶ At home 93%
- ▶ More than half of victims are under 6 yr old
- ▶ Second peak: 18-21 yr old (college)
- ▶ Boys more likely to be injured (60%)

Mack, Injury Prevention, 2007

- ▶ 23000 children injured each year (age 0-9 yr old); 3% hospitalized
- ▶ 14600 were less than 6 yr old (63%)
- ▶ Laceration from ceiling fan (8%)
- ▶ Injuries: fractures (28%), lacerations (23%), contusions (21%)
- ▶ Head/neck (51%), upper ext (27%), lower ext (12%), trunk (10%)
- ▶ Under age 1 yr old: 94% of injuries were head injury
- ▶ Estimated 8 million bunk beds in use

FIGURE 2
Emergency department surveillance of injuries associated with bunk beds according to age and sex, CHIRPP, all ages, 2002–2006, Canada (N = 1545)^a



Abbreviation: CHIRPP, Canadian Hospitals Injury Reporting and Prevention Program.

^aCounts normalized to the total number of cases in CHIRPP for the specific age-sex combination.

McFaul,
 Chronic Dis
 Inj Canada,
 2012

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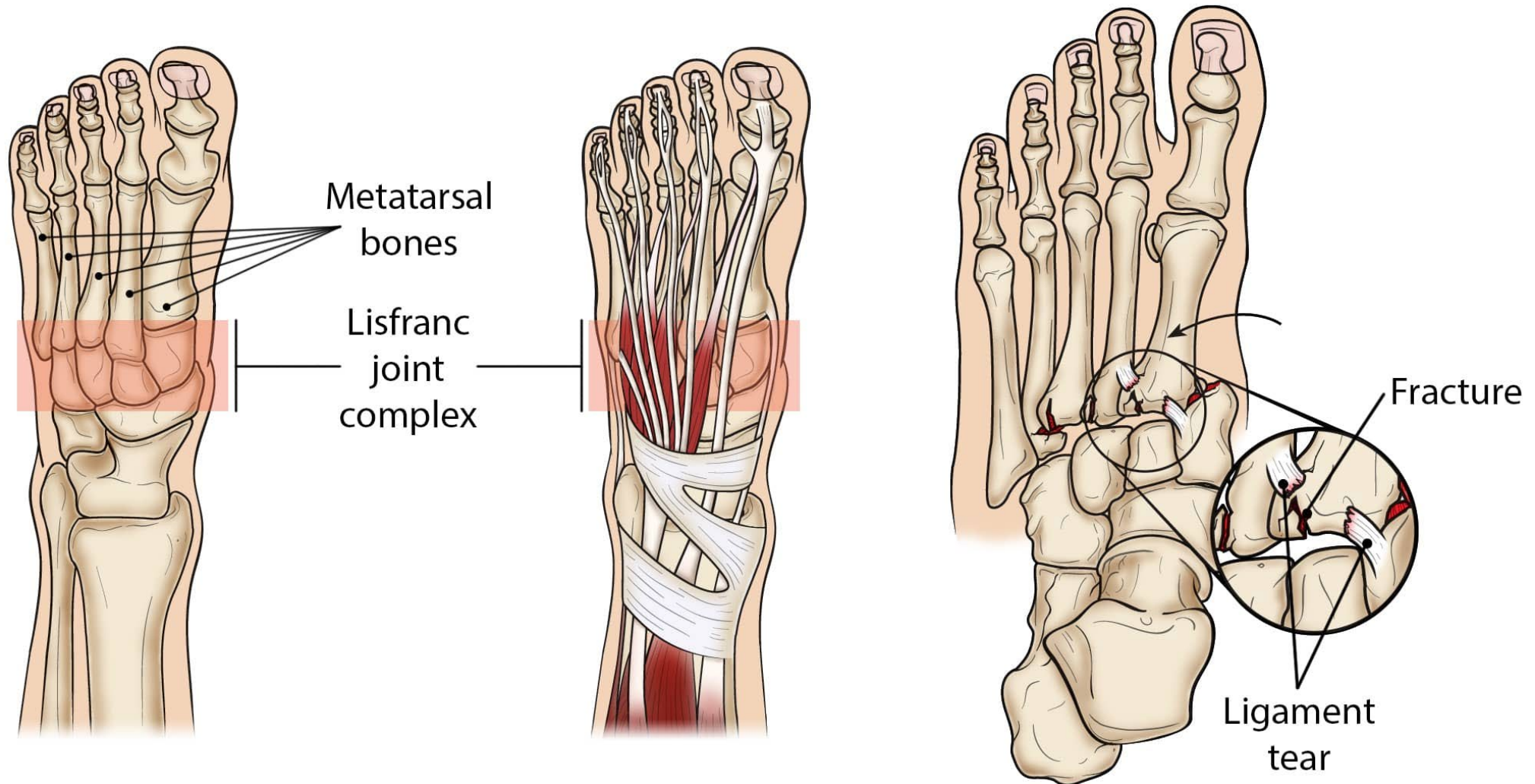


Deuss, Medicina (Kaunus) 2022

- ▶ 162 patients with bunk bed fall, 60% male, 26% hospitalized
- ▶ Fracture (50%)
 - ▶ Forearm (43%)
 - ▶ Clavicle (16%)
 - ▶ Humerus (13%)
 - ▶ Foot (10%)
 - ▶ Hand (6%)
 - ▶ Lower leg (6%)
 - ▶ Skull (6%)



Jacques Lisfranc de St. Martin, calvary injury



Source: American Academy of Orthopaedic Surgeons

CPSC Guidelines

- ▶ If > 30 in high: guard rails on both sides. Fixed. At least 5 in high
- ▶ One guardrail: continuous end to end
- ▶ Other guardrail: no gap greater than 15 in (ladder side)
- ▶ No gap that admits a wedge block
- ▶ Ends of bed: 5 in high structure for 50% of width of bed
- ▶ Any opening that admits wedge block must allow 9 in ball
- ▶ Guidelines from 2000 (avoid bunk beds produced before 2001)

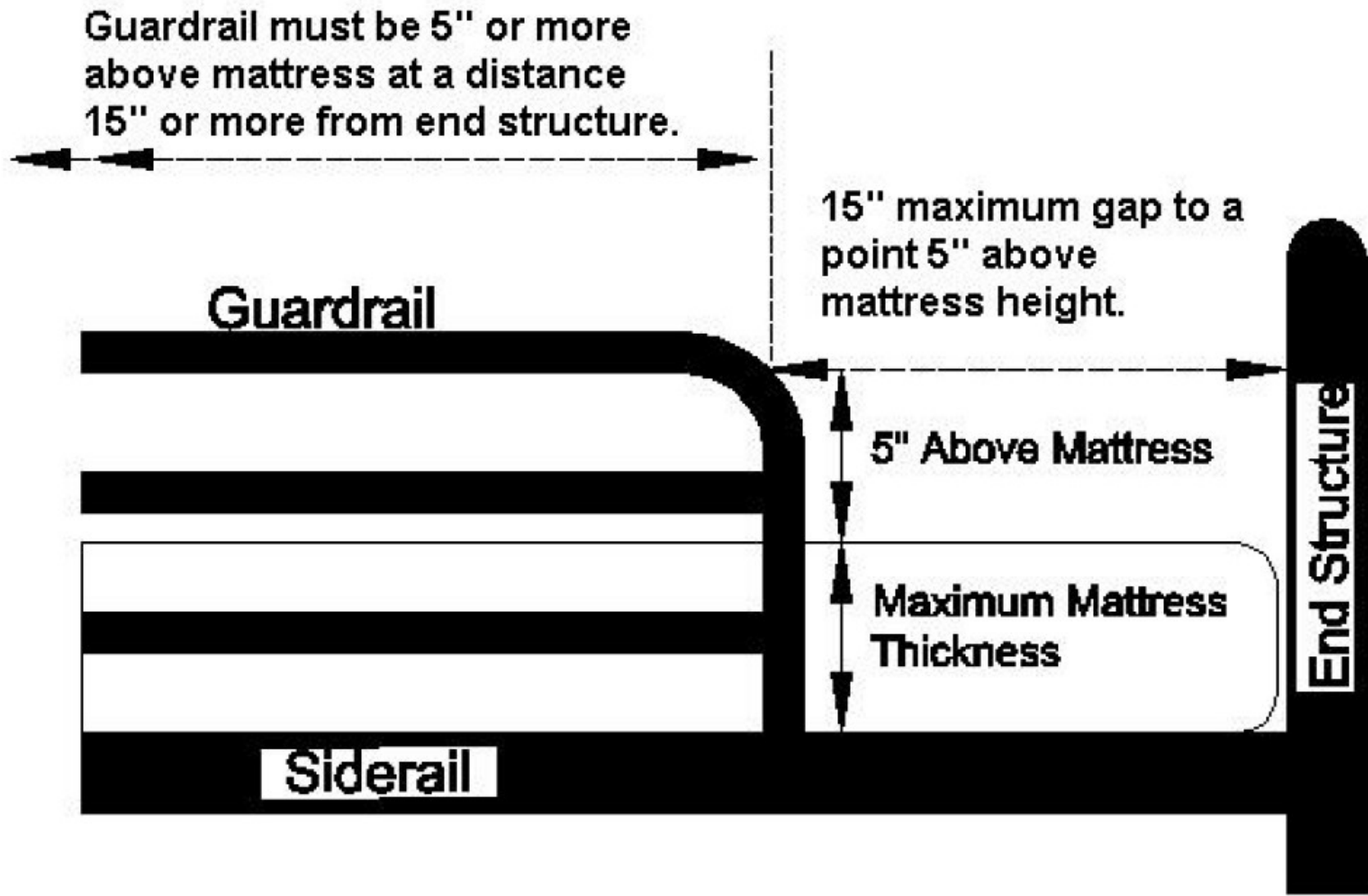


Figure 2 - Guardrail with Maximum 15-inch Gap

Source: CPSC

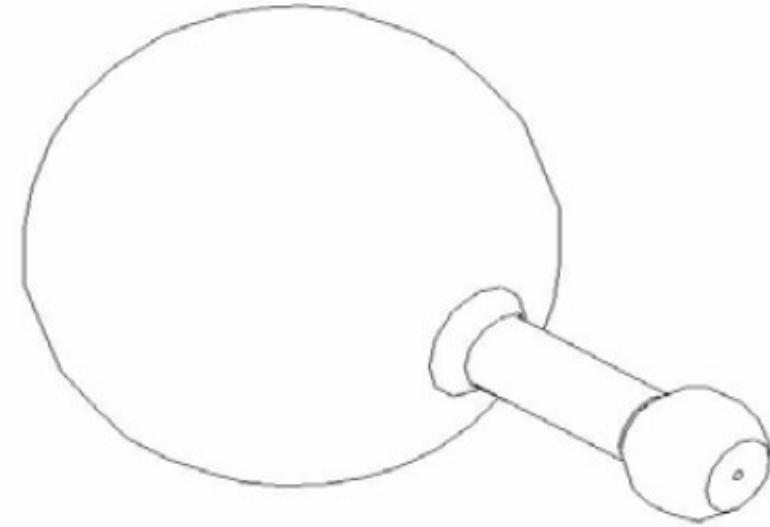
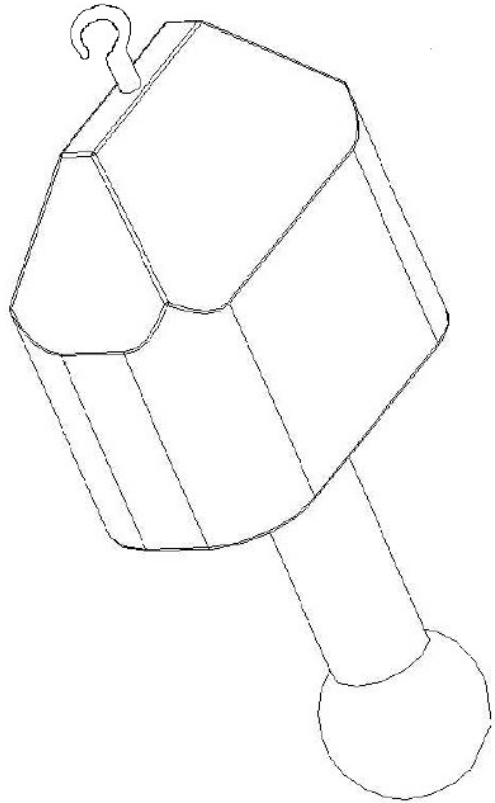


Figure 4 – 9-inch diameter Spherical Probe with Handle

Source: CPSC

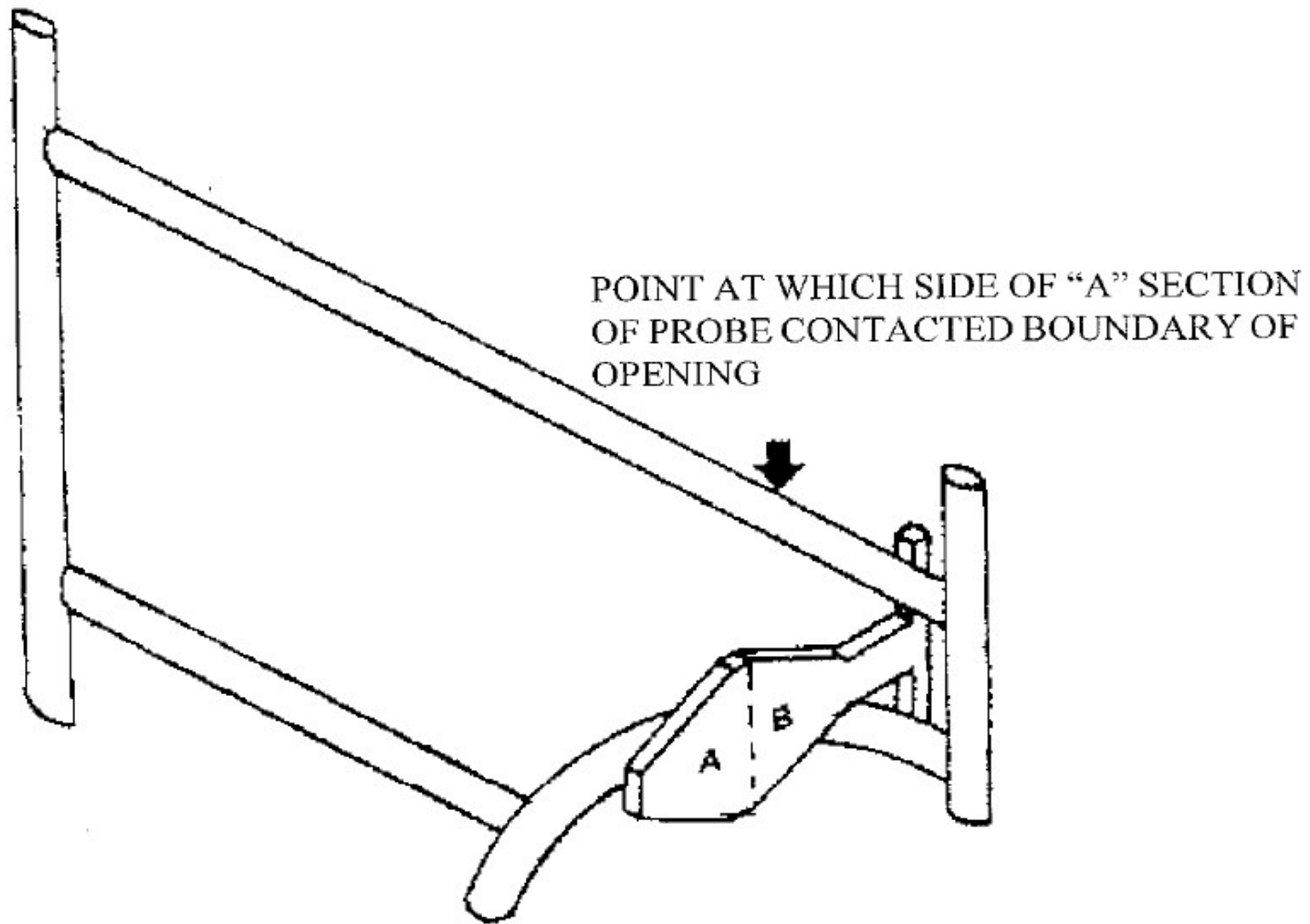
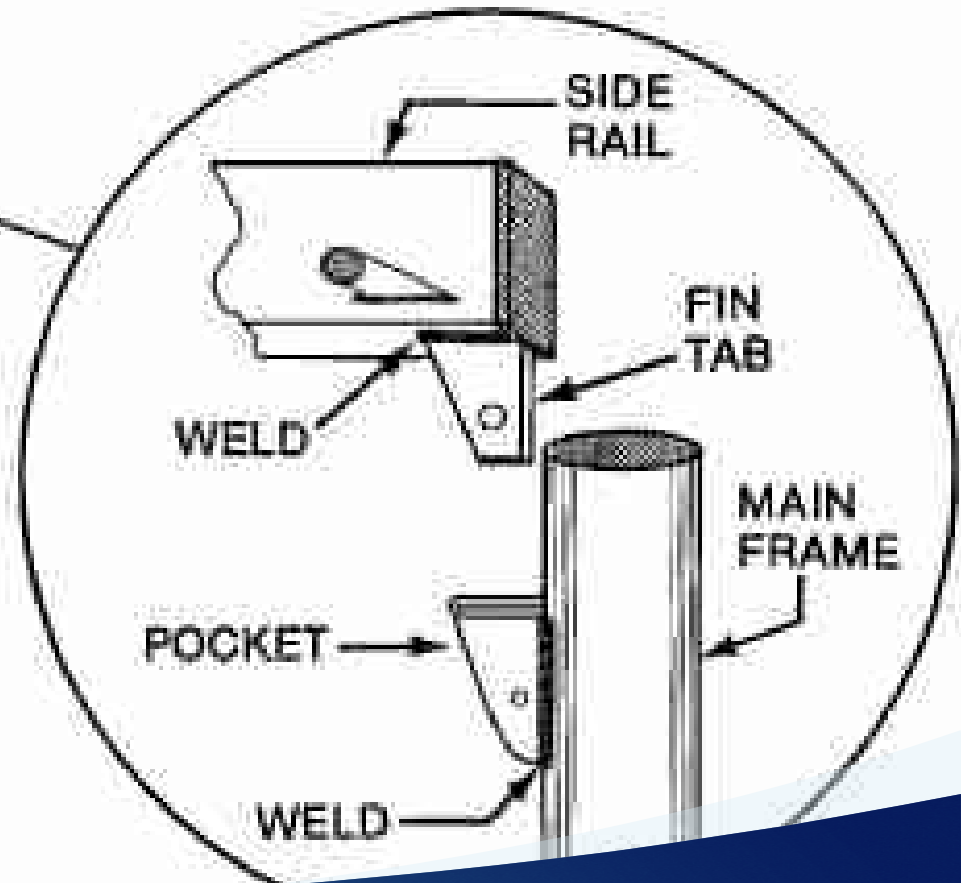
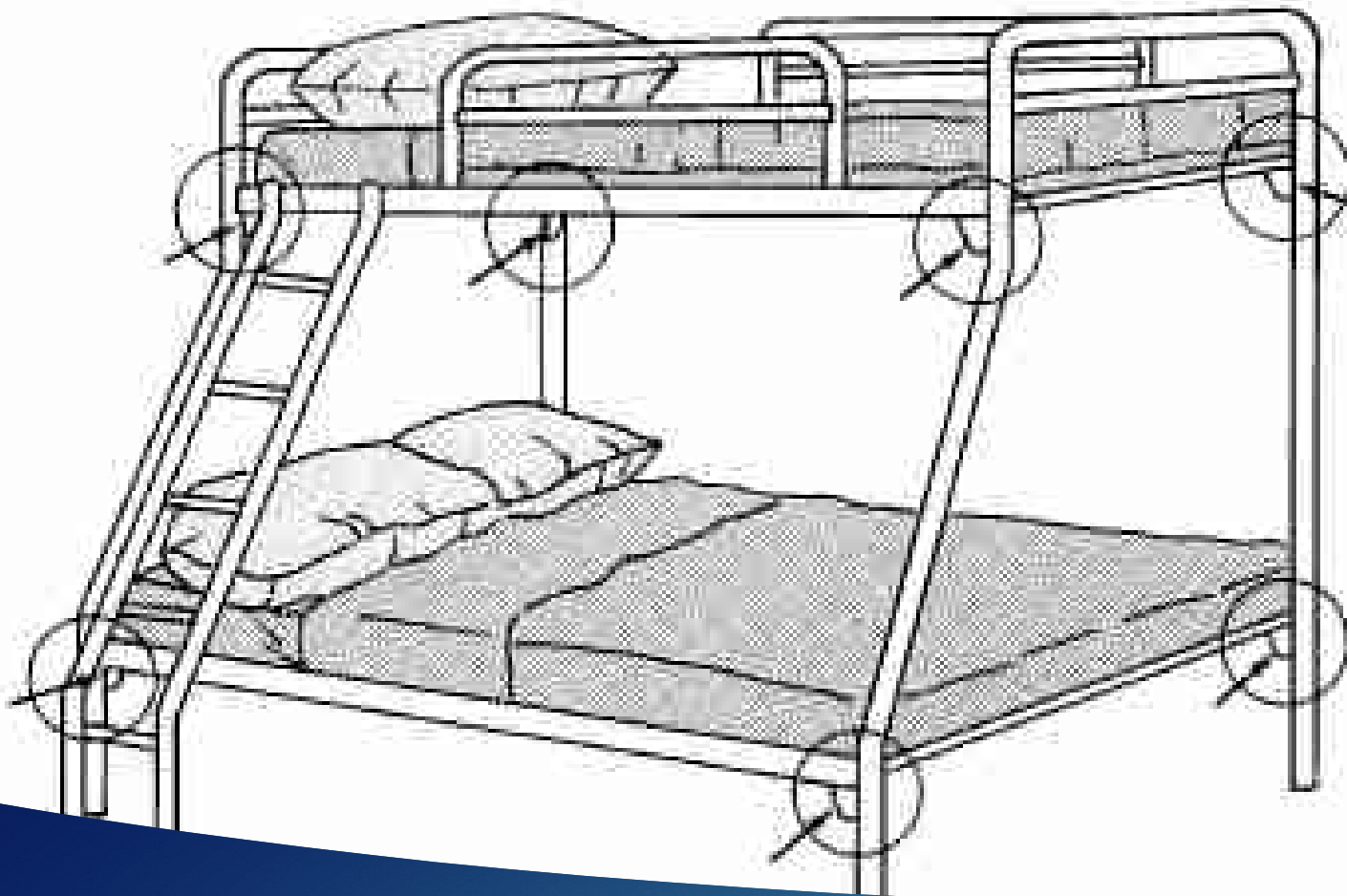


Figure 7 - Example of Entrapment: Neck Section Enters Area Beyond Marks

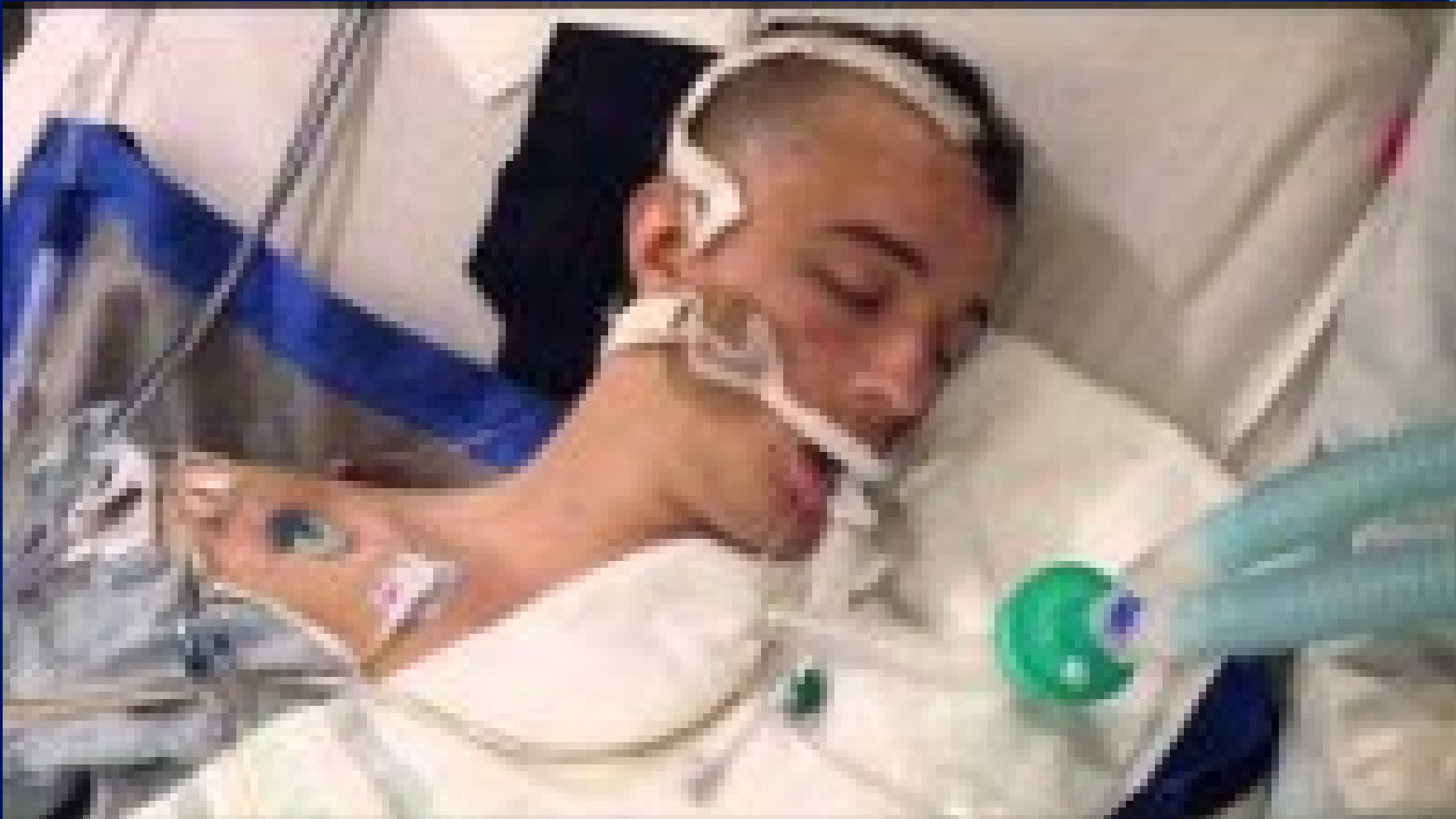
Source: CPSC



Older models and recalls

Safety Advice

- ▶ Ensure bunk bed meets CPSC regulations
- ▶ Fit mattress to bed
- ▶ No children under 6 on top bunk
- ▶ Only one child on top bunk
- ▶ No play on top bunk
- ▶ Have bed against wall, but not near window
- ▶ Don't hang things on bunk bed
- ▶ Don't place under ceiling fan, light, or low ceiling
- ▶ Illumination/night light near ladder
- ▶ Grip traction on ladder



Geisinger



Janet Weis
Children's Hospital

Media and Social Networks

- ▶ Care of child comes first
- ▶ Great interest and good will
- ▶ Family under stress and needs support
- ▶ Respect privacy and HIPAA regulations
- ▶ Media department of hospital
- ▶ Helps to have family delegate representative
- ▶ Family decides what they present on social media and fundraising
- ▶ Legal implications



Source:
Penn Live